THE BIOARCHAEOLOGY OF MORTUARY PRACTICE AT MARRQUÍES BAJOS, SPAIN

by

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Preface

The Iberian Copper Age is a period dominated by the emergence of early complex societies. In sharp contrast with the preceding Neolithic, the Chalcolithic is characterized by agricultural intensification, population aggregation, political centralization and the appearance of "mega-villages" on the landscape. Previous research has focused on the phenomenon of collective burial to suggest that these broad-scale social processes are underwritten by a "communally-organized society." However, the internal organization of such communities is still poorly understood, particularly because the taphonomy and social function of such collective burials are underexplored. At 113 ha in size, Marroquíes Bajos is one of the largest settlements known for the time period, and contains evidence of four different burial programs. This project's bioarchaeological analysis of the mortuary variability at the site will allow for the investigation of whether Iberian Copper Age societies were collectively organized, or whether significant disparities in health, diet or material culture existed among the social units being represented in these burials. Through osteological analysis, isotopic analysis of diet and mobility, AMS radiocarbon dating, and an archaeological analysis of tomb form and grave goods, my investigation at Marroquíes Bajos will allow for a more nuanced reconstruction of the ways in which Copper Age societies were organized, while deepening our understanding of how and why collective burials were used by prehistoric populations.

This research will contribute to a growing body of work on the significance of collective burials in prehistory. While this topic that has merited increasing anthropological attention in recent years, few Iberian-specific analyses have been conducted that permit us to understand what such large-scale sites represent in terms of social organization. Importantly, a better understanding of the communal interments so characteristic of the Iberian Chalcolithic will allow for a more detailed understanding of how these amorphously "collective" early complex societies were actually organized.

This project's intellectual merit lies in the fact that its multi-component bioarchaeological and archaeological analysis offers a novel approach to mortuary work in Spain, and should offer a framework for future projects.

Theoretical Context

Theoretical constructions of the relationship between mortuary practices and social structure are rooted in early work that explored funerary ritual as a "trait" within a broader cultural and historical framework, followed by processual investigations of explicit relationships between social organization and mortuary practices in human societies, particularly the correspondence between the social identities assumed by a living individual and their subsequent mortuary treatment. This research explored the patterning of variables like spatial organization, social rank, and energy expenditure to reconstruct aspects of the social organization of prehistoric communities.

Importantly, however, such work has been tempered by ethnographic explorations that underscore the ways that funerary practices can be used to manipulate and blur social distinctions maintained in life. However, changes in funerary practices do not only reflect shifts in social organization and ideology. Ethnographic evidence suggests that mortuary rituals are also affected by factors like local environmental change, technology and fashion. Despite these multiple influences on mortuary ritual, an important thread tying diverse funerary practices together is that they reflect an identity ascribed to the deceased by living members of a social group. Cross-culturally, living communities isolate and identify particular social identities that are referenced during mortuary ritual. While not all aspects of such differentiation are preserved in the archaeological record, all evidence suggests that there are regularities in mortuary differentiation, individual social roles, and social complexity that link archaeological preserved mortuary practices to aspects of the social organization of prehistoric societies.

Contributions of Research

Most archaeological research connecting mortuary practices and social organization has focused on individual burials, where it is understood that a relatively direct relationship exists between grave form, grave goods, and the social identity of the interred individual. Such an approach is apparent in archaeological investigations of some Iberian Bronze Age societies, when individuals were buried under household floors with distinctive grave goods. In contrast, societies practicing collective burials are viewed as promoting communal identities at the expense of individual identities. This conclusion is particularly prominent in studies of prehistoric social organization in Europe. Rather than identifying and interpreting the explicit relationships between formal, taphonomic, and bioarchaeological components of collective burials, previous research on collective burials focused on social meaning. However, despite initial informative analyses of intrasite mortuary variability and discussions of Copper Age social organization, we still do not know how these social units were organized or delineated, or whether these collective burials conceal a significant degree of social inequality. Instead, European collective burials tend to be treated as instances of amorphous ancestor cults.

Comparatively the mass investments of communal labor and collective burial practices are geographically and chronologically widely spread. However, before making broad-scale interpretations, we must understand the social processes that produce these mortuary records. Specifically, we must question (1) how such collective inhumations were produced by living groups; (2) what factors structure and influence the mortuary variability inherent in the archaeological record and (3) whether similar forms of mortuary treatment reflect or conceal significant differences in lived experience in prehistory.

Structure of the Dissertation

This dissertation is organized into nine chapters. In Chapter 1, I introduce the cultural background of Late Prehistoric Iberia. I begin with a description of the geography and climate of Andalucía, before introducing important aspects of regional history, including subsistence, settlement patterns, material culture and mortuary practices. For each dimension, I begin with the Neolithic, then subsequently describe the record for the Copper Age. In this way, I ground the Copper Age landscape with reference to the history of the preceding Neolithic period. The chapter then covers the transition from the Neolithic to the Copper, outlining and addressing the larger archaeological debates about the development of social complexity in Late Prehistoric Iberia.

In my second chapter, I describe the mortuary theory that underlies archaeological interpretations of social organization. First, I outline the history of mortuary theory in archaeology, moving from initial anthropological approaches, through culture historical formulations and processual and post-processual approaches. I then describe a significant gap in the literature, namely the failure of much existing mortuary theory to address the problem of collective burials, where the link between individual identities, their mortuary treatment, and the artifacts and skeletal remains preserved in the archaeological record is much less clear. I describe why this issue is particularly pertinent in Iberian Late Prehistory, as many Neolithic and Copper Age interments are collective in nature. I then introduce bioarchaeological analysis and theory as a solution to this problem. Due to its ability to contribute unique information concerning Minimum Number of Individuals (MNI), age, sex, activity, health, diet, and mobility, even in contexts where human remains are commingled and fragmentary. I then describe the ways in which bioarchaeological analyses of communal interments can make necessary and novel contributions to discussions of social complexity in Iberia. Finally, I outline three different models of mortuary variability at Marroquíes Bajos – change over time, the use of a multi-stage mortuary program, and social differentiation – that can be tested in order to begin unpacking the social organization that underlay this large village.

In Chapter 3, I describe the archaeological history of the site of Marroquíes Bajos, little of which has been previously published in English. Drawing upon both the Spanish literature and site reports, I describe the internal organization and architecture that characterize the settlement as well as the local environment of Jaén, and previous paleobotanical and archaeological research on subsistence at Marroquíes Bajos. I then address current debates about the historical trajectory of the site. One group of scholars argues for a unitary model of development, in which most of the enclosures and supporting architecture are built rapidly, foregrounding a more delimited "peak" of occupation and activity at the site during the Middle Copper Age (c. 2600-2200 BC). A second "accretional" group of scholars posits that the growth of the site was much more gradual, and that its broader use extends into the Early Bronze Age (c. 1900-1800 BC). I conclude the chapter by introducing the mortuary areas that were not analyzed in this dissertation, focusing on Necropolis 3 and *Fosa Común* 2, which have been the subject of earlier bioarchaeological analyses.

In Chapter 4, I describe the three unstudied mortuary areas that form the core of this dissertation – Necropolis 1, Necropolis 2, and Necropolis 4 (also known as Marroquíes Altos). I draw primarily upon unpublished site reports, site maps and photographs, and conversations with the archaeologists responsible for excavating the burials in order to describe the archaeological backdrop and organization of each necropolis. Necropolis 4 is the most complex case, and this mortuary area was excavated repeatedly between 1957 and 2001. Here, I also drawn upon published documentation of the layout and material culture of each of the artificial mortuary caves.

In Chapter 5, I provide descriptions of the bioarchaeological methods I used to conduct my analyses. I begin with a description of the initial condition of materials at each necropolis, before moving on to screening, cleaning, and sorting procedures. I then address how skeletal and dental completion were scored, as well as the nature of the skeletal and dental data collected. I move on to address estimation of Minimum Number of Individuals (MNI) at each necropolis, and describe the various strategies used to estimate age and sex. After introducing the methods and standards of my bioarchaeological data collection, I address the laboratory analyses that produced the AMS radiocarbon dates and carbon, nitrogen, strontium, and oxygen isotope studies, as well as the strategy that underlay the selection of samples for each procedure.

In Chapter 6, I illustrate the results of dental analyses for Necropolis 4. I outline the strategies I use to analyze Necropolis 4. This necropolis was unique because the high volume of human remains recovered necessitated a dental analysis. Accordingly, I describe the complex strategies that I employed in order to calculate MNI for adults and subadults. I also illustrate the canine metric method used to assess sex, the atlas of human dental development that guided my assessments of subadult age, and the modification of the Miles' molar wear aging method that provided my estimates of age for adults. I then describe the level of dental completion observed for this necropolis, as well as the frequency of dental pathologies such as caries and hypoplasias.

In Chapter 7, I illustrate the results from bioarchaeological analyses of Necropolis 1 and 2. I treat each necropolis separately, and begin by describing the calculation of MNI, then moving to assessments of sex, subadult and adult age, skeletal and dental completion, and mortuary treatment. After separately addressing Necropolis 1 and 2, the chapter concludes with a comparison of all three necropolises in regard to mortuary treatment, dental pathology, and demography.

Chapter 8 describes the isotopic analyses and radiocarbon dating undertaken for the Marroquíes Bajos sample. First, the strategy used to select the sample of 113 human and 7 faunal individuals for strontium, oxygen, carbon, and nitrogen analyses is described. I then detail the results of the samples processed and analyzed by Dr. Marta Díaz-Zorita Bonilla at the University of Tübingen, moving from analyses of mobility and water sources (strontium and oxygen) to diet (carbon and nitrogen). AMS radiocarbon dates from the University of Heidelberg and the University of Arizona are modeled in OxCal, to identify the most probable chronology of Necropolis 1, 2, and 4.

Finally, in Chapter 9 I discuss my conclusions, and weave together the results of bioarchaeological analyses and archaeological evidence to discuss the degree of inequality between individuals or social groups as evidenced by bioarchaeology. These new understandings of life at this macro-villages contribute to our understanding of social organization during the Copper Age and the historical trajectory of Marroquíes Bajos.

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Abstract

The tension between living in groups and the maintenance of individual autonomy is a common anthropological thread that links human societies ranging from nomadic hunter-gathers to state societies and empires. The anthropological literature has addressed the maintenance of egalitarianism and the emergence of institutionalized inequalities, but the mechanisms underlying societies that fluctuate between levels of complexity are less well understood. This dissertation focuses on the Iberian Copper Age (c. 3100-2250 cal BC). In contrast with the preceding Neolithic, the Iberian Copper Age is characterized by agricultural intensification, population aggregation, political centralization and the appearance of large-scale “macro-villages” on the landscape. This suggests that managerial divisions of labor were needed to manage new social demands like establishing property ownership and organizing labor.

At 113 hectares in size, the site of Marroquíes Bajos, in Jaén, Spain, is one of the largest settlements known for this period. This project’s bioarchaeological analysis of the mortuary variability at three different necropolises investigates whether Iberian Copper Age societies were collectively organized, with relatively equal access to social and symbolic resources for all individuals or whether there were significant disparities in health, diet or mortuary treatment between individuals and social units. This study tests the null hypothesis that that there are no significant differences in health, diet, or demographic representation (e.g. age, sex) between individuals or mortuary areas.

This investigation of 280 individuals from Marroquíes Bajos provides a nuanced reconstruction of the ways that Copper Age societies were organized. Radiocarbon results suggest that Necropolis 1 and 4 date to the mid-third millennium, while Necropolis 2 were reused during the Early Bronze Age. Bioarchaeological analyses show that mortuary treatment included members of both sexes and a wide range of ages, most individuals were local, skeletal evidence of paleopathology is scarce, and there were no significant inter-group inequalities in health or diet. These results suggest that marked

increases in inequality were not necessary to found a macro-village of this size, and that collective burials may have been used as a means of creating and reinforcing community identities that allowed for the emergence of these kinds of centers.

Chapter 1

Coalescing Complexity: The Iberian Copper Age

> *Between the relatively egalitarian tribal society which we may imagine for some early neolithic cultures of Europe - Starčevo perhaps, or Danubian I - and the civilizations of Crete, Mycenae, Classical Greece or Rome, there lies a considerable gap.*
> – *Colin Renfrew, Monuments, Mobilization and Social Organization in Neolithic Wessex, (1973:542)*

The site of Marroquíes Bajos is nestled in the foothills of the Sierra de Jaén, perched at the intersection of the undulating olive-covered hills of the *campiña* to the north and the steep, imposing mountain range of the Sierra Magina to the south (Figure 1.1).

Figure 1.1 The city of Jaén as viewed from the summit of the Cerros de los Morteros in the Sierra de Jaén

Like many Late Prehistoric settlements in Andalucía, the location of Marroquíes Bajos was shaped by its proximity to the Guadalquivir River, the sinuous body of water that stretches from the mountains of Cazorla to the plains of Seville, emptying into the Gulf of Cádiz. The geographic channel of the Guadalquivir Basin played a significant role in the lives of Copper Age communities in the region, with clusters of sites springing up all along the broad east-west valley. While the environmental setting of Marroquíes Bajos is thus typical for the Chalcolithic, its size and internal organization mark it as one of the first large village sites that characterize the increasing development of complexity during the Iberian Copper Age, comparable to contemporaries like Valencina de la Concepción (García Sanjuán and Murillo-Barroso 2013) or Los Millares (Chapman 1981).

Before examining the ways in which the community at Marroquíes Bajos represents a distinct and novel form of social organization relative to the smaller Chalcolithic settlements sprinkled throughout the Guadalquivir River Valley, it is first necessary to come to an understanding of the unique environmental and historical framework in which these initial manifestations of social complexity developed in Iberia.

To that end, this chapter introduces the history and geography of the Iberian region, which encompasses the modern countries of Spain and Portugal. I begin by briefly describing the geography and climate of southern Spain, an area that, along with the Tagus estuary in Portugal, has been regarded as one of the "epicenters" of increasing social complexity during the Copper Age (Gilman 1987). By social complexity, I am referring to an interrelated suite of archaeological indicators of increasing socioeconomic intensification, including population growth, subsistence intensification, expanding exchange networks, and increasing evidence of differentiated social statuses that move beyond age and gender distinctions. Historically, archaeological research has emphasized the primacy of southeastern Spain – specifically the provinces of Almería, Murcia and Granada – in the development of burgeoning social complexity in Late Prehistory, but recent research in the Guadalquivir Basin (e.g., Zafra de la Torre et al. 1999; Díaz-del-Río 2004b; Nocete et al., 2010; García Sanjuán and Murillo-Barroso 2013) indicates that this geographic focus could be profitably expanded to include the rest of Andalucía.

In order to understand the magnitude of the social transformations during the Iberian Copper Age, it is necessary to appreciate the preceding Neolithic period. Similarly, discussions of the subsequent Bronze Age provide a useful foil to highlight the ways in which Chalcolithic social complexity was still incipient and constrained relative to these later full-blown manifestations of territoriality and social ranking.

This chapter focuses on the period 5600 – 2200 cal BC, covering the early Neolithic – Late Copper Age societies of the Peninsula. I will present the economic framework of each period is first, highlighting societies' increasing emphasis on cultivated plants and animals. I then discuss settlements and settlement patterning to introduce the sparse early Neolithic record, before describing the advent of the larger village sites (known in Spanish as *macroaldeas* – "macro-villages" or "mega-villages") that provide one of the first true indicators of distinctly Chalcolithic forms of social complexity, including the clustering of previously dispersed populations, the marshaling of communal labor to participate in large-scale architectural projects, and the increasing territorial sweep of exchange networks. Such exchange networks are detailed more thoroughly in the following section on material culture, which covers the development of metallurgy and the increasing circulation of extra-continental exotic goods during the latter period. Changes in social organization are approached by analyzing the form and function of mortuary practices. Though there are important regional variations, there is a broad shift from commingled and communal graves incorporating all members of society during the Neolithic, to differentiated individual burials placed beneath house floors (in the southeast), or inside living areas (in central Iberia) during the Bronze Age.

Finally, this chapter assesses the many causal explanations that have been proposed for the significant differences in socioeconomic systems between the Neolithic and Copper Age periods, focusing particularly on the contrasting "early state" and "competing lineage" hypotheses that have held sway in Spanish interpretations in recent years.

These conventional temporal boundaries will be used for the following chronological units: c. 5600—3200 BC (Neolithic), c. 3200-2250 BC (Copper Age) and c. 2250 – 1550 BC (Bronze Age) (after Chapman 2008); taken together, these three distinct chronological units comprise the Late Prehistoric period in Iberia (García Sanjuán and Díaz-del-Río 2006).

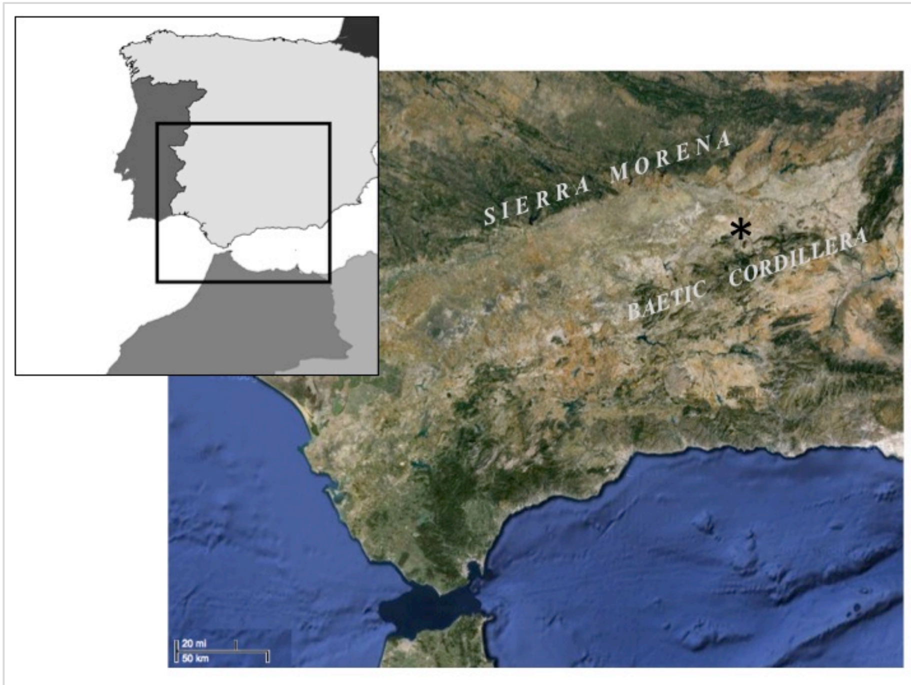
Geographic and Environmental Background

Geography

The province of Jaén is located in the Autonomous Community of Andalucía, a large administrative unit that includes eight provinces covering over 87,000 square kilometers. At a broad scale, the territory is characterized by two primary geographical units – the plain of Andalucía along its northern extent, and the high mountain chains that rise up along its southern reaches (Chapman 2008). The region is home to multiple mountain chains, including the northern Sierra Morena, eastern Cazorla-Segura and southern Baetic ranges. Jaén is found in the northeastern corner of Andalucía, tucked in between the provinces of Granada to the southeast and Córdoba to the northwest. The province is characterized by a diverse spectrum of environments. These range from the Guadalquivir River basin, which is dotted with permanent springs and is the most fertile landscape in all of Iberia, to the northern mountains of the Sierra Morena and the gentle hill relief of the southern campiña. Here, rainfall ranges from 300 to 1600 mm annually depending on micro-environment (Chapman 2008; Díaz-del-Río 2004b).

While Jaén is thus close to the famous epicenters of Late Prehistoric complexity in southeastern Spain that drew Anglo-American archaeological interest to the Iberian region as a result of early processual analyses conducted by Robert Chapman, Antonio Gilman or Richard Harrison, it is somewhat peripheral to the Millaran and Argaric heartlands, and as such was not subject to the climatic and environmental extremes that have been argued to underlie the development of social complexity in such areas (Lull et al. 2011). However, the Copper Age communities of Jaén *were* situated in a location that facilitated inter-regional exchange, as both the Sierra Morena and the Pre-Betic range are riddled with small valleys and passes that would have permitted prehistoric inter-regional connections (Díaz-del-Río 2004b) (Figure 1.2).

Figure 1.2 The location of Jaén, marked with an asterisk[1]



Climate

Long-term anthropogenic environmental degradation, due to the effects of deliberate deforestation, charcoal burning and sheep- and goat-grazing, has exacerbated the extreme climate and harsh landscape of southern Iberia. One of the hottest areas of Europe, the region is very arid with extremely high summer temperatures, particularly in the lower Guadalquivir River valley and southeastern Andalucía (Gilman and Thornes 1985; Chapman 2008). The Iberian southeast has been argued to be hot and dry in prehistory, with highly variable rainfall of less than 300 mm annually (Chapman 1978; 2008; Mathers 1984a; Gilman and Thornes 1985; Gilman 2001), though this argument has been contested by some (Ramos Millán 1981). However, the most recent paleoenvironmental research suggests that while rainfall levels were similar to the present, the greater amounts of vegetation cover in prehistory actually made the region wetter and more verdant during the third millennium (Molina González and Cámara Serrano 2005). In contrast to contemporary southeastern Spain, the Upper Guadalquivir

[1] Satellite map of southern Spain taken from Google Maps.

Basin is less arid, and likely has the highest agropastoral potential in all Iberia. Its contemporary climate is typically Mediterranean, with cool and wet winters followed by arid heat during the summer months (Yanes et al. 2013). Average summer highs for Jaén are around 35˚C, while winter lows drop to around 0˚C. Rain and high winds are more typical for the colder months of the year, and snow is also an occasional threat.

Archaeological climate reconstructions have historically focused on southeastern Andalucía due to its centrality in discussions of increasing social complexity at sites like Los Millares (see Gilman and Thornes 1985 and Chapman 1990 for a detailed review of climate evidence for the southeast). However, recent paleoclimatic work has been conducted specifically for the site of Marroquíes Bajos, and isotopic analyses of snail shells with secure proveniences from the Copper Age levels of the site suggest that the Late Prehistoric climate was similar to the climate today, with hot, arid summers and cooler winters, though conditions may have been slightly wetter during the earlier period (Yanes et al. 2013).

Historical Framework: The Culture History of Copper Age Iberia

The Advent of the *Policultivo Ganadero*: Subsistence During the Neolithic and Copper Age

The Neolithic inhabitants of Iberia relied upon a wide variety of subsistence resources, encamping in small settlements scattered across the landscape that allowed them to exploit a combination of terrestrial and aquatic resources while engaging in incipient forms of cereal cultivation and pastoralism (Forenbaher 1999; Chapman 2008). Initially, few sites were known for this period in southeastern Iberia or western Portugal, regions which are later epicenters of burgeoning social complexity, and the settlement evidence in regions like the central Meseta has likewise been deemed "almost invisible" (Gilman 1987; Díaz-del-Río 2006). The paucity of the prehistoric record is likely reflective of "a reality of sparse, ephemeral settlement" rather than insufficient archaeological investigation (Gilman 2001:62). The meager archaeological record for this period is compounded by historical constraints in Spanish disciplinary practice, for "within Iberian Culture-History archaeology, human, botanical or faunal remains were often considered of little or, at most, secondary epistemological value" (García Sanjuán and Díaz-del-Río 2006:6). However, the burgeoning expansion of professional archaeology in Spain in the 1970s, and the increasing emphasis on regional survey, spatial archaeology and processual approaches in the next decade all helped to remedy this deficiency (Gilman 1995; García Sanjuán and Díaz-del-Río 2006).

While floral and faunal domesticates and semi-subterranean storage pits do occur at Neolithic sites in southeastern and eastern Spain, there is no architectural or paleobotanical evidence for “any horizon of intensified agricultural production during the Neolithic” (Chapman 2008:200), though charcoal and pollen analyses provide evidence of forest clearing related to “extensive agriculture” in eastern Spain at this time (Pérez Jordà and Peña-Chocarro 2013). During the Copper Age, the location of open-air sites in regions like Valencia suggest that Iberian Copper Age peoples were experimenting with small-scale and diversified horticulture rather than intensive agriculture, preferentially locating sites in close proximity to good agricultural soil to facilitate cereal cultivation (Chapman 2008; Pérez Jordà and Peña-Chocarro 2013).

Domesticates like barley, wheat, legumes, sheep, goat and pigs have been documented at a variety of Spanish Neolithic sites, but occur in tandem with wild species like acorn, wild fruits, poppy seeds, shellfish, rabbit, deer and occasionally fish (Chapman 1990, 2008). In regions like central Andalucía, Neolithic groups adopted only certain components of the agropastoral package, focusing on livestock pastoralism that could be practiced in the region’s mountains and intermontane basins (Chapman 2008). The ability of Neolithic peoples to pick and choose attractive components of agricultural packages is characteristic of the Mediterranean transition to agriculture more broadly, where “individual elements of the farming technocomplex were selectively integrated within an existing way of life” (Sherratt 1990:148). Indeed, the small size and low density of sites, combined with the perishable nature of architectural structures found at these settlements, all imply that early Neolithic populations were still highly mobile. During the later Neolithic, in contrast, settlements increase in size and density, and there are quantitative changes to zooarchaeological and artifact assemblages that emphasize the increasing sedentism and decreasing mobility of local populations over the course of the fourth millennium (Chapman 2008). Taken together, the current archaeological data suggest that subsistence practices during the Neolithic were regionally variable, and at the local level were contingent upon vagaries of site location, available resources, the richness of the microenvironment, and each group's preferences.

During the third millennium BC, at the onset of the Copper Age, multiple lines of archaeological evidence suggest that agrarian economies were intensifying as local populations began incorporating larger numbers of agricultural products into their diets (García Sanjuán and Murillo-Barroso 2013). In Almería, for example, populations began to migrate out of the humid and ecologically rich uplands into more unpredictable river terraces and valley bottoms, a territorial shift that signifies their increasing reliance on the agricultural production that allowed communities to cope in this novel, semi-arid ecosystem (Mathers 1984a). However, this increasing emphasis on domesticated crops did not signal a radical and immediate shift towards large-scale agriculture. Instead, Copper Age peoples pursued a subsistence strategy known as "mixed farming," combining dry or irrigated farming with pastoralism, hunting and gathering (Mathers 1984a; Mico Pérez 1995). The agricultural component of the "mixed farming" strategy was two-pronged, relying on both cereal cultivation and stock-breeding (Chapman 1978). Elsewhere, a similar bipartite division between intensive (tree crops/irrigation) and extensive (forest pastoralism) cultivation has been emphasized (Vicent García 1995). Paleobotanical remains from this period document the popularity of plant staples like breadwheat, hulled barley, corn, linseed, flax, peas, broad beans, lentils, grapes and olives[2], and residue analysis of Beaker ceramics attests to the presence of primitive forms of wheat beer (Rojo Guerra et al. 2006). Aspects of material culture likewise highlight participation in activities related to the management of domestic crops including "harvesting (sickle-teeth), processing (grinding-stones, ovens) and storage (in pits, pots or baskets) of cereals (Chapman 1990:114). Zooarchaeological evidence suggests a more intensive exploitation of sheep, goat, pig, horse and cattle, though species such as hares, rabbits, birds, red deer and mollusks still contributed significantly to Chalcolithic diets (Chapman 1978; Gilman 1987; Castro Fernández 1995). The resultant agropastoral package of cultivated crops and domesticated livestock changed little regardless of environmental aridity (Gilman 1987), though diachronic change in subsistence strategies

[2] Grapes and olives were, however, not yet domesticated.

is evident in zooarchaeological assemblages. Quantitative assessments of species-specific bone weights show that "pigs decline steadily in importance from the Neolithic to the later second millennium," while red deer only comprise 2-8% of the total bone weights for sites after 2500 BC (Harrison 1985:92, though see Morales Muñiz 1990 for a sharp counter-argument).

As in other areas of Europe, animal domesticates were not exploited solely for their meat, but were also used for "secondary products" like milk, transport and traction (e.g. ploughing) (Greenfield 2010). Sherratt (1983) untangled multiple lines of animal and artifactual evidence to posit that a significant shift in the exploitation of animals took place in Europe during the middle of the fourth millennium BC. He touches upon archaeological evidence, including plough-marks, ox burials, and artistic depictions of oxen and carts, in order to pinpoint the appearance of the scratch-plough at around 3,500 BCE. Geographical evidence and the appearance of equine-related technology (like cheek bits) in the archaeological record, testify to the spread of horses in temperate Europe by 3000 BC. Finally, the spread of wool sheep in Europe from 3500-2000 BCE can be mapped using textile evidence for wool fibers at archaeological sites. In short, between 3500 and 2500 BC "three important innovations reached Europe in the order: plough, horse, wool" (Sherratt 1984:93). The geographic patterning of lactase persistence, in tandem with the spread of artifacts like ceramic churning vessels, also attest to the increasing popularity of milk-drinking during and after the European Neolithic (Sherratt 1981, 1983).

In Iberia, this secondary products revolution took the form of a *policultivo ganadero,* or "livestock polyculture," as evidenced by the presence of artifacts used to exploit the secondary products of animals, such as cheese-strainers (Chapman 1990:114). Working with a sample of fourteen sites that (1) spanned the Neolithic to Bronze Age and (2) had been reliably and extensively excavated during the 1970s and 1980s, Harrison (1985) tested the applicability of Sherratt's secondary products revolution model to Spanish and Portuguese contexts. He used zooarchaeological methods to analyze bone survival rates, estimate the sex and assess the age of animal specimens collected from all settlements in the sample. His results suggested that horses were used for hard work or transport, rather than meat, as older animals predominate in the assemblages; in contrast, the age ratios of the cattle sampled and the wear patterning of their metatarsal bones suggest "…that the secondary products – labour, milk and calves – progressively replace beef as the chief product from herds of cattle, and this pattern extends across much of "dry" Spain" (Harrison 1985:89, though once again see Morales Muñiz 1990 for an opposing view). Goats and sheep were popular throughout Late Prehistory, likely due to their drought tolerance, earlier breeding ages, and capacity to produce milk. While there is zooarchaeological evidence of the use of both species for both meat and dairy products, there is no evidence of wooly breeds of sheep until a much later period, so it is unlikely that Iberian populations were keeping sheep to harvest their wool. Based on the proportions of gross bone weights for various domesticates, Harrison postulates that Late Prehistoric economies were situated within an "integrated economic framework" that was founded upon inter-settlement exchanges of animals. Importantly, specialization in producing specific types of domesticates was environmentally constrained:

> "the drier the region the smaller is the proportion of cattle…[while]…sheep/goat numbers increase with aridity, as would be expected, since they are better adapted to dry pasture. In other words, the predominant force in the selection of a successful 'mix' of livestock is the local environment, the availability of water, pasture at lean period of the year, shelter at lambing time, and so on" (Harrison 1985:95–96).

In addition to the regional integration of livestock exchange networks, another important aspect of the Chalcolithic subsistence quest was the procurement of water. Contemporary visitors to southern Spain are well aware of pernicious summer temperatures that can rise as high as 50˚C at sites like Écija, a city so infamous for its blistering heat that it is known locally as "*la sartén de Andalucía*" or "the frying pan." While likely climatically similar to present-day Spain, the prehistoric landscape was not identical to the contemporary countryside. For one, it showed less anthropogenic degradation, with the prehistoric Iberian southeast exhibiting denser forest and increased levels of precipitation (Castro Fernández 1995). Greater vegetation cover would have made the region wetter and more verdant during the third millennium (Molina González and Cámara Serrano 2005). However, recent carbon discrimination analyses, paleobotanical evidence and faunal data all suggest that climatic conditions in Iberia were comparable to those of the present day (Chapman 1978; Mathers 1984a; Gilman 2001). Accordingly, in the less hospitable regions of the south, it is likely that Copper Age peoples “made up for insufficient rainfall by controlling and diverting water sources” (Gilman 1987:28).

Chapman (1978), in particular, has argued that artifactual and architectural evidence attest to the use of water-control technology in the Iberian Copper Age and Bronze Age, underscoring the cisterns, conduits and beehive-shaped “storage pits” uncovered at sites like Los Millares, Gatas and Las Anchuras as evidence of water storage facilities. He also highlights two lines of evidence for the Late Prehistoric use of water diversion technology, emphasizing (1) the irrigation channel at the site of Cerro de la Virgen and (2) the location of sites like Los Millares (Copper Age) or El Barranquete (Bronze Age) in coastal lowland areas, likely in order to facilitate floodwater farming. The popularity of water-demanding domesticates like pigs and cattle across the entire Iberian peninsula, regardless of local aridity, also implicitly indicates that Copper Age peoples practiced some form of hydraulic manipulation (Gilman 1987:28).

From Defensibility to Decline: Settlement During the Neolithic and Copper Age

Chapman (1978) argues that the need for a stable and reliable water source could act as a driving factor underlying the significant changes in settlement pattern and density that occur during the Chalcolithic. Across Iberia, the Copper Age is marked as a time of “population concentration and progressive sedentarization,” in marked contrast to the preceding Neolithic era (Delibes de Castro et al. 1995). Neolithic settlements were predominantly small-scale, unstratified sites demarcated archaeologically by clusters of pits and hearths (Díaz-del-Río 2006; Chapman 2008). In southeast Spain, these occupational traces are clustered in moist upland caves and rock-shelters, while in Central Iberia settlements are located in bluffs and river valleys (Díaz-del-Río 2006). Initially, caves were thought to be such favored occupational sites that the Neolithic culture groups across Andalucia were first called *Cultura de las Cuevas* or “culture of caves” (Gilman and Thornes 1985; Martínez Navarrete 1989:228). Tellingly, in more arid areas like Almería, upland zones exhibited high and annually stable levels of resource diversity and productivity, making them easier to exploit than the more ecologically limited lowlands, which suffered from punctuated fluctuations in resource availability. Almerían populations did not move into these harsher and more trying lowland areas until agriculture, and its concomitant investment in water control, became more widespread – during the third millennium BC (Mathers 1984a). To date, there is little evidence for comparably intensive irrigational projects during the Neolithic. Instead, short-term occupations and minimal investment in long-lasting architecture attest to the small size and mobility of local communities (Díaz-del-Río 2006; Chapman 2008). Similarly, there is little architectural or mortuary evidence for inequality within or between settlements (Díaz-del-Río 2004b), though Gibaja Bao (2004) has argued for Catalonian evidence for emergent inequality based on inter-site and inter-individual differences in grave goods in a sample of three sites near Barcelona.

In contrast to the ephemeral and small-scale settlements of the Neolithic, Copper Age sites show a greater amount of internal organization and investment in permanent structures, with village inhabitants expending time and energy to construct stable dwellings, ditches, or stone walls (Díaz-del-Río 2006; Chapman 2008).

Indeed, in many regions of Iberia, the advent of the Chalcolithic marks a deliberate break with earlier practices: old settlements were abandoned in favor of new sites that were more difficult to access and easier to defend, though in Portugal the transition between the Neolithic and Chalcolithic is more gradual and older settlements continue to be occupied throughout the third millennium (Forenbaher 1999). In the rest of Iberia, settlements are moved to locations that are more impregnable (as along mountain ridges or high plateaus), or to areas situated close to productive agricultural land and located in close proximity to water sources like springs and rivers (Mathers 1984a; Mico Pérez 1995; Castro et al. 1998). Both settlement size and the number of settlements increase during the Chalcolithic, and settlements are inhabited long-term (Gilman 1987; Chapman 2008; Díaz-del-Río 2011; García Sanjuán and Murillo-Barroso 2013). Despite such shifts in settlement organization, there is still little household domestic evidence to suggest the development of hereditary social hierarchies. Even at large-scale sites like Los Millares, there is no evidence for social differentiation in consumption patterns, through either the documentation of significant differences in the size of dwellings, or the higher consumption of preferred foods (e.g. more cattle than sheep/goats) at specific dwellings relative to others. Instead, "variability in architecture and domestic consumption falls within the range one would expect for families of somewhat different sizes over the course of their developmental cycle" (Gilman 2013:23–24).

Houses during the Copper Age largely consisted of wattle-and-daub dwellings (Díaz-Andreu 1995; Díaz-del-Río 2006). However, for the first time, there is evidence for significant community investment in settlement architecture; in the Spanish Meseta, aerial survey has identified at least 50 ditched-enclosure sites, settlements characterized by deep ditches that expand outward in concentric rings, circling a fixed central point. These range from <1 hectare to more than 90 hectares in size in Iberian contexts (Díaz-del-Río 2006). Key ditched enclosure sites in the region contain paleobotanical evidence of stored cereal grains and architectural evidence for postholes, suggesting that enclosures were barriers that signaled restricted access to, and a monumentalization of, domestic space (Díaz-del-Río 2004a). In the Meseta, such sites tend to be small scale, on the order of 2-3 hectares in size, and likely did not require more labor effort than that marshaled by immediate kin groups[3]. However, this labor effort is regionally variable, for the Copper Age is also characterized by the first appearance of a novel form of social aggregation: large population centers characterized by significant communal investment in settlement architecture. Such sites are variously known as "macro-villages" or "mega-sites," and Los Millares, Valencina de la Concepción and Marroquíes Bajos represent three of the most famous instantiations of this trend (Chapman 1995; Zafra de la Torre et al., 1999; Díaz-del-Río 2011, 2013; García Sanjuán and Murillo-Barroso 2013).

Los Millares itself is widely agreed to be the "holotype" site for the Iberian Chalcolithic. Just as the renowned Bronze Age site of El Argar gave the later metal age the sobriquet "Argaric," the communities of the Spanish Copper Age are known as "Millaran" societies. Los Millares is located in the Andarax river valley in the modern province of Almería in southeastern Spain. The site was first identified and excavated during the late 19th century by Luis Siret, one of the much-lauded Siret brothers, who were a pair of mining engineers hailing from Belgium. Though not Spanish themselves, the Siret duo represent pioneers of Iberian prehistory as a result of their dedicated

[3] An exception to this tendency is the Copper Age enclosure settlement of Camino de las Yeseras, which may have been greater than 22 hectares in size (Liesau et al. 2008).

archaeological explorations in Almería and Murcia. Their work led to the development of the Late Prehistoric relative chronologies employed in Spain until the radiocarbon revolution (Chapman 1990).

Figure 1.3 A reconstruction of the site of Los Millares [4]

Early excavations at Los Millares revealed that defensibility appeared to be the primary factor structuring the location and internal organization of the site; it is located on a promontory protected by the course of local rivers and hills, and is enclosed by multiple bastioned lines of defense and up to ten surrounding forts that look out over the surrounding landscape (Figure 1.3). In total, the occupation area of the settlement is only 2 hectares in size, but it is surrounded by 310 meters of wall defenses. The archaeological record contains evidence of both domestic occupation, in the form of circular huts with stone foundations, and funerary structures, as at least eighty-five tombs of varying size and form have been revealed outside of the 2 hectares of enclosed settlement over the course of numerous archaeological investigations (Almagro and Arribas 1963; Chapman 1981; Molina González et al. 1986; Castro Fernández 1995).

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[4] Reconstruction of Los Millares attributed to Miguel Salvatierra Cuenca, accessed through Wikipedia. Note that evidence for bastions has only been found for the outermost wall (Díaz-del-Río 2011:53).

Like Los Millares, Valencina de la Concepción is a large-scale center, though this settlement is located far to the west of the Millaran heartland, at the coastal extremity of the Guadalquivir Valley, just outside of the contemporary city of Seville. The entire settlement complex has been argued to occupy as much as 400 hectares (Chapman 2008; Costa Caramé et al. 2010). Archaeological investigation began in earnest during the 1970s, largely as the result of a series of salvage excavations. Despite its magnitude, the settlement has only recently become internationally publicized (García Sanjuán et al. 2013a).

Radiocarbon dates suggest an occupation stretching from the start of the third millennium to the middle of the second millennium BC. While preliminary spatial analysis indicated a potential bipartite division of the site into "habitational" and "funerary" sectors, later investigations suggest that such a distinction is specious (see Costa Caramé et al. 2010). Nocete et al. (2008) have interpreted evidence from the site to indicate large-scale metallurgical production in certain areas, labor investment in ditch-type structures and storage pits, participation in "supra-regional trade networks of luxury commodities," as evidenced by and the elaborate ivory grave goods found in some burials. Building on these claims, they argue that Valencina de la Concepción acted as a "primary political center" that extended its coercive power across much of southern Spain (Nocete et al. 2005, 2008). This interpretation has been disputed, with many archaeologists arguing that none of the evidence thus far analyzed attests to the codified programs of social stratification or inter-settlement hierarchies that would be characteristic of a class-based society (García Sanjuán and Murillo-Barroso 2013; García Sanjuán et al. 2013a).

Like Valencina de la Concepción, the entire corpus of excavations at the site of Marroquíes Bajos has been salvage in character[5], though here the evidence for population aggregation occurs during the *second* half of the third millennium BC. By 2450 cal BC, the surrounding countryside is largely depopulated, and the site itself has become a locus for enormous energy expenditure on part of its inhabitants, with six concentric ditches (ranging from 6-10 meters in depth and 2-5 meters in height), excavated out around the

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[5] With the exception of Enclosure 0, which was excavated by a team from the Universidad de Jaén (Rodríguez Ariza et al. 2006)

settlement. The fifth and third rings were at points reinforced by adobe walls or wooden palisades, and the entire settlement is likely encircled by a final ditch that is nearly 4km long, enclosing an area some 113 hectares in size (Díaz-del-Río, 2004b). Combined with the well-known mortuary excavations of the richly-accoutered cave burials of Marroquíes Altos, a late prehistoric necropolis located outside of the ditched boundaries of the settlement, the staggering scope of the "*macro-aldea*" has drawn significant interest and interpretation within the field of Spanish archaeology (Espantaleón Jubes, 1957, 1960; Zafra de la Torre et al. 1999). The size and scale of the Chalcolithic "public works projects" at Marroquíes Bajos attest to the concentration and mobilization of labor at a scale that dwarfs anything else known for the Upper Guadalquivir Valley. Additionally, unlike other ditched enclosure sites such as Valencina de la Concepción, Marroquíes preserves an important record of dwellings, with evidence of domestic architecture throughout its sequence.

Most "laundry list" descriptions of the Iberian Copper Age emphasize fortification as a recurring motif that characterizes the Late Prehistoric increase in social complexity (e.g. Mico Pérez 1995; Vincent García 1995). Fortifications are certainly key at stone-walled hilltop settlements like Alcores and Albalate, located on the banks of the Salado River in Porcuna. Alcores has both a bastioned exterior and an inner wall built on adobe, while Alcores displays five lines of stone defenses. The sites are located less than 1 km away from one another, and show such commensurate historical trajectories (both were first fortified at the beginning of the third millennium B.C. and renovated and maintained their fortifications until 2200 cal B.C), that their fortifications are clearly defensive in nature (Díaz-del-Río 2004b; Chapman 2008). Similar processes unfolded in Portugal, where settlements were moved to defensible and elevated locations by the Late Neolithic. Defensible locations were later fortified with defensive architecture - the Chalcolithic of the Portuguese Estremadura boasts a number of impressively fortified sites like the hilltop settlements of Zambujal and Leceia, and some have gone so far as to argue that the wealth of flint arrowheads hoarded at the type site at Vila Nova de Sao Pedro constitute "military arsenals" (Forenbaher 1999; Cardoso 2000).

While there is thus strong evidence for a tendency towards fortification during the Iberian Copper Age, other researchers have argued that this is not a ubiquitous trend. The appearance of fortifications would benefit from more in-depth archaeological analysis. Indeed, as Mico Pérez (1995) has underscored, the trait-list approach to "Millaran" settlements proves inapplicable on closer examination, as only three of the eleven sites regularly attributed to the Millaran evince fortifications with towers. The walls at Los Millares, for years the type specimen of the fortified Chalcolithic site, could instead have been used for demarcating and organizing domestic space, rather than for defensive purposes, since they are structurally weaker and shorter than would be expected for a true fortification, and domestic deposits have been found in their bastions and towers (García Sanjuán and Murillo-Barroso 2013). Additionally, many of the so-called "forts" surrounding the settlements are the size of houses at contemporaneous settlements, and thus could simply be domestic facilities of some kind (Díaz-del-Río 2011). The ditches at Valencina de la Concepción are similarly problematic – though they have been argued to act as a form of internal resource defense, they lack evidence of further construction (e.g. walls, embankments, post-holes), storage pits occur both inside and outside their boundaries, and in some instances they were clearly used for non-defensive purposes, like the burial of the dead. Indeed "[t]he ditches at Valencina probably were complex entities with different functions that perhaps changed through time, which calls, first and foremost, for avoiding simplifications of the nature of the empirical record" (García Sanjuán and Murillo-Barroso 2013:130). Additionally relevant is the fact that despite its impressive 400 hectare size, no evidence for wall structures has ever been found during the course of 120 excavations at Valencina de la Concepción.

The organization of Marroquíes Bajos further serves to highlight the functional ambiguity of large-scale Copper Age architecture. Though the impressive concentric ditches at Marroquíes Bajos have been argued to act as a system for the capture and distribution of water (Zafra de la Torre et al. 1999), the evidence is far from incontrovertible. Instead, such large-scale structures likely served a variety of primary and secondary functions (Díaz-del-Río 2004b). As García Sanjuán and Murillo-Barroso underscore, the lay-out and function of architecture at large-scale Copper Age settlements in Iberia is far from uniform, and still poorly understood:

> "On the one hand, the consistency and efficacy of the concept of fortifications has been openly questioned…On the other hand, large sites—generally quite larger than the walled ones—lacking stone walls or with mixed structure (walls and ditches), and which therefore show greater architectural complexity, have been found, adding to the difficulty of defining third-millennium settlement patterns. This suggests, first and foremost that the variety of ways of life of third-millennium societies is far greater than thought until now, making the possibility of a single explanatory theory for Chalcolithic settlements a difficult challenge" (García Sanjuán and Murillo-Barroso 2013:124).

Finally, the transition between the Copper Age and the Bronze Age (circa 2250 cal B.C.) witnesses a radical reorganization of regional settlement systems, one that attests to wide-scale changes in social, economic, and political organization. In Portugal, there is evidence for social fission and collapse by the post-Beaker Bronze Age (Forenbaher 1999). The abandonment of earlier sites, the increasing focus on individual burials rather than collective interments, and the decreasing investment in long-distance exchange all testify to the occurrence of a "significant social rupture" in the region (Lillios et al. 2010). Focusing on her research in the Sizandro Valley in central Portugal, Lillios (2014) makes the provocative suggestion that the significant societal shifts in Copper Age Iberia that are customarily *indexed* by shifting mortuary practices are in fact partially *constituted* by the mortuary practices themselves. In particular, she argues that during the third millennium, the increasing reliance on previously constructed collective tombs and the accruing mnemonic density of such spaces would have led to increased levels of social differentiation based on differential access to burial spaces on part of the living and the dead: "…after tombs were constructed, and while they were all in use, there would have been a high degree of mortuary diversity and presumably a high level of social differentiation resulting from that, yet that collective labor which might provide a check for social tensions was no longer being regularly deployed in tomb building" (Lillios 2014:10).

Evidence for abandonment and fission is not limited to western Iberia. Throughout the Upper Guadalquivir Valley, macro-villages like Marroquíes Bajos and fortified hilltop settlements like Alcores and Albalete fission into smaller, dispersed Bronze Age populations around the end of the third millennium BC (Díaz-del-Río 2004b; Nocete et al. 2010). Valencina de la Concepción, at the western end of the Guadalquivir

Valley, is also affected, losing sway as a political and economic center at around the same time (Nocete et al. 2005). Finally, the "emblematic" Los Millares is also abandoned by 2200 cal BC (Díaz-del-Río 2011). Multiple causal explanations have been proffered to explain the largely contemporaneous collapse of such complex centers. The two most popular interpretations have involved either the collapse of a broad-scale hierarchical class society (Nocete et al., 2005, 2010), or the burgeoning tensions generated by factionalism wrought by competing lineages (Díaz-del-Río 2004a, b; Gilman 2001, 2013). Whatever the cause, it is widely agreed that the Chalcolithic system undergoes a radical reorganization during the period 2400-2200 BCE, with the decline or abandonment of sites that had previously been centers of activity, fissioning of sites, and a general collapse of inter-settlement organization (Díaz-del-Río 2004a, b; García Sanjuán and Murillo-Barroso 2013; Nocete et al. 2010; Balsera et al. 2015).

From Ceramics to Copper: Changes in Late Prehistoric Material Culture

One of the first broad-scale chronologies for human prehistory was outlined by Danish archaeologist Christian Jürgensen Thomsen in the early nineteenth century, whose typological and chronological studies of artifacts at the National Museum of Denmark led him to create a tripartite temporal division between the stone, bronze, and iron ages (Trigger 2008). Though Thomsen's system has been greatly refined over the course of the last two centuries, in essence it still serves to describe the greatest shift in material culture in Iberian Late Prehistory: the advent and increasing importance of copper and bronze metallurgy.

Prior to the "metallurgical revolution," Iberian Neolithic assemblages were characterized by incised or impressed-ware ceramics, with certain regional traditions, such as the mostly Andalusian *almagra* variety. Pottery forms like denticulate-rimmed pots and round spherical bowls predominated, along with curated lithic technologies and limited numbers of bone artifacts (Gilman and Thornes 1985; Forenbaher 1999; Díaz-del-Río 2006). On the whole, lithic raw materials and clay and temper sources are likely local during this period, though there is occasional evidence of medium-distance (circa 50km) transport or exchange of such functional raw materials. Regional studies attest to a "…common appreciation of fine stones, ornaments, beads and polished implements" including shell and schist bracelets (Harrison and Orozco Köhler 2001:107). There is occasional evidence for more intensive exploitation of specific types of resources, as at the Early Neolithic Casa Montero flint mine in the central Meseta, where flint was mined and then knapped to produce blades and some flakes. The mine contains more than 4000 vertical shafts that measure up to one-meter wide and up to seven meters deep, and likely required "cooperative social mechanisms" for their excavation (Díaz-del-Río 2006; Díaz-del-Río et al. 2010). There is evidence of similarly complex variscite mines in northern Spain, as at the site of Can Tintorer, which contains a "…complete system of shafts, galleries and interconnected chambers" (Harrison and Köhler 2001:112). XRD sourcing studies demonstrate that variscite from this mine traveled as far as 550 km during the Neolithic period. Despite long-distance exchange of variscite, "[t]he two great Neolithic exchange networks of jade from the western Alps and obsidian from Lipari and Sardinia, completely by-passed the Iberian Peninsula," and it is not until the Late Neolithic or early Copper Age that other artifacts, like polished stone implements, are transported great distances, suggesting that networks of local sourcing and distribution predominated during this time (Harrison and Köhler 2001:114). Overall, the Iberian Neolithic toolkit has been described as "a material culture of restricted range" (Chapman 1982:47), and in the Chalcolithic literature acts largely as a convenient and unimpressive foil for the explosion of complex and elaborate materials that follow.

Ceramics are one of the most frequently recovered categories of artefacts from Copper Age sites. Open ceramic forms like *cuencos, escudillas* and *fuentes* are favored, with bowls being a typically Chalcolithic ceramic endeavor (Mico Pérez 1995). Early Chalcolithic ceramic assemblages are marked by channeled decorations and *copos*-style vessels with concave contours in Portugal, but such pottery is generally plain and rarely incised or painted, in contrast to Neolithic wares (Gilman and Thornes 1985). During the Late Chalcolithic there is a movement towards more Beaker pottery, though it still comprises only a minor portion of total ceramic assemblages (Forenbaher 1999). Characteristically Portuguese Maritime Beaker pottery was widely traded across Iberia, Morocco, and France during the Villa Nova de Saõ Pedro 2 period, though in the final stages of the Copper Age other Beaker styles, like the Ciempozuelos Beakers of the Spanish Meseta, obviated the need for Portuguese products (Harrison and Gilman 1977;

Gilman 1987). In central Iberia, Beaker ceramics are extremely scarce in habitation sites, generally comprising < 5% of total pottery fragments, but large deposits are documented at sites like El Ventorro (Díaz-del-Río 2006). Despite the impressive proliferation of Beaker ceramics, most production during the Copper Age was likely organized domestically by households or families, and there is little evidence for unequal access to resources, raw materials, or specialized knowledge of craftsmanship (Gilman 2013).

The development of copper metallurgy is, unsurprisingly, one of the defining traits of the Iberian Copper Age (Gilman 1987; Mico Pérez 1995; García Sanjuán and Murillo-Barroso 2013). The technology and craft skills necessary for copper working appear to have been widely distributed across Iberia – in the Northern Meseta, the presence of crucibles and the remains of ceramic vessels containing refined copper indicate that local groups produced metal themselves, rather than simply obtaining artifacts from larger centers in the south through trade networks (Delibes de Castro et al. 1995). Evidence for a simple copper metallurgy also occurs in central Iberia, though it is relatively small-scale, which is typical of the larger region at this time (Díaz-del-Río 2004a). In both southeastern and western Iberia, similar copper composition and production practices underscore that metal-working "was a commonplace activity requiring no special facilities and carried out at both larger and smaller sites" (Gilman 1987:26). Settlements were typically located some distance from ore sources, suggesting that communities located and transported material from sources >16 km away (Castro Fernández 1995). Despite the impressive proliferation of this new metal, copper metalworking was not necessarily a form of production that required devoted specialists. During the Chalcolithic, the smelting of ores was still an inefficient process undertaken in domestic contexts, and the overall scale of production was "tiny," with copper-working focused largely on the production of small functional or ornamental objects like knives, awls, chisels, tanged daggers, tanged points and flat axes (Gilman and Thornes 1985; Montero Ruiz 1994; Mico Pérez 1995; Gilman 2001).

Despite the small scale of production throughout the Iberian Peninsula, some have argued for the evidence of specialized copper-working centers, particularly the "smelting quarter" at Valencina de la Concepción. Nocete et al. claim that the Plan Parcial Matarubilla (PPM) sector of Valencina produced "a minimum production of one ton" of the material, basing their estimate on the crucibles, slag, copper minerals and smelting vessels that were recovered in this sector (2008:728). However, other Copper Age specialists are dubious, noting that the smelting quarter claims are "…. hard to square with the weight of totality of metal artifacts that have been found at the site (about 5 kg) or at all the Copper Age sites in southwest Spain (about 10 kg)" (Gilman 2013:21). Similarly, even at later Bronze Age sites like Peñalosa that contain evidence for all steps of the metallurgical production process, copper-working is still folded into the pursuit of other subsistence and economic activities. Archaeologists excavating Valencina de la Concepción have also questioned the smelting quarter assignation for PPM, emphasizing that the 105 metal objects found in Valencina are comparable to numbers found at contemporaneous large-scale sites like Los Millares (101), Cerro de la Virgen (44) and Almizaraque (42). They underscore that Nocete et al.'s (2008) interpretation consists, at heart, of "approximations based on residual [smelting] elements" rather than the recorded number of objects (García Sanjuán and Murillo-Barroso 2013:129).

Many Copper Age implements were still made from lithic raw materials; at Los Millares "[t]ools for cutting wood, such as axes or adzes, and sharpening tools – such as chisels – were still made of stone. The main agricultural tool, the sickle, had its cutting edges made from small pieces of silex. Knives were also silex implements" (Castro Fernández 1995:25). There is some evidence for specialized flint working during the Chalcolithic, such as the workshop at Los Cercados in the northern Meseta, where excavators recovered a flint-worker's tool kit containing antler tines, bone awls and picks, and quartzite for flaking (Delibes de Castro et al. 1995; Ramos Millán 2013). There is also evidence for some degree of specialized lithic technology in the Central Meseta (Díaz-del-Río 2004a) and Portugal (Forenbaher 1999), in the latter region particularly in the form of chipping stations around flint procurement areas. Products of flint-working primarily consisted of flakes, large blades and bifacially-flaked arrowheads (Mico Pérez 1995; Ramos Millán 1998; Morgado and Lozano 2011). While artifacts such as pressure-flaked arrowheads and large blades may have resulted from the activity of specialists (Gibaja Bao and Terradas Battle 2009), it is important to remember that "…skilled production does not necessarily imply full-time specialization and thereby exemption from basic productive activities" (Chapman 2008:203). Indeed, although

Ramos Millán has argued for a system of wealth accumulation based on flint craftsmanship, describing the Spanish Copper Age political economy as characterized by "surplus production of razor blades, artisitic arrowheads, colored talisman[s], and multipurpose flakes" (2013:86), he also describes these goods as being produced by part-time domestic craft-workers or collective village labor during mining expeditions.

In keeping with their previous interpretations of the Guadalquivir River valley as an early state embedded in regional core/periphery framework, Nocete et al. (2005) have argued that long-distance trade of finished silicified oolitic limestone blades demonstrates the coercive power of the large centers like Valencina de la Concepción to access the raw material from more than 300 km away, though the claims of Valencina acting as a “principal state center” have been vociferously disputed elsewhere (García Sanjuán and Murillo-Barroso 2013; Gilman 2013).

Finally, and perhaps most famously, the Copper Age is a time when exotic or prestige goods begin to regularly occur in inhumations (Forenbaher 1999). These include items like ivory, amber, callais, variscite and ostrich eggshell, which attest to the significant expansion of extra-regional trade networks. As Díaz-del-Río underscores, the Iberian Chalcolithic “…has, in quantity and quality, the best evidence for long-distance exchange prior to the participation of Iberia in the Mediterranean world-system during the first millennium BC” (2011:40), though these scales of exchange apply to exotic raw materials rather than more utilitarian sources of chipped stone or clay and temper (Chapman 2008). Even Marroquíes Bajos, which has far fewer exotic or luxury goods than other macro-villages, contains a number of famous ivory anthropomorphic idols (Figure 1.4). At Los Millares, where the presence of worked ivory, ostrich eggshell, and amber beads in mortuary contexts demonstrate that this settlement was embedded in broad-reaching systems of exchange. Indeed, the preponderance of elaborate grave goods excavated at Los Millares is impressive:

> “The richest tombs at Los Millares contained selected objects made of ivory – beads, rods, buttons, cylindrical ‘idols’ and even small containers or sandals. Such items were carefully included in a series of gravegoods made of a variety of materials: limestone (chisels and necklace beads; ritual slabs (*betilos)*); mussel shells (ornamental pieces of perforated *Cyprea, Pecten, Cardium*, and so on); bone (rods, punches and gravers); copper (axes, knives, blades, daggers or nails);

silex (daggers and arrow points); alabaster (vases or idols); amber (beads); and jet (beads)" (Castro Fernández 1995:27–28).

Figure 1.4 Copper Age anthropomorphic idol from Marroquíes Bajos

Photo taken at Museum of Jaén.

However, nowhere is the staggering scope of Late Prehistoric trade networks more evident than at Valencina de la Concepción. While the settlement is notorious for producing some of the most elaborate evidence of Copper Age craftsmanship, such as amber pommels, large crystal daggers, carved ivory elephant tusks, dagger hilts and sheaths, what is perhaps even more impressive than *how* such items are crafted is *where* their raw materials are procured or originated.

Source studies of the elaborate ivory grave goods interred in the PP4-Monteliro sector of the site demonstrate that the ivory came from both Africa and Asia, attesting to the vast geographic reach of Late Prehistoric exchange networks (Schuhmacher 2012; García Sanjuán et al. 2013b). The Maghreb is the closest region that would have contained both ostrich and elephant resources, but in spite of the popularity of North African products like ivory and ostrich eggshell in Chalcolithic Iberia, there is little concrete evidence of exchange in the other direction during the early Copper Age. This paucity of Iberian material culture in North African contexts may be the result of either an exchange of perishable items, or of more utilitarian objects that lack the distinctly identifiable parameters of Copper Age ritual culture. By the later Copper Age, however, distinctly Iberian Maritime and Palmela Beaker ceramics begin to appear at sites in the Maghreb, providing evidence that the southernmost extent of the Iberian exchange network could be found in this desert region (Harrison and Gilman 1977).

The subsequent Bronze Age again witnesses the appearance of novel forms of material culture like storage jars, increasing numbers of serrated flint sickle teeth, and, of course, metal artifacts like riveted daggers, halberds and silver ornaments (Shennan 1982; Montero Ruiz 1994; Díaz-del-Río 2006; Lull et al. 2010). Argaric pottery and metal production demonstrate an increasing standardization over time, with marked concentrations of foundry areas in specific settlements suggesting incipient division of labor and specialization (Lull 2000; Gilman 2013), economic harbingers of the "ratcheting up" of social divisions that typify the late metal age period as a whole. In addition to bronze-smelting, silver was also produced and worked, and the overall breadth of forms of metal objects, and their frequency in the archaeological record, increases (Chapman 1982; Montero Ruiz 1994).

Disposing of the Dead: Mortuary Practices in Iberian Late Prehistory

Late Prehistoric mortuary practices in Spain and Portugal are most easily conceptualized as a funnel, one that moves from the incorporation of almost all members of society in communal graves during the Neolithic, to the spatially and socially restricted inhumations of the Bronze Age that stress *individual* identity and achievements. Just as the focus shifts from the level of the community to the individual, there are also significant changes to the location of interments on the landscape over time. Neolithic peoples preferred more natural or naturalized settings, like natural and artificial caves, or megalithic chambered tombs raised out of local rocks. In contrast, the later Bronze Age inhabitants of the region quite literally kept their dead "close to home" by burying them in individual deposits under house floors. Grave goods also underwent significant transformations over the Late Prehistoric period, moving from more functional offerings of pottery and stone tools during the Neolithic to the inclusion of exotic and elaborate items crafted on materials that had been exchanged or brought from far away during the Copper Age. Understanding the mortuary practices used at Marroquíes Bajos, a site dated to the mid-third millennium at the temporal zenith of the Late Prehistoric period in Iberia, thus requires an understanding of how the funerary behavior at this Copper Age settlement was situated relative to the Neolithic practices that preceded it and the Bronze Age rituals that replaced it.

Throughout Iberia, the Neolithic mortuary landscape is characterized by communal interments in natural or semi-natural features (Forenbaher 1999, García Sanjuán 2006, Lillios et al. 2010), a practice that dates back to the preceding Mesolithic when the dead were buried in depressions and natural cavities in caves, covered by small mounds of stone or sediment, and equipped with predominantly utilitarian grave goods like tools and food, though ornamental offerings were also occasionally present (Arias 2007). During the Neolithic, two separate burial tracks occur within such cave depositions: (1) bodies were nestled into natural hollows or crevices, and (2) small burial pits were deliberately dug out to inter individuals. The continued Neolithic practice of capping such burials with slabs of stone or small mounds of rocks presents a clear ritual link back to the preceding era (García Sanjuán 2006).

While Neolithic practices thus have distinctly Mesolithic roots, over time these burgeoning agricultural societies elaborated and expanded upon earlier funerary templates, manipulating landscape features like massive stones in order to create a mortuary environment that was partially natural and partially artificial. The hybrid funerary architecture grew more complex over time – in Central Iberia, for instance, the first phase of the Neolithic (c. 5200-5000 cal BC) was characterized by a mixture of megalithic and non-megalithic vertically-accessed tombs (García Sanjuán 2006), a construction which gave way over time to even more elaborate manifestations of communal labor effort, like large-scale passage graves and standing dolmens during the fifth millennium BC (Bueno and Balbin 1998) (Figure 1.5). The immense effort that could be channeled into levering up dolmens and digging out passive graves was related to the economic changes that mark the start of the Late Prehistoric period. As subsistence strategies tied people ever more tightly to their lands, and stockpiles of livestock and cultivated crops freed up hands and energy for extra-subsistence labor, it became possible for communities to invest energy in projects that were a testament to local identities. As Sherratt underscores, "[i]n a society where labour was the most important commodity, moving large stones symbolized the size of the workforce which could be assembled at any one time – an epideictic demonstration of demographic strength and coordinated effort" (1990:150).

Figure 1.5 Dolmen I at the Late Prehistoric site of Rego da Murta, Alto Ribatejo, Portugal

The transition to megalithic mortuary architecture is not limited to the geographical cul-de-sac of the Iberian Peninsula, but instead characterizes the Late Prehistoric transition to agriculture in Europe more broadly (Chapman 2006). Large-scale monuments constructed of earth or stone are also reported for Britain, France, Germany, Poland, and Scandinavia (Renfrew 1973; Barrett 1988; Sherratt 1990). Initially argued to represent the diffusion of ideas from advanced Oriental civilizations, the advent of radiocarbon dating demonstrated that many such monuments appeared earlier in Europe than in their purported areas of eastern origin (Renfrew 1967; Trigger 2008). Since the "radiocarbon revolution," megalithic monuments have been variously argued to represent demonstrations of chiefly control of labor and assertions of territoriality (Renfrew 1973), platforms for "public staging of ritual processes" (Barrett 1990) and ideological nexuses where novel agricultural principles were wed to persisting and local Mesolithic ideologies (Sherratt 1990).

This intersection between incipient agriculture and mortuary monuments is not a phenomenon unique to Europe. Similar displays of community labor investment in mortuary monuments (*sensu* Chapman 2006) also characterize some of the earliest horticultural societies worldwide. One well-known archaeological case study can be found in the American Midwest, along the banks of the Illinois River. The impressive flood-plain mounds that sit atop the bluffs of the Lower Illinois River valley present one clear instance of an increasingly sedentary and agriculturally-inclined society marshaling local labor to erect large-scale funerary monuments, a process that has been tied to constructing community identities, demarcating territory, and worshipping the ancestors (Buikstra and Charles 1999; Charles and Buikstra 2002) – the same arguments that have been used to explain their popularity in European contexts (Chapman 1995). Indeed, as Mathers notes of Copper Age Iberian mortuary facilities "[m]arked graves appear physically to identify the dead with the living, emphasize settlement and social continuity, and mark off communal territory" (1984a:22). This parallel between Old World and New World early agriculturalists has been drawn before – Renfrew noted the Hopewell/European Late Prehistory connection as early as the 1970s (1973:555), while Chapman (2006) recently outlined the historical and archaeological parallels between Late Prehistoric Europe and the "Hopewell Interaction Sphere" in order to emphasize potentially fruitful new exchanges in mortuary theory.

Just as megalithic mortuary architecture was popular across vast expanses of space within the European continent, it was also popular over extended periods of time. The communal investment of labor in mortuary features that began during the Iberian Neolithic continued into the Copper Age, with some later communities actually interring their dead in Neolithic megalithic monuments (Delibes de Castro et al. 1995; Rojo-Guerra et al. 2006; Aranda Jiménez 2013). However, while the focus on communal interments was maintained during the early Chalcolithic (c. 3300-2100 cal BC), the location of mortuary sites shifted; natural cave burials decreased in frequency, while hypogeum type burials in artificial caves became increasingly popular. Circular-chambered *tholos* tombs also appear on the landscape during this period, frequently located alongside earlier megalithic mortuary monuments, perhaps in recognition of the importance of ancestral ties to the land. Despite formal variability in funerary treatments, they still share "the basic characteristic of clustering together a number of deceased" (García Sanjuán 2006:157). This increasing proliferation of tombs and tomb types occurs in Portugal as well as Spain, and is characteristic of Europe more broadly during the early third millennium BC (Lillios 2014).

Though mortuary facilities thus retained their overall communal character during the Chalcolithic, Mathers (1984a) indicates that the early Copper Age also marks the period when the first hints of a novel emphasis on individual identities began to arise in the cultural treatment of the deceased. The preliminary indications that individuals are being recognized at death come from the increasing popularity of architecturally segmented tombs, with bodies deliberately buried in "side chambers and niches" that are spatially separated from the rest of the tomb.

Evidence from macro-village sites like Los Millares (Chapman 1981) and Valencina de la Concepción (Mathers 1984b; García Sanjuán et al. 2013) attests to the popularity of segmented or chambered tombs at these novel types of large-scale settlements. During this time, mortuary practices also began to vary regionally; the practice of segmented tombs and evident wealth differences in grave goods occurred more commonly in the arid regions of Almería and Seville (Mathers 1984a; Gilman 2001). However, smaller-scale megalithic constructs were still represented in the western part of the region, where passage graves were popular, and collective burials in caves are known for Murcia, Granada, Extremadura and both Mesetas.

Grave goods during the Copper Age were largely utilitarian (Murillo-Barroso and Montero Ruiz 2012), with 90% of funerary assemblages dominated by offerings like ceramics and stone tools, while only 10% of funerary assemblages comprised magico-religious artifacts or objects of personal adornment; <1% of burial assemblages at the time were composed of metal objects. However, at macro-village sites like Valencina de la Concepción and La Pijotilla, the inclusion of larger numbers of ornaments or idols into mortuary contexts suggests that "the dynamic of association between status and prestige objects was more developed among the elite of the[se] settlement[s]" (García Sanjuán 2006:158).

The emphasis on demarcating individual identities and achievements, either spatially (through the use of segmented tombs) or materially (through the incorporation of "elite" grave goods) is a process that increases in intensity during the Late Copper Age, a harbinger of the shifts in funerary ideology to come (Table 1.1). Indeed, Shennan (1982) has suggested that during the earlier periods of Late Prehistory in Europe "considerable social differentiation had developed which was increasingly incompatible with existing ritual forms" and that "it may be that we can see the Early Bronze Age change rather as the "catching-up of conservative ritual with previous social change" (1982:157–158). During the Bronze Age, increasing emphasis is placed on individual burials, in funerary containers such as *covachas* (small lateral chamber tombs cut into the soil), pits, cists, or urns that were usually located underneath house floors, with the dead interred in a flexed position (Lull 2000). At most, two or three individuals were interred in a single inhumation, and graves were opened once for interment, rather than used repeatedly (Lull et al. 2013).

Table 1.1 Key transformations in Iberian mortuary practices over the course of the Copper to Bronze Age transition (after Mathers 1984b)

Element	Copper Age	Bronze Age
Tomb Morphology	Rock shelters, rock-cut tombs, artificial caves, megalithic tombs proliferate. Overall, there is tremendous variability in tomb construction.	Cists, urns, stone mounded tombs, of smaller and less elaborate construction; widespread similarities and repetition of tomb form.
Tomb Location	Above ground and line-of-sight from associated settlements, distinct, formalized areas for burial outside the settlement proper.	Visually unmarked burials beneath house floors.
Body Treatment and Arrangement	Disarticulated and fragmented collective burials that frequently show signs of burning.	Individual burials within living areas.
Funerary Objects	Wide variety of raw material types and decorative motifs, as well as artifact types, particularly flint arrowheads, daggers, knives; polished stone axes; various stone and bone idols.	Standardized repetition of forms and marked increase in quantity of metal objects.

The movement from communal burials outside of the settlement to individual burials underneath the dwellings within it has been interpreted to represent a significant shift in social ideology and the construction of community identities. Lull opines that "individuals took on a social identity through being members of certain lines of descent, precisely because in death they returned to the unit that gave them social significance" (2000:587). During the Copper Age, this unit was arguably that of the lineage or extended family (Chapman 1990; Díaz-del-Río 2006), but the spatial focus of the domestic dwelling suggests that by the Bronze Age, the smaller-scale aggregation of the nuclear family had become the social unit *par excellence* (Lull 2000: García Sanjuán 2006). During this period in regions like the Meseta and the Argaric homeland, human burials occur in almost all settlements, where males and females are interred in flexed fetal depositions in underground storage pits, sometimes outfitted with grave offerings of domestic animals (Díaz-del-Río 2006; Pérez Villa 2015).

One particularly stark contrast between the funerary rituals of the Iberian Bronze Age and the mortuary practices that preceded it can be found in the increasingly standardized approaches to the dead during the latter period. The funnel metaphor is again appropriate; during the Late Neolithic and Copper Age, a wide variety of funerary tracks and treatments coexisted, with the structure and positioning of tombs, treatment and arrangement of bodies, and form and combination of grave goods all exhibiting significant spatial and temporal variability (Lillios 2014). However, during the Bronze Age this proliferation of practices is winnowed down and made more homogeneous: individuals are buried with standardized sets of grave goods, greater numbers of which were worked on metal. Idols and amulets largely disappear from funerary contexts, while metal artifacts show an astronomical increase in popularity; symbolic emphasis also shifts from functional objects to weapon and items of personal adornment worked on bronze and silver, inclusions that are usually related to the gender of the interred individual (Murillo-Barroso and Montero Ruiz 2012). This standardization is regional in scope, and the similarities in the organization and nature of prestige materials employed in funerary displays signify the increasing degree to which Argaric communities were interconnected (Mathers 1984b). The mortuary transitions from the Copper Age to the Bronze Age can thus be conceptualized as chiasmus of architecture and artifacts; during the Copper Age, tombs were outwardly ostentatious, but grave items were utilitarian, while during the Bronze Age, tombs were small and simply constructed, but contained richly elaborate grave goods. The unequal distributions of these grave goods among individual Bronze Age burials in Spain has led some researchers to suggest that significant levels of inter-individual social differentiation, perhaps so pronounced and codified as to delineate different social classes, existed during prehistory (Lull et al., 2005).

Finally, in addition to the incorporation of greater numbers of luxury goods into individual graves, the increased attention to child burials during the Bronze Age attests to the growing emphasis on social inequality and the identity of individuals, rather than sodalities or lineages (Lull 2000; Mathers 1984a). In central Iberia, infant burials become common during the early Bronze Age, suggesting that "…in these small-scale groups with high infant mortality, descendants became the key factor for the reproduction of labour force" (Díaz-del-Río 2006:76). The distinctions we can discern in the quantity and quality of the grave offerings associated with adults are also visible in a sample of Bronze Age subadult burials (N = 227) from the large-scale settlement of El Argar, suggesting that these "differential patterns of ritual consumption" were present from a very young age. Lull et al., suggest that "the classification of grave assemblages of children dying at all ages into the five social categories…. confirms that social differences were continuously manifested. The only exception is premature or newborn children, the most homogeneous group where ritual consumption hardly went beyond the right to be buried" (2005:260–261).

In summary, over the course of about two millennia the Iberian mortuary record witnessed significant shifts. The gradual replacement of large-scale communal tombs by individual containers or small pit burials suggests a decreased amount of community investment in mortuary practices, while the standardization of grave goods and tomb form is indicative of the existence of a widely recognized symbolic framework with which to signal social differentiation (Mathers 1984b; García Sanjuán 2006). Gilman nicely summarizes the abundance of evidence drawn from studies of material culture, bioarchaeology, and mortuary architecture by underscoring that "the differences in constructional scale and grave goods exhibited in the Copper Age funerary record of southern Iberia suggest the existence of tensions within a society that is in principle collective in social organization, but is ceasing to be so" (2013:25).

Understanding the Neolithic to Copper Age Transition

Forenbaher has perhaps framed it best, arguing that "[a]lmost everybody agrees that, at the beginning of the Late Neolithic…Iberian society was more egalitarian and decentralized than at the end of the Chalcolithic, by which time there is more evidence for inequality and centralization. What happens in-between is much less clear" (1999:9). Many factors have been suggested as the catalyst that triggered the aggregation of populations and increased social complexity during the third millennium BC. These include the development of systems of irrigation and water control (Chapman 1978; Gilman and Thornes 1985), the concentration of agricultural surplus in a system of staple finance (Díaz-Andreu 1995; Gilman 1987), the conversion of surplus into valuables or exotic products of long-distance trade (Díaz-Andreu 1995; Gilman 1987), the increasingly intense cultivation of cereals and livestock (Mathers 1984a), the exploitation of domesticates for their secondary products (Sherratt 1983; Harrison 1985; Vicent García 1995) and the production and incorporation of new metallurgical products and luxury goods into systems of exchange controlled by elites (Nocete et al. 2005, 2008, 2010). Given the myriad lines of archaeological evidence that attest to changes in material culture, metallurgical technology, exchange networks, subsistence practices, settlement patterning and social organization during this period, it is likely that the significant increase in social complexity over the course of the third millennium was a multi-causal phenomenon that reductive uni-causal explanations will never fully account for in a satisfactory fashion. Whatever the catalyst for complexity, it is widely agreed that the Chalcolithic system undergoes a radical reorganization during the period 2400-2200 BCE, with the decline or abandonment of sites that had previously been centers of activity, fissioning of populations, and a general collapse of inter-settlement organization (Díaz-del-Río 2004a, b; García Sanjuán and Murillo-Barroso 2013; Nocete et al. 2010).

Such hallmarks of developing social complexity have been most thoroughly investigated in southeast Spain and the southwestern realm of the Portuguese Estremadura (Gilman 1987), but similar signatures of complexity have been highlighted in the lower Duero basin (Díaz-Andreu 1995), the Central Meseta (Díaz-del-Río 2004a; 2006), the Northern Meseta (Delibes de Castro et al. 1995) and Portugal more generally (Forenbaher 1999). Across Iberia, the archaeological record thus provides evidence for a pattern of economic intensification, demographic growth and the concentration and organization of large amounts of labor that increases over the course of the third millennium before disintegrating around 2200 cal BC.

To date, there are two general models that seek to explain the Iberian Chalcolithic pattern of burgeoning complexity followed by abrupt collapse: (1) an "early state" hypothesis that underscores evidence for extreme inter-individual and inter-settlement inequality in the archaeological record, and (2) a "competing lineage" model which hypothesizes that the material signatures of differential access to exotic goods and the range of settlement sizes that occur during the Copper Age should be read as evidence for competing lineages or kinship units struggling to attract followers.

The first perspective employs an "early state" model of population aggregation, in which large centers exploit and dominate smaller outlying settlements (Nocete et al. 2005, 2006, 2008, 2010; Cámara Serrano et al. 2012b). The rise of centralized, fortified settlements at the beginning of the third millennium, their location relative to possible key resources (such as copper or flint), the pattern of circulation of exotic goods and the differential inclusion of such goods in inhumations have led this group to argue for a framework in which dominant elites at regional settlements created relationships of dependence and subordination at the local level through institutional coercion (Nocete et al. 2005). In the Guadalquivir Valley, the site of Valencina de la Concepción is viewed as a socially stratified primary political center controlling the distribution of metal goods and other exotics (Nocete et al. 2008). Evidence for the presence of a "class society" ruled by elites is found in archaeological signatures of differential consumption and spatial segregation, a pattern that has trickled down to even the smallest outposts in the inter-settlement hierarchy (Nocete et al. 2006). Within this framework, the significant reorganization and dispersal of populations and decline of related industries and exchange networks at the end of the third millennium is seen as the result of the collapse of the "inter-settlement hierarchical system" based at Valencina de la Concepción (Nocete et al. 2010).

However, this portrayal of third millennium southern Iberia as an early state has been strongly contested. A second perspective interprets the regional record as evidence for a lineage-based form of social organization, where centralization occurs less as the result of coercion than of collective cooperation mobilized by emergent chiefs. Here, proponents emphasize the lack of evidence for functional differentiation between households, the weak signature of hereditary social hierarchies (Gilman 2013), the dearth of functional evidence for site fortification (García Sanjuán and Murillo-Barroso, 2013), and insufficient spatial evidence to address the "territorial dimension of spatial hierarchy" (Costa Caramé et al., 2010). They argue particularly against the focus on Valencina de la Concepción as a primary political center, noting that "the referred proponents seem to confuse the notion of "centre" (the seat of a state) with that of "central place" (a place that caters for goods and services that lesser settlements cannot offer, and which exist in any type of non-state society," underscoring that while "…linguistically similar, conceptually both notions are worlds apart" (Garía Sanjuán and Murillo-Barroso 2013:205).

In sum, these investigators consider the evidence for statehood either insufficient or absent. Instead, they highlight such features as regional settlement patterns of aggregation and fission (Díaz-del-Río 2004a), the predominance of collective forms of burial, and the relative homogeneity in the size and contents of domestic structures at large-scale sites (Gilman 2013) to argue that the evidence is more reflective of "unstable chiefly societies" than anything resembling a state. The changes circa 2200 B.C.E are seen as the result of internal lineage competition - social aggregations were disbanded due to the tension between "communal structures and household interests" (Díaz-del-Río 2004b). In this view, the archaeological evidence highlights increasing pressures in a society in which no single social group could ever attract enough followers to dominate all others; instead "competition and shifts in factional support, and contradictory interests between potential emerging elites and commoners … undermined the particular interests of each group," and by the end of the third millennium "…all potentially leading lineages failed to consolidate stable political structures…[and] aggregation processes ended well before critical political and economic inequalities arose (Díaz-del-Río 2011:51–52).

Chapter Summary: The Interwoven Foundations of Social Complexity in Late Prehistoric Iberia

"Southeastern Iberia has been the main laboratory for debates surrounding prehistoric social inequality since the seventies" (Díaz-del-Río 2006:67), and while Marroquíes Bajos is located in central Andalucía, to the west of the "laboratory," the same broad-scale trends that demarcate the explosion of Millaran social complexity are also archaeologically observable in this region. However, the popular environmentally deterministic explanation for southeastern signatures of complexity – which is, in essence, an irrigation-themed riff on Frank Herbert's "he who controls the spice, controls the universe" – cannot be applied to the Iberian region more broadly (Chapman 1981; Mathers 1984a, b). The concomitant increase in agricultural production, rise in the number and size of settlements, expansion of exchange networks and significant investment in both defensive and non-defensive site architecture are trends that occur across Iberia, regardless of local ecologies and climates. Thus, while uni-causal explanations of such shifts can be intellectually compelling, they are rarely capable of explaining the full range of variability preserved in the archaeological record. In Iberia, Shennan's (1982) call for an increased focus on local histories and regional trajectories in order to fully unpack archaeological signatures of transformations in social organization is just as appropriate to Copper Age societies as it is to Bronze Age societies.

Despite the many impressive transformations that unfold over the course of the third millennium, the clearest and most important distinction between the Copper Age and the preceding Neolithic is that the latter period entails "the concentration and immobilization of vast investments of labour" (García Sanjuán and Díaz-del-Río 2006). Though Neolithic communities across Europe invested effort in constructing elaborate mortuary monuments, the scope of such labor was at a markedly different scale than that required to erect the impressive walls encircling Los Millares, or to dig the four kilometers of ditches that encircle the habitation area of Marroquíes Bajos. While such architectural grandeur is thus a testament to the capacity of local groups to marshal and control remarkable amounts of labor, upon closer examination such features also reveal the roots of the widely observed Chalcolithic decline. As Díaz-del-Río underscores, a detailed study of the sequence of events involved in building the Los Millares fortifications reveals that, even though their structure suggests a unified vision as to the end result of labor efforts, the construction of the defensive architecture was in fact a lengthy process:

> "…whatever social institutions were behind the deployment of surplus labor, they lacked the means to recruit, to organize, and to mobilize it in order to create a unified monumental project. As a result, the final picture is one of an aggregation of segmented building projects with a somehow similar idea as to what the result should look like... The multiple constituent pieces of the fortifications at Los Millares are no metaphor, but the result of the actual structure of its society" (2011:46)

Because Chalcolithic community labor investment was directed at non-essential architecture like fortifications, towers, and enclosure ditches, individuals were still able to "vote with their feet" and disperse away from macro-villages if ruling lineages began making exorbitant demands. However, the differential distribution of exotic grave goods at macro-village sites like Los Millares and Valencina de la Concepción suggests that there were still persistent social inequalities at such centers, at least in terms of access to elaborate material culture, during this period.

By analyzing mortuary variability, this dissertation will shed light on how the competition brought about by different lineages striving for dominance was expressed. Were the struggles between rival groups embodied in the day-to-day lives of community members through unequal access to subsistence resources or differential labor burdens? Or, at the other end of the spectrum, was such competition inherently symbolic in nature, inculcated in ritual material culture and the construction of different types of funerary monuments? Teasing out the social organization at these early centers, where people were aggregating at a scale unknown for the previous Neolithic period, is a complicated venture, but has the potential to offer novel insight about the costs and benefits associated with population concentration in early agricultural societies. As Richard Lee noted as early as 1979, there is an "inherent contradiction" in human social aggregations that rise above the familial scale. He wrote of the !Kung San: "people sought the stimulation of a more intense social life, but there was always the danger of serious conflict…In this atmosphere even small disagreements may erupt into conflict, and this conflict usually results in one or both parties splitting off to seek greener pastures" (1963:367). In this vein, the Iberian Copper Age is particularly fascinating case study because, in sharp contrast to the later Bronze Age, it offers evidence of a particular cultural and historical situation where the costs of aggregation apparently outweighed the benefits. Despite the clear attraction to large-scale centers like Valencina de la Concepción or Marroquíes Bajos, by 2200 cal BC, all such large-scale villages had dissolved and dispersed. Whatever the reason for their decline, bioarchaeological analysis provides a unique lens with which to examine such early complex societies, by revealing the degree to which the inter-individual and inter-group inequalities recognized mortuary ritual actually permeated daily lives and routines.

Chapter 2

Collective Burials, Collective Experience?

> *The largest groupings the !Kung could muster thus had an inherent contradiction. People sought the stimulation of a more intense social life, but there was always the danger of serious conflict…*
>
> – *Richard B. Lee, The !Kung San: Men, Women and Work in a Foraging Society, (1979:367)*

A desolate expanse of sunbaked earth dotted with acacia trees and patches of scrub grass seems an unlikely place for a twenty-three year-old Canadian to pursue his professional ambitions. Despite the unforgiving terrain, anthropologist Richard B. Lee spent nearly half a decade entrenched in the Kalahari Desert of South Africa, living with an indigenous group called the !Kung San. While conducting fieldwork during the 1960s and 1970s Lee immersed himself in the daily tempo of desert life, analyzing everything from local eating habits to exchange networks. The San normally lived in small groups of 10 - 30 individuals, and Lee's curiosity was particularly piqued by the tension he observed between the desire to aggregate in larger groups, and the feisty independence that characterized San temperament. These conflicting traits necessarily constrained larger aggregations of people during the dry season:

> "Keeping very large groups together requires special efforts from individuals. They must maintain higher levels of cooperation and coordination…than are necessary in smaller domestic groupings. For this reason, the largest aggregations of !Kung and other hunters… were inherently unstable […] In this atmosphere even small disagreements may erupt into conflict, and this conflict usually results in one or both parties splitting off to seek greener pastures. Hunters say "to hell with it."
>
> - Lee (1979:366–7).

This tendency is not unique to the San; it has been observed among all documented groups of contemporary hunter-gatherers, ranging from the Iñupiat Eskimo of Alaska to the pygmy tribes of the Congo. Indeed, the tension between a desire to aggregate on the one hand, and a desire to maintain individual autonomy on the other, characterizes the full spectrum of human societies. Traces of these conflicting pressures are imprinted on the entire archaeological record, from Mesolithic ritual gatherings in Northern Europe, to the settlement pattern of chiefly cycling documented in the protohistoric American Southeast and the evidence for the internal strife that brought about the collapse of Teotihuacan. This tension is a topic of significant anthropological debate. What factors lead individuals to relinquish their autonomy in favor of aggregation? How do humans handle the potential for conflict inherent in living in large groups? Is the establishment of administrative hierarchies essential to larger concentrations of population, or have human societies developed a range of different strategies to handle the problems of living in groups?

The site of Marroquíes Bajos provides an excellent case study in which to explore factors that promote aggregation and factors that lead to fissioning. One of the largest settlements known for Copper Age Iberia, Marroquíes also contains large-scale architecture that attests to the organization of significant amounts of human labor. Both its considerable size and the complexity of its infrastructure suggest that large numbers of people congregated here and organized communal forms of labor in a way that was markedly distinct from preceding Neolithic villages in the region, making it an appropriate site at which to study the dynamics of early aggregation. The historical trajectory of the site is likewise intriguing. Like the handful of other macro-villages in third millennium Iberia, Marroquíes flourished for several centuries as a large-scale center that was quantitatively and qualitatively different from any settlements that preceded it. The size and scale of its ditched enclosure system attested to a need for defense and a new ability to marshal significant amounts of human labor, while the record of its domestic architecture suggests gradual changes in the way household and communal labor were organized over time. However, by the start of the second millennium occupation at the site petered out; there is evidence of small-scale activity, and re-use of some features, but local populations had largely disbanded.

The history of Marroquíes Bajos bears the characteristic imprint of a recurring tension between aggregation and dissolution due to conflict. The strategies first used to bring large groups of people together foundered by the early centuries of the second millennium, leading most people to disperse into the surrounding countryside, and a sharp drop in activity at the village. Why did people initially flock to this settlement, and why did activity at the site drop off precipitously by the end of the third millennium? More importantly, how did these variables affect the mortuary and osteological record of human burials at the site? Mortuary practices give us the opportunity to understand how ancient people conceived of themselves and their communities, while human osteological remains allow us to uncover evidence of what life was like for individuals (Quinn and Beck 2016). By contrasting the mortuary markers of social organization with the osteological markers of lived experience, we gain a better understanding of strategies that facilitated or undermined these early human aggregations can be achieved.

This chapter is divided into three parts. The first section provides the middle-range theory required to link social organization and mortuary practices. This section illustrates the shifting anthropological understanding of mortuary practices over the past century, from the early treatment of funerary behavior as a "random" culture trait isolated from broader political and economic factors, to its current understanding as a multivocal process that communicates information about both living societies and deceased individuals. The second section introduces the study of collective burials in Late Prehistoric contexts. The third section unpacks the relationship between bioarchaeological analysis and aspects of social status, social organization, and diet, emphasizing the potential for nuanced osteological analysis to reveal economic, ideological, and political inequality. Finally, the last sections focus on the particular case of Marroquíes Bajos, discussing the evidence for the tension between aggregation and independence at this large-scale settlement, and elaborating the three different models of social organization that this dissertation will test.

Using Mortuary Archaeology to Reconstruct Social Organization

A History of Mortuary Theory in Archaeology

Funerary rites were once regarded as a "trait" within a broader cultural and historical framework. Early anthropologists were concerned with large-scale trends in cultural processes, and examined expansive swathes of archaeological and ethnographic data from different regions using a comparative approach. Childe (1945) considered funerary practices to be "patterns of behavior" that gradually became reified into ritual over time. He explored such variables as body placement, burial location, grave form and grave goods, seeking cross-cultural patterning that might reveal prehistoric pathways of diffusion or innovation. He also hunted for cultural regularities or universals in his chronologically and geographically extensive dataset, formulating rules that appeared to hold true cross-culturally, such as the reduction over time of the quality and quantity of grave goods in "stable societies" (1945:16).

Rather than focus on widespread trends in funerary ritual, Kroeber (1927) emphasized that mortuary practices demonstrate a surprising degree of instability relative to other cultural customs. Ethnographic and historical evidence for intra- and inter-group variability in mortuary behavior, combined with the maintenance of multiple modes of disposal within a single population (e.g. cremation and inhumation being used simultaneously) led him to argue that mortuary practices were in constant flux. After examining a geographically broad data-set and finding little apparent rhyme or reason to burial practices, Kroeber postulated that funerary practices were less rigidly regulated than other aspects of culture, in part due to their isolation from more codified aspects of life like law or religion. This isolation put mortuary behaviors on par with fashion – trends were prone to change at whim for no discernible reason: "In their relative isolation or detachment from the remainder of culture, their rather high degree of entry into consciousness, and their tendency to strong emotional toning, social practices of disposing of the dead are of a kind with fashions of dress, luxury, and etiquette" (1927:314).

These early studies made an impact due to their ability to highlight the broad diversity of human mortuary behaviors, gathering information drawn from a variety of different contexts into anthologies of what was known about funerary practices in the early 20th century. However, these analyses were overly simplistic when it came to their insistence on channeling disparate, culturally distinct practices into regimented cultural laws and universal norms. Part of the problem lay in early theorists' nebulous approach to causal relationships – researchers assessed bodies of data qualitatively, drawing their conclusions based on an overall sense of patterning brought about by their familiarity with the material record.

The next wave of mortuary theory sought to correct this qualitative approach. Beginning in the second half of the 20th century, processual investigations of funerary behavior labored to establish explicit relationships between social organization and mortuary practices in human societies. Lewis Binford, the founding father of North American processualist theory, took umbrage with earlier cultural-historical theoretical explanations of funerary variability. In contrast to Kroeber's conceptualization of mortuary practices as existing in a state of constant flux, Binford maintained that "there seems to be a wide range of variability in the relative stability of mortuary practices. Some historical sequences exhibit a rather remarkable stability, while others change radically and rapidly" (1971:11). He proceeded to explicitly evaluate Kroeber's claim that mortuary practices varied independently of social organizational or technological variables. Before the 1970s, mortuary variability had largely been argued to be the result of (1) environmental restrictions; (2) "mutual effects of inter-societal contact"; or (3) indicative of societal relationships between the deceased and living society. While Binford deemed the first argument "reasonable," he abandoned the second explanation as specious because it was founded on ambiguous ideas about changes in mortuary practices being linked to changes in *beliefs* about death and dying, a proposition that was impossible to rigorously evaluate for prehistoric societies as beliefs do not fossilize.

A review of the extant anthropological literature provided strong evidence for the third argument, as "[t]he empirical generalizations which have been advanced consistently link formal differentiation in mortuary rites to status differences and to differences in the group affiliation of the deceased…[demonstrating]…a set of mutual dependencies between forms of mortuary rites and social organizational features" (15). Instead of funerary practices being independent from aspects of social organization, Binford postulated that heterogeneity in mortuary practices would vary directly with the complexity of the status hierarchy and the overall organization of society. In short, the expectation was that a society with greater infrastructural variability and complexity (e.g. with many different ranks, or many different institutions) would have more complex and complicated mortuary practices than a society with less infrastructural variability.

Binford defined mortuary ritual as the execution of symbolic acts that varied in form, number and kind. These were most profoundly constrained by two variables: (1)

the social persona of the deceased, and (2) the composition and size of the social unit recognizing status responsibilities to the deceased. He expected that these two variables would be positively correlated; the higher an individual's social status, the greater the number of individuals having obligations to the deceased. Binford tested these hypotheses against a sample of ethnographic studies from the Human Relations Area Files, examining the distribution of "dimensional distinctions" (variables like age, sex, social position, sub-group affiliation, cause of death and location of death) relative to complexity, for which he used level of subsistence as a proxy. He found that settled agriculturalists employed a greater number of dimensional distinctions than hunter-gatherers. He also predicted that less complex groups would be more likely to recognize age and sex in mortuary ritual, while more complex societies would be more likely to acknowledge an individual's social position and sub-group affiliation. Binford's hypotheses were "crudely confirmed," and he concluded that "the form and structure which characterize the mortuary practices of any society are conditioned by the form and complexity of the organizational characteristics of the society itself" (1971:23).

Binford was not the only processual archaeologist concerned with developing quantitative approaches to mortuary practices. In 1970, Arthur Saxe, then a graduate student at the University of Michigan, focused his dissertation on testing a set of eight hypotheses that sought regularities between treatment of the dead and the organization of living societies. Like Binford, Saxe departed from the cultural-historical concept of mortuary practices as emotional acts out of step with the larger organization of society. Instead, he was determined to "build and test models of how treatment of the dead is related to other elements of sociocultural systems" (Saxe 1970:12). Like Binford, Saxe believed that

> "When archaeologists excavate a set of burials they are not merely excavating individuals, but a coherent social personality who not only engaged in relationships with other social personalities, but did so according to rules and structural slots dictated by the large social system" (Saxe 1970:4).

The first four hypotheses he developed focused on the representation of social personae within a given burial domain (e.g. within the mortuary practices of a specific society at a specific time). The second four hypotheses sought to compare different burial domains (e.g. to compare mortuary practices between different societies) to reveal broader aspects of social organization (Table 2.1).

Saxe tested his hypotheses using mortuary data drawn from groups from three different cultural areas: The Kapauku Papuans of West New Guinea, the Ashanti of West Africa, and the Bontoc Igorot of Luzon, Philippines. Of these hypotheses, Saxe found support for 1-3, while 4-7 were untestable or demanded refinement (see O'Shea 1984, Table 1.2 for a useful synopsis). His conclusions have been most accessibly glossed by Tainter, who underscores that the values resulting from Saxe's key diagrams "…are consistently high, indicating tree-like keys, and suggest…that mortuary ritual as a communication system *may* universally employ a highly redundant code. This finding suggests a high degree of reliability for the archaeological record in respect to the information communicated through the disposal of the dead" (1978:114).

Despite the breadth of Saxe's hypotheses, Hypothesis 8 was the postulate that received the greatest amount of attention from archaeologists. In particular, Lynne Goldstein's re-working of Hypothesis 8, often referred to as the Saxe-Goldstein hypothesis, investigated the ramifications of bounded disposal areas in greater detail. Goldstein tested Hypothesis 8 using 30 global ethnographic examples, and adjusted its parameters to reflect these new data. In particular, her test demonstrated that not all groups with corporate rights to resources maintained bounded cemeteries. The primary issue with Saxe's formulation is that it assumed that formal specialized disposal areas were the *only* way for societies to symbolize corporate group rights – "considering the wide range of variability in cultures, there is a low probability that certain groups, even when in similar economic and environmental conditions, will symbolize and ritualize aspects of their organization in precisely the same way" (Goldstein 1981:61). However, the converse did hold true – groups with circumscribed formal disposal areas did have corporate group rights to resources, and the more formal the disposal areas, the more circumscribed the rights.

Table 2.1 Saxe's eight hypotheses

No°	Hypothesis	Explanation
1	Different components[6] of burial treatments are combined to represent different social personae[7].	Saxe's example here is the use of black ox skin (a component) to represent royalty and political functionaries (a social identity) among the Swazi.
2	The social personae represented at death parallel the social personae that organize social relations in the society at large.	"For example, if a sociocultural system is of the type defined by Fried as "egalitarian" …then all (or most) of the social identities present in the disposal domain should be of the type acquired on the basis of age, sex, and/or personal attributes. Conversely, if the distribution of the components in the disposal domain can be accounted for on the basis of age, sex and/or personal attributes alone, the social structure that produced them is egalitarian" (1970:67).
3	Social personae that are less significant have fewer positive components representing their social identities (and conversely).	Saxe's example details the distinction between infant and adult death in egalitarian societies. An infant death only affects the parents, while the death of a headman affects many more individuals and groups. Because these individuals and groups will likely make contributions of some kind to the headman's mortuary treatment, the headman will be represented by more components.
4	The greater the social significance of the deceased, the more likely the social persona represented at death will prioritize the representation of high status social identities at the expense of less significant social identities.	In short, a deceased man may be a father, lover, householder and hunter, but if he was also a king that is the identity most likely to be represented at death. The other social identities may lose out, as it is not possible to represent all contrasting identities at once. Saxe noted that "[o]bviously, the disposal domains of societies possessing greater inequalities between people can be expected to evidence more of these disparities, and evidence them more obviously, than societies that are more egalitarian" (73).

[6] Saxe refers to these attributes as "components," which include such variables as "grave proximity to village center," "number of artifacts in burial," etc., etc.
[7] A social persona is a composite of several social identities (social identities being categories like "father," "king," "policeman" and "child").

5	More egalitarian social organizations can be distinguished from "more complex" social organizations based on the statistical structure of their attributes when key mapped[8].	Here Saxe distinguished more egalitarian societies as being "paradigmatic" in their organization, and more complex societies as being "tree-like." Saxe described how "the complexity of a sociocultural system is determined…by counting the number of parts (groups, institutions, etc.) and the number of different kinds of parts. Ideally, this can be expressed numerically for each system" (84), and underscored that complexity was thus a quantitative judgment rather than a value judgment of inferior or superior. In short, Saxe's argument is that "differences in the complexity of sociocultural systems should be reflected in the number of elements present, and the way they are related among themselves" (102).
6	The simpler a sociocultural system, the greater the likelihood of a linear relationship between number of components representing social personae (and conversely).	Here Saxe postulates that in more egalitarian social systems, the representation of individuals will differ by degree, rather than kind: "[t]hus the closest thing to a true paradigm we can expect will occur in quite egalitarian societies (where given age grades and sex limitations there is a continuous grading of achievement and hence prestige) where significata will not contain the same number of components but will tend to grade from the shallowest disposal type of least social significance to those of greater depth of most social significance" (115).
7	Simpler sociocultural systems are less likely to make sharp distinctions between different kinds of deviant social personae (and conversely).	As societies grow more complex, there are more categories of deviancy – "With increasing complexity…we would expect the disposal treatment of the ill, lame, and those who die of disease to increasingly diverge from the treatment afforded criminals and to increasingly approximate those considered normal" (118-9).
8	To the degree that corporate groups rights are accorded through lineal ties to ancestors, such groups will maintain some form of bounded spatial area for the disposal of the dead, and as such ties become less important the mortuary area will become less formally bounded.	Essentially, Saxe postulated that if rights to resources or territory were legitimized through ancestral claims, groups would bury their dead in a circumscribed area so as to remind everyone exactly where their ancestors came from.

[8] In particular, Saxe argued that more complex societies are more likely to show tree-like attributes, and more egalitarian societies are more likely to show paradigmatic attributes. A perfect tree is a redundant structure where the choice of one decision automatically constrains the nature of subsequent decisions. A perfect paradigm refers to a situation where all attributes are independent, and choosing one attribute does not constrain the choice of subsequent attributes. See Tainter (1978, 111-112) for a useful description of these concepts.

The search for explicit, quantitative relationships between funerary practices and social organization was not limited to the study of cemeteries. During the processual era of mortuary analysis, research focused on the patterning of variables and the establishment of quantifiable relationships between mortuary practices and social organization. A synopsis of key studies during this period allows for the identification of broad analytical concerns and shared methods. For example, Renfrew (1973) analyzed the spatial distribution of large-scale earthen and chalk mortuary monuments in Neolithic Wessex to suggest that they reflected the emergence and distribution of hierarchical territorial chiefdoms across the landscape. Goldstein (1981) used cluster analyses on a sample of two prehistoric cemeteries in the lower Illinois River valley to shed light on aspects of Mississippian social organization. She examined such variables as distribution of graves, cardinal orientation, artifacts, and body positioning to distinguish which variables signaled individual characteristics like age and sex, and which signaled membership in a larger group. Brown (1971) investigated burial disposition, context, and the biological profile of interred individuals in a series of interments at the Mississippian site of Spiro using key diagrams. He compared the degree of differentiation between social statuses at Spiro to the degree of differentiation apparent in two ethnohistorically known Southeastern U.S. societies[9], to argue that high status at Spiro was markedly more emphasized and internally differentiated than in the comparative case studies. Peebles and Kus (1977) took these measures one step further and developed an explicit list of the broad correlates of ranked societies, including ascribed ranking, settlement hierarchies, local subsistence sufficiency, supra-domestic productive activities, and society-wide organizational activity to buffer stressors. Importantly, ascribed ranking could be identified through mortuary practices via expressions of both a superordinate[10] and subordinate[11] dimensions of social personae.

Finally, Tainter (1978) explicitly linked Binford's ideas about duty status

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[9] The Choctaw and the Natchez-Taensa.

[10] The dimension of status conveyed by symbols, energy expenditure or other ritual variables that are not simultaneously ordered by age and sex (e.g. membership in a ranked class related to an individual's genealogy). This means that some subadult burials will be equal or greater in rank than adults of lower social positions.

[11] The subordinate dimension will be an ordering of ritual variables partially based on age, sex and individual achievement. In this dimension, the older an individual, the higher the rank.

relationships and rank distinctions in mortuary ritual to energy expenditure, arguing that higher-status individuals would be distinguished by greater energetic investment in the "size and elaborateness of the interment facility, method of handling and disposal of the corpse, and the nature of grave associations" (Tainter 1978:125). Tainter experimented with quantifying this principle by using different mortuary variables in a sample of Middle and Late Woodland burials to differentiate rank levels within the interred population and make arguments about diachronic changes in social complexity. All of these studies exemplify the processual approach to mortuary practices that held sway for multiple decades: applying quantitative approaches to archaeological data sets that are explicitly concerned with developing rigorous methods to determine explicit links between funerary practices and social organization, factoring in the effects of such variables as spatial organization, social rank, social complexity, and energy expenditure.

While the tight causal relationships between social organization and representations of the dead are intellectually appealing, these quantitative approaches have been tempered by ethnographic explorations that underscore the ways in which funerary practices can be used to manipulate and blur social distinctions maintained in life. Like Childe and Kroeber, Ucko (1969) referenced a cross-cultural ethnographic hodgepodge to illustrate the point that wildly different cultural explanations and intentions often underlie similar forms of mortuary treatment. For example, among the Lugbara of Uganda, grave goods were representative of an individual's social personality, while among the Nankanse of Ghana, objects were only placed in a burial if a still *living* person's soul has become trapped there. Ucko highlighted the recurring potential for interpretive equifinality based on the mortuary record, and stressed that a solid command of the ethnographic mortuary literature served to expand the number of possible explanations for a funerary behavior, broadening the interpreter's understanding of the social mechanisms underlying an archaeological event.

Bloch's (1968) analysis of tombs among the Merina of Madagascar made a similarly seminal contribution to the development of mortuary archaeology. During his observations of life in Madagascar, Bloch noticed the marked disparity between mortuary practices, during which people were buried in ancestral tombs that closely tied kinship networks to particular territories, and 20^{th}-century social organization, which was characterized by high levels of population movement. In essence, he outlined a curious paradox – even though people were being *buried* in ancestral tombs, they were *living* farther afield and rarely returning to their home territories. Bloch was one of the first anthropologists to underscore the ability of mortuary practices to reflect an ideal social order rather than actual social organization.

> "However, the sets of groups, statuses and roles implied by association with a *tanindrazana*, though they may in the past have been the basis of the political and economic organization, are irrelevant to most aspects of the political and economic organization of the present, since this is linked to villages where people live now and which are not normally their *tanindrazana*. In other words the focusing of emotions and allegiances through the tomb and ancestral village means *a deep involvement with groups and relationships with no immediate practical value*" (Bloch 1969:102, emphasis mine)

By unpacking the tenacious attachment that the Merina displayed to their ancestral tombs, Bloch demonstrated that "violent social change" (103) is not always reflected in mortuary practices – indeed, in this case, traditional funerary behaviors served as a means of retaining an identity that had been largely eroded due to political and economic circumstance.

However, mortuary practices are not only linked to social organization and ideology. For example, many influential early mortuary theorists (Kroeber 1927; Binford 1971) readily admitted that local environmental factors had the potential to constrain the form of mortuary practices. It is unlikely that a society living at high altitudes would commonly practice any form of disposal at sea, or that immediate interment in a deep grave would be practiced during the dead of winter when the ground was frozen. However, local environments are not the only factor that molds the form of funerary ritual. Ethnographic evidence suggests that funerary rituals are also affected by economic transformations, technology and fashion.

Metcalf (1981), for example, underscores the gradual change in funerary practices among the Berawan of Borneo; over time, elaborate and extended secondary burial rituals called *nulang* were gradually replaced by abridged primary burial interments. In contrast to Hertz's claims that such a shift represented acculturation and weakening of traditional beliefs, Metcalf's Borneo informants resolutely maintained that the same ideology underlay both types of burial, insisting that in essence the extended and abridged tracks were ritually "the same thing" (1981:567). The reason for the growing predominance of abridged funerals was related to larger economic and technological shifts in society: the ability to accumulate credit from outside traders meant that families did not have to wait until a later secondary burial to accrue sufficient capital to support a funeral, while the growing popularity of concrete meant that a final tomb could be constructed relatively rapidly. Since both forms of burial were equally ritually effective, individuals often chose to perform the quicker abridged burial. As Metcalf (1981:572) noted "factors of a practical nature," above all else, tended to determine the choice of burial.

Cannon (1989) was also concerned with the import of changes in mortuary practice. He charted the tempo of change of Victorian funerary ritual to illustrate that mortuary display is an inherently dynamic phenomenon, with higher-class practitioners continuously seeking out new media or forms that would distinguish them from their social "inferiors." Strikingly, he found that the pattern of increasing elaboration in mortuary display followed by a period of restraint and abandonment of specific forms of grave goods or mortuary forms was a recurring motif in societies as disparate as those of Victorian England, Iroquoian North America and ancient Greece. However, status aspirations are not the only driver causing change in funerary practices. Hijiya (1983) and Rainville (1999) examined stylistic shifts in gravestones in the American northeast and found that in this context, class relationships were not as important. Instead, their studies demonstrated that attitudes about death and the religious treatment of the afterlife shaped the boundaries of appropriate aesthetic expression. These authors also demonstrated that such changes can occur within a relatively short period of archaeological time. Within 150 years, different motifs, material, language, and architecture all replaced one another as the result of changing conceptions of religious duty and death.

Archaeologists concerned with unpacking the complicated relationship between the material record and past social organization have also underscored the recursive nature of the relationship between mortuary practices and society. Barrett, for example, has emphasized that "material culture does not so much reflect social conditions as participate in the structuring and transformation of those conditions" (1990:179). His analysis of Bronze Age round mounds from second millennium Britain provides a counterpoint to processual formulations that equate energy expenditure with social importance, as he rightly underscores that energetically expensive aspects of ritual are not necessarily preserved in the archaeological record. The transition to cremation burials in the round mounds during the later second millennium was initially interpreted as an "impoverishment" of earlier mortuary traditions, but Barrett says that rituals themselves may have become more grandiose over time. The mounds were rebuilt and reformed gradually, in a cumulative process that likely incorporated elements like procession, display, and feasting that would have focused on the cremation pyre. Many of these practices were not directly reflected in the mortuary record. As such, even though the barrows acted as "a final stage upon which increasingly elaborate funeral dramas might have been performed" (Barrett 1990:186), this considerable investment in mortuary ritual would be missed in interpretations linking the "simple" cremations to social organization. O'Shea (1984) has also pointed to this flaw in Tainter's application of energy expenditure principles, as their energy expenditure dedicated to rank differentiation will not always manifest itself in mortuary practices, or even be preserved archaeologically.

Despite these multiple influences on mortuary ritual, an important thread tying together diverse funerary practices is that they reflect an identity ascribed to the deceased by living members of a social group – as Lillios underscores, "the dead don't bury the dead, the living do" (1999:241). Cross-culturally, living communities isolate and identify particular social identities (Goodenough 1965) that are referenced during mortuary ritual (O'Shea 1984). While not all aspects of such differentiation are preserved in the archaeological record (Beckett and Robb 2006), all evidence suggests that there are regularities in mortuary differentiation, individual social roles, and social complexity that "link…aspects of the living society and its procedure for the disposal of the dead" (O'Shea 1984:21) as long as archaeologists embed their search for regularities in a nuanced understanding of the pattern and process of the archaeological record.

The Problem of Collective Burials

A synopsis of the past century of mortuary theory in archaeology illustrates the range of connections that can be made between funerary practices and social organization. Most mortuary research has focused on individual burials, where a relatively direct relationship is understood to exist between grave form, grave goods, and the social identity of the interred individual. However, less attention has been devoted to developing middle range theory to explain mass graves or communal burials, and traditionally there has been little emphasis on establishing methodological approaches to overcoming the problem of commingled remains.

Fortunately, over the past decade this once barren landscape has begun to issue new approaches, from volumes dedicated to establishing foundational methods and theory for handling commingled remains (Osterholtz, Baustian and Martin 2014; Osterholtz 2015), to research that explicitly grapples with the difficulties inherent in interpreting collective materials (Knüsel and Outram 2004; Stodder 2005; Fox and Marklein 2014). Because this analytical focus is relatively recent, to date only a limited number of bioarchaeologists have profitably explored strategies for engaging these problems in Late Prehistoric Iberian contexts (McClure et al. 2011; Waterman et al. 2014, a, b, 2015; Fernández-Crespo and de-la-Rua 2015).

A gap exists in the archaeological literature, as few studies have had the specific aim of understanding collective burials. Kroeber and Childe focus on the form of graves, but not on how many people are interred within them. Saxe and Binford emphasize quantifiable relationships between social organization and individual burials, but are noticeably silent when it comes to the topic of collective burials. This is in part related to their intractably difficult character. As Chapman notes

> "As excavated [collective burials] represent a palimpsest of activities, often spanning several centuries, and in favorable circumstances the archaeologist can expect to discern general patterns rather than individual acts of deposition…This necessitates the development of somewhat different assumptions and procedures to those employed in the analysis of single burials" (1981:398).

Thus far, the "development of different assumptions and procedures" has largely focused on elaborating the ideologies that might underlie multiple inhumations. Because the diagnostic characteristic common to such inhumations is their tendency to "cluster together a number of the deceased" (García Sanjuán 2006:157), a recurring motif in interpretations of collective interments[12] has been that societies practicing this form of burial are promoting communal identities at the expense of individual identities. In some cases, mass graves are those of marginal members of society or those killed in one or multiple battles.

In his work in Madagascar, Bloch was one of the first to make the argument that collective burials were representations of a certain kind of community (1968), in this case the idealized ancestral groups of the Imerina of Madagascar. Since Bloch, anthropologists have continually toyed with the idea that communal interments "sacrifice" the representation of individual social roles in favor of a broader ideological statement concerning the larger social group. Brown, for example, argues "the social collectivity is represented physically by thorough-going commingling of human bone and skeletal parts" and "the integrity of the individual is lost upon death" (1995:5).

Indeed, in contrast to the processual approaches to individual inhumations that sought explicit, quantitative links between the complexity of social organization and the complexity of mortuary practices, interpretations of collective burials have focused more intensely on reconstructing prehistoric ideologies of community and identity. Hutchinson and Aragon (2008:28), for example, emphasize that mortuary remains "form deliberate, planned and sacred spaces that serve to symbolically integrate families and communities and provide continuity in the deep time of buried descent groups." They emphasize the ways in which the social importance of communal burials can change based on larger historical factors. As an example, they discuss the Ngaju people of Borneo who began using communal burial to gather together non-kin, emphasizing their membership in the same religious group, rather blood relationships. Hutchinson and Aragon argue that these practioners of the ancestral religion Kaharingan buried their dead together "to [express] the group's separate religious identity in the Indonesian nation" (2008:46).

Barrett has also focused on the active role that communal burials play in shaping social life, arguing that the commingled remains in British megalithic tombs are not a reflection of the structure of an egalitarian society, but rather "they are the heavily

[12] In this section, collective burials refer to interments that contain several individuals for deliberate ritual and cultural reasons, rather than due to mass deaths that result from disease outbreaks, warfare, or genocide. The latter types of inhumation can normally be identified based on the bioarchaeological profile of interred individuals – see Table 2.2.

reworked symbolic residues through which communities will have re-established the primacy of certain cultural values and, in so doing, will have inscribed those values upon the social identities of the living" (1990:183). The view that mortuary practices are reflexive, both shaping and shaped by aspects of social organization, is common among the post-processual cohort of archaeologists, and collective graves are often interpreted in this light.

Damm, for example, in her analysis of changes in tomb form between the Early and Middle Neolithic in Eastern Denmark, emphasizes that even though individuals of all ages and genders were buried in megalithic tombs, their individual identities were deliberately dissolved through the sorting and commingling of remains. Bones were piled up in jumbles of multiple individuals or sorted by elements, highlighting that "[o]nce inside the tomb the dead person ceased to be an individual: she was now part of an anonymous group of ancestors" (1991:46). Damm contrasts this with stone-packing graves in Western Denmark, which emphasized the individual; their more personalized focus is likely related to the growing popularity of cattle husbandry in this region, where the rights or ownership of individuals and small families were more important than the entire social group. Damm argues that "these graves stressed and naturalized individuality and independence, in contrast to the megalithic tombs which emphasized the community and supported the traditional organization of society established in the early Middle Neolithic" (48).

Popular examinations of collective burials also share a focus on the "ancestral" identity assumed by individuals interred within the graves. Much like the focus on "communal" or "collective" ideology, this interpretive crutch that has become so in vogue that some archaeologists have bemoaned that there are simply too many ancestors populating the literature (Whitley 2002). Whitley underscored that "not all the dead are ancestors, and not every fragment of human bone found in a barrow, cursus, causewayed enclosure or henge can be construed as evidence that these monuments were "ancestral" (200:122), and this caveat holds just as true outside of the British Isles. As Waterman and Thomas (2011) have noted, many communal tombs in prehistoric Portugal house large numbers of subadults, and given their younger age and consequent inability to beget offspring, children, toddlers and adolescents are a curious category of person to include in communal burials if the only important social function of these mortuary features is as loci for ancestor worship. Instead Waterman and Thomas suggest that "in the collective burials of late prehistoric Portugal, funeral rituals related to ancestor worship coincided with other types of funerary remembrances, creating diverse layers of ritual activities and experiences" (2011:175).

The one context in which archaeologists have confidently interpreted collective burials is when individuals are clustered together in both space and time – specifically in mass graves that result from violence or disease outbreaks. Gowland and Chamberlain (2005), for example, have emphasized that paleodemographic profiles of collective interments can be used to determine whether such assemblages are the result of deliberate ritual choices or mass fatality events. The basic premise for such research stems from the existence of two broad categories of mortality profiles: *attritional mortality*, the "normal" mortality structure, characterized by a high number of infant deaths, a low number of adolescent deaths, and a gradual increase in mortality risk through adulthood as individuals age, and *catastrophic mortality*, which is characterized by an even risk of death across age categories, and is the result of an abnormal mortality pattern caused by infectious disease, violence or other atypical stressors.

Evidence of trauma can likewise be informative about the nature of a synchronous communal inhumation. In his synopsis of bioarchaeological approaches to the history of human violence, Walker (2001) describes a number of instances where perimortem trauma clearly stems from "malevolent intent." One particularly noteworthy example comes from the Mesolithic Bavarian site of Ofnet, which contains a number of skulls with evidence of perimortem bludgeoning (blunt force trauma to the occipital) and decapitation. Walker also describes an Inuvialuit village cemetery containing the bones of women and children that show significant perimortem trauma, a physical record of violence that agrees with evidence from oral history documenting an attack by the Dene. Positioning of the bodies can also be revealing. Walker cites an Archaic period cemetery in Kentucky in which the bones of six people show signatures of perimortem violence, with individuals "…apparently killed in a massacre, whose bodies were haphazardly thrown into a mass grave" (2001:588). Finally, contextualizing patterns of trauma within a larger regional framework can provide further clues as to the nature of collective interments. At Crow Creek, a pre-Arikara palisaded village in South Dakota, excavations revealed 486 victims of a mass killing event from the early fourteenth century; 95% of the recovered skulls bore scalping marks, and many individuals showed evidence of decapitation and dismemberment. Because other similar mass graves had been found at surrounding sites, archaeologists concluded that the massacre was the result of inter-village warfare.

Archaeologists like Outram et al. (2005) and Roksandic (2002) echo these strategies for differentiating ritual aggregation of the deceased from violent or epidemiological mass fatality events. However, when the demographic profile of the interred population does not reflect a catastrophic mortality curve, and there is little evidence that the individuals buried in such a collective burial were victims of violence, the picture becomes much more ambiguous. Bioarchaeologists still struggle with developing rigorous strategies for interpreting mortuary clusters. For example, while interpretations focusing on collective ideology or ancestral worship are correct to emphasize the ways in which mortuary practices both shape and are shaped by notions of community identity, they are exceedingly vague about the direct links between social organization and the mortuary choices being made, and it is unclear *who* precisely is making these mortuary choices. Are the decision-makers social group leaders or chiefs, lineage heads, extended families or the deceased's closest kin? As Whitley argues, "[i]f we cannot distinguish between different kinds of ancestor, we cannot make distinctions between the kinds of relationship that might have been established between the past and the present in the past, and we cannot arrive at interpretations that respect the specificity of the evidence we seek to understand" (2001:122).

A more fruitful line of inquiry lies in asking whether collective burials masked or mediated inequality in prehistory. This possibility was first discussed by post-processual archaeologists concerned with prehistoric ideology in Neolithic Britain and Scandinavia. In their statistical analysis of anatomical representation relative to age, sex and skeletal completion, Shanks and Tilley (1982) argued that collective burials in northern Europe were deceptively communal, as osteological analysis revealed significant political and economic tensions within Neolithic societies. Though the clustering together of human remains did represent, on the surface, an "assertion of the collective, [and] a denial of the individual and of differences between individuals" (Shanks and Tilley 1982:150), significant differences in the treatment of adult and subadult remains and between males and females demonstrated that ideological and political power not equally distributed among all individuals. In Shanks and Tilley's framing, the "solidarity" implied by the communal tomb, and the commingling of individual elements were a strategy for paying lip service to a communal ideal that did not reflect the actual distribution of societal power. They note that "…the expression of collective identity was a direct result of asymmetrical social relations. Mortuary practices do not just reflect, they also invert and misrepresent. In this way they may act as a powerful means to reproduce and legitimate the social order" (Shanks and Tilley 1982:152). Given that (i) social inequalities became more pronounced over the course of Iberian Late Prehistory, particularly during the Bronze Age (Gilman 1975), and (ii) during the second millennium all Chalcolithic macro-villages experienced significant transitions, characterized broadly by steep declines in occupational activity and use (Lull et al. 2010; Balsera et al., 2015), examining the potential for Iberian collective burials to mask significant disparities in lived experience is potentially fruitful and underexplored approach to such interments.

Collective Burials in Late Prehistoric Iberian Contexts

Rather than identifying and interpreting the explicit relationships between formal, taphonomic, and bioarchaeological components of collective burials, the majority of research on collective burials in Late Prehistoric Iberia has paralleled the broader trends in mortuary archaeology and focused on social meaning (Chapman 1981). As Lull underscores, the underlying assumption is that membership in such an inhumation was a signal of social identity: "in death [these individuals] returned to the unit that gave them social significance" (2000:585).

Some of the earliest significant work on collective burials in Late Prehistoric Iberia focused on the mortuary organization of the famous Chalcolithic site of Los Millares. Abandoning earlier religious or diffusionist interpretations of the megalithic tombs, Chapman (1977, 1981) was one of the first to apply the tenets of the Saxe-Binford paradigm to the Iberian mortuary record, postulating that at least part of the patterning in cemeteries with communal tombs was likely to reflect social organization. He sought to identify social differences within the community by focusing on the range and frequency of prestige grave goods, energy expenditure in tomb construction, and the number of individuals interred in a given tomb. Chapman combined site chronology with crude MNI estimates and predicted population sizes to estimate the proportion of the living population accorded cemetery burial. Based on the disparity between the estimated population size for Los Millares and the number of individuals interred in the tombs excavated by Siret, he concluded that there was evidence for differential burial at the site, with a portion of the population clearly excluded from interment within the tombs. Chapman also analyzed the differential distribution of exotic grave goods at Los Millares, noting "that we are concerned more with social groups rather than individuals in these communal tombs" (1981:399). Based on the concentration of greater quantity and variability of prestige items in specific tombs, he concluded that the patterns from the communal tombs at Los Millares were more indicative of a ranked rather than egalitarian society, likely a form of organization comparable to a chiefdom with institutionalized leadership. Importantly, Chapman (1981:407) stressed the potential of skeletal analysis to contribute insights into the nature of communal tombs, and linked the appearance of these cemeteries to the development of corporate descent groups.

Iberian archaeologists argue that the construction of monumental mortuary spaces themselves may have contributed to developing a sense of community identity, as megalithic construction would have entailed significant logistical effort, collective cooperation, and potentially contributed to inter-clan or inter-group competition (García Sanjuán 2006:157). Interpretations of the funerary ideology materialized in the collective tholos tombs of the Copper Age, led García Sanjuán to characterize Chalcolithic societies in Iberia as a "primigenial social system, based upon inter-group solidarity and communalism as well as inter-group symbolic competition" (2006:164). However, despite initial informative analyses of intrasite mortuary variability (Chapman 1981) and discussions of Copper Age social organization (Chapman 1977, 1990, 2003; Díaz-del-Río 2006; García Sanjuán 2006), we still do not know how these social units were organized, or whether these collective burials conceal a significant degree of social inequality. Instead of focusing on the specifics of social organization, Iberian collective burials have traditionally been treated as instances of amorphous ancestor cults (García Sanjuán 2006; Waterman and Thomas 2011).

Despite the recurring emphasis on ancestors in the Iberian record, some concerted efforts have been made to incorporate more nuanced understandings of the primacy of mortuary practices in shaping social organization to Late Prehistoric contexts in Iberia. Lillios in particular has argued that rather than being an enduring symbol of the social collectivity, collective burials have meanings that necessarily transform over time due to their *mnemonic density*, or the accruing symbolic power of spaces that are used repeatedly over long periods of time. However, she also underscores that the very nature of such spaces would eventually erode the social landscape in which they originated. Over time, the spatially circumscribed layout of the tombs would come into conflict with their ideally socially inclusive character when bodies began to fill up these tombs:

> "As the mnemonic density of collective tombs increased, access to their interior spaces, where intimate contact with the dead and the rituals of the dead could be directly viewed and experienced, became increasingly constrained and restricted to fewer people (at least at any given moment in time). Thus, as these sites became increasingly potent, fewer people could experience their potency collectively, leading, I suggest, to increasingly diverse experiences and social identities based on these experiences" (Lillios 2014:8).

Lillios makes an important point that links the formal and demographic aspects of Neolithic and Copper Age tombs to the widespread Late Prehistoric social changes witnessed in Iberia (what García Sanjuán (2006) refers to as "demonumentalization and individualization").

Chapman first drew attention to the fact that communal burials were under-theorized in 1981, writing that:

> "European prehistorians have yet to use cemeteries of communal tombs as basic units of analysis in studies of social organization. Indeed there has been little discussion of the social, economic, religious and technological factors whose interaction must be behind the patterning visible, or potentially visible, in the location and organization of such cemeteries" (1981:388).

The work of Iberian archaeologists like Waterman et al. (2014a, b 2015), Waterman and Thomas (2011), Fernández-Crespo and de-la-Rua (2015) and Lillios (2014), demonstrates the ways in which links between communal burials and social organization can be teased apart by combining mortuary evidence with bioarchaeological studies of mobility, health, diet and demography. These represent important steps towards solving a long-standing archaeological problem. Though the mass investments of communal labor and collective interments that characterize Late Prehistoric Iberian mortuary practices are geographically and chronologically widespread, ranging from Initial Period Peru to the Hopewell communities of the American Midwest, too little attention has been devoted to how to interpret these patterns archaeologically. Before making broad-scale generalizations about "ancestors" or the "social collectivity," we must understand the social processes that produce these mortuary records (Roksandic 2002). Specifically, we must question (1) how such collective inhumations were produced by living groups; (2) what factors structure and influence the mortuary variability inherent in the archaeological record and (3) whether similar forms of mortuary treatment reflect or conceal significant differences in lived experience in prehistory.

Using Bioarchaeology to Understand Social Organization

One indispensable tool with which to address these questions is bioarchaeology. Osteological analysis of human skeletal remains has the ability to reveal aspects of lived experience like diet, activity, mobility, health, and disease. Archaeologists can then explore how such factors interact with age, sex and mortuary treatment in order to reconstruct aspects of prehistoric social organization. As such, bioarchaeology provides a means of analyzing the "black box" of collective burials. The study of human skeletal remains contributes directly to our understanding of the lived experience of individuals interred in such inhumations. The first two questions outlined above can only be answered with reference to a composite analysis of chronology, material culture, mortuary organization and osteological data. However, the last question, which asks whether similar forms of mortuary treatment reflect or conceal significant differences in lived experience in prehistory, falls predominantly under the purview of bioarchaeology.

Bioarchaeology has the potential to reveal inequalities between individuals and between groups. Analysis of carbon, nitrogen, and oxygen isotopes has been shown to reveal both low inter-individual variability in diet (McClure et al. 2011; Waterman et al. 2015) and stark inter-individual differences in access to given types of subsistence resources (Ambrose 2003). Similarly, pathological indicators like enamel hypoplasias and Harris lines can identify individuals or groups who suffered malnutrition or nutritional stress during childhood (Cook and Buikstra 1979; Goodman et al. 1980). Bioarchaeologists have also used both terminal adult stature and growth velocities in subadult individuals to assess the degree to which prehistoric populations were affected by developmental stress (Klaus and Tam 2009). Labor burdens and activity levels, as documented through the robusticity of musculoskeletal stress markers, have likewise been profitably analyzed when recreating inter-group differences in habitual movement (Hawkey and Merbs 1995). Osteoarthritis, the bone-on-bone rubbing that produces diagnostic modifications to articular surfaces, can result from heavy prehistoric workloads (Tainter 1980). These osteological data on health disparities can be profitably combined with evidence of ranking or status drawn from other archaeological domains to determine whether material evidence of status and rank correlates with markers of biological stress (Powell 1992).

Careful study of paleopathology and enthesopathy is thus capable of revealing embodied *economic* inequalities in the osteological record that are related to access to nutritional resources and labor burdens. Bioarchaeologists can also access *ideological* inequalities preserved in the mortuary record if these are communicated through human skeletal remains via differential mortuary treatment based on biological attributes like age, sex, and ancestry. For example, in many societies, subadults are distinguished from older members of society either through their absence from community cemeteries (Crawford 2000), their interment in distinctive locales separate from adults (Skeates 1991; Moore 2009; Liston and Rotroff 2013), or differential mortuary treatment (Beck 2015). Gender is ideologically instantiated in mortuary practices through the association of specific grave goods that denote gendered roles and practices (Treherne 1995; Lull 2000). In some cases, contrasting grave goods with the biological sex of interred individuals has even revealed new insights into prehistoric conceptions of gender, as in the much publicized case of a Neolithic male individual with female burial positioning and grave goods excavated in the Czech Republic (see Gast and Aarhtun 2011). Documented evidence of female burials in richly accoutered royal tombs (Bell 2002), and in kurgans surrounded by the armaments of war (Davis-Kimball 2002) have also underscored the problems inherent in mapping modern ideas of gender, including the idea that women have globally and historically been consigned to domestic social roles, directly onto the archaeological record. Without bioarchaeological assessment of the sex of individuals interred in such tombs, these insights would not have been possible. If differential funerary treatment or aspects of lived experience are related to ancestry, such relationships are also osteologically accessible via reference to non-metric cranial or dental traits (Buikstra 1980), or through stable isotope analysis of strontium in preserved human remains (Bentley 2006).

Finally, osteological analysis additionally has the potential to identify *political* inequality in the archaeological record, through combining skeletal evidence of biological marginalization with data drawn from other archaeological domains such as settlement patterning, urban infrastructure, and the distribution of prestige goods. Studies of colonized indigenous populations (Larsen et al. 2001; Klaus and Tam 2009), New World slave cemeteries (Rathbun and Steckel 2002; Shuler 2011) and imperial polities (Schug et al. 2012), have all revealed significant biological differences in subject populations with limited or non-existent political power. Biological markers of political inequality range from increased levels of osteoarthritis and more robust musculoskeletal markers resulting from lifetimes of heavy labor, higher incidences of violent trauma, decreased growth velocities among subadults, evidence of severe childhood nutritional stress, increased frequency of indicators of anemia or pathogen loads, decreased fertility, and lowered life expectancies. While the relationship between high levels of biological stress and decreased decision-making authority is of course oblique, complementary evidence from the archaeological record can be used to make an educated estimate of whether such variables are likely indicative of political inequalities. By contrasting health and well-being in contemporaneous social groups (Rathbun and Steckel 2002) or designing a diachronic examination of a population before and after significant political change

(Klaus and Tam 2009), bioarchaeology can be used to identify and illustrate the often significant effects of political inequality.

In sum, due to its ability to shed light on economic, political, and ideological inequalities, bioarchaeological analysis presents a novel means of approaching communal or commingled burials. Through examining inter-individual and inter-group differences in nutrition, labor burdens, disease, and regional affiliation, osteological analysis provides a pathway by which to rigorously analyze whether collective burials were used to make or mediate inequalities in dimensions of lived experience.

Reconstructing Social Organization in Copper Age Iberia

Iberianist archaeologists broadly agree that evidence from settlement patterns, domestic organization, subsistence practices, craft production and funerary ritual indicates that Copper Age communities were collectively organized (Díaz-del-Río 2004a, b; García Sanjuán and Díaz-del-Río 2006; Gilman 2013) rather than the hierarchical and inegalitarian form of organization that characterizes states (but see Nocete et al. 2006, 2008, 2010). Copper Age communities have been described variously as "pre-state societies organized along communal economic principles" (García Sanjuán and Díaz-del-Río 2006), "segmentary groups" (Díaz-del-Río 2006), and "lineage-based" communal institutions (Mathers 1984a, b; Gilman 2001). However, the *nature* of this collective organization remains unclear, and the degree to which collective mortuary practices either mirror or mask nascent social inequality is also unclear. As discussed in Chapter 1, one broad model for social organization during this period is that of a society structured by competing lineages, but the character of such lineages and the magnitude and nature of the competition between them is not widely discussed. Was labor organized by nuclear families, regulated by differentially ranked kin groups or lineages, or were incipient chiefs or "big men" (Díaz-del-Río 2004b; Chapman 2008) responsible for marshaling and maintaining large-scale investments of labor?

Questions about Copper Age social organization become even more pertinent when considering the rise of macro-villages. Large-scale settlements like Valencina de la Concepción (Seville), Los Millares (Almería), and Zambujal (Torres Vedras) began to appear on the Iberian landscape during the mid- to late 3rd millennium, but it is still unclear how and why local populations began to cluster in these larger scale aggregations (see 1.2.5 and Chapman 2008 for further discussion). The massive investments of labor and energy in site components like the walls, forts and bastions of Los Millares (Díaz-del-Río 2011) and Zambujal (Kunst 1995), or the concentric enclosure system at Marroquíes Bajos provide evidence for the organization and execution of complex, well-planned architectural features that would have required logistical planning beyond the level of a single domestic unit. Given the magnitude of labor investment at such settlements, and the maintenance of architectural coherence in features that were gradually constructed and maintained over long periods of time (Díaz-del-Río 2011), it is unlikely that random individuals from local populations were contributing work efforts to such projects haphazardly. So who was doing the organizing?

This question is especially puzzling because there is scarce evidence for significant social inequalities in Iberian Chalcolithic society at the broad scale – houses were relatively uniform in terms of size, structure, and wealth, burials were communal, and there is limited evidence for intensive craft or subsistence specialization during that time (though see Nocete 2006 for a counter-argument). As Díaz-del-Río explains, Copper Age Iberian society was not one in which distinct class differentiations were readily apparent: "if elites did exist, they did not feather their nests. They seem to have been "faceless," leaving no clear trace in the archaeological record of their everyday life" (2011:39)

Despite the limited evidence for social inequalities in the broad Copper Age record, over the past decade archaeologists have begun to focus their investigations more specifically on macro-village settlements. Díaz-del-Río points to architectural differentiation as one possible fruitful avenue of inquiry, noting that the dispersed rectangular buildings that appear later in time at Marroquíes Bajos may be "chiefly" households or open-air storage facilities potentially manipulated by them in their own advantage" (2004b:94). Other archaeologists have followed suite in scanning the material record of macro-village sites for signs of emergent inequality. García Sanjuán has noted that macro0village sites like Valencina de la Concepción and La Pijotilla deviate from the typical Copper Age pattern of largely utilitarian grave goods; their larger numbers of ornaments and idols may suggest that "the dynamic of association between status and prestige objects was more developed among the elite of these settlements" (2006:158). Valencina de la Concepción is also marked by the presence of beautifully crafted grave goods in certain tombs and around certain individuals. In the romantically named megalithic tomb 10042-10049, one individual was buried covered in red cinnabar pigment, surrounded by an unworked elephant tusk, an almond rim plate, 23 flint blades, many fragmentary ivory objects, a flint dagger blade, an amber pommel and a small copper object (García Sanjuán et al. 2013). These indications of the emerging recognition of social differentiation at some large settlements are contrasted with evidence from smaller settlements – for example, at the Copper Age dolmen Palacio III (García Sanjuán and Wheatley 2006), grave goods occur as a standardized burial package, with examples of slate "trays" supporting ceramic vessels containing arrowheads or blades, an assemblage which García Sanjuán interprets as "a sharp sense of equality in the symbolic treatment of the dead" (2006:158).

Overall, however, Iberian societies seemed to have been inching towards a more socially differentiated framework over the course of the Chalcolithic; the appearance of curved stone staffs in southern Portugal may be markers of individual and ancestral prestige, while subtle evidence of intra-tomb differentiation may point to the emergence of nascent social differentiation during this period (García Sanjuán 2006). Mathers (1984a) likewise points to the increasing architectural segmentation of tombs with the use of side chambers and niches as a signal that specific individual identities were being marked and spatially delineated, even while still buried in communal tombs.

All together these converging lines of evidence, particularly those from macro-village sites, provide tantalizing if nebulous evidence that during the Copper Age certain individuals and social groups were becoming recognized as socially distinct by virtue of access to enhanced political and economic power. This system, however, appeared to be ultimately unstable, which may be why all of the large macro-villages were abandoned by the second millennium. Díaz-del-Río argues that such villages would have been beset by a multitude of potential problems, including

> "…intergroup strife, decreasing production, internal disputes or competition, or the inability to transform collective ideologies into a stable structural power. Lacking the infrastructural investments that could have prevented fission, groups

> would have been capable of voting with their feet whenever these processes and social institutions reduced their material benefits" (2011:41).

Recent research has demonstrated the utility of grave goods, tomb form, settlement patterning and domestic architecture for evaluating the existence of inequalities at macro-village sites. However, an even more applicable but underutilized line of evidence is human bone. Examining the evidence for economic, political and ideological inequality embodied in human skeletal remains provides a precise way to measured differentiated aspects of social experience in these first Iberian experiments with aggregation.

Reconstructing Social Organization at Marroquíes Bajos

Until we answer basic questions about the nature of Copper Age mortuary variability, it is impossible to rigorously analyze the "collective" forms of social organization that have been argued to underlie the explosion of complexity in third millennium Iberia. This dissertation research evaluates the nature of the mortuary variability at Marroquíes Bajos by examining how the archaeological and bioarchaeological evidence corresponds to three distinct models:

- **Model 1**: Multiple funerary programs were pursued simultaneously, with members of different social groups buried in different locales.
- **Model 2**: Different mortuary areas represent sequential components of the same funerary program, where the archaeological record has simply captured individual bodies undergoing different stages of the same process.
- **Model 3**: Different mortuary areas reflect diachronic change in funerary ritual at the site.

These models are not mutually exclusive, but the strength of each signature has important implications for understanding how Copper Age groups handled the multiple pressures associated with increasing social complexity. If different burial areas were used by different social groups, bioarchaeological analysis will reveal the kinds of social distinctions that were necessary to manage and maintain large-scale communal labor projects. If the burial areas represent a multi-stage mortuary program, only select individuals will have received costlier secondary processing, contributing to our understanding of the degree of social ranking present during the Copper Age. Finally, if mortuary variability is the result of chronological change, it will clarify how funerary practices evolve relative to the origin, maintenance and collapse of early complex centers. Evaluating the complexity and organization of the funerary program at this macro-village will enhance our understanding of the complexity and organization of Copper Age Iberian societies.

To evaluate these models, I will focus on three lines of evidence, each of which seeks to answer a specific set of research questions: (1) bioarchaeological characteristics of the mortuary population; (2) grave form and material culture recorded in site reports, and (3) stable isotope analysis and radiocarbon dating. I will use these domains to test three specific models of funerary practices (outlined in Figures 2.1–2.3), and analyze whether variability in mortuary practices at such large-scale sites is predominantly chronological, is related to contemporaneous multi-stage mortuary programs, or is rooted in distinctions between social groups. Understanding *how* the mortuary record of Marroquíes Bajos was produced will make it possible to address whether complex Copper Age societies were truly organized as a collective, with little or no differences in status or access to certain foods, or whether there are formal and bioarchaeological signatures of inequality within and between social units.

Figure 2.1 Mortuary variability model 1

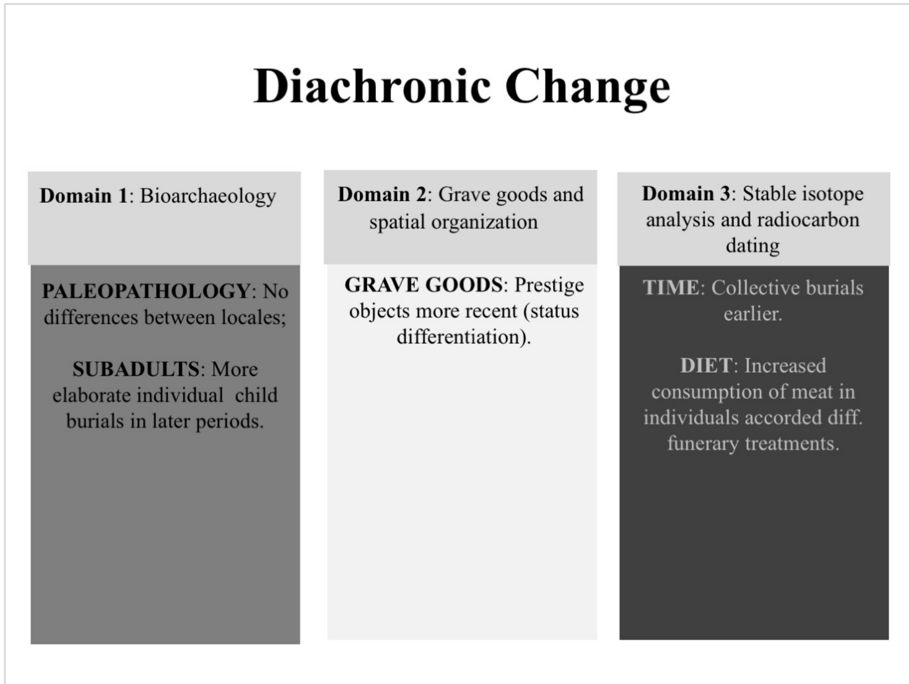


Figure 2.2 Mortuary variability model 2

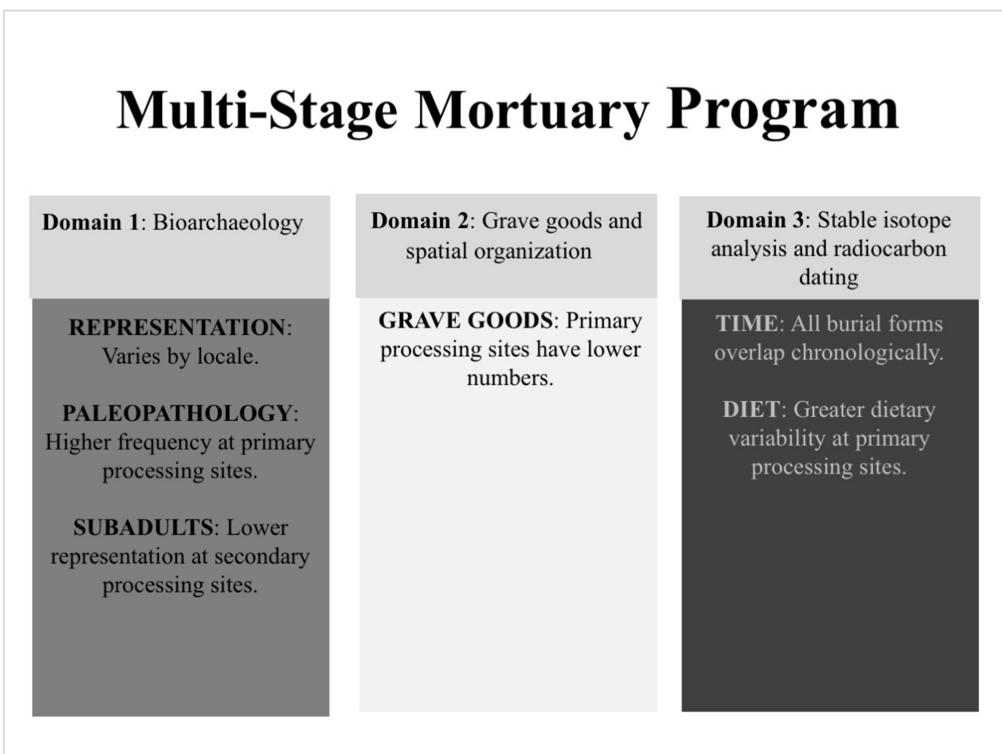
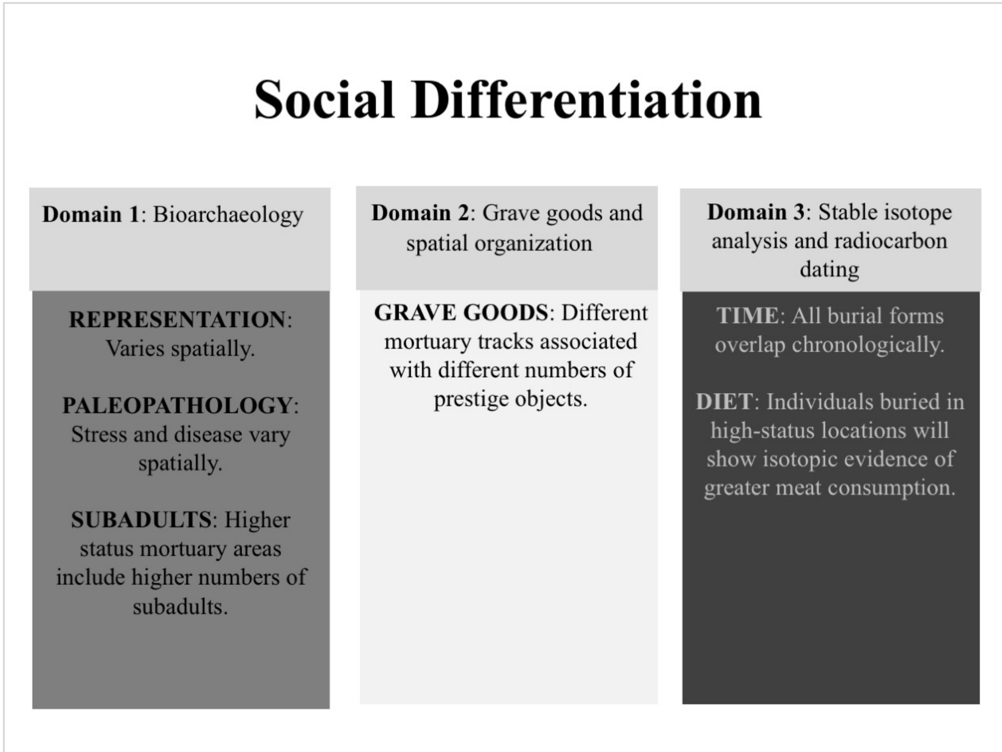


Figure 2.3 Mortuary variability model 3



<u>Domain 1: Bioarchaeological Analysis</u>

- Do anatomical completeness and representation differ between the mortuary locales?
- Do signatures of multi-stage mortuary tracks differ between mortuary locales?
- Are there significant differences in the demographic composition of each mortuary locale in terms of age, sex or paleopathology?

Collecting data on skeletal completion, articulation, indications of primary processing like cutmarks or gnawmarks, and the orientation of elements within formal disposal areas allows researchers to identify discrepancies between expected patterns of preservation and what is observed in the archaeological record (O'Shea and Bridges 1989; Roksandic 2002; Larsson 2003; Outram et al. 2005; Stodder 2005; Beckett and Robb 2006; Lieverse et al. 2006; Redfern 2008). Primary inhumations, secondary burials and mass graves all produce different preservation signatures, which can be used to identify the mortuary program pursued by a population (Table 2.2).

Table 2.2 Taphonomic indicators of different mortuary tracks

Type of Burial	Taphonomic Indicators
Ossuaries (Diachronous & Synchronous)	1. If diachronic: Uniformity in the degree of decomposition (Roksandic 2002). 2. If synchronic: Variable patterning in anatomical connections, related to differing degrees of decomposition. (Roksandic 2002). 3. Sorting, elements grouped and spatially segregated from other elements (Olson 1966; Larsson 2003); 4. Large but fragile bones (e.g. scapulae, pelves) should be well represented (Beckett and Robb, 2006). 5. Small and fragile bones (e.g. carpals, tarsals) will likely be missing (Beckett and Robb, 2006).
Excarnation by exposure	6. Evidence of gnawing, cutmarks and dry bone fractures, weathering or burning (Olson 1966; Redfern 2008) 7. Archaeological evidence of exposure platforms and/or pits containing disarticulated human remains; 8. Patterning or differential representation relative to known sequences of disarticulation (e.g. cranium first, legs last) (Redfern 2008).
Primary Burials	9. Higher completeness, virtually all bones present (Roksandic, 2002; Beckett and Robb, 2006; Lieverse et al. 2006); 10. Presence of small bones (Reilly 2003; Becket and Robb, 2006*); 11. High articulation – fully or partially articulated individuals present, with both persistent and non-persistent articulations present (Roksandic 2002; Reilly 2003; Lieverse et al. 2006).
Secondary Burials	12. Lower completeness and articulation, remains "disorganized" (Olson 1966; Lieverse et al. 2006); 13. Sorting of human bones, (Olson 1966); 14. Lower number of small bones observed (e.g. vertebrae, phalanges,) than expected (Olson 1966; Roksandic 2002) 15. Long bones and ribs heavily outnumbered tabular bones such as pelves and scapulae (Olson 1966). 16. Weathering or burning may indicate processing or exposure for excarnation (Olson 1966). 17. Underrepresentation of normally well-preserved elements (Roksandic 2002). 18. Lower levels of dental completion than expected (teeth susceptible to falling out of the alveoli after the decay of the periodontal ligament) (Roksandic 2002).
Synchronous Primary Burials (Mass Graves)	19. Partial or full articulation of individuals (Outram et al. 2005). 20. Evidence of trauma (Outram et al. 2005) 21. Bioarchaeological signatures of (i) epidemics, (ii) massacres or (iii) ritual suicides of elite households (Roksandic 2002).

For example, primary burials are likely to preserve more fragile bones and non-persistent articulations (Roksandic 2002), while secondary dispositions where bodies have been moved are more likely to demonstrate incomplete dentition, underrepresentation of normally well-preserved elements and preferential inclusion of specific anatomical regions like crania or limb bones (Olson 1966; Haglund 1997; Roksandic 2002). A full set of taphonomic expectations for different mortuary tracks have been outlined in Table 2.2. Similarly, data on paleopathology and the age and sex composition of the mortuary population can highlight significant diachronic or synchronic differences in diet, activity patterns, infectious disease prevalence and nutritional stress (Buikstra 1977, Cook and Buikstra 1979; Cook 1981; Goodman et al. 1980; Cohen and Armelagos 1984; Steckel and Rose 2002).

An initial reading of the existing site reports in summer 2013 suggested that at least 81 individuals were buried in the unstudied necropolises (N1, N2, and N4). Later analyses (Chapter 6, Chapter 7) revealed that more than 280 individuals were buried in these three mortuary areas. Importantly, the projected MNI of >100 individuals in the unstudied mortuary areas provides a large enough sample size to confidently ascertain statistical significance.

Domain 2: Grave Goods and Spatial Organization

- Does the quality or quantity of grave goods differ between mortuary locales?
- Are there typological differences in the artifacts included in different mortuary structures?
- Does the presence of grave goods co-vary with paleopathology or dietary differences?
- Do differences in burial form or mortuary treatment co-vary with differences in diet or chronology?

Tomb architecture and grave goods have the potential to reveal both (i) the size of social units being recognized at death (Bloch 1968) and (ii) the number of differentiated social identities being acknowledged in mortuary practice (Binford 1971, O'Shea 1984). For example, the increasing segmentation of megalithic tombs during the late Copper Age in Iberia, and the florescence of individual inhumations under household floors during the Bronze Age, speaks to "an important step away from broadly based communal systems of status and authority, and towards greater individual control of production, prestige and resources" (Mathers 1984b:1173). Similarly, the standardization of grave goods during the second millennium B.C., in tandem with the increase in prestige artifacts at the expense of utilitarian artifacts, suggests an increasing emphasis on smaller units of social organization than clans or lineages (García Sanjuán 2006).

Excavations at Marroquíes Bajos have revealed formal variability in tomb type, from primary interments in discrete subterranean structures to collective burials in caves (Espantaleón Jubes 1957, 1960; Serrano Peña et al. 2000), but we do not yet know whether this variability suggests synchronic differentiation or diachronic change. Similarly, there has been no formal analysis of variability in grave goods within and between the mortuary locales at the site. The presence of artifacts like the bronze halberd from N2 (Pérez Martínez 2005) and the famous anthropomorphic ivory idol from Marroquíes Altos (Enríquez Navascués 2000) suggest that prestige objects occur, but are not deposited uniformly throughout the mortuary locales. In order to enhance our understanding of the type of social units being recognized through mortuary practices, and to unpack how such units were distinguished from one another, it is essential to analyze both architectural and artifactual variability at this site.

Domain 3: Stable Isotope Analysis and AMS Radiocarbon Dating

- Does diet differ significantly between and within mortuary locales?
- Are there diachronic changes in diet?
- Do formal characteristics of the mortuary programs reflect change over time?

Previous isotopic studies of diet in archaeological human remains have highlighted the relationship between social stratification and differential access to preferred food types (Ubelaker et al. 1995). In complex societies of the prehistoric American southeast, there is evidence that elites had greater access to meat than non-elites (Peebles and Schoeninger 1981; Ambrose et al. 2003; Yerkes 2005). Zooarchaeological evidence suggests that this pattern may also characterize the Iberian Copper Age (Nocete et al. 2010), but the few dietary isotopic studies that have been conducted to date do not demonstrate significant levels of inter-individual or inter-site dietary differentiation (McClure et al. 2011). While collective mortuary rituals often mask differences among individuals, dietary differentiation is a biological signature that can provide evidence of significantly different lived experiences, despite similar mortuary treatments.

Finally, establishing the chronology of the site through AMS radiocarbon dating represents an essential step in determining if and how mortuary practices changed over time and space in the history of Marroquíes Bajos. While human bone collagen has been successfully sampled for dating from Marroquíes Bajos previously, both from individuals from F1 (Sánchez et al. 2005) and human and animal bone from N3 (Cámara et al. 2012), many questions remain unanswered. In particular, the temporal relationship between the mortuary locales, and the use of the mortuary locales relative to the history of the larger site, is unknown. For example, it is currently unclear whether all individuals in the *fosas comunes* were deposited simultaneously, or whether these mortuary locales were used contemporaneously with the necropolises. Similarly, we do not know whether Marroquíes Altos, the sole mortuary locale situated outside the fifth ditch, was established during or after the second half of the third millennium B.C.

Conclusions

The tension between individual freedom and the social compromises that are part and parcel to group living is one that characterizes the majority of human interactions. Developing a nuanced understanding of the conflicting pressures of autonomy and aggregation is particularly important for anthropologists concerned with human groups moving between different levels of social organization, whether from mobile bands to sedentary villages, from paramount chiefdoms to small hamlets, or from urban centers to mega-cities. The pervasiveness of the problems associated with human aggregation, ranging from the necessity to navigate complex interpersonal relationships, establish property ownership, organize labor, and maintain infrastructure, are dilemmas that have plagued both ancient and modern societies. As such, understanding the breadth of solutions to the problem of living in large groups has ramifications for analyzing our past and preparing for our increasingly populous future.

The site of Marroquíes Bajos provides a particularly apt setting in which to examine issues of aggregation because it represents one of the first Iberian instances of human groups experimenting with living in a more concentrated settlement, in particular one which required a significant investment of labor to build and maintain its complex infrastructure of large-scale ditches and adobe walls. Importantly, like other macro-village settlements in the Peninsula, at Marroquíes Bajos numerous lines of evidence suggest that the density of population and the amount of activity at the site increasingly declined from 2200 cal BC onwards. Unpacking the strategies that facilitated the foundation of the village in the mid-third millennium BC, and untangling the social, economic, and political perturbations that later led to the drop and activity and occupation at the site thus provides archaeologists with an enhanced understanding of the paths by which early human aggregations were founded, flourished, and collapsed.

Finally, this chapter also introduces a previously underutilized methodological tool with which to approach social organization at such settlements. Bioarchaeology, by virtue of its ability to reveal skeletally manifested economic, political and ideological inequalities, makes a unique contribution to anthropological understandings of early complex societies. Skeletal data documenting diet, health, disease, age, sex and mobility can be woven into a broader analysis of the material culture and chronology of the site in order to address the question of whether similar treatment in death, specifically, interment in collective burials, honestly reflects similar treatment in life. Answering this question makes it possible to illuminate the historical trajectory at Marroquíes Bajos, to determine whether most individuals had comparable labor burdens and access to nutritional resources, whether significant disparities in aspects of lived experience like diet and health were present from the very foundation of the site, or whether social inequality grew more pronounced over time, leading to the tensions that led to the abandonment of the site.

Chapter 3

Uncovering a Macro-Village: Salvage Excavations at Marroquíes Bajos

> *Jaén is a city of the piedmont, built on the slopes of the mountain that opens in the north towards the countryside…Its appearance prior to urbanization was the result of the superposition of different communities over the course of at least 4500 years, inhabiting and exploiting the territory, leaving powerful material traces of their passage... Channeling systems succeed one another over time, and under the ditches still in operation are the drainage systems of the seventeenth century; culverts, canals, windmills and water-wheels of the Islamic period; mills, pools and channels of the Romans; and supporting it all, the great prehistoric hydraulic system that continues today to decide the pathways of groundwater in the area.*
>
> – *Narciso Zafra de la Torre et al., Una Macro-Aldea en el Origen del Modo de Vida Campesino, (1999:79, translation mine)*

In the summer of 1957, workmen laboring to build a house foundation on a plot of land in the northern reaches of the city of Jaén broke through a patch of ground to reveal an ancient burial cave (Espantaleón Jubes 1957). The newly discovered necropolis was named Marroquíes Altos[13], or the "Higher Moroccans," and over the next fifty years its artificial caves would be excavated by a number of different regional archaeologists. These scholars publicized the intriguing mortuary rituals and cache of Late Prehistoric material at Marroquíes Altos within the Spanish archaeological literature. However, the cohort of twentieth-century excavators who dug at the necropolis, including Ricardo Espantaleón Jubes and Rosario Lucas de Pellicer, wondered about the origins of the interred population, emphasizing that the "habitat" of the people who buried their dead in these caves had yet to be discovered (Lucas de Pellicer 1968:23).

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[13] As Zafra de la Torre et al. (1999:79) note, the city of Jaén comprises three distinct zones: the hilltop castle of Santa Catalina, the northern slope of the hill surrounded by the Roman and medieval wall, and the lowlands with their extensive areas of orchards. The majority of the prehistoric archaeological site is located in the lowlands to the north of Marroquíes Altos (hence the use of *Bajos*, meaning "low"). Because Marroquíes Altos was the first component of the site discovered, and because it is perched in an area of higher altitude south of the fifth ditch, it retains its distinct name. However, when the site name Marroquíes Bajos is used, it also encompasses the area of Marroquíes Altos, since the two areas are chronologically and culturally related.

It was not until 1995, during the significant northward expansion of the modern city of Jaén, that salvage excavations finally revealed the location of the prehistoric population that produced the necropolis. There traces of an impressive 113-hectare Copper Age settlement were first uncovered (Hornos Mata et al. 1998). Since then, archaeological investigations at the site have proceeded apace with the growth of the modern city with ZAMB (*Zona Arqueológica de Marroquíes Bajos*) hosting more than 100 excavations (Zafra de la Torre et al. 1999:79) in an area that spans most of the northern lowlands of the contemporary city. Excavations began with Espantaleón and Unguetti's first foray into the chambers of Marroquíes Altos in 1957 and continue to the present day, where excavations are still conducted in advance of further construction.

Given the staggering number of excavations conducted at the site, the extent of fieldwork conducted by different teams, and the vast timespan of nearly six decades of archaeological activity, any analysis of the prehistoric life ways of Marroquíes Bajos must be grounded in a comprehensive understanding of the settlement's history as an archaeological site. In order to present a nuanced portrait of the site across both space and time, this chapter is divided into four main sections, each of which varies in its organization.

The introductory section begins by providing an overview of the site, describing the scope and extent of its prehistoric occupation, and underscoring the multi-component nature of the city of Jaén. This section contextualizes the excavations within the historical and geographic landscape of Jaén, and also describes ongoing archaeological debates about the nature and chronology of prehistoric organization at Marroquíes.

The second section focuses on the four mortuary areas of Marroquíes Bajos (Necropolis 1, *Fosa Común* 1 and 2) that either (i) have been published in academic journals or (ii) were not analyzed during the course of this research project. The two mortuary areas for which bioarchaeological analyses have previously been conducted (Sánchez et al. 2005; Cámara Serrano et al. 2012b) are briefly summarized, with specific emphasis on the formal characteristics of their funerary depositions and the demographic characteristics of their interred populations. Because these areas have already been published in academic journals, the site reports are not duplicated here. Similarly, my descriptions of *Fosa Común* 2 will be brief, because human remains from these areas were not analyzed during the course of my research. Instead, this section details the organization of the human remains, the structure of mortuary features, and any initial bioarchaeological estimates or information described by excavators.

Marroquíes Bajos: A Brief History of the Site

At 113 hectares, Marroquíes Bajos is one of the largest sites known for the Iberian Copper Age, matched in size and importance only by the Chalcolithic holotype of Los Millares in Almería, which contains 5 hectares of fortified habitation and 13 hectares of tombs, and the expansive settlement of Valencina de la Concepción in Seville, which has 400 hectares of settlement complex total (Chapman 2008; Díaz-del-Río 2011). However, Marroquíes Bajos is distinguished from other macro-villages by its multi-component nature. The landscape of Jaén is a historical palimpsest representing at least four and a half millennia of human exploitation and occupation, beginning with the prehistoric period, and moving through Iberian, Roman, Visigoth, Islamic, modern Christian and contemporary occupations (Hornos Mata et al. 1998; Sánchez et al. 2005). The enduring popularity of the Jaén location is driven by two primary factors: water and land. Diverse ancient communities recognized the local environment's potential for agriculture, and excavations at the site testify to the repeated use and re-use of the landscape. At Marroquíes:

> "Systems of channels succeed each other in time, and underneath the irrigation ditches still in operation lie the localized drainage of the seventeenth century; the culverts, canals, windmills, and water wheels of the Islamic period; the mills, pools and channels of the Romans; and supporting all of it, the great prehistoric hydraulic system that still continues to decide the paths of groundwater in the area today" (Zafra de la Torre et al. 1999:83, translation mine).

The overarching economic landscape has not changed markedly from ancient times. A large sculpture on the western border of the city proclaims the municipality to be "The World Capital of Olive Oil," and the rolling hills surrounding the city are uniformly stamped with the dark parallel striations of the provincial capital's ubiquitous lines and rows of olive groves.

However, just as the site and city are historical palimpsests, they also represent something of an archaeological pastiche. Excavations at Marroquíes Bajos have been conducted by a number of different teams over approximately a fifteen-year period, beginning in 1995 and continuing, at a much lower volume, into the present day. The site's excavation fell under the purview of the Andalusia Heritage Act of 1991 (*Ley de Patrimonio Histórico de Andalucía*), and legally it represents one of the first instances of the enactment of a *Catalogación Específica con Instrucciones Particulares de Andalucía*. As such, the period between 1995 and 1998 represented "a concentration of research centered on the archaeological zone of Marroquíes Bajos, in a manner that is incomparable to anywhere else in the territory of our province" (Zafra de la Torre et al. 1999:78, translation mine).

The sheer scope of this archaeological research produces its own particular set of problems. The salvage project at ZAMB was so massive that it involved multiple institutions, including the *Consejería Cultural de la Junta de Andalucía (Delegación Provincial de Jaén)* and the University of Jaén. The majority of archaeologists who excavated the site were freelance professionals, largely employed by Cultural Resource Management companies, sometimes commissioned by the Cultural Administration through grants, though largely commissioned by property development companies (Hornos Mata et al. 1998). The scale of the salvage excavations necessarily required different archaeological teams, working on multiple projects, using disparate methods, all of which produced vast amounts of archaeological materials that, due to their volume, could not be studied immediately.

The picture that emerges from this early synopsis of the site's history is one of a patchwork. Marroquíes Bajos was excavated over many years by many different archaeological teams, with excavations that varied in both quality and scale (Cámara Serrano et al. 2012a). Additionally, the successive occupations of the area make this settlement the epitome of a multi-component site. Fortunately, the modern excavations were conducted by professional archaeologists who took great care with provenience and recording. As a result, despite the tortuous nature of the site's excavation history, a number of significant occupational patterns have been identified, leading Spanish scholars to grapple with reconstructing the history of this unique macro-village for over a decade (Hornos Mata et al. 1998; Zafra de la Torre et al. 1999; Díaz-del-Río 2004; Barba Colmenero et al. 2010; Serrano Peña et al. 2011; Cámara Serrano et al. 2012a, 2012b)

Internal Organization and Architecture

With its concentric rings of ditches, Marroquíes Bajos exemplifies the layout of a typical Copper Age enclosure site (Figure 3.1). The most noteworthy aspect of its internal organization is the system of five circular ditches, formed by either “u-” or “v-shaped” trenches that are dug into the bedrock. These vary between 1.5 and 5 meters in depth, and between 4 and 22 meters in width. The series of inter-ditch spaces are organized concentrically, expanding outwards from the center of the site. Portions of some ditches were reinforced with supplementary defensive architecture, including adobe or stone walls, palisades and bastions. In particular, the third ditch was reinforced by a 375-meter-long wooden palisade with bastions, and the fifth ditch was partially surrounded by a bastioned adobe wall that was 3 meters in height and 2 kilometers in length (Díaz-del-Río 2004).

Figure 3.1 Reconstruction of Marroquíes Bajos (Narciso Zafra de la Torre, Provincial Delegación de Cultural)

One camp of archaeologists has postulated that the enclosure ditches formed a kind of hydrological circuit, built to “capture water from the northern slopes of the hills of Santa Catalina and El Neveral” and distribute it throughout the settlement (Hornos Mata et al. 1998:85, translation mine). Without such a water distribution system, destructive accumulations of water (which still occur in the area during the autumn rains) would have flooded parts of the prehistoric village. Analyses of sedimentary deposits from the bases of the ditches, as well as the layout of the fourth ditch – where deliberate modifications to the ditch structure are argued to maintain a gradient suitable for the conduction of water – support the irrigation argument. Similarly, the excavated offshoots that connect the third and fourth ditches have been offered as evidence supporting this hypothesis (Zafra de la Torre et al. 2003)

However, this hydrological interpretation of the function of the enclosure system is contested. Some of the archaeologists who excavated the site highlight the potential dual function of the ditch as both an irrigation canal and a defensive structure (Pérez Martínez 2005), while others have suggested that the hydraulic features are more likely a *byproduct* of the system of enclosures, rather than their main function (Díaz-del-Río 2004). Finally, instead of a series of irrigation channels, the enclosure system may have been intended to act as a primarily defensive structure related to the rise of social conflict in the region. Proponents of the fortifications/defensive model point to "a lack of references to irrigated plant crops, to intermediate canals for the distribution of water, weak pollen results, discontinuity and irregularity of the traces of the ditches that would make them unsuitable for drainage, and the evidence of walls and fences also attached to the ditches which would give them a primarily defensive character" (Sánchez et al. 2005:154, translation mine) as intrinsic weaknesses of the hydrological argument.

Whichever interpretation one favors, the available archaeological evidence suggests that (i) the enclosure system was maintained, re-excavated, and modified over time (e.g., Pérez Martínez 2005; Sánchez et al. 2005); (ii) specific elements of its construction (like the adobe wall, bastions, and access points) were likely defensive in nature; (iii) modifications to the ditches themselves, such as the deliberate increase in the slope of the 4th ditch (Hornos Mata et al. 1998) and the deviation in the trajectory of the fifth ditch to reach the Magdalena stream (Pérez Martínez 2005), were likely intended to increase water capture efficiency, and (iv) sedimentary evidence, namely the thick levels of silt and lacustrine sediments that were concentrated along some of the ditch bottoms, attests to the prehistoric flow of water through the ditches (Pérez Martínez 2005; Sánchez et al. 2005). In addition to its supposed function for irrigation and defense, the enclosure system also functioned as a means of dividing the occupational area of the site from outlying storage and fields (Zafra de la Torre et al. 1999). Site reports attest to the scarcity of ceramics, chipped stone, ground stone, and architectural features outside of the fifth ditch, meaning that this area was most likely used as agricultural land (Pérez Martínez 2005). However, within the interior of the enclosure system, salvage excavations have revealed abundant evidence for domestic architecture, which witnesses important changes in form and function over the course of the Late Prehistoric occupation (Table 3.1).

There appears to be a gradual shift in domestic architecture, from functionally differentiated dwellings grouped around central plazas after 2450 cal BC to multiple domestic complexes bordered by stone walls after 2200 cal BC (Cámara Serrano et al. 2012a, 2012b; Díaz-del-Río 2004b; Zafra de la Torre et al. 1999), though as Cámara Serrano and Molina have indicated, this process is not unilineal, and there is some variability across different areas of the site (Cámara Serrano and Molina González 2016:50). Overall, this architectural trend likely reflects changes in the social organization of the macro-village. During the early phases at the site, when the ditch and wall enclosure system was constructed, there is little variability in the size and contents of dwellings and features. However, once the enclosure system was constructed, the site became marked by a pattern of increasing architectural differentiation. In particular, the institutionalization of family households (represented by the walled extended domestic complexes) *after* the conclusion of communal labor investment in the enclosure system may reflect the increasing power of lineage groups relative to individual leaders. The increasing tension between the leader(s) who initially organized the investment of communal labor in the ditch and wall system and the lineage groups themselves may have led to the abandonment of the enclosure system and subsequent dispersal of the Marroquíes population at the turn of the 2nd millennium (Díaz-del-Río 2004).

Table 3.1 Change in domestic organization over time at Marroquíes Bajos (after Zafra et al. 1999 and Díaz-del-Río 2004)

Phase	Organization of domestic spaces
ZAMB 1	Subterranean huts, storage features, and refuse deposits that do not vary in size or wealth are dug into bedrock.
ZAMB 2	All features, including residences, storage pits, trash pits, tombs and "workshops" are dug into the bedrock. A "hive-like" organization emerges during this phase, as different chambers are linked together and have multiple points of access.
ZAMB 3	Wooden, open-air extensions to buildings are documented during ZAMB 3. Circular floors defined by postholes and external wall trenches spread throughout the settlement; short entryways (often covered), hearths, and complex systems of support are also frequently found. One potential rectilinear structure with walls built of large tree trunks has been partially excavated inside of the fifth ditch (E-1 of UA 23). Functional variability between buildings increases during this time, and evidence from some excavations suggests that dwellings were grouped around and oriented toward central open spaces.
ZAMB 4	Dwellings are now built with stone foundations. The open central areas of the preceding phase are replaced by extended family household compounds, where individual dwellings (which can reach up to 8 m in diameter) are separated by small streets. The extended compounds contain a wealth of architectural features such as circular huts, wells, underground storage facilities, ovens, and trash pits. A relatively extensive domestic complex dating to this period was excavated in sector UA 23. The diverse structural complex was bounded by a wall of low height, and an aperture in the wall opened into a "street" leading to one of the gates of the wall. The well-maintained interior of the complex contained floors constructed from layers of stones, and showed evidence of significant internal organization, with compartments, hearths, workbenches, underground structures, and outdoor activity areas. The adobe wall delimiting the complex had stone foundations, and delineated the space for a long enough time that it required reconstruction and maintenance. Finally, occasional rectangular buildings are distributed throughout the site, with front access corridors; some include large storage jars and accumulations of loom weights.
ZAMB 5	This period is characterized by smaller and more dispersed Bronze Age occupations.

Local Environment and Subsistence

Recent work has targeted the paleoclimate and paleovegetation of Marroquíes Bajos in order to reconstruct the prehistoric landscape. An isotopic analysis of $\delta^{13}C$ and $\delta^{18}O$ between modern snail shells and snail shells securely provenienced to Copper Age levels at the Subestación and Paseo Estación sectors of the tramway excavations revealed that the Late Prehistoric climate in Jaén was likely similar to today's climate (Yanes et al.

2013). The $\delta^{13}C$ values for archaeological snails and contemporary snails largely overlap, though the archaeological snail shells have lower average values, suggesting lower water stress conditions during the third millennium. Similarly, the differences in $\delta^{18}O$ values suggest slightly wetter conditions during the period 2530 – 1930 cal BC[14] (the date range for the archaeological sample of snails), which agrees with other paleoenvironmental reconstructions derived from ancient snail research for this region.

These claims are bolstered by the study's shell deposition model, which suggests that the ancient Marroquíes snail sample deposited their shells during times of higher humidity (~92-95%) than present values (~86-89%). Given the deep occupational record of Marroquíes, the authors emphasize the following "[t]he inferred wetter conditions during the Copper Age interval may have favored agricultural practices during that time interval in Jaén. Moisture conditions may have reduced the necessity of artificial irrigation of crops in this ancient human civilization" (Yanes et al. 2013:84).

Indeed, the effects of agricultural activity at Marroquíes Bajos can be seen as early as the Copper Age. During this time period, charcoal analyses of a number of sites from the Alta Andalucía demonstrate a decline in oak woodland, while the increase in wild olives and vegetation of open areas indicate that new areas were ploughed for crop planting. Ash trees decreased in number while shrubby legumes proliferated, likely due to the spread of flood irrigation in the water-adjacent areas formerly dominated by ash trees. However, forests were not seriously degraded, so occupational levels were likely still moderate in this region, and the appearance of plants like strawberry trees and the Portuguese oak indicate the persistence of areas of relative moisture during this time (Rodríguez-Ariza 2012; Montes Moya 2014).

Montes Moya (2014) has conducted research charting the diachronic development of agriculture in Alta Andalucía through carpological and paleobotanical analyses. Her archaeobotanical investigations of the Late Prehistoric levels of Marroquíes Bajos and other regional sites spanning a broad time span including Las Eras de Alcázar (Late Prehistoric), Cerro del Alcázar (Bronze Age), Puente Tablas (Iberian), Villa Romana de

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[14] Reported in Yanes et al. 2013 as 4470-3880 cal BP.

Gabia (Roman) and the Roman levels of Marroquíes Bajos document a complex agriculture in which cereals, legumes, and fruits are the most important crops.

Cereals

Of the seven main cereal species identified in Montes Moya's sample of seven local sites, six occur in the Late Neolithic – Middle Copper Age levels at Marroquíes Bajos: naked barely (*Hordeum vulgare var. nudum*), hulled barley (*Hordeum vulgare*), club wheat (*Triticum aestivum*), durum (*Compactum tipe*), emmer (*Triticum dicoccum*), and einkorn (*Triticum monococcum*), with only millet (*Panicum miliaceum*) not represented. Archaeobotanical analyses show that at Marroquíes, hulled barley and naked barley were present in comparable quantities over the course of the Copper Age, though naked barley was slightly better represented. This pattern contrasts with the pattern apparent at sites like Las Eras de Alcázar, where naked barley predominated for the entire Copper Age, and may be related to the moister setting of Marroquíes, which would have allowed for the cultivation of both species of grain. However, after this point in time Marroquíes Bajos and other sites in High Andalucía demonstrate a progressive replacement of naked barley by hulled barley, until the naked variety disappears.

Hulled barley may improve the storage and conservation of grains (due to protection from pests and diseases) and is more resistant to climate change as it adapts better to dry conditions. However, "hulled processing requires more work that can be guaranteed only in completely sedentary communities, where…cooperation between the inhabitants enables the generation of surpluses and trade" (Montes Moya 2014:316). Accordingly, shifts in social organization, combined with gradual environmental changes leading to drier conditions, could be responsible for this pattern. Club wheat was also a popular grain during the Middle Copper Age to Early Bronze Age at Marroquíes Bajos, occasionally surpassing barley in frequency. Its predominance over hulled wheat during certain periods may be related to both its adaptability and to its utility for bread-making. Finally, throughout Alta Andalucía there are signs of agricultural intensification in cereal crops during the Late Cooper Age – Bell Beaker period, namely the increase in a secondary species like einkorn.

Legumes

During the Early Copper Age, the faba bean (*Vicia faba*), pea (*Pistum sativum*), grass pea (*Lathyrus sativus*), and red pea (*Lathyrus cicero*) were all documented at Marroquíes Bajos, although the first two species dominate at the site. The provenience and concentration of the faba beans and peas in areas of burning suggests that they were stored for use as food by both humans and animals, while the rest of the legumes may have been used as green fertilizer. Because legumes do not preserve well, it was difficult to differentiate between preservational bias (where low numbers of legumes reflect taphonomy), and prehistoric subsistence patterning (where low numbers of legumes reflect less cultivation). The greatest deposits of legumes in all Late Prehistoric contexts came from burned storage units, where "massive" amounts of legumes were documented. Overall, however, Montes Moya documents a trend towards legumes since the Middle Copper Age in Alta Andalucía that began to truly intensify during the Bell Beaker period, likely related to the adaptation of new irrigation techniques to handle the drier climate, a model supported by the increasing presence of flax (a crop that also needed greater amounts of water).

Oil Plants, Textile Plants, and Tree Cultivation

Flax (*Linum usitatissmum*) and esparto grass (*Stipa tenacissima*) occur at low levels in Copper Age Marroquíes Bajos, comprising less than 20 % and less than 10% of the botanical sample, respectively. Flax would have been planted close to water courses or in irrigated fields, and was most likely exploited for both its fibers and the edible oil from its seeds. In contrast, esparto grass formed part of the natural vegetation and would have been collected for different uses, including the production of baskets, ropes, mats, and footwear.

Only two types of trees are documented in the Late Prehistoric levels of Marroquíes Bajos: the olive (*Olea europaea*) and the grape vine (*Vitis vinifera*), both of which occur during the Copper Age. It is unclear whether either species is domesticated during this period; Montes Moya describes how grapevine "appeared with values lower than for the olive/wild olive, although in this case it could be entirely wild, since proximity to water courses favours riverside vegetation, of which wild grape forms a part" (2014:325). As grape vine does not appear at any contemporaneous regional sites, it is likely that the grapes at Marroquíes are wild. Olive remains during the Copper Age are isolated specimens, and almost all are fragmentary, in many cases likely corresponding to fruits that still clung to branches used for fuel. Evidence for deliberate cultivation of olives, in the form of massive concentrations of olive stones in tandem with olive mills, does not appear until much later in the record in Alta Andalucía, perhaps because the stringent requirements of the crop:

> "One of the characteristics of fruit crops is that they involve a long-term human-plant relationship without immediate crops, this being complemented by the crop cycle of cereals and legumes, which provide profit in the same year. To begin with the intensive cultivation of olives, which in this case would have happened in a family context, it would be necessary to define the ownership of the land. Only then would the owner feel secure enough to invest the effort in growing medium- to long-term crops. Until then, fruits could be collected in the woods from wild olives close by and the milling system could be simple and impermanent, such as a sack to which torsion is applied (Montes Moya 2014:331)."

Additional classificatory difficulties arise because wild olive stones do not appreciably differ in their morphology from domesticated olive stones. However, given the dearth of evidence for significant levels of olive or olive oil production in prehistoric and protohistoric phases, it is likely that the inhabitants of these periods manipulated, gathered, or cultivated wild olives.

Unfortunately, the paucity of both zooarchaeological analyses (with the exception of Riquelme Cantal 2010) and holistic analyses conducted on the Marroquíes Bajos materials, makes it difficult to develop hypotheses about the pastoral practices of the Copper Age inhabitants of the site. However, excavations at Necropolis 3 documented the presence of domesticates like cattle, pigs and sheep/goats (Cámara Serrano et al. 2012b) as grave offerings, making it likely that these animals were managed for the harvesting of either secondary products (e.g., wool, milk, traction) or for consumption during daily life.

Debates About the Historical Trajectory of Marroquíes Bajos

To date there are two overarching models for the chronology of the Marroquíes Bajos occupation. The first is a "unitary" model of site formation, in which Marroquíes inhabitants assembled the materials and labor necessary to build the complex and large-scale system of ditches and walls within a single generation, constructing the layout of the site according to a pre-planned design (Hornos Mata et al. 1998; Zafra de la Torre et al. 1999, 2003). The second explanation is an accretional model, where the ditches and necropolises were constructed piece-meal, over a long period of time (Cámara et al. 2012a, b), in a fashion similar to the process responsible for the walls and bastions of Los Millares (Díaz-del-Río-2011).

The multi-component site has been divided into 19 different stages, ranging from the Neolithic period to contemporary times. The first seven stages are identified and delineated based on technological bases, the second nine relate to cultural characteristics (Iberian, Roman, etc.), and the final two are the most recent (Modern, Contemporary) (Zafra de la Torre et al. 2003). Both the unitary and the accretional models of site formation use the periods ZAMB 0 – ZAMB 5 to refer to the Late Prehistoric component of the site (Table 3.2).

Table 3.2 Late Prehistoric phases at Marroquíes (after Zafra de la Torre et al. 2003)

Phase	Cultural Period	Approximate Temporal Boundaries
ZAMB 0	Late Neolithic	Second half of fourth millennium BC
ZAMB 1	Early to Middle Copper Age	3100 – 2500 cal BC
ZAMB 2	Late Copper Age – Pre-Beaker	2450 –2125 cal BC
ZAMB 3	Late Copper - Beaker	2125 – 1975 cal BC
ZAMB 4	Late Copper – Early Bronze	1975 – ? cal BC
ZAMB 5	Middle Bronze	First half of second millennium BC

Archaeologists in the unitary camp argue that the enclosure system was built and consolidated during the ZAMB 3 phase, with the exception of Enclosure 0, which was constructed during ZAMB 2. The similarity in the size and organization of the inter-ditch spaces and the base dimensions of the ditches themselves attest to a single, pre-planned design for the site that was executed in a relatively short amount of time. In this model, the fortification takes place simultaneously in the fields and the village core. The ditches are subject to constant renovations and remodeling during the entirety of the ZAMB 3 phase (Hornos Mata et al. 1998; Zafra de la Torre et al. 2003), but within a period of three centuries the system of ditches is almost completely abandoned and it becomes silted in. Overall, the unitary model posits that the population and activity levels peaked at the site for only half a millennium (Cámara Serrano et al. 2012a). This group has highlighted a series of radiocarbon dates taken from archaeological features that support this chronology (Table 3.3). This framework has led to the interpretation of the social organization of the village as indicating increasing factionalism due to the presence of competing lineages over the second half of the third millennium (Díaz-del-Río 2004).

Table 3.3 Radiocarbon dates from archaeological features (Zafra de la Torre et al. 2003)

Sample	Date	Context
Utc 6548	3910 ± 50 BP	Foundation of the wall.
CSIC 1345	3705 ± 28 BP	Moment of total in-filling of the fourth ditch.
Ua 20267*	3885 ± 40 BP	Stratum of use of the base of the 5^{th} ditch.
Ua 21455*	3775 ± 45 BP	Stratum of use of the base of the 5^{th} ditch.

However, this unitary interpretation of site history is contested. Proponents of the opposing accretional model have pointed to a "dearth of concrete data on the stratigraphy" of the site in general (Cámara Serrano et al. 2012a), and instead focused on more recent series of radiocarbon dates, drawn primarily from the Necropolis 3 mortuary structures. The second accretional model diverges from the unitary model in several important regards (Cámara et al. 2012a, b). First, it argues that the surrounding countryside was *not* emptied during the foundational phase of Marroquíes; instead contemporaneous smaller villages like Venta del Llano, Venta del Rapa, and Cerro de la Horca persisted in the surrounding landscape during the Marroquíes occupation. Second, it deviates from the specific timing proposed by the unitary camp, emphasizing that the purported peak period at Marroquíes, around 2500-2450 cal BC, is "underrepresented" in the total sample of dates available for the site; in contrast, far more occupational intensity is documented during the second half of the third millennium BC (although it must be underscored that the majority of the dates from this period come from funerary, rather than domestic, contexts). Finally, proponents of the accretional model disagree with the interpretation that the enclosure system was dismantled in the late third millennium, as a number of their dates cluster in the early second millennium BC (e.g. Ua40760, U40763), and instead argue that because most of the new dates from contexts of abandonment fall between 2495 and 1880 BC, the occupation and abandonment of the site was a far lengthier process.

The patterning of the new expanded sample of dates leads Cámara Serrano and colleagues (2012a) to argue that not all the ditches were abandoned simultaneously, nor even all abandoned before the end of the 2nd millennium. Instead,

> "the frequency of dates in the early second millennium BC, contemporary to Argaric contexts east and northeast of the province of Jaén, suggest to us that the collapse often envisaged for the site of Marroquíes…should be qualified, and should also take into account the potential shifts toward the steepest zone currently occupied by the core of the urban area of the city of Jaén" (Cámara Serrano et al. 2012a:91, translation mine).

The accretional model posits that Marroquíes was continuously occupied for up to one thousand years, from 2800 BC to 1800 BC, with ritual areas continuing to be frequented and reused throughout the entire third millennium BC. This purported occupational duration, in tandem with the arguments for the persistence of smaller outlying villages, led Cámara Serrano et al. to posit that Marroquíes was likely a hierarchical political center for the Upper Guadalquivir valley (*sensu* Nocete et al. 2010 – see also Chapter 1), in stark contrast to the trajectory of lineage factionalism and settlement collapse circa 2000 BC (Zafra de la Torre et al. 1998) proposed by the unitary model (Díaz-del-Río 2004).

The complex site history and extensive territory of Marroquíes Bajos make this a difficult question to resolve. While proponents of the accretional model have assembled a large sample of dates (42), the majority of them (64%) are derived from the tramway excavations (Cámara Serrano et al. 2012b). Because only a handful of these dates actually derive from the second millennium, and the late dates are predominantly drawn from mortuary contexts their claims of a 1000-year occupation must be bolstered by a larger sample of dates from other areas of the site. While Cámara Serrano et al. (2012b) may be correct in identifying four periods of significant funerary activity at Necropolis 3 (2575-2400/2350; 2400/2350-2100; 2100-1950; 1950-1750) funerary activity is distinct from occupation. Other analyses of Late Prehistoric European contexts have demonstrated that punctuated re-use of funerary structures several centuries after the period of initial mortuary use is possible (Quinn and Kujit 2013). Indeed, to make the claim that Marroquíes Bajos was a “hierarchical political center” (Cámara Serrano et al. 2012a:91) that witnessed a significant amount of human occupation and activity for more than 500 years requires explicitly addressing two types of evidence. Specifically, (i) the purported use of the site in the first half of the second millennium must be demonstrated to go beyond simple re-use of mortuary features in a single necropolis, to the temporally extensive reuse of multiple mortuary areas, continued agricultural investments, domestic activity, and investment in site architecture, and (ii) larger regional patterns in settlement patterning, subsistence, and exchange must suggest marked spatial concentration of resources in the primary center.

This dissertation research will contribute to the resolution of these debates. The 37 new radiocarbon dates increase the number of available dates by 88%. As these were sampled from three different mortuary areas during the course of this dissertation research, the new dates will contribute to establishing the history of prehistoric use of this macro-village. Additionally, demographic and dietary analyses will explore the degree of inter-individual variability in resource access, another avenue through which emerging inequality can be explored.

The Mortuary Areas

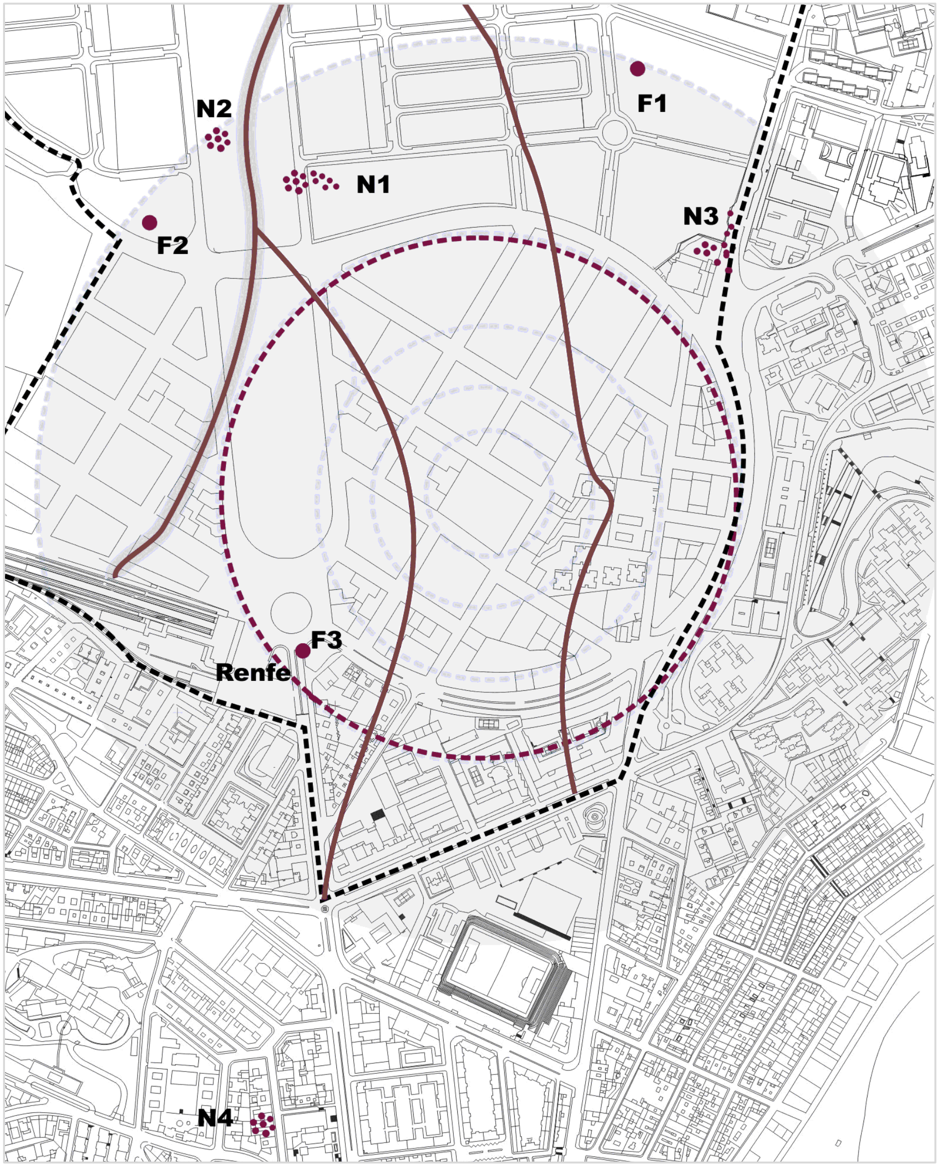
Over the course of salvage excavations, seven different mortuary areas were discovered at Marroquíes Bajos (Figure 3.2). Though archaeologists have distinguished between Necropolises (N) and *fosas comunes* or common graves (F) (Narciso Zafra de la Torre, personal communication), salvage excavations suggest at least four spatially segregated mortuary tracks, as described in the regional site reports provided by the provincial Delegación de Cultural (Espantaléon Jubes 1957, 1960; Lucas Pellicer 1968; Serrano Peña 2000; García Cuevas 2005; Manzano Castillo and Martínez Ocaña 2001; Pérez Martínez 2005; Sánchez et al. 2005; Crespo Kayser et al. 2009, García Cuevas et al. 2012; Cámara Serrano et al. 2012b)

- Commingled and secondary inhumations in discrete mortuary structures (N2);
- Collective deposits in pits lacking discrete structures (F1, F2, F3)
- Multiple individual inhumations in discrete mortuary structures (N1, N3);
- The burial of a large number of individuals in a series of artificial caves located outside of the enclosure system (N4);

The locations of these mortuary areas relative to the enclosure system have been mapped by Narciso Zafra de la Torre, regional archaeologist for the provincial Delegación de Cultural (Figure 3.1). Two of these mortuary areas have been analyzed previously (F1, N3); one has yet to be analyzed (F2); and three were the subject of bioarchaeological analysis over the course of this dissertation (N1, N2, N4). There are additional small depositions of human remains documented throughout the site, including fragments of human remains inside the fourth enclosure ditch, in close proximity to the *Ciudad de la Jusiticia* excavations, identified during faunal analysis of materials from the ditch (Marta Díaz-Zorita Bonilla, personal communication). The number of human remains documented will thus likely continue to increase as more of the material that has been excavated from Marroquíes Bajos is analyzed.

The following sections of this chapter fully describe the archaeological backdrop and the results of any existing bioarchaeological analyses for F1, F2, and N3, and also provide a summary of the archaeological backdrop of N1, N2, and N4. However, the results of the new bioarchaeological analyses conducted for N1, N2, and N4 are discussed in Chapters 5 and 6.

Figure 3.2 Map of Marroquíes Bajos mortuary areas relative to enclosure system (courtesy of Narciso Zafra de la Torre)



Early Bioarchaeological Studies and Unstudied Mortuary Areas (N3, F1, F2)

Of the mortuary areas at Marroquíes Bajos, one has never been subject to bioarchaeological analysis (F2), and two have been analyzed by Spanish physical anthropologists and published in academic journals (N3 and F1). Because these areas were not the focus of this dissertation research, they are summarized briefly below, with an explicit focus on the organization of the mortuary areas, the condition of the human remains, and any anthropological information made available by excavators or collected during bioarchaeological analysis.

The Tramway Mortuary Areas (N3)

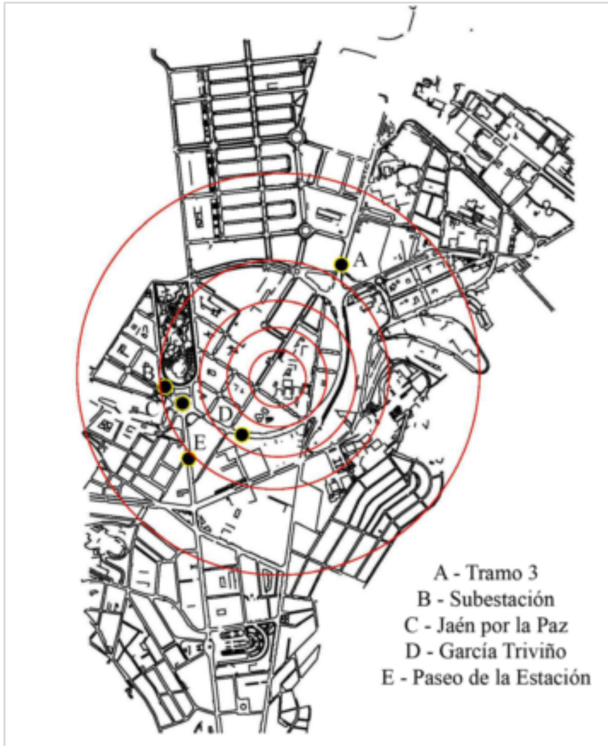
Necropolis 3 is located in the northeast quarter of Marroquíes Bajos, in between the fourth and fifth ditch of the settlement. The necropolis was discovered during the construction of the Tramway System of Jaén. Ironically, this extensive public works project never came to fruition; after the lines were built, the trams functioned for only two weeks before being halted in 2011 due to pressure from the local constituency. Indeed, one of the only concrete benefits of the construction of the Tramway thus far has been the fact that it led to the discovery of a number of Late Prehistoric mortuary areas documented in unpublished site reports (Serrano Peña et al. 2000; García Cuevas et al. 2012) and several summary articles (Cámara Serrano et al. 2012b; In Press).

A number of different areas were investigated over the course of Tramway excavations (Figure 3.3), providing evidence of a range of prehistoric activities. However, the greatest concentration of mortuary activity occurred in Section 3. This is home to the cluster of structures that has been deemed Necropolis 3.

One of the primary goals of the archaeological analyses was to establish the chronological relationship between the various structures and areas excavated in the larger site. In their summary article, Cámara Serrano et al. assembled all 43 available dates for the entirety of Marroquíes Bajos, taken from a range of contexts including carbon samples, ditches, and human and faunal remains. They concluded that the dates[15] suggest a development of the settlement "between 2580 and 1860 cal B.C. with 90% probability, according to the combination of dates using the program Calib 6.1.1... within the arch of 2σ, that can be subdivided in different ranges of probability (2571-2381 at 24% within the arch of 1σ, 2348-2112 at 58% and 2102-1913 at 17%)" (2012b:52).

[15] Two dates, Ua40044 and Ua40053, were anomalous, and appear to have been excluded from the combined chronological analysis.

Figure 3.3 Mortuary areas from the tramway excavations of Jaén (after Cámara Serrano et al. 2012b)



More than 1200 fragments or complete bones were analyzed during the course of anthropological analysis (Martín-Flórez et al. 2011; Cámara Serrano et al. 2012b). The remains were taken from four different zones: Section 3, Subestación, Paseo de la Estacíon, and García Triviño. The majority of the remains were disarticulated, distributed "chaotically" within the structures, covered with an abundant clay matrix, and affected by different forms of taphonomic disturbance including invasive root growth and water contact. When diagnostic elements like the pelvis were not available, sex was estimated with reference to anthropometric evaluations of robustness or gracility. Some of the excavated areas include both mortuary and non-mortuary components (Table 3.4). The mortuary structures for the four different excavated areas are described in greater detail below.

Table 3.4 Excavations of the tramway system of Jaén

Location	Area Excavated	Description	Mortuary Structures
Section 3	3400 m^2	A number of subterranean or semi-subterranean structures were excavated in this region, all of which contained a mixture of human and animal bones.	**Structure**[16] **1, 2, 4, 5, 8, 9, 14** and **18**
Paseo de la Estación	292 m^2	An area 30 m in length and 0.8-1.5 m in width that ran parallel to the ditch and showed traces of prehistoric human activity.	**Structure 9:** contained the remains of at least 16 individuals (and many crania), accompanied by animal remains.
Subestación	196 m^2	26 free-standing subterranean or semi-subterranean huts with excavated "perimetral" trenches and post-holes.	**Structure 14:** Contained two articulated individuals accompanied by four ceramic vessels.
García Triviño	120 m^2	9 subterranean or semi-subterranean structures, and two sections of perimeter trenches of free-standing Chalcolithic huts.	**Structure 11:** Different levels of burials separated by accumulations of stone. Cow and ovicaprid included.
Jaén por la Paz	320 m^2	12 structures with different functions were excavated, as well as sections of 11 huts with external wall trenches (some of which had double sections).	None.

Section 3

Full descriptions of each structure excavated in Section 3 have been published elsewhere (Cámara Serrano et al. 2012b:49–51), but all are subterranean or semi-subterranean complexes between 1.9 and 8.50 meters in diameter and between 0.30 and 2 meters in depth. Human remains were recovered from eight different structures (Structure 1, 2, 4, 5, 8, 9, 14 and 18). The majority of the structures contained a mixture of human and animal remains, and show episodes of reuse, either in terms of repeated human or

[16] The individual structures are referred to as "Structure" in text, after the Spanish *Complejo Estructural* or "structural complex."

faunal interments, or bouts of construction that involved building walls around the structures.

The initial MNI estimate for these structures was 173 individuals. 51 of these individuals were under 21 years of age, and while Cámara Serrano et al. indicate that it was possible to estimate sex for 94% of the MNI, it is unclear how they estimated the sex of these subadults. Despite the methodological ambiguity, the necropolis contains representatives of both sexes and a wide range of ages. Nearly all of the structures housed burials that were collective in nature, though there was high variability in the number of individuals present, and primary burials, secondary burials, and ossuaries were all documented for this area. Functionally, the structures range from dwellings hosting multiple levels of occupation with only the base stratum containing disarticulated human remains (Structure 1) to structures with multiple different funerary deposits (Structure 5). Importantly, the organization of the mortuary structures shows that seven of them (Structure 6, 9, 12, 13A, 13B, 14 and 15) are clustered around Structure 5, a larger central structure. This pattern replicates the internal organization of Necropolis 1, where the majority of mortuary structures encircle Structure 22.

Subestación

The remains found in Unit 2 of Structure 14 consist of two younger adults (one male, one female), estimated to be between 25-35 years of age with reference to dental wear. Both were buried in the bottom of the storage-pit/grave with four ceramic vessels. The dates for this context situate it in the final quarter of the third millennium B.C.

Paseo de la Estación

The material from Structure 9 was mixed with faunal remains, and consisted of 16 individuals ranging in age from Child I to Old Adult. The initial site report describes the human skeletal material as incomplete and lacking anatomical articulation. The excavators interpreted this mortuary structure as containing "dumped" deposits, with post-mortem fractures observed (Zafra de la Torre, personal communication; García Cuevas et al. 2012:93).

<u>García Triviño</u>

This area housed only one mortuary structure, Structure 11, which contained different levels of inhumations separated by accumulations of stones. The lowest levels of the structure could not be excavated due to the constrained parameters of the excavation. The structure also contained small numbers of cow and ovicaprid faunal remains.

Overall, the Tramway excavations are most notable for their ability to illuminate previously unexplored aspects of Late Copper Age mortuary practices at Marroquíes Bajos. In particular, the discovery that "the population of Marroquíes maintained a "continuous link with [the dead] that indicated periodic exhumation and removal…of bones" (Cámara Serrano et al. 2012b:57, translation mine) underscores the extent to which funerary practices were an important thread tying together social life during the Copper Age, even within a large-scale macro-village site. The excavation of relatively complete animals, particularly sheep, goats, and pigs, in close proximity to the human burials, also highlights the ritual importance of fauna, likely functioning either as offerings or sacrifices (Cámara Serrano et al. 2012b). The presence of articulated dog skeletons is specifically underscored, as this is a recurrent motif in the Alto Guadalquivir during the Late Prehistoric period. Dogs of varied ages occur in the deposits of Section 3. The presence of at least some young dogs is suggestive of deliberate sacrifice, although there is no evidence of perimortem trauma to the canids. Finally, the dates for these mortuary areas, particularly the dates available for Structure 9 "suggest a utilization for the length of the entire sequence considered, that is between 2550/2500 and 1800/1750 cal BC" Cámara Serrano et al. 2012b:62, translation mine). The long chronology of the use of some of these mortuary areas has led to the debates about the historical trajectory of this site discussed in earlier in this chapter.

Fosa Común 1

Fosa Común 1 (F1) was discovered during excavations of the fifth ditch in the northern sector of the settlement, in the excavation area called plot DOC-1 (SUNP-1) (Sánchez et al. 2005). The area of land was salvage excavated because it had been chosen as the new location for the Cándido Nogales public school, and so the Andalusian Center of Iberian Archaeology (*Centro Andaluz de Arqueología Ibérica*) was commissioned to organize salvage archaeological activity at the site. These excavations lasted from November 2001 – May 2002, focusing mainly on a northeastern section of the fifth ditch and an associated semicircular hollow tower. Overall, non-architectural material was relatively scarce in the fill of the excavation units, but all that *was* recovered was prehistoric (the discovery of a broken terracotta female idol is particularly noteworthy as a means of relative dating the material).

Over the course of excavations, archaeologists also uncovered a deposit of osteological remains, a mixture of human and faunal bone located at *a high point of runoff into the ditch*, in an area of whitish sediment 3.5m in diameter. The deposit has been interpreted as a deliberate secondary burial, because (i) the pit was dug *after* the abandonment of the ditch; (ii) the bones were disarticulated and lacked anatomical articulations, suggesting that skeletonized or partially skeletonized elements were deposited, rather than complete individuals; and (iii) the absence of grave goods, together with the presence of animal remains, suggests some kind of "filtering" or "translation" of the typical complex of funerary elements.

An anthropological study of the excavated human remains was conducted by Professors G.J. Trancho and B. Robledo of the Department of Animal Biology I (Anthropology) at the Complutense University of Madrid. The initial hypotheses of secondary burial were borne out by the skeletal materials: no complete skeletons were recovered, and the preserved elements were extremely fragmentary. The most well-represented anatomical regions were crania, mandibles, and the diaphyses of long bones. However, these elements allowed for the calculation of an MNI using the mandible, which testified to the presence of at least five individuals. Dental wear, as well as mandibular shape and angle[17] were used to assess age for four of the five individuals, who all demonstrated adult characteristics. Dental attrition scores and the crown heights of lower teeth were further used to estimate age ranges for these adults, who all fell between about 20 – 55 years of age-at-death. Though the fifth mandible had lost all teeth post-mortem, the individual was identified as subadult (12-16 years), based on the

[17] It is not clear precisely how mandibular angle can be used to assess age; I assume that the anthropologists used angle as a proxy for size and robusticity.

preservation of a third molar socket demonstrating eruption, as well as the presence of an unfused distal fibula which the researchers associated with the gracile jaw bone. The subadult mandible was too young to produce a rigorous assessment of sex, but all of the remaining mandibles were estimated to be male, based on typically male non-metric characteristics, such as everted gonial angles and prominent, square chins. In terms of pathology, Trancho and Robledo noted instances of caries, periodontal disease (presumably antemortem tooth loss), cribra orbitalia, degenerative joint disease, and trauma.

Finally, the team of anthropologists from Complutense also conducted an isotopic analysis of diet, examining nine different elements (Ca, P, Mg, Zn, Fe, V, Cu, Sr and Ba) in four human samples, one faunal sample, and one sedimentary sample drawn from an area in contact with the remains. Overall, the isotopic results indicate that the diet for all five individuals was based on terrestrial products, likely a "primarily vegetarian-based diet composed of products high in fiber, green plants, berries, grains and nuts, with an average intake of animal protein" (Sánchez et al. 2005:163, translation mine), and no evidence for reliance on marine resources. However, there was some dietary variability among the four individuals sampled. While sample size is small, these results are intriguing because the subadult shows particularly marked differences with the older individuals; while the subadult signature shows consumption of high levels of nuts and grains and a vegetarian diet, the isotopic evidence also suggests this individual consumed a diet especially rich in meat.

Fosa Común 2

Fosa común 2 was discovered during salvage archaeological work in advance of the planned construction on a plot of land in the northwest quadrant of the ZAMB area in the late 2000's. The archaeological work that was conducted is only described in the gray literature, and took place between October 2008 and August 2009 (Crespo Kayser et al. 2009; Narciso Zafra de al Torre, personal communication). The affected area is bordered to the south by Calle Federico Mayor Zaragoza, to the north by Calle Henry Dunant, and to the east by Paseo de la Estación, forming a triangular wedge just to the west of the sequence of parks that runs through the center of the Boulevard neighborhood. In total, a surface area of 5945.20 m^2 was investigated, located within the fifth ring of the Chalcolithic macro-village. The start of the excavations revealed that the area was covered in modern deposits, the result of debris from previous years of road construction nearby, as well as modern trash, and in some areas this debris formed a level up to 2 meters thick.

Accordingly, excavations began by removing the accumulations of modern debris, to prevent it from obscuring intact stratigraphy or collapsing onto the archaeological materials. Then two longitudinal transects running east-west were laid out in order to try to identify any portions of the fifth ditch and associated wall that might traverse the affected area. Excavations proceeded in approximately 20 cm levels that allowed archaeological material to be categorized by natural strata or sedimentary units. The base geological layer could not be reached in most units, due to the location of the wall above the ancient course of a stream or ravine that crossed the plot from southeast to northeast.

The initial transects provided evidence of the wall structure, but not of the ditch itself. The confirmation of the wall led the archaeologists to set new excavation units centered on the western and central areas of the parcel of land, where the majority of structures had been found. Because there was no evidence of archaeological materials in the eastern area, only two of the three planned trenches were actually put in place there. In total, nine units were dug, referred to as *sondeos* 1-9 in the site report, and the ditch itself, as well as two associated semicircular bastions, were eventually uncovered. All of the structures corresponded to the existing categorization of ZAMB 3 (2464-2313 BC), with the exception of some evidence for Roman irrigation systems in the eastern zone of the excavated area. The bastions consisted of semicircular walls that attached to the larger circular wall. The northern bastion had a depth of 1.8 meters, and the bastion itself had a radius of 3.45 meters at its interior and 5.10 m at its exterior. It was built of well-worn, medium-sized stones joined together using small quantities of mortar so that the stones were perfectly aligned and leveled. The southern bastion had comparable dimensions to the northern bastion.

During excavations, archaeologists also discovered a mortuary area (*Zona de Enterramiento*). The mortuary area emerged in the center of the plot of land where Unit 8 was located; the discovery of human bones and a cranium led to an expansion of Transect 2. The transect was made larger in order to accommodate and excavate the burial, becoming a large unit that contained a communal grave. This was designated a communal grave rather than a structural complex because the bodies were not interred in a clearly defined structure; the grave appeared to be dug into the earth. The pit was filled in, in turn, by the same earth that had been taken out of it, meaning there was no clear stratigraphic distinction that allowed archaeologists to delineate its precise shape.

The form and location of this burial is noteworthy for a number of reasons. Most graves at Marroquíes were normally dug out of the bedrock, placed in locations like the bases of huts or purposefully excavated subterranean tombs, with bodies laid out in an orderly fashion. At F2, a pit was dug into channel fill, and no part of it reached bedrock. The archaeologists argue that because of this unique sedimentary context, the bones were subject to post-depositional movement. The elements appeared commingled, dumped on top of the surface of the excavated area. A preliminary MNI calculated based on skulls indicate 11 individuals. Observations of bones and teeth allowed archaeologists to make initial estimations of age and sex; the burial contained at least two subadults (one less than 2 years of age) and the rest of the individuals were older adults.

The site report also presents a dramatic interpretation of the burial, suggesting that these individuals may have been either (i) "outsiders" who were killed by the population at Marroquíes, and buried outside of the wall to highlight their status as outsiders, or (ii) members of the local population who were killed and not given typical Marroquíes burial due to their transgressions (but were still buried close to the town because of their ancestral ties to the settlement). The evidence presented to support this interpretation is twofold: (1) that some skulls were shattered with stones and long bones were cut and regular intervals, and (2) that the bodies were buried outside of the boundaries of the settlement and haphazardly thrown into a quickly excavated pit. Unfortunately, the claims in the site report are not supplemented by any details of bioarchaeological interpretation, specifically *how* the purported perimortem damage to the crania and long bones was distinguished from postmortem taphonomic damage (Figure 3.4)[18]. Similarly, the disarticulated jumble of remains is characteristic of other burials at Necropolis 2 and Marroquíes Altos. The motif of "crania crushed by stones" is also documented at Marroquíes Altos, where no evidence for perimortem trauma or violence is discussed in the literature. Finally, like F2, Necropolis 2 and Marroquíes Altos are both located *outside* of the fifth ditch of the settlement, so it appears that extramural burial was actually a common Chalcolithic practice at the site.

Figure 3.4 Photograph of *Fosa Commún* 2, from unpublished site report (Crespo Kayser et al. 2009)

The proposed chronology for these structures is Copper Age, relative dated with reference to the ceramics recovered, though there are also some Bronze Age ceramics described in the site report. The archaeologists posit that during the first phase (2450-2125 BC, Late Copper Age – Early Bell Beaker) activity began with the construction of

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18 In the two available photos of the burial, many of the long bones show perpendicular transverse smooth fractures, which are characteristic of postmortem, rather than perimortem damage to bone (see Stodder and Osterholtz, 2010, Fig. 12.1).

the ditch. After this, the wall was constructed, with a first narrow gate and two upper access platforms for the defense of the gate. Later during the Copper Age, the gate was walled in, and it appears as though another was opened very close to the first, maintaining the defensive system associated with the earlier gate. Before abandoning the use of this area, the communal grave was dug, which was filled with the same levels of abandonment as the rest of the site. The adobe from the wall fell apart and crumbled, creating a waterproof layer that covered and protected the area.

Conclusions

An initial survey of the unpublished site reports reveals the complexity of Marroquíes Bajos, both in terms of its long excavation history, position on the local landscape, and internal prehistoric organization. The synthesis produced by this chapter also serves as an introduction to some of the unique analytical obstacles that preclude any conclusive analysis of the entire history of the site. Multiple excavations, conducted by different archaeological teams over a period spanning more than a decade, have produced glimpses of the organization of this Late Prehistoric settlement. However, an additional confounding factor is that the site itself is so large that it has only been partially excavated, and the unexcavated portions are buried deep beneath the modern city of Jaén. For this reason, the bioarchaeological data recovered from individuals buried within and immediately outside of the settlement are particularly important to developing an understanding of the social and chronological trajectory of the site. In order to understand the bioarchaeological data and situate information from human skeletal remains within a larger narrative of the history of the site, it is first necessary to develop a detailed description of the site's mortuary areas, which are covered in the next chapter.

Chapter 4

Necropolis 1, 2, and 4

> *The summer is upon us, and as in past years we have spent our vacations exploring the spacious countryside, bristling with olive groves. In the field of archaeology, as in else, our province of Jaén is extremely rich and varied, never disappointing the traveler who, with his eyes open to discovery and heart open to the landscape, will discover archaeological thrill. And so, once again this summer, the land has surprised us with its customary archaeological finds, the most important of which fell into our hands by chance in the capital of the Kingdom of Jaén in late July. The site was discovered on the north slope of the castle of Santa Catalina, in the place called Marroquies Altos…*
>
> – *Ricardo Espantaleón Jubes, La Necrópolis Eneolítica de Marroquíes Altos, (1957:165, translation mine)*

This chapter presents the background one needs to understand the layout, organization, and excavation history of Necropolis 1 (N1), Necropolis 2 (N2), and Necropolis 4 (N4) from Marroquíes Bajos. The first two sections cover Necropolis 1 and Necropolis 2, two mortuary areas first analyzed in 2013 and 2014. These areas are only described in unpublished site reports available at the Ministry of Culture in Jaén. As this dissertation is the sole context for which the information contained in these site reports is currently publicly available, a thorough account of each area is presented here, describing the salvage excavations, archaeological backdrop, necropolis organization and mortuary structures in detail for each locale.

Finally, the third section covers the caves of Marroquíes Altos, also known as Necropolis 4. While the excavations of this mortuary area have been extensively published in archaeological journals (Espantaleón Jubes 1957, 1960; Lucas de Pellicer 1968), the human remains at the site that I analyzed were all recovered during professional salvage excavations in 2001. These salvage projects were undertaken because further construction work was being conducted in the neighborhood. In contrast to Necropolis 1 and Necropolis 2, where each mortuary area was only excavated once, archaeologists have been rummaging through the environs of Marroquíes Altos for decades. Accordingly, each excavation is documented separately within this section, to clearly delineate the historical trajectory of archaeological activity in the area.

Necropolis 1

Necropolis 1 was discovered during salvage excavations prior to the urbanization of the SUNP-1[19] sector of Jaén. Necropolis 1 is an area of Chalcolithic funerary activity, with evidence of later Bronze Age reuse of funerary structures as areas of occupation. This mortuary area was discovered near the confluence of two streets, Paseo de la Estación (henceforth referred to as *Calle A*) and Calle Esteban Ramírez Martín (henceforth referred to as *Calle 1*), that were excavated during the urbanization project. This area is solely documented in the gray literature (Serrano Peña et al. 2000).

Salvage Excavations

Salvage excavations began in July 1998 and concluded in December 1999. Two different areas of this section of the Boulevard neighborhood were excavated in advance of urban construction: *Distribuidor Sur* and *Calle A*. *Distribuidor Sur* runs east-west in an curve that follows the route of the old railway line, connecting the neighborhood of the Boulevard to that of Avenida de Madrid. The contemporary road is called Calle Federico Mayor Zaragoza. This road provides a useful point of reference when conceptualizing the prehistoric organization of the site, because its curve essentially traces the path of the fourth ditch. *Calle A* runs in a roughly north-south direction, perpendicular to the Distribuidor Sur, in the area where Paseo de España runs today.

In 1998, the project began with a series of test pits to delineate the stratigraphy of the area, followed by the removal of vegetation cover along the length of *Calle A*. *Distribuidor Sur* contained barely 30 cm of organic cover before the appearance of bedrock and the archaeological levels. Methodologically, the project combined

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[19] SUNP stands for "S*uelo Urbanizable No Programado 1,*" meaning developable land without a set or fixed final function. This designation is determined by the General Urban Development Plan (*Plan General de Ordenanción Urbanística*) of the City of Jaén, a body that directs urban development (Narciso Zafra de la Torree, personal communication).

stratigraphic documentation with the complete excavation of all phases and time periods observed. Once a given phase was documented, excavators proceeded to remove any structural elements that might impede the documentation of earlier phases.

Archaeological Backdrop

Distribuidor Sur: Portions of this area were excavated in 1997, revealing a section of the fourth ditch as well as a number of Chalcolithic structures. Therefore, it is unsurprising that the 1998-99 excavations also revealed sections of the fourth ditch and a few Copper Age features, as well as medieval structures. The scarcity of Late Prehistoric materials is likely related to the soil composition in this area, which is characterized by sharp edges of fractured marl that would have made the land undesirable for the construction of prehistoric residences. The two structures that were discovered, Structure[20] 1 and Structure 2, are heavily eroded and contain Chalcolithic materials that preserve barely 30 cm of their original height. Structure 1 represents the base of a hut 3 m in diameter and 0.5 m in depth, containing 8 well-defined inhumations, and some dispersed bones that likely indicate another burial that had been moved from its original position. These burials were non-overlapping, distributed along the perimeter of the structure and aligned with its walls (similar to Structure 27).

One of the most interesting results of the *Distribuidor Sur* excavations is the discovery of this isolated tomb, which demonstrates that Chalcolithic structures were found outside of the fourth ditch, in this case less than 5 m from the funerary complex of *Calle A* (Necropolis 2). This area also preserved evidence of a medieval water canal, relative dated through the presence of medieval vessels, such as jars with red decoration, *ollas trípodes,* and *discos de horno*.

Calle A: As with much of the rest of the site of Marroquíes Bajos, the area at the confluence of *Calle A* and *Calle 1* was multicomponent, containing both Islamic period burials and Late Prehistoric tombs. Here, archaeological investigations covered a surface area of 120 m^2. These excavations revealed a series of medieval burials to the south of

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[20] In this dissertation, "structure" is used in place of the Spanish term "*complejo estructural*," or "structural complex."

the zone, and a group of seven large underground Copper Age mortuary structures to the north. Smaller Copper Age structures were scattered throughout the area, including two domestic structures (Structure 11 and 21), which were relatively empty. Due to their superposition above the level of the funerary structures, these appear to have been constructed at a later date than the necropolises, possibly during the Late Chalcolithic or Bronze Age component of the area. Given the scarcity of the material culture available in their fill, even a relative date cannot be ascertained for these features.

The Necropolis

The bulk of the Chalcolithic necropolis is located in the *Calle A* section of the 1998-1999 excavations (Figure 4.1). It contained two types of mortuary features that are distinguished by their size, formal characteristics, and internal organization[21]:

<u>Type 1 (Structure 13, 14, 25, 26, 27 and 52 of *Calle A*)</u>

These large underground structures were dug into the marl. They have base diam of 6 m and depths that oscillate between 1.5-2 m, with limited variability in size. All have a vault, though the upper portions of the structures were broken off before the salvage excavations. Their dearth of archaeological fill is what led to their rapid collapse, and their destruction was hastened by recent agricultural work conducted with heavy machinery. The surfaces of the structure walls were smooth, occasionally showing horizontally drilled holes for posts, and their floors were smooth and well cared for, without any type of preparation or elaboration of the floors above the level of bedrock.

All of these structures are found clustered in a limited area of *Calle A*, arranged in a roughly circular arrangement around Structure 22 (Figure 4.1). No similar structures were found in either *Distribuidor Sur* or *Calle 1*. During the Chalcolithic, these structures do not show any human activity apart from the funerary rituals. After these features were constructed and emptied of sediment, multiple individuals were interred in the center of each structure (Table 4.1). Burials seem to have been one at a time next to each other, without any layering of remains on top of one another. Once the last individual was buried, the tomb was closed by covering it with a layer of clay or sterile marl, and

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[21] Serrano Peña et al. (2000) note that only Structure 27 has a distinct stratigraphy from the other structures.

successive layers of sediment were superimposed on the burials in the center of the structure. These artificial mounds have heights ranging from 30 cm (Structure 13, 52) to 60 cm (Structure 14, 22). Once the tumulus had been created, the tomb was closed and abandoned until the later re-use of the area.

Figure 4.1 Organization of Necropolis 1, showing re-use of features during Phase 1b (Early Bronze Age)

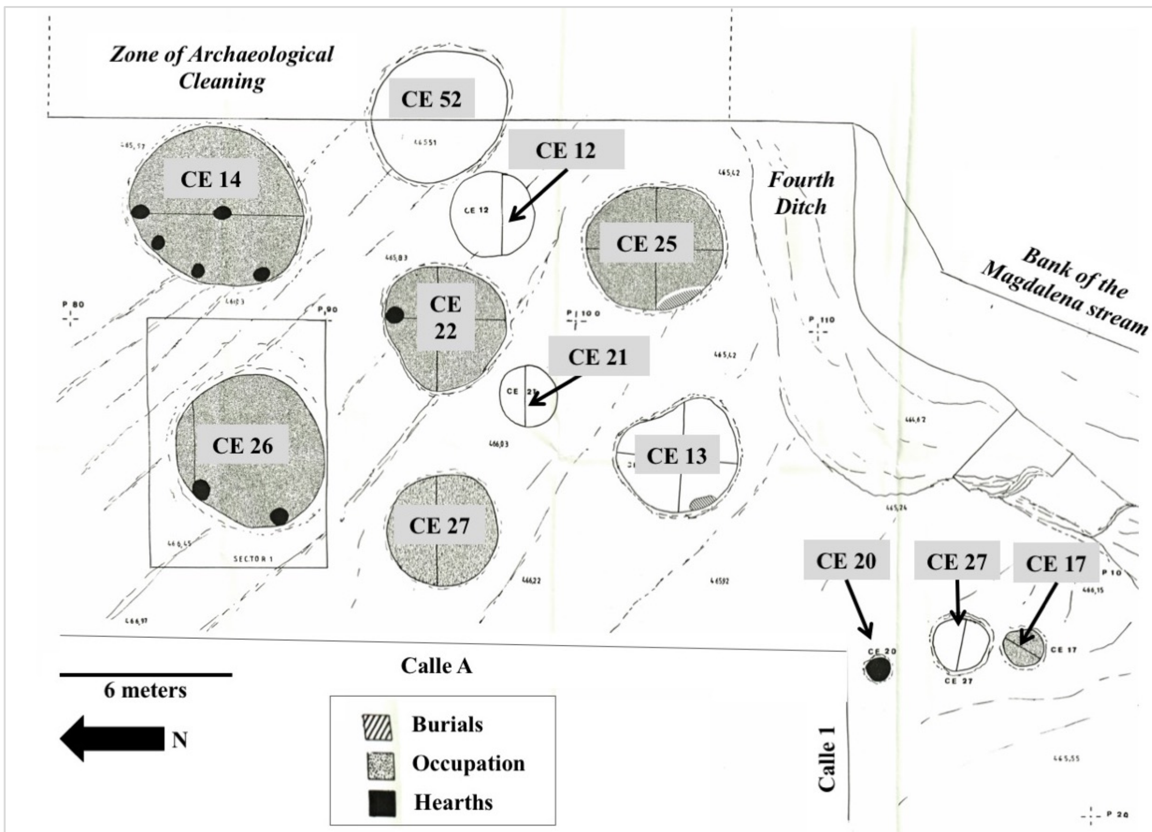

Table 4.1 Number of individuals documented by the site report for each structure

Complejo Estructural	Number of Individuals
13	3-4
14	12
25	1
26	0
27	0
52	1
Total	18-19

Type 2 (Structure 1 of *Distribudor Sur*, Structure 27 of *Calle 1*)

These small underground structures were dug into bedrock, with diam ranging from 2 m (Structure 27 of *Calle 1*) to 3 m (Structure 1 of *Distribuidor Sur*). They demonstrate a consistent depth of 0.5 m from the structure edge to its base. In contrast to Type 1 structures, the walls of Type 2 structures are not vaulted, and show a relatively straight profile, though their profiles are irregular and poorly maintained. The floors are also irregular and poorly maintained, and in both cases a pavement built upon stones and fragments of marl is found above the bedrock. These smaller funerary structures were located in the surroundings of the Type 1 cluster, but never inter-mixed with them. For example, Structure 27 of *Calle 1* is located 20 m north of the closest structure in the Type 1 circle, while Structure 1 of *Distribuidor Sur* is located 80 m south.

Type 2 tombs are simpler than those of Type 1. Burial placement was constrained by the small sizes of these tombs, so some individuals appear to have been positioned against the walls of the structures. Once the interior space was filled, later burials were layered on top of earlier ones. These tombs do not appear to have been sealed.

The site report indicates that despite the formal, spatial, and organizational differences between the two types of tombs, their ritual characteristics – including the position of burials, the demographic composition of interred individuals, and the grave goods included with the burials – are similar. Both types of tombs evince individuals in either a fetal or flexed burial position (though the deliberately arranged position of some individuals could indicate an erect or seated position at the time of burial). Initial field observations for both types of tombs led the archaeologists to believe that “men, women, and children were buried indiscriminately, without placing any in an apparently secondary position due to their age or condition” (Serrano Peña et al. 2000:19, translation mine). Finally, both types of tombs have few or no grave goods. Large ceramic sherds were found in both Type 1 (Structure 27 of *Calle 1*, Structure 1 of *Distribuidor Sur*) and Type 2 tombs (Structure 13, 14 and 22 of *Calle A*). These fragmentary vessels may have been related to libations or to some kind of burning[22]. The most frequent grave goods, however, are the faunal remains dispersed throughout almost all of the tombs. Burials of

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[22] Individual N˚1 of Structure 22 was found with ash deposits in his immediate surroundings.

whole animals appear to have been used to seal and end particular burial episodes, as between the first and second round of inhumations in Structure 14, and between the second and fourth round of inhumations in Structure 13.

Intriguingly, the Type 1 tombs witnessed a period of significant re-use during the Late Chalcolithic or Early Bronze Age. All of the large Type 1 funerary structures witnessed some type of re-use and human activity during this later period. The archaeological materials reveal evidence of both domestic and utilitarian activities. Hearths excavated in the funerary tumuli of Structure 14, 22, and 26 are associated with abundant ceramic cooking vessels, with "S" profiles, everted rims (*bordes exvasados*) and mid/low-carinated vessels (*carenas medias-bajas*). Structure 27 also shows a continuous occupation in this period, with the superposition of hearths and floors. Other structures appear to show deliberate leveling to create habitable surfaces on top of the funerary spaces. The strata above the Structure 25 tumulus, for example, contain many fragments of flint flakes and cores, and abundant ground stone *(piedra pulida)* that indicate an intensive flint-working activity area. The strata above the Structure 22 tumulus contain worked bone tools, cut faunal remains, and bone splinters that attest to an activity area focused on the production of bone tools. Finally, some inhumations also appear to stem from this period of re-use – the individual inhumations appearing in the highest levels of the Structure13 stratigraphy (located in the corners of the structure, with individuals in the fetal position) appear to date to this later time. Structure 25 may also show a later mortuary reuse, as some remains appear underneath a fill of rocks against a structure wall, and show taphonomic damage from roots. However, the site report emphasizes that these burials only occur occasionally.

One of the reasons that these tombs were likely reused during the Bronze Age is that they were still visible on the landscape. Even after the necropolis was abandoned, there is no evidence of vault detachments or erosive fill in their interiors that would suggest their destruction and collapse. Instead, it seems likely that they were maintained intact over the course of the Bronze Age. Even during the first millennium B.C. and first millennium A.D., some of the structures were still likely visible as huge hollows. During this period, Iberian ceramics are found in the interior fill of structures. Finally, during the Islamic period, the Emiral necropolis (8^{th}- 9^{th} centuries A.D.) overlapped some of the

Chalcolithic structures, with some later graves dug into the layers above the Copper Age burials. Site maps document one Islamic grave superimposed over the northeastern edge of Structure 13, four surrounding Structure 22, and two along the northeastern and northwestern edge of Structure 26.

The Mortuary Structures

Brief structure descriptions are provided in the Necropolis 1 site report. These list initial observations concerning the dimensions and contents of the individual mortuary structures. Detailed maps of the majority of these structures can be found in Appendix A. Translations of their descriptions are compiled below.

- **Structure 13:** A structure 6 m in diameter at base with a bell-shaped section. *Beneath the tumulus:* 3 disturbed individuals plus two complete animal burials and fragments of fauna. *Surrounding:* 7 complete individuals plus five animals and fauna. *Dispersed:* 5 complete animals plus fragments of fauna.
- **Structure 14:** A structure 6 m in diameter at base with a bell-shaped section. *Beneath the tumulus:* 13 individuals, though some are disturbed. Dispersed faunal fragments appear on this level. *Inside:* 3 complete animal burials, and above this entire complex there are 3 complete individuals, that served to seal the tomb after its final use.
- **Structure 22:** Structure with a bell-shaped section, 6 m in diameter at base; There is one individual beneath the tumulus, plus bone fragments of animals.
- **Structure 25:** Structure with a bell-shaped section, 6 m in diameter at its base. No individuals were found individuals below the tumulus.
- **Structure 26:** Structure with a bell-shaped section, 6 m in diameter at its base. There are four individuals beneath the tumulus.
- **Structure 27:** A structure 5 m in diameter at its base with a bell-shaped section. No tumulus or burials are present. Two floors with abundant broken vessels may indicate that this was a place of domestic or ritual activity.
- **Structure 52:** A structure 6 m in diameter at base with a bell-shaped section. Underneath the tumulus there is a fragment of a human fibula and fauna.
- **Structure 27 of *Calle 1*:** This structure is a hut base 2 m in diameter, with 14 individuals.
- **Structure1 of *Distribuidor Sur*:** This structure is a hut base, 3 m in diameter containing 8 individuals plus fauna.

Summary of Necropolis 1

Necropolis 1 contains nine mortuary structures – seven in a concentrated cluster in *Calle A*, one in *Distribuidor Sur*, and one in *Calle 1*. Two of the mortuary structures in the *Calle A* zone (Structure 25 and Structure 27) did not contain human remains. The necropolis has been relative-dated to the Copper Age based on tomb form, though the area also appears to have been reused at a later point in time (either during Late Copper Age or Bronze Age) as a site of bone and stone tool production, domestic activities like cooking, and a limited number of further funerary rituals.

Necropolis 2

Salvage Excavations

Necropolis 2 was discovered during excavations in the Bulevar 2ª Fase, SUNP-1 sector of the site, a zone that roughly corresponds to the area between Calle Federico Mayor Zaragosa to the south and the intersection of Ronda de los Marroquíes and Ronda de los Olivares to the north (Figure 4.2) (as detailed in the site report by Pérez Martínez 2005). The Necropolis 2 area was excavated in 2006, in advance of the construction of a large public park which covers 73,953.03m^2, and extends north along the newer neighborhood of apartments that the Jiennense residents call "The Boulveard" (*El Bulevar*). *Parque Andres del Valdivira* can be divided into three sections.

The Northern Zone is bounded by cypress hedges and criss-crossed by a network of paths, fountains and pergolas, with beds of plants and trees in its interior. It is separated from the intermediate and southern zones by Calle Catalina Mir.

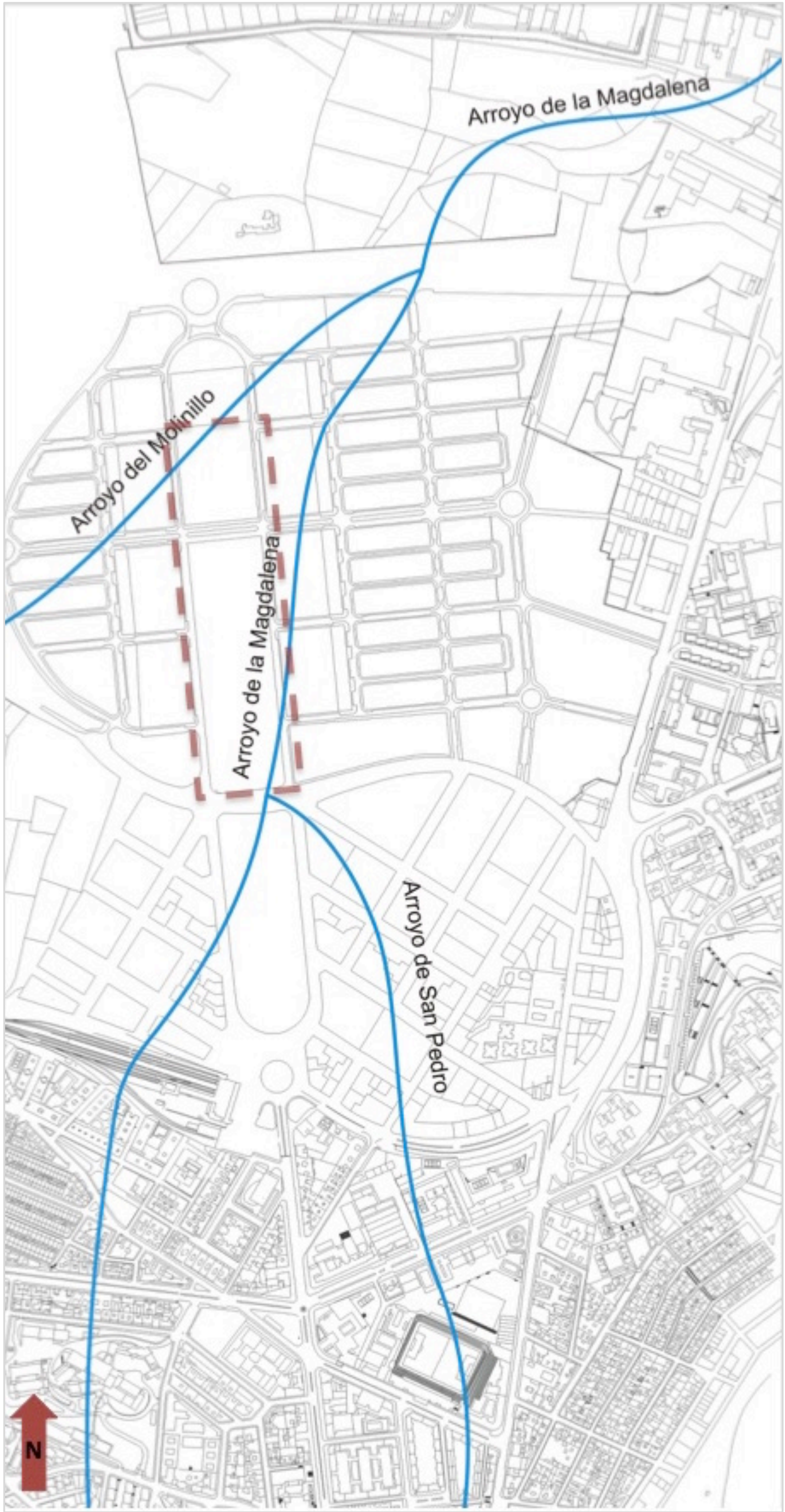
The Middle Zone is the largest and most popular section of the park today, including two large central fountains, geometric central hedges to the south, a peripheral running track, internal roads, and a sporting area with skateboard ramps to the north.

The Southern Zone comprises a grassy meadow, south of the fountains and jogging path that circles the periphery of the park. This area was not altered by park construction, with the sole exception of the planting of the lawn.

The archaeologists who excavated N2 maintained this general division into three zones, so in their reports they refer to a "Northern Zone" (*Zona norte*), "Middle Zone" (*Zona intermedia*) and "Southern Zone" (*Zona sur*). Importantly, this area of Marroquíes Bajos is located between two ancient water courses, the Magdalena arroyo and the Molinillo arroyo (Figure 4.3), making it an attractive location for prehistoric occupation.

Figure 4.2 Zones of Parque Andrés de Valdevira

Figure 4.3 Prehistoric streams of Jaén (map courtesy of Narciso Zafra de la Torre)



The approximate perimeter of the SUNP-1 Bulevar 2a excavations is bounded by a dashed red line.

Pérez Martínez notes that this sector of Jaén witnessed four episodes of archaeological activity between 1994 and 2003 (Table 4.2).

Table 4.2 Archaeological activity in the SUNP-1 sector of Marroquíes Bajos

Year	Archaeological Activity
1994	A preliminary survey for archaeological material was first conducted, categorizing the area as an "urbanizable zone."
1997	The company GEPARQ. S.C. conducted both survey and excavation to define the precise extent of the archaeological remains and assess their state of preservation. Investigations revealed a portion of the fifth ditch of Marroquíes Bajos, as well as Iberian-Roman and medieval Christian deposits.
1999	Excavations were conducted during the *Galería visitable* project (during which a large sewer was installed on the western side of Parque Juan Pablo II. However, these only revealed fill from contemporary dumping, and some underlying geomorphological landscape features.
2002-3	Salvage excavations in advance of sewer installments revealed both Roman and Arab materials, as well as further traces of the fifth ditch (with associated bastions and silos).
2005	Salvage excavations were conducted along the course of Calle Catalina Mira Real in 2005 (Pérez Martínez 2005).

Though the excavation history of this area of Marroquíes Bajos is complex, previous work provided excavators with an initial sense of where archaeological remains would most likely be discovered: first, in the environs of Cortijo Los Robles**,** just northeast of the Northern Zone of the Park (López Marcos and Buzón Alcarón 2013-14), where Roman and medieval structures had previously been detected, and second in the large area that stretched up to and encompassed the fifth ditch. Secondary deposits of ceramics had previously been detected in this area, and given the earlier excavations that demarcated portions of the layout of the fifth ditch, the presence of the ditch itself, along with its associated defensive structures "was inevitable" in this area of the site (Pérez Martínez 2005).

A total area of 10541.42 m^2 was excavated, with test pits and trenches used to determine stratigraphic sequences and assess the preservation of archaeological remains. The results of these initial investigations were used to decide whether excavation proceeded as (i) controlled, accelerated, and mechanical removal of natural sedimentary deposits using picks and adzes, or (ii) more gradual manual excavation of detected structures, levels of occupation, activity areas, *in situ* material, and burials. The salvage excavations conducted in and around Necropolis 2 are only referenced in the gray literature (Pérez Martínez 2005).

Archaeological Backdrop

The two prehistoric water courses of the Magdalena and Molinillo streams acted as magnets for prehistoric activity. They were key features of the Chalcolithic landscape and affected the location of architectural features (Figure 4.3). The Molinillo stream traversed the northern zone of the Boulevard, producing a lacustrine zone that has been stratigraphically documented in a suite of excavations in the Boulevard zone. The Magdalena stream is located to the southeast, and its path generated a significant depression in the ground surface that would have led to an accumulation of standing water in this area during prehistory. This course of this stream has also been repeatedly documented during salvage excavations in the Boulevard zone, which show evidence of a huge ravine 50 m wide and 5-6 m deep, that expands to some 80 to 90 m in width at the mouth of the waterway.

The trajectories of these two streams carved the prehistoric topography of this zone into a vast natural recess, its surface marked by natural waterways and depressions. However, this landscape was also punctuated by promontories of higher elevation, specifically a series of small, plateaus or knolls. Early human groups were quick to use the local topography to their own advantage. The path of the fifth ditch was laid out along one of the elevations, while Necropolis 2 was constructed along its edges. The waterways themselves were also exploited, as there is evidence that the construction of the enclosure ditches was modified in order to articulate with the streams.

The Fifth Ditch

The most significant deposits of Copper Age date, namely the traces of the fifth ditch and wall complex, as well as Necropolis 2, were found in Sector 2 of the Middle Zone of the excavations, in the area of the park now home to a large rectangular fountain (Figure 4.2).

The fifth ditch is documented in six of the excavation units[23] (C/42, C43, C/39, C/40, C/41 and C/47). Archaeological investigations of this ditch revealed two significant discoveries that illuminated aspects of the internal organization of Marroquíes Bajos. First, archaeologists found evidence of a "door or gate" in Unit C/42, close to the bastion documented in the salvage excavations of the sewers. Second, in Unit C/40, the ditch deviates from its curving path to connect with the Magdalena stream. These two discoveries highlight what Pérez Martínez argues to be the two primary functions of the ditch system - first, as an irrigation canal, and second, as a defensive structure.

Pérez Martínez interprets the "100˚ swerve" in the ditch trajectory in unit C/40 as evidence of a larger articulated system of water capture and regulation. This deviation would have allowed water to be conducted into the ditches to circulate along the base of the trenches. Additionally, the structure of the ditch in this area:

> "demonstrates a profound knowledge of the topography and behavior of both surface and subterranean water courses. Although the basic cross-section is "U" shaped, both its form and depth are variable and are a function of following a hydrodynamic gradient that allows for the circulation of water through the canal, as well as taking in water from the level of the water table" (Pérez Martínez 2005:53, translation mine).

The offshoot towards the Magdalena stream is deliberately narrowed, which may have allowed the regulation of the volume of water admitted to the trench to be controlled via a wooden or stone sluice. This structure would also have allowed for the diversion of any cascades of water that might harm the ditch structure, such as during the periods of torrential rains which occur in Jaén to this day, particularly during the autumn months. There is also stratigraphic evidence for the circulation of water through the enclosure system, as layers of silt up to two m in thickness have been documented at the base of the ditches. These layers document the likely abandonment of the hydrological system, which took place quite rapidly judging by the levels of clay that filled in the structure. There are thick alluvial deposits dated to around 2100 BC, meaning that the abandonment must have occurred before this time (Pérez Martínez 2005:55). Pérez Martínez highlights that "[t]he maintenance of a system of this magnitude and character must have been very

[23] "C/" is an abbreviation of *corte*, or "cut," the Spanish term for excavation unit.

complicated, [requiring] an investment of time and effort that could only have been undertaken by community labor" (2005:53, translation mine). Accordingly, any change in social organization would have made it extremely difficult to manage the system, so such shifts in social structure may have been what led to the ditches' eventual collapse.

The purported defensive function of the ditch in this zone is largely based on the two segments of "wall line" (*linea de muralla*) built at various points along the length of the inner side of the ditch. The absence of the wall line from other sections of the ditch is probably related to the local topography – either the wall was *never* constructed at these points, because prehistoric flooding would have already made the area difficult to access, or the wall *was* constructed during prehistory, but the continuous flooding led to its disappearance from the archaeological record. However, given that no wall debris was documented in any of these sections, the former scenario seems more likely.

In addition to the segments of wall line, other elements of reinforcement and control such as bastions and gates were recovered in both the 2005 excavations and the excavations in advance of the sewer installation. Intriguingly, some of these defensive structures appear to have been used after the irrigation function of the ditch was abandoned – Pérez Martínez describes evidence for wall repair and access points built *on top* of the level of ditch collapse, meaning that the system of defense and control was maintained even after the trenches themselves were abandoned. While the scarcity of ceramics and the characteristics of the stratigraphy did not allow for absolute dating, the archaeologists who excavated the site argue that "the dynamic in this section of the ditch is similar to the chronologies hypothesized for other areas," placing it during ZAMB 3 (2450-2125 BC). Importantly, the period of agricultural intensification posited for this time would provide an explanation for the initiation of a system of canalization and defense (Pérez Martínez 2005:55).

The Habitation Area

Evidence from the Boulevard excavations supports previous hypotheses (Zafra de la Torre et al. 1999) that divide the settlement into a central habitation area and a wider expanse of outlying storage and fields (see Díaz-de-Río 2004, Figure 6). However, within the Boulevard, the area immediately inside of the fifth ditch likely would not have been inhabited due to the zone of more or less perpetual standing water that pooled in the large landscape depression. The scarcity of artifacts in the ditch fill, the concentration of soluble and insoluble salts on the ceramics from Necropolis 2, and the results of nearby excavations support the hypothesis that the northernmost sector of the site, inside of the fifth ring of the enclosure system, was not occupied during the Copper Age. However, there were more elevated areas in the southwest of this sector (UE6 of C/34, UE5 of C/38) that may have been used as cultivated fields in prehistory.

The Necropolis

Like the traces of the fifth ditch, all of the mortuary structures were located in Sector 2 of the Middle Zone, in the area between the edge of the fifth ditch and Unit C/37, where archaeologists cleaned a very wide area (4441.28 m^2) of fill. They documented seven[24] mortuary structures containing human remains, distributed in a line along the external edge of the ditch. The presence of gender-specific grave goods, particularly the sword blade ("*hoja de una espada con remaches*") and possible bone hairpin from Structure 44) led to their initial proposal of an Early Bronze Age date for these structures, though the ceramic offerings "show traces of continuity with earlier periods" (Pérez Martínez 2005:57). Because contemporary fill covered and, in some cases, affected these structures, the stratigraphic relationship between structures was not preserved, so they were excavated individually. The archaeologists documented three types of burials:

- Burials in shallow graves (30-40 cm) of variable size (Structure 40, 43, 44, and 45);
- Burials interred directly on the clay (*greda*) without graves excavated (Structure 41-42);
- Burial interred directly on the clay with stone covers (Structure 39);

Despite these formal differences, Pérez Martínez describes all interments as sharing certain characteristics. All bones were found disarticulated, making determination of MNI and the positioning of the bodies difficult. The bones of the pelvis, and smaller bones like ribs, phalanges, vertebrae and clavicles, were also absent. No faunal grave

[24] The site report initially notes that there are eight mortuary structures, but then only proceeds to describe seven (CE 39, 40, 41, 42, 43, 44, 45), which is the number used in this chapter.

goods were found among the grave goods (with the exception of a bovid long bone in Structure 43), but large-scale and often well-preserved ceramic offerings were found in each structure (with the exception of Structure 39). Additionally, each deposition seemed to occur at a single moment in time – there is no evidence that the graves were re-used. Evidence supporting a single mortuary use of the structures is found in the excellent preservation of their ceramics as episodes of reburial would have led to breakage and deterioration of the vessels. Finally, some of the collective burials, particularly that of an infant burial in a ceramic receptacle in Structure 44, may have been family groups.

These traits led the archaeologists to argue that this necropolis represented either a secondary or selective deposition of large bones, or a primary deposition made by some unknown form of ritual likely involving burning (due to the recovery of some remains with traces of burning and carbonization of the interior of one of the small ceramic vessels (*ollitas*).

The Mortuary Structures

Archaeologists excavated three subterranean structures of unknown function (Structure 41, 42 and 47), and seven structures with clear mortuary functions within the area along the edge of the fifth ditch. A single cranium was also recovered from an excavation unit that transected the fifth ditch (C/47). The structures are referred to as "Structure" in text, and the excavation unit is referred to as Unit 47. All mortuary structures are described in detail below:

Structure 39: This circular structure had an approximate diameter of 1.7 m, was excavated into bedrock, and appeared to be covered with a rock tomb. A burial level, with the remains of an incomplete and poorly positioned individual (missing vertebrae, ribs, hand and feet, according to the site report) was uncovered in the shallow fill of the structure. This was the only burial for which the archaeologists report an absence of grave goods.

1. *Stratigraphic Unit 1 (UE1):* In the burial level the remains were covered with a layer of clay-like and compact sediment that was grayish white in color.
2. *Stratigraphic Unit 2 (UE2):* Stone cover.

Structure 40: This was a roughly circular structure with many irregularities in shape, excavated into the bedrock. It was approximately 1 meter in diameter and its fill was shallow. One inhumation level was documented, similar in characteristics to Structure 39, containing three crania, two of which were quite small. This led excavators to believe that it contained the burial of an adult and two children, though Pérez Martínez highlights that the number of remains recovered was not sufficient to represent three complete burials. Grave goods were represented by ceramic sherds. Remains from this structure could not be located at the Museum of Jaén during the 2013 - 2014 bioarchaeological analyses.

a) *Stratigraphic Unit 1 (UE 1):* In this inhumation level, the remains were dumped on a very clayey and compact inhumation level of a white-gray hue, which was essentially similar to the bedrock in which the grave was dug.

Structure 41: This interment was uncovered while archaeologists were cleaning a section of the ditch. During the process they observed an accumulation of ceramics and some bone, and so designated it a *Complejo Estructural*; however, further excavation revealed that the remains were not actually in their own discrete structure, but instead were intentionally deposited in the external edge of the ditch. The stratigraphic relation between the features is not reported, so it is not possible to determine whether the bones were deposited before of after the ditch was filled in. Despite the difference in depositional context, the excavators maintained the Structure descriptor. The dimensions of the structure measured 3 x 3 m, and its average depth was 10 cm. The excavation documented two strata: a white-gray, compact and clay-like stratum containing nodules of bedrock (which matched other documented levels above the bedrock that had not been altered by contemporary fill), and a thin stratum above it, in which disarticulated long bone fragments were observed. Based on the disarticulation of the remains, this area was characterized this as a secondary funerary deposition. The observed grave goods comprised large ceramic sherds.

Structure 42: This structure had similar characteristics to Structure 41, which is why a unit was excavated to document it. Its preserved dimensions measured 5 x 2 m, with an average depth of 10 cm. The site report notes that this was likely a secondary deposition of remains and large, disarticulated bone fragments (extremities) were observed, but no crania were found. Grave goods comprised large well-preserved ceramic sherds. Archaeologists highlighted the contrast between the good preservation of the ceramics and the poor preservation of the human remains. Remains from this structure could not be located at the Museum of Jaén during the 2013 - 2014 bioarchaeological analyses.

b) *Stratigraphic Unit 1 (UE 1):* Stratum of compact whitish-grey clay with nodules of bedrock; this is the same level that was located above the bedrock at certain points in the site that had not been altered by contemporary fill. Its fill was shallow and above this layer a layer of inhumations was deposited.

Structure 43: Half of this structure was missing; the complex was cut in half by a modern ditch. Structure 43 consisted of an oval structure dug into the bedrock (space B); its northern end opened into a small, shallow semicircular structure (space A). The burial level was concentrated in space B, although a single cranium was found in space A. In the site report this inhumation was identified as an "individual burial," though it notes that the possible existence of another individual cannot be dismissed because the middle of the structure has disappeared. Stratum UE1 contained a level of human remains that were disarticulated and could not be associated with individuals, accompanied by large ceramic sherds and a shell identified as a scallop. The site report identified this assemblage as a secondary funerary deposit, and noted that it is "possibly an individual inhumation." The preserved dimensions of the structure measure 2.7 x 0.9 m, and its average depth is 30 cm.

- *Stratigraphic Unit 1 (UE 1):* A gray-hued stratum that is compact, clayey and quite hardened. This was treated as the same stratum located directly above bedrock that had been found in other areas of Marroquíes Bajos.

Structure 44: This was the best-preserved funerary structure, both because of the sheer number of individuals buried within it, and the accompanying collection of complete ceramic materials deposited as grave goods. One of the most impressive artifacts recovered from N2 – a sword with rivets ("*la hoja de una espada con remaches*") – was recovered from this context. The site report dates this type of artifact to the Early Bronze

Age from its style. The preserved dimensions of the structure measure 2.2 x 1.6 m and its average depth is 30 cm.

- *Stratigraphic Unit 1 (UE 1):* This comprised a compact, clayey and very hardened stratum of a white-gray hue, associated with the level of bedrock. Three separate layers were excavated as a result of the process of removing distinct skeletal elements. Eight crania are documented, which the archaeologists could not associate with the remaining bones. Large bones, some appearing relatively articulated, also appeared, while smaller bones (phalanges, vertebrae, ribs) were relatively scarce. Grave goods included four hemispherical earthenware bowls, a small flat plate, and three large-sized platters. On one of the platters, the site report notes that "presence of human bones of very small size (children possibly 0-3 years of age at death) … [were detected] during the process of restoration" (Pérez Martínez 2005:41; translation mine). The presence of gender-specific grave goods, including the dagger blade and a bone hairpin, is also emphasized.

Structure 45: This comprises a shallow oval, irregular structure excavated into bedrock. It contained the remains of a burial including four crania and disarticulated postcranial elements that could not be associated with the crania, as well as grave goods of complete ceramics. The preserved dimensions of the structure measured 2.30 x 1.08 m, and its average depth was 30 cm.

- *Stratigraphic Unit 1 (UE 1):* This layer demonstrated the same characteristics that have been defined for all of the structures: a compact, clayey stratum of a clear gray hue, in this case so hardened that is complicated the removal of the burial, since the sediment impeded the excavation of the remains without fragmenting them.

Unit 47: This excavation unit was put into place after the removal of sediment for the rectangular fountain, to corroborate the coincidence of the fifth ditch and the Magdalena stream. The unit revealed that the ditch swerved to open towards the river, and had an east-west slope of such a gradient that it was able to channel the water with sufficient force. There was also a marked narrowing of the ditch that would allow for control of the water channel with a wooden sluice or an accumulation of stones. Additionally, the presence of a thick layer of sediment, composed of sand, gravel, and lake-bed mud found in the base of the ditch, seems to support the hypothesis of the use of these ditches for control of water circulation. Only one human skeletal element was documented in this unit, a human cranium found in stratum U.E. 3. All strata appeared on an east-west slope.

- *Stratigraphic Unit 1 (UE 1):* Stratum with a very darkened hue, clay-like and compact, that was identified as part of the lacustrine zone. The material documented in this level stems from the Iberian and Copper Age eras. Below this, bedrock is found.
- *Stratigraphic Unit 2 (UE 2):* This brown stratum contained sand and mud from the lacustrine bed, which was concentrated in the area of unit C/40, belonging to the in-filling of the ditch.
- *Stratigraphic Unit 3 (UE 3):* A greenish gray clay level of decomposing chalk.
- *Stratigraphic Unit 4 (UE 4):* A very large stratum composed of sand, gravel and mud, found in the base of the ditch.

Additionally, two empty structures (Structure 48 and 49) were discovered to the northeast of the rest. While they did not contain any cultural materials or osteological remains, their similarity to the other structural complexes led the archaeologists to posit that these may have been structures that were prepared for burial but never used.

Summary of Necropolis 2

In total, Necropolis 2 contains seven mortuary structures (Structure 39, 40, 41, 42, 43, 44 and 45), arranged in a roughly linear fashion just north of the fifth ditch of Marroquíes Bajos. One cranium was also recovered from a layer of fill within the fifth ditch itself, during the excavations of the unit Unit 47. There were an additional two empty structures documented in this area of the Boulevard (Structure 48 and 49) that did not contain any osteological or cultural material, but had such similar forms to the other mortuary structures that they were likely mortuary in nature. This necropolis was relative dated to the Early Bronze Age based on recovered grave goods (specifically the riveted bronze dagger and worked bone artifact from Structure 44).

Caves and Continuity: The Artificial Caves of Marroquíes Altos (N4)

Marroquíes Altos was discovered in late July of 1957, when workmen laboring to remove sediment from a plot of land on the northern slope of city broke through the earth to reveal a small opening into a hollow space. When this aperture was enlarged, it revealed "a vast artificial cave with a central column of surprising and rare beauty" (Espantaleón Jubes 1957:166, translation mine). The large number of human remains uncovered in the cave attracted more attention, and later that same afternoon an apprentice carver began to chip away at another wall, exposing a second cave. By the next day, members of the Institute of Jaén Studies (*Instituto de Estudios Giennenses*) were alerted to the remarkable find, and visited the site to conduct a preliminary survey of the materials. The Institute comprises one branch of the provincial governing body (*Diputación Provincial*), and is tasked with the organization, promotion, and administration of social science, humanities, and natural science research that pertains to the province of Jaén[25].

Upon arriving at the site, the visitors became aware of a third chamber, as well as another niche that had already been destroyed by the workers. The apprentice carver, who appeared to have been instructed to shepherd the institute members around the site, described the niche as containing "two skulls and numerous bones." He also showed them "a bronze dagger, a flint scraper, pieces of pottery and some bivalve mollusk shells" that were found at the foot of the niche. The visitors recovered these artifacts for the Institute's collections. These materials led them to classify the site as Eneolithic, likely temporally close to the Bronze Age. On August 1, Ricardo Espantaleón Jubes returned to the site with Mr. Unguetti, the head of the Institute's Archaeological Restoration Workshop, in order to begin to explore it more fully.

The 1957 Excavations of the Cave of the Column and the Cave of the Child

Espantaleón details his first visit to the site in his 1957 article. The burial floor was formed of a lime-rich compacted sand that became cement-like as a result of the humidity, forming a kind of "coarse" sand. The burials were oriented approximately east-

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[25] As per the Diputación de Jaén website: http://www.dipujaen.es/conoce-diputacion/areas-organismos-empresas/ieg/conoce-el-ieg/objetivos.html

west. Espantaleón noted that the caves likely formed part of a funerary complex of great importance; discussions with locals had revealed that other such caves had been encountered when building the foundation for nearby houses. Some of the described caves were purportedly larger in size, and filled with a similar profusion of human remains. During their investigations, Espantaleón and his team uncovered two caves: a circular cave which they called the Cave of the Column (*La Cueva de la Columna*), and another cave with an entrance hall that they called The Cave of the Child (*La Cueva del Niño*).

The Cave of the Column

The Cave of the Column was the area first discovered by workmen, and comprises a large standing column surrounded by a semi-circular space (Figure 4.4). Espantaleón described the inhumation as a collective burial with a "radiating" distribution, in which flexed skeletons lay with their heads pointing towards the walls (Figure 4.5). Many of the crania were found in close proximity to vessels that were possibly intentionally broken or "ritually killed." These ceramics were of the crudest form – pots and spherical bowls of the Bell Beaker (*campaniforme*) type. The crania were overlain with and crushed by stones of uniform size, but archaeologists were able to count up to eighteen individuals. However, many of the bones were so thoroughly mixed with the sand and in such disorder that their original deposition could not be determined. The initial explorers thought it likely that this chamber originally possessed an entry corridor like that found for the Cave of the Child. However, because the builders of the neighboring house had dug a pit into the chamber to facilitate leveling the house foundation, so the archaeologists were not able to verify its existence. Espantaleón notes that the cave fill was such a jumble of human bone, sediment, ceramics, flint, and large rocks, that the place appeared to have served as an ossuary for a long time. Overall, the cave was reminiscent of other artificial tombs known for Iberia.

Figure 4.4 Plan of Cave of the Column and Cave of the Child, from Espantaleón Jubes 1957

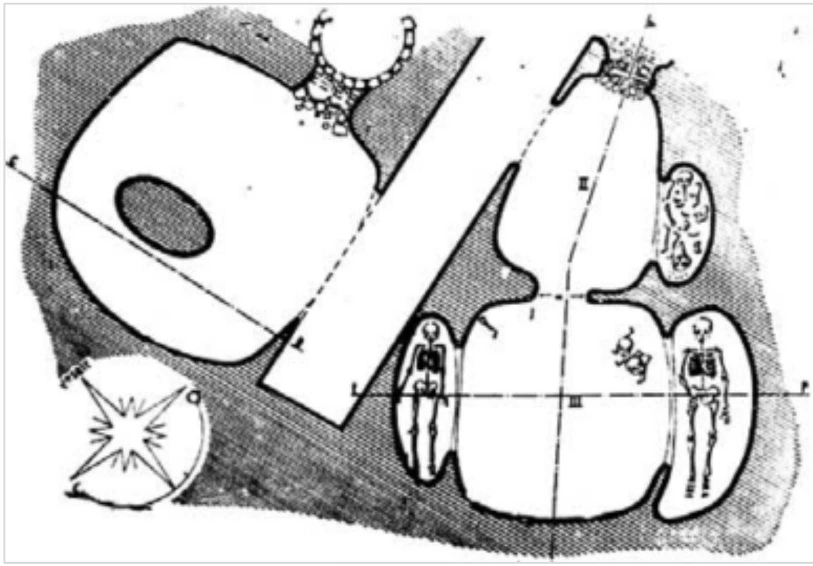
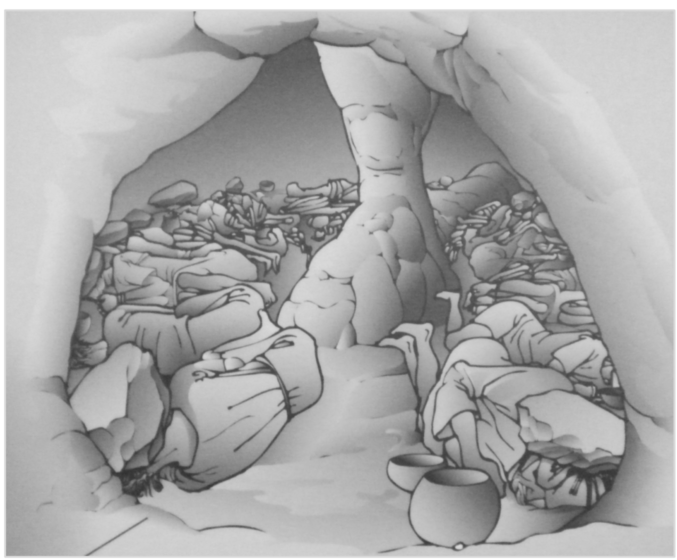


Figure 4.5 Hypothetical reconstruction of the interments from the Cave of the Column (Museum of Jaén)



<u>The Cave of the Child</u>

The design of the Cave of the Child appeared to have been formed by the deliberate joining of two chambers. The first chamber was designated an "antechamber," both because its shape was similar to that of an access corridor, and because the floor sloped downward approximately 15˚, leading down towards the door of the second chamber. The entryway to the cave was covered with two "well-crafted" slabs of stone, and a small niche measuring 1.25 m x 0.40 m was excavated into the wall; Espantaleón's initial reports describe this niche as appearing to contain the remains of two subadults. The bronze dagger and flint scraper retrieved by the apprentice carver came from the foot of this niche, and two clay pots and a flint knife were also recovered in this area. The antechamber led to a rectangular door 75 cm in width that opened into the second chamber. The second chamber gives the cave its name, for each of its sides contained a niche housing a skeleton. On the right, the niche contained an individual that Espantaleón estimated to be around seven years of age using the dentition, and on the left the skeleton of an "adult male" (for whom Espantaleón neglects to describe how age or sex were estimated). A bronze axe typologically attributable to the Early Bronze Age, and a few loose pieces of bronze, were recovered from the foot of the niche containing the adult skeleton. The two individuals in these lateral niches were the only relatively complete and well-preserved skeletons described by the initial team.

However, these interments did not represent the only human remains in the Cave of the Child. There were around 60 cm of earth in the cave above the level of the sterile soil, and some 20 cm of this fill contained human remains. Espantaleón describes a minimum of seven individuals "gathered in two groups on both sides of the door," arranged close to the five relatively well-preserved ceramic vessels. In his initial description, Espantaleón (1957) underscored the Late Prehistoric character of the assemblage for both the Cave of the Column and the Cave of the Child, noting that the Bell Beaker (*campaniforme*) ceramics and lithics appeared to date to the end of the Neolithic, while the bronze axe was so primitive in nature (with its trapezoidal shape and flange (*con reborde*), that it was unlikely to be Bronze Age, rather than Copper Age, in origin.

The 1959 Excavations (Cave III)

In December 1959, two years after Espantaleón's preliminary explorations of the cave, some troubling news reached D. Ramon Espantaleón Molina[26] of the Provincial Delegation of Archaeological Excavation (Espantaleón Jubes 1960). He heard of further construction activity just 20 m down the road from the Caves of the Child and of the Column, at N˚ 9 Cristo Rey Street. When he contacted D. Tomás Fernández Amela, the owner of the lot, Amela informed him that the workmen had been removing human remains and sherds of Neolithic, Roman, and Islamic period ceramics from the construction area "daily." In this particular plot of land, the monitoring work of the Institute had lost out to the economic interests of the contractors, for by the 17th of December, when Espantaleón Molina was first informed of the construction activity, the leveling of the area was almost complete.

The original clearance cut revealed an artificial cave comparable to the other two; it had been transversally sectioned in such a way that only a quarter of it was preserved intact. The vertical cut revealed a number of different stratigraphic layers: first, at the top, a 70 cm layer of modern fill that graded into a mixture of ploughed earth containing inlaid sigilatta and glazed Islamic ceramics, then a typically Roman layer, 9 cm in height and 7.30 m in length, filled with rounded pebbles agglomerated with lime mortar and crushed brick. This was followed by a base layer of compact, sandy soil. Fifteen centimeters below this base layer, the roof of the artificial cave appeared, the cave was completely filled with black earth mixed with human bones and ceramics (see Espantaleón Jubes 1960, Figure 2, for a photograph of this stratigraphy).

The portion of the cave left intact by the contractors measured 1.05 m in height, 2.00 m in diameter, and 0.60 m in depth. The remnants of a niche, excavated flush with the soil, were located along its right wall. The missing portion of the cave likely contained a corridor or entry passage; excavators were able to estimate the length of this architectural feature with reference to a test unit (*testigo*) from a portion that was left in the chamber in order to measure the amount of earth that had been removed. The workers indicated that this area had been totally sunken, and a great number of human bones and

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[26] Who is, it should be emphasized, a distinct individual from Ricardo Espantaleón Jubes.

ceramics were discovered along the length of this corridor. Based on these dimensions, the team was able to estimate the original dimensions of the cave as having a diameter of 2 m, a height of 1.05 – 1.30 m. The corridor would likely have measured 3.5 m in length, 1.05 m in height and 0.8 m in width. The cave was filled with a 70 cm layer of fill that contained intermixed human remains, ceramics, and sediment.

The team began their excavations by carefully removing all the remaining fill, and screening all of the sediment that was extracted from the cave. The arrangement of the burials was difficult to define because the remains appeared "totally disarticulated." However, Espantaleón describes a certain order to the deposition of the remains, so that each ceramic bowl was associated with a skull and surrounded by the "most characteristic bones of the skeleton," the whole assemblage crushed by one or more rocks, just like the arrangement described for the Cave of the Column.

Espantaleón notes that previous research on Late Prehistoric mortuary caves indicated that they usually appear in groupings of between four and six tombs. Here, Marroquíes Altos is distinct even within Iberia. Including the caves that were destroyed during the construction of the neighborhood church, the work on houses N˚5 and N˚7 on Cristo Rey street, another cave that was filled with concrete in a nearby lot, and still other caves with known locations that were not explored due to lack of funding, there are at least nine caves that make up this funerary complex. As Espantaleón himself noted, the expansive complex "in truth deserves more attention than has been devoted to it" (1960:40, translation mine).

In regard to the material culture from Cave III, the metals were analyzed by German archaeologists, who found that the copper comprised a 3.3 level of arsenic and just under 0.01 of tin (and Espantaleón notes that this composition indicates that the metal is thus not authentic bronze or native copper). The flat and trapezoidal shape of the axes suggests that these interments belong to a later phase, a temporal identification corroborated by the lack of arrowheads and low numbers of flint blades recovered. However, the presence of green bead necklaces ("*cuentas de collar trabajadas en pasta vitrea verde*") and other Bronze Age II artifacts seem to situate the cave within the height of the period, as does the discovery of a magnificent knife with rivets (see Espantaleón 1960: Figure 8).

The 1964 Excavations (Cave IV)

The discovery of a fourth artificial cave followed the same pattern as the previous three caves. Five years after the discovery of Cave III, on March 30, 1964, a contractor notified Ramon Espantaleón Molina that more archaeological material had been discovered during the course of further neighborhood construction work. Espantaleón Molina, who must have been suffering from terrible déjà vu at this point, contacted the Director General of Fine Arts in the hopes of continuing the excavation work initiated by Ricardo Espantaleón Jubes. A number of prominent individuals conducted a preliminary site visit on April 11, 1964, including the Director General of Fine Arts and the Inspector General of Excavations. Other visitors included Francisco J. Presedo Velo, the technical secretary of the General Inspector of Excavations, who directed the first day's work; María Rosario Lucas de Viñas, who was in charge of the excavation in the following days (aided by Rafael del Nido Gutiérrez, a member of the Archaeological Seminar of the Institute of Jiennense Studies) and Vicente Viñas Torner, who produced the planimetry of the cave, as well as the photographs and drawings of the material. Descriptions of the excavations at Cave IV are documented in Lucas de Pellicer (1968).

Cave IV was located to the northeast of the earlier discoveries, about 25 m away from Cave III, though the exact spatial relationship between the two areas was impossible to determine as Cave III was buried during the construction of house N°9 on Cristo Rey street. The discovery of Cave IV increased the total number of documented caves for the Marroquíes Altos necropolis to ten.

As with the other caves, the completely subterranean roof of Cave IV lay about 15cm below the natural surface of the hill, and its prehistoric construction had been facilitated by the lower resistance of the sandstone that lay beneath the rocky surface of the hill. When the excavators arrived on scene, they found that the shaft (*pozo*) was nearly totally destroyed, and the rectangular vestibule had already begun to disappear. The cave was oriented along a north-south access, with the entrance to the cave opening towards the north. No trace of a closing stone was found near the cave entrance, but the vestibule (Figure 4.6) contained ridges carved at right angles into its jambs and lintel, into which the closing slab would likely have slotted.

The chamber walls and floor preserved traces of a coat of red ochre, and the floor was broken in the center, consisting of a sinking trench that reached 30 cm in depth as it grew close to the entrance. The fill had already been extracted from this trench by the time the excavators arrived. Similarly, the floor of the corridor or entry passage appeared to have been cleaned. As one progressed from the entry passage to the burial chamber, the corridor reached a maximum depth of 70 cm below the original level (Table 4.3). To the right, the team found a niche with an ellipsoidal floor that opened towards the west, while to the left, the eastern wall of the chamber was partially broken as the result of the construction work (Figure 4.6). The original floor of the chamber and niche appeared to have been broken and destroyed, though the records are unclear as to whether this destruction occurred in antiquity or as a result of the construction efforts. The roof of the chamber was marked by a large, intentionally constructed hole whose irregular circumference encompassed almost the entire vault. Though Lucas de Pellicer notes that roof apertures of this kind have been described and attributed to accidental collapse at other artificial caves in Iberia, she emphasizes that the hole in Cave IV may be the deliberate result of "individuals in later eras facilitating the reuse of the chamber."

Figure 4.6 Plan of Cave IV, from Lucas de Pellicer 1968 (English labels mine)

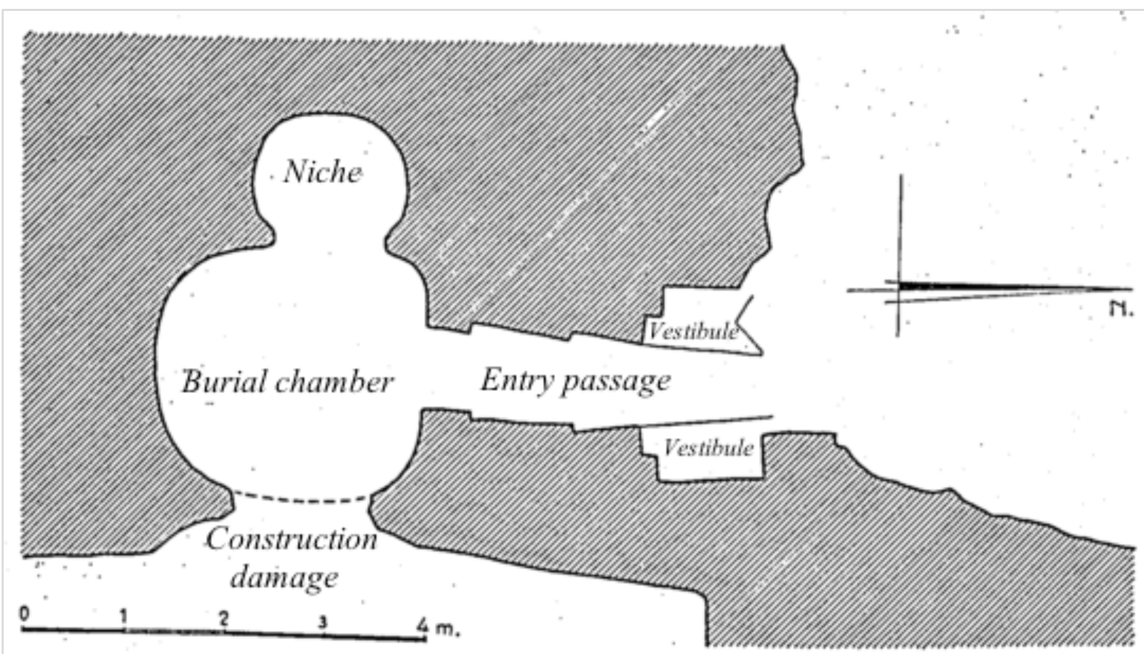


Table 4.3 Dimensions of Cave IV, as described in Lucas de Pellicer (1968:9)

Measurement	Dimensions (m)
Sides of the vestibule	2.10 x 1.10 (approximately)
Interior height	1.61
Door Height	1.17
Door Depth	0.80
Length of corridor	2.15
Width of corridor	0.75-0.80
Minimum - maximum height of corridor	1.14 – 1.26
Height of entrance to the chamber	1.22
Width of Entrance to the chamber	0.79
Diameter of the chamber	2.70
Original height from the floor to the vault	1.80
Axes of niche	1.24 x 1.52
Maximum height	1.60
Entrance height	1.60
Super width of entrance	1.00
Inferior width of entrance	1.10
Maximum diameter of roof aperture	1.65

After the excavation team removed the sediment filling the chamber and niche, they described several layers of strata, including sterile, chalky layers sandwiched in between layers of darker earth intermixed with ash and charcoal. However, Lucas de Pellicer emphasizes that there was enough evidence of admixture that these distinct sediments likely did not represent a true stratigraphy, and the initial descriptions of layers were likely the result of the specious activity of natural flooding through the aperture in the cave roof. The fill in both the niche and the larger chamber contained a mixture of sherds (the majority of which comprised a Roman red type "*terra sigillata*"), ancient roof tiles (specifically Roman *imbrices* and *tegulae*), modern tiles, and the faunal remains of small animals, rodents, birds and snails. A handful of fragmentary bone needles were also recovered, but like all of the other artifacts documented, these were observed randomly scattered throughout the cave fill. Importantly, though the floor of the chamber and niche had been destroyed, its fill was replete with "fragments of red tuff" that led archaeologists to believe that the interior of the cave had been painted red during some form of "traditional burial rite" (Lucas de Pellicer 1968:9; translation mine). While the excavation team did not recover any human remains, "presumably the buried bones, whether buried individually or collectively, would be stained red" (Lucas de Pellicer

1968:9, translation mine). With the exception of a single crudely knapped stone, no grave goods were recovered.

The excavators note that the burial chamber had been disturbed and reused in ancient times, which could explain the absence of human skeletal material and grave goods. The material that was recovered from the grave included ceramics, metal, and flint. The ceramic assemblage was predominantly common style Roman bowls and plates with “back edging” (*de borde vuelto*), made on reddish clay, as well as some sherds that could be attributed to the Iberian period. Metal artifacts included functional items including a brooch spring, pilum, rod, and weights made on iron, bronze, copper and lead. Additional material includes painted stucco and fragmentary pieces of glass. With the exception of the flint blade, all of the material culture recovered can be dated to the cave’s reuse in the Roman epoch, likely during the 2nd century BC.

The 2001 Excavations and Re-excavations

In 2001, almost four decades after the last excavations at Marroquíes Altos, the need for salvage archaeological excavations arose once again due to another construction project being undertaken at Calle Cristo Rey N˚5. Workmen were digging in the same parcel of land that Espantaleón and Unguetti excavated in the 1950s when the laborers broke through the clay to reveal the entrances to the ancient tombs (Manzano Castillo, personal communication). As a result, a professional archaeological team was hired to excavate the area. On their initial visit to the site, before the demolition of the building, the real estate agent showed the archaeologists a small hollow under the steps of a stone staircase that led to a “dovecote” (*palomar*) in the courtyard, which they identified as one of the tombs that was discovered in the 1950s.

These excavations are documented in an unpublished site report, written by Ana Manzano Castillo and José Luís Martínez Ocaña, the two archaeologists who re-excavated Marroquíes Altos (Manzano Castillo and Martínez Ocaña 2001). During two face-to-face meetings with Manzano Castillo and Ocaña at the Museum of Jaén in August and October 2014, additional important aspects of the excavations were revealed. These meetings are particularly important because at the time only one set of physical copies of the excavation plans and drawings existed; a number of photographs were taken during excavations and stored on a computer that was subsequently damaged by a flood, and these photographs could not be recovered. Accordingly, discussing the excavation organization with the archaeologists themselves and accessing the numerous, detailed and hand-drawn maps that they created was an important first step in untangling the excavation history of this part of Marroquíes Altos.

After discovering the original excavations, the archaeologists put in five excavation units (referred to as Units 1-5 in text), relative to the earlier work conducted by Espantaleón and Unguetti. During the 2001 re-excavations, Manzano Castillo and Ocaña uncovered the actual prehistoric entryways and antechambers for both previously excavated tombs (Figure 4.7); so all of the material removed from these areas was *in situ*. In addition to the original entryways, the team also excavated parts of the chambers that were not excavated by Espantaleón, meaning the lowest deposits were first excavated by Manzano Castillo and Ocaña. The re-excavation project also uncovered a third tomb that Espantaleón's team did not identity – a forgivable error as there was a building on top of this tomb during the 1950's. Manzano Castillo and Ocaña named this new, entirely *in situ* discovery Tomb III. In addition to the new nomenclature employed for Tomb III, they followed Espantaleón's convention of secondary names for the Cave of the Column (Tomb I) and the Cave of the Child (Tomb II). Finally, whether *in situ* or disturbed, all material from the 2001 excavations was screened (Manzano Castillo, personal communication), and the bones and associated artifacts carefully mapped.

The location, extent, and archaeological condition of each unit are most easily understood with reference to site maps (Figure 4.7) and individual descriptions of the units (Table 4.4). The archaeologists excavated each unit by stratigraphic layer, and the condition of each stratigraphic layer (e.g. *in situ* or disturbed) is described individually in the stratigraphic descriptions listed on the hand drawn site maps. Tomb III was completely excavated, but Tomb I and Tomb II were partially excavated. The four units that correspond to the Copper Age are described in greater detail below. Importantly, Unit 4 overlaps Unit 1 and Unit 2, and is located above them (Figure 4.7).

Figure 4.7 Map of units from 2001 excavations of Marroquíes Altos

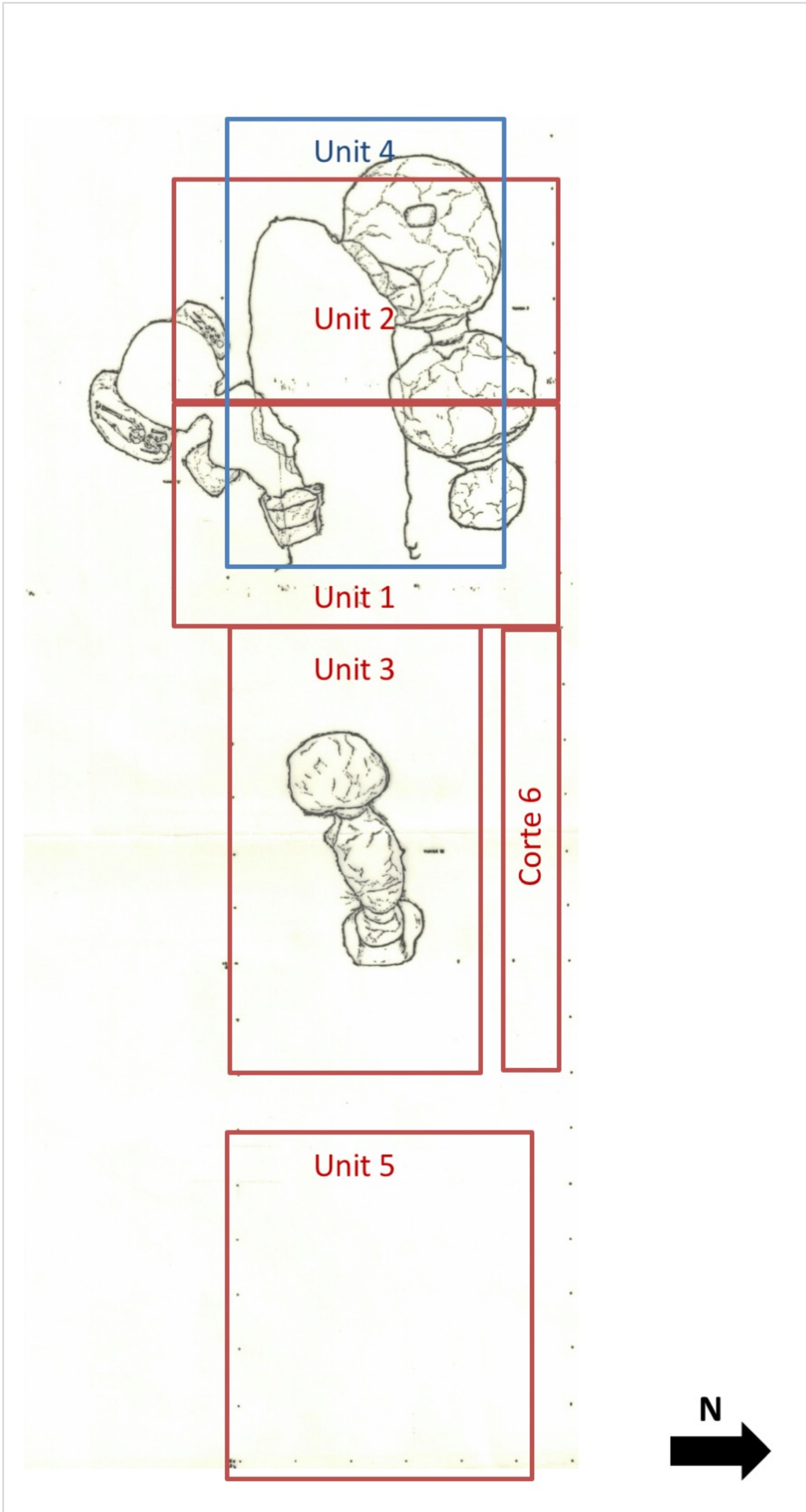


Table 4.4 Excavation units from the 2001 excavations of Marroquíes Altos

Unit	Location	Previously Excavated or Backfill?	Features
Unit 1	Cueva del Niño (Tomb II). This unit allowed the archaeologists to define the entrance to Tumba II. This entrance was the true prehistoric entrance to the burial chamber, and consisted of a small passage with lateral niches, leading into the main chamber which contained two niche burials. This unit also exposed a rectangular pit that hinted at a type of tunnel in the west wall. This tunnel (6 m in length, 2.5 m in width) was partially filled with debris and human remains	Layers from the antechamber to the Cueva del Niño are intact, because Espantaleón and Unguetti broke into the burial chamber through a sidewall, rather than accessing it through its prehistoric entrance.	**C1. UE1**: Pit 1 m in diameter in bedrock with limited human remains, ceramic sherds and copper fragments. **C1. UE2:** Entrance to the Cueva del Niño, two slabs of rock covering a doorway.
Unit 2	Cueva del Niño (Tomb II)	Layers from the antechamber to the Cueva del Niño are intact, because Espantaleón and Unguetti broke into the burial chamber through a sidewall, rather than accessing it through its prehistoric entrance. **This is a multicomponent unit as some materials are Roman.**	**C2.UE3**: A circular pit cut into the rock containing materials which suggest it was a Roman storage pit.
Unit 3	This unit was located in a new tomb (Tumba III). This tomb was not excavated in the 1950s because there was a building on top of it at that time. Manzano Castillo and Ocaña located it when they exposed the artificial steps through which Espantaleón's team accessed the tombs in the 1950s.	All layers intact – newly excavated.	**C3.UE4:** Entrance shaft; **C3.UE5:** Access passageway **C3.UE6:** Principal Chamber (**Note**: despite the confusing nomenclature, these are distinct from stratigraphic units 1-4 referenced in text).

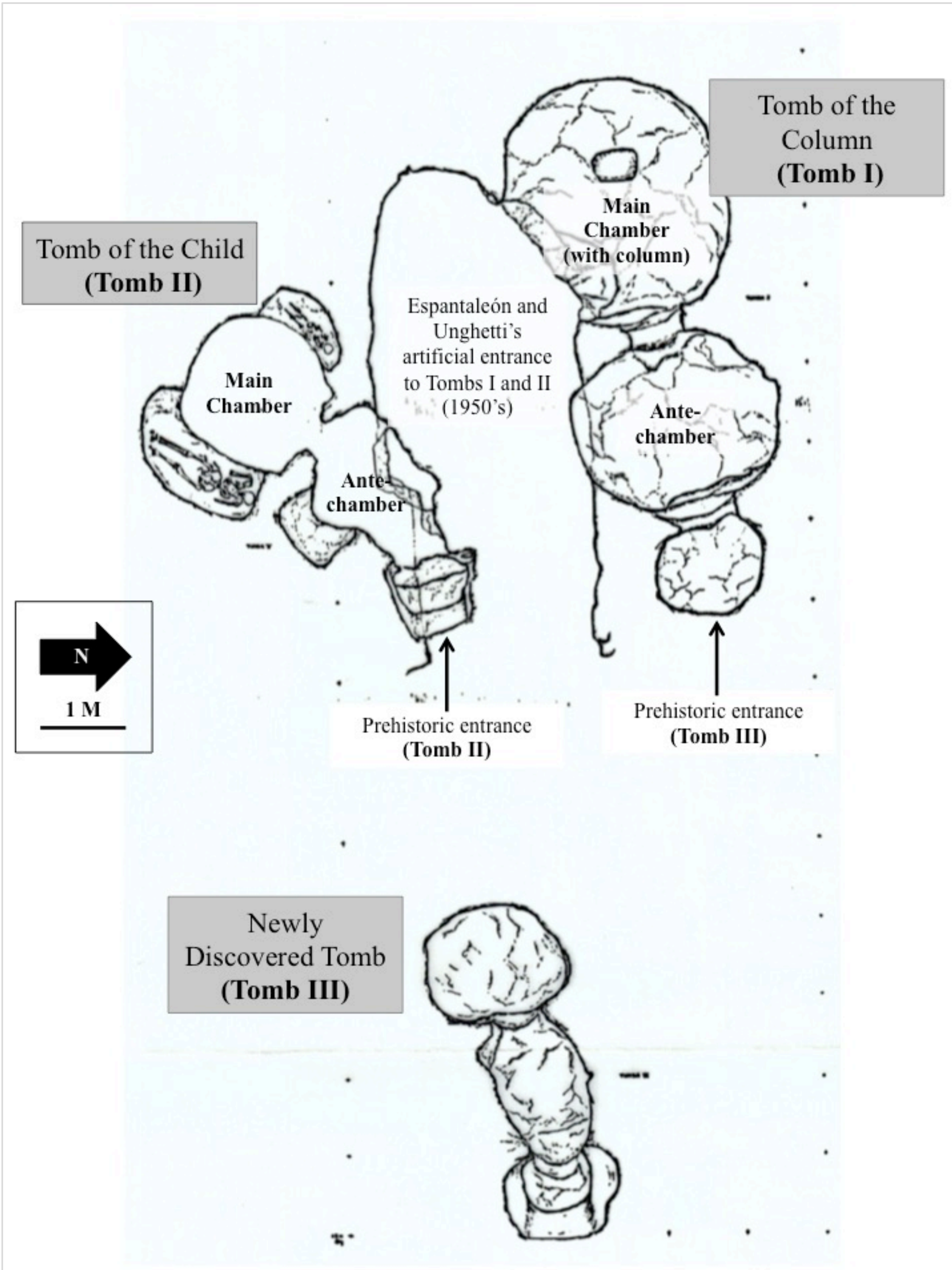
Unit 4	This was located in a corridor or passageway of Cueva de la Columna (Tumba I). The objective of C4 was the removal of the loose earth that was backfill from the 1950s excavations. However, over the course of the excavation, the archaeologists realized some of the lower sediment was still *in situ*. This unit exposes the artificial passage made by Espantaleón and Unguetti in the 1950s. Its western wall opens into a niche from the Cueva del Niño, and its eastern wall opens into the first room of the Cueva de la Columna.	Higher layers are 1950s backfill. Lower layer intact.	**C4.UE7:** Part of Tomb I - Cueva de la Columna.
Unit 5	ROMAN: This cut exposed a portion of the Roman villa that was most likely not related to the prehistoric necropolis.	N/A	N/A
Unit 6	CONTEMPORARY: Located next to Unit 3, this unit exposed the slope of the bedrock along the northeast portion of the solar, and uncovered a foundation wall belonging to the demolished home.	Disturbed by contemporary building.	N/A

The excavated tombs are referred to both by their original 1950s designations and by a new set of numbers. The correspondence between the named tombs and numbered tombs is as follows:

- **Tomb I:** Cueva de la Columna
- **Tomb II:** Cueva del Niño
- **Tomb III***:* The new tomb uncovered during the 2001 excavations that had never previously been excavated.

Importantly, Tomb III from the 2001 excavations should not be confused with Cueva III that was dug by Espantaleón Molina in 1959. Cueva III lay further down the street, at No˚ 9 Calle Cristo Rey, and was *not* re-excavated in 2001.

Figure 4.8 Base map of the Marroquíes Altos caves, from Manzano Castillo and Unguetti's excavation documents



Unit 1

This unit revealed a rectangular pit with rounded corners, filled with a yellowish-brown cement-like sediment mixed with medium-sized rocks. The unit contained very few ceramic vessels, and when they did occur they were extremely fragmentary and subject to taphonomic damage. This unit revealed the entryway to the Cave of the Child (Tomb II). After removing a fill of earth and rock, excavations uncovered a rectangular doorway with rounded corners, covered by two slabs of rock. The top of the doorway was partially broken due to previous construction work in this area. The door opened into a small passageway containing lateral niches, which, in a Russian-doll like fashion, opened into the main chamber itself, which also containing lateral niches. The northern edge of the antechamber (specifically, its right lateral niche) was damaged due to Espantaleón and Unguetti's artificial entryway in the 1950s. The left lateral niche was left unexcavated because of stabilization problems that rendered excavation unfeasible.

Both the antechamber and the main chamber it opened into were partially excavated in the 1950s. However, excavators still observed *in situ* skeletal remains lining the walls and floor of the area, which means that Espantaleón and Unguetti did not define the precise limits and shape of the prehistoric cave. Unfortunately, because the salvage excavations were circumscribed to the area underneath Calle Cristo Rey N˚5, only the door and the antechamber were excavated in 2001. The main chamber, including the two individuals laid out on lateral niches, is actually located under Calle Cristo Rey N˚3 (as is visible in Figure 4.8), and so was left undisturbed.

This unit also preserved evidence of a rectangular cut in the bedrock that was the result of contemporary clay extraction for the creation of adobe bricks in the 1950s. Traces of pick marks from clay extraction were preserved along its walls. This became Unit 4, referenced below.

Unit 2

This unit essentially acted as a witness column or test section of strata (*testigo*) that was used to facilitate stratigraphic readings. These excavations also revealed a circular pit dug into the bedrock which contained typically Roman *sigilatta* and ceramic vessels, which was interpreted as a storage unit.

Unit 3

This unit documented the newly discovered Tomb III. Initially this area was cleared to expose the artificial steps that led down to Espantaleón and Unguetti's artificial entryway from the 1950s. The steps were dug partially into the bedrock and partially into sediment, and when they were cleared, a new subterranean structure was revealed. The door to this tomb was intact, but its walls and roof had been broken by Espantaleón and Unguetti's creation of the artificial entryway.

The new tomb was divided into three different features: the entrance shaft (UE.4), the access passageway (UE.5) and the main chamber (UE.6). Each of these was subsequently divided into stratigraphic units which, confusingly, share the same "UE" designation as the features:

Unidad Estratigráfica 1: Material from the demolition of the contemporary building.
Unidad Estratigráfica 2: Phase of excavation and backfill of the tombs in the 1980s.
Unidad Estratigráfica 3: Horizon of material from the Roman era.
Unidad Estratigráfica 4: The Copper Age necropolis.

One modern pit filled with contemporary material was also documented in this unit.

Unit 4

This unit overlaps three different components of the site, two prehistoric and one contemporary:

- The artificial entryway that was carved out by Espantaleón and Unguetti in the 1950s that runs between the Tomb of the Child and the Tomb of the Column;
- The right lateral niche of the antechamber of the Tomb of the Child;
- The antechamber of the Tomb of the Column.

The entire unit contains a stratified layer of anthropic silt that preserves no *in situ* material aside from the human remains lining the walls and floor mentioned previously. The walls and roof of the artificial entryway show traces of pick scars from clay-mining, but otherwise feature some in situ remains. In terms of taphonomy, this passageway also shows evidence of water flow and water damage, as evidence by the travertine deposits and millimeter-wide channels carved along its walls and floor. The water activity in this area may be the initial culprit for the breaks in the walls of the Tomb of the Column and the Tomb of the Child that were later deliberately widened by Espantaleón.

Finally, the excavators proceed to summarize the condition of the two previously excavated tombs (Table 4.4).

Table 4.5 Summary descriptions of the Tomb of the Column and the Tomb of the Child, derived from Manzano Castillo and Martínez Ocaña 2001

Tomb I: Tomb of the Column
In this tomb, a vertical door led into a square antechamber (**Figure 3.10**), which then opened into the main chamber of the Cave of the Column. The shaft in the tomb was poorly preserved, having been essentially destroyed when workmen in the 1950s were extracting clay for adobe bricks. However, the floors and walls of both chambers were preserved relatively intact. The antechamber had much of its roof broken by the clay extraction process, so its highest stratigraphic levels consisted of a layer of loose earth in which contemporary remains mixed with pieces of the roof and osteological remains that came from the shaft. Beneath this sediment there was a layer filled with rocks of medium to large size, as well as fragments that resulted from the destruction of the shaft. This stratum included the remains of a single individual in a very poor state of preservation, and essentially comprised the collapse and subsequent in-filling of the structure after the breakage of the roof. The next stratum encountered represented the level of the burials (U.E.1), a yellow and gray layer of cemented mud that made it extremely difficult to excavate the interments, and required the use of small chisels and hammers to delineate the remains. This stratum was excavated using artificial levels, which revealed a chaotic profusion of human remains. The only organization that could be observed was a tendency for the majority of crania to be grouped together with long bones along the walls of the chamber. There were, however, an accumulation of crania located next to the door to the tomb (Figure 5 in site report), which the archaeologists interpreted as either the result of cleaning the chamber (i) before interring a new burial, or (ii) in order to clear the entryway to the cave. All of the bodies were found disarticulated, with the exception of one of the crania, which was placed on its side, with orbits facing north. This individual preserved two articulated upper cervical vertebrae. The archaeologists interpreted this articulation as indicative of the fact that the placement of the body occurred before skeletonization, since these bones would not otherwise have stayed connected. The material culture within the tomb consisted of typical Late Prehistoric ceramics, including globular pots, serving dishes, and vessels. Some of these were black burnished, and others were red coarse-manufactured items. The majority showed either fine or quartzite tempers. The ceramic goods were accompanied by fragments of copper, copper slag and copper ore, as well as some copper plates and bone awls (*puzones*) that were intermixed with animal remains and shells (*malacofauna*). Lithics were scarce, although these included fragments of flint blades, a scraper, and many microlithic blades. Once the burial layer was removed, a final stratum appeared. This was up to 10 cm thick, and separated the bottom of U.E. 1 from the bedrock. The 2001 excavations of the Cave of the Column also revealed that the excavations in the 1950s were not completed. The walls and the floor still retained a very loose layer of earth mixed with osteological remains, a result of the screening of sediment during the first excavations. Its removal revealed a cemented layer comparable to that described as U.E. 1, and cleaning uncovered a multitude of human remains that were damaged by the earlier excavation, as well as ceramics and copper and bone tools. Almost all of the material in this tomb was inter-mixed, fragmented, and taphonomically affected by hydrological processes that altered the substrate, walls and ceiling of the chamber. On site MNI estimates indicated at least 17 individuals in the antechamber and 12 in the main chamber.

Tomb II: Tomb of the Child
The entrance to this tomb is comparable to the entrance to the Tomb of the Column – a square shape with rounded edges approximately one meter beneath the current ground surface. The entrance shaft (U.E.4) was filled with rocks, likely as a method of sealing the tombs. After the rocks were removed the first burial appeared 20 cm beneath the surface. This individual was flexed and the torso was discovered above the inferior extremities. This was the only individual located in the entry shaft, and was likely the last individual buried in this tomb. Material culture deposited in the individual's immediate surrounding included ceramic sherds from a bowl, and a copper punch. The individual was surrounded by extremely cemented limestone sediment. Even though the entry shaft was comparable to that for the Tomb of the Column, no large slabs of rock (of the kind typically used to close these tombs) were found. The passageway (U.E.5) still preserved its walls and roof. Its first levels of fill consisted of very loose earth, in which some extremely fragmentary osteological remains appeared, as well as a medium-sized orange globular bowl with a thickened interior rim. The loose earth is likely the result of in-filling after the partial breakage of the passageway roof and the main chamber during the creation of Espantaleón's artificial entryway in the 1950s. Ten cm above the floor of the passageway this stratum disappears and is replaced by the original sediment of the tomb, which contains material culture and a "complete chaos" of disorganized human remains. The artifacts included ceramic sherds from a pot, small burnished fine-ware bowls with fine and quartzite temper, flint sickle teeth, denticulates, scrapers and blades, fragments of copper and a copper knife in sheet form that appeared to have been manufactured by hammering. This level of the passage contained at least three burials, one of which was a young subadult. As in the Cave of the Column, there was a great profusion of medium-sized rocks mixed in with the remains. This passage leads back to the main chamber of the tomb. The door to the main chamber is trapezoidal in shape with rounded angles, and was broken by Espantaleón's artificial entryway. Beyond and about 20 cm beneath the door, the same layer of cement-like earth containing a greater number of inhumations, particularly infant remains, was encountered. This level also contained ceramic artifacts, some of which had S-shaped profiles that led the archaeologists to posit a relative date for this chamber that fell between the Copper Age and the Bronze Age. The material culture included very burnished ceramics, fragments of flint tools, bone awls, another copper knife (with a complete blade and no rivets), and twelve small slate necklace beads (5 mm in diameter, 1-2 mm in thickness) as well as a bone and a perforated shell bead. The necklace beads are comparable to those documented in the 1950s excavation that were described as "green glass beads," likely taking on their green hue from polishing. The area also contained malacofauna.

The archaeologists conclude their report by underscoring the many unexpected dimensions to the excavations, focusing on three specific topics. First, they emphasize the impact of previous excavations on the archaeological record at Marroquíes Altos. Based on reports of the initial excavations in the 1950's, Manzano Castillo and Martínez Ocaña initially anticipated that the prehistoric tombs would be completely empty. However, their initial clearing work revealed an appreciable archaeological stratum that had not been touched, with the exception of surface damage to upper-lying human remains, indicating that the work during the 1950s had largely focused on the collection of artifacts that were in plain sight. The 2001 excavations also clarified the nature of the 1950s backfill, as it became clear that all of the human bone and sediment that had originally been removed from the tombs was then used as backfill, leading to the large number of bones detected in Units 1 and 4 that were mixed in with contemporary materials. Finally, the new excavations successfully uncovered the original and undisturbed prehistoric entrance shafts into the tombs, and were able to document the extent of the damage caused by Espantaleón and Unguetti's artificial entryway created in the 1950s.

Second, Manzano Castillo and Martínez Ocaña focus on the disparity between initial reconstructions of the site (e.g. Figure 4.5) and the actual condition of the remains encountered during the 2001 excavations. There was no evidence that corroborated the radial disposition of burials in flexed or fetal positions around the central column in Tomb I. At most, the archaeologists were able to delineate a pattern in which crania and long bones were clustered together, along with grave goods. The only documented evidence for a partially articulated disposition is the cranium with two upper cervical vertebrae; however, the fact that the rest of the skeleton lacked anatomical connection is likely due to the collapse of one of the limestone roof slabs on top of it. The articulation of this individual leads the archaeologists to believe that it was likely the last burial interred in the tomb. There were also associated grave goods including a copper knife, ceramic objects, shells and flint tools, while the relocation of earlier inhumations to the sides of the chamber "provided a privileged position for this last inhumation." There is a different approach to the placement of human remains in the Tomb of the Child. The lateral niches are likely the "privileged positions" reserved for the individuals who were last buried, while earlier inhumations are clustered at the foot of the niches, freeing the passageway from the door. While Espantaleón and Unguetti referenced two infants placed in the antechamber niches, this could not be verified due to the destruction or compromised integrity of these features in 2001.

Finally, the third aspect of the new excavations that the archaeologists emphasize is the taphonomic evidence preserved in the caves. The geological matrix of the underlying hill is formed by loam and argillaceous limestone, and the travertine-like formations on the tomb walls and roofs attest to their contact with water, forming the small channels visible in the present day due to capillary action. The walls also change color – half way up their heights, the color grades to orange, a transformation that occurs in the main chamber of the Cave of the Column, in the passageway, and in the Cave of the Child. This perfectly level line of color change is likely the result of structure flooding that occurred before the Roman occupation of the area, and explains the cement-like limestone sediment that makes up the archaeological substrate. This potential water action also explains the disorganization and state of preservation of the bones. Despite the geological evidence for water action, Manzano Castillo and Martínez Ocaña emphasize the need for confirmation of this hypothesis by a karstic taphonomic specialist.

Conclusions: Stitching Together the Patchwork of Marroquíes Bajos

The complexity of the prehistoric organization of Marroquíes Bajos, in tandem with the multiple, overlapping and rapid excavations that took place in advance of urban construction, produce an overwhelming deluge of information for the reader. Despite the tortuous details woven into the site reports and published articles, certain key features stand out as important for understanding the mortuary landscape of Late Prehistoric Jaén.

First, the site is intractably multicomponent, with Copper Age interments frequently punctured by Islamic period graves or modern building foundations. Despite the overlapping occupations, both the formal characteristics and the material culture that characterize the burials at N1-N4, F1 and F2 situate them firmly in the Late Prehistoric period. However, the *tempo* of the use of the Late Prehistoric mortuary landscape remains unresolved. There is evidence for some mortuary reuse of funerary structures at N3 well into the Bronze Age, at the turn of the second millennium. However, N1, N2[27] and N4 have yet to be dated, and without understanding how the chronologies of the various necropolises insect, it is impossible to determine whether all mortuary areas were being used simultaneously, or reflect a degree of temporal variability. Accordingly, contextualizing the chronology of the mortuary areas is a necessary first step in understanding social organization at this macro-village.

Second, these mortuary areas are communal in nature, and for the most part it is difficult to associate grave goods with a single individual, especially given the rapid salvage nature of most excavations (though see earlier in this chapter for descriptions of such work during the 2001 re-excavations of Marroquíes Altos). For this reason, traditional evaluations of social inequality that focus on differential access to wealth or to exotic grave goods are here limited in their scope. If individuals were interred in the

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[27] Initial dates were taken for N2 remains in fall 2013 to ensure dates would be returned for the very fragmentary osteological material. These documented a chronological range of 2210-1940 cal BC at 1σ.

tombs with specific sets of grave goods, or were laid to rest with complex and costly rituals, the post-mortem commingling of the remains during their reuse means that there is no way to associate artifacts with individuals with any degree of certainty. However, just because individuals are buried together does not mean they shared equal access to resources during life, or were all from the same place. Here, the analyses of diet and mobility conducted in this dissertation will tease apart the relationship between any differential access to resources or variability in regional affiliation and burial location.

Third, mortuary practices at Marroquíes Bajos were complex and multi-stage. Instead of simply digging a grave and placing an individual body within it, the site reports and publications describing N1-N3 and F1 document a mixture of primary and secondary burials. The presence of empty mortuary structures at N2, and the evidence for movement of bones between structures at N3 attest to deliberate ritual contact with interments post-skeletonization. At Marroquíes Altos, the clustering of crania and long bones against cave walls and the deliberate placement of individuals in lateral niches demonstrate a Late Prehistoric reuse of these areas that required clearing passages and making way for new remains. Similarly, the placement of rocks above crania is documented repeatedly at the site, both in the Cave of the Column at Marroquíes Altos, and in the communal grave of F1. Despite the disparate nature of the excavations of the mortuary areas, certain ritual motifs become apparent when analyzing all of them together.

Finally, the fragmentary and disarticulated skeletons in the burials demands the application of innovative bioarchaeological methods to determine aspects of biological profiles like MNI, age, and sex. In particular, understanding whether access to mortuary areas was restricted or open demands knowing who was buried where and when they were buried. Previous site reports and publications allow us to establish the "where," and radiocarbon dating allows us to determine the "when," but only bioarchaeology can paint a portrait of the interred population. For example, though some of the grave goods recovered from these mortuary areas have been argued to be gender-specific, such assertions are difficult to evaluate without reference to osteological analyses of aspects of biological identity. Similarly, determining whether the demographic composition of this macro-village was comparable to other Iberian Late Prehistoric settlements necessitates a thorough investigation of the age structure of the mortuary population. Accordingly, the precise bioarchaeological methods and strategies used to piece together aspects of these prehistoric identities are described in the next chapter.

Chapter 5

Piecing Together Prehistoric Puzzles: Bioarchaeological Methods

> *In a regional context, the investigation of the human biological system is critical to the investigation and development of local histories and the derivation of deductively testable models of human behavior. While anthropological archaeologists develop increasingly complex models of interaction between biological, environmental and cultural variables, the physical anthropologist frequently can provide unique clues to aspects of social organization, demography, population interaction and relationship, and the efficiency with which temporally sequential paleopopulations have dealt with universal problems of nutrition and disease.*
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> – *Jane Buikstra, Biocultural Dimensions of Archaeological Study: A Regional Perspective, (1977:67–68)*

Popular television shows like *Bones* paint a romantic picture of the nature of skeletal data collection, leading the uninitiated viewer to envision a stern researcher swathed in a pristine lab coat, crouched over a relatively complete articulated skeleton. In reality, collecting rigorous data on archaeological skeletal remains is far more mentally and methodologically taxing, and not all skeletons are complete. This dissonance is due largely to the fact that prehistoric burials do not always contain the complete, articulated individuals we see on TV. As Stodder indicates, "[f]or those of us accustomed to clearly defined pit features containing extended skeletons with grave goods, the notion of what constitutes a burial and mortuary feature must be reshaped to accommodate the archaeological record in a place where there is in a sense no such thing as a primary burial" (2005:249). Because Copper Age collective burials are thousands of years old, have suffered significant amounts of weathering, post-mortem breakage, and additional post-excavation admixture, this "reshaping" must also extend to the methods used during the course of bioarchaeological analysis.

The Spanish term for "puzzle" is *rompecabezas*, a word that has its etymological origin in the verb *romper,* meaning "to break" and the noun *cabezas*, meaning "heads." Its literal translation is therefore "broken heads." The multiple meanings woven into this word provide a particularly apt introduction to the process of conducting bioarchaeological research on fragmented Copper Age inhumations, because Chalcolithic remains predominantly consist of broken and mixed elements that must be sorted and refit like puzzle pieces.

At Marroquíes Bajos, human bones from mortuary contexts were rarely complete, and far more frequently they were highly fragmentary and intermixed, to the extent that simple skeletal recording forms did not provide adequate ways to document the remains. Instead, I employed feature-based zonation methods, processes of conjoin and refitting, and tallying of fragments and dental approaches in order to analyze the individuals buried in these necropolises. As Osterholtz et al. (2014:1) note "…there is no *right* way to analyze a commingled assemblage," since individual researchers are faced with context-specific concerns and limitations that shape their data-collection strategies. However, this potential methodological challenge and lack of standardization must be tempered by careful attention to outlining methodological standards that can be replicated by other researchers in any such bioarchaeological analyses.

To that end, this chapter details the methods that I used in the bioarchaeological analyses of Marroquíes Bajos during the summer of 2013 and 2014. I cover the initial condition of the remains as encountered in the collections at the Museo de Jaén, outline the sorting and cleaning procedures used for each different necropolis, and discuss the modified fragmentation-zonation standards that I employed when identifying specific elements and documenting their state of completion. I also detail the multiple strategies used to assess age and sex and to establish the Minimum Number of Individuals, noting when such strategies differ between necropolises due to the significant differences in preservation and volume of materials that distinguished these three mortuary areas. This chapter briefly covers the theory underlying the biochemical studies of carbon, nitrogen, oxygen and strontium that are used to analyze inter-individual differences in prehistoric diet and mobility, while outlining the sampling strategy used to select samples from discrete individuals at each of the three necropolises. I conclude by summarizing the theory underlying Accelerated Mass Spectrometry radiocarbon dating, and by outlining my strategy for selecting samples of human bone in order to establish a chronology of the mortuary areas at Marroquíes Bajos.

Finally, it is important to note that the Marroquíes Bajos bioarchaeological analysis focused on three different mortuary areas – Necropolis 1, 2, and 4 (also known as Marroquíes Altos). Each necropolis was excavated by different salvage archaeology teams. The resultant variability in taphonomic conditions, museum storage practices, and significant differences in the volume of material recovered from each necropolis necessitated the development of different data collection strategies for each mortuary area, so each necropolis is addressed individually in each section of the following chapter.

Initial Condition of Materials

Preservation of materials differed significantly between mortuary areas. Necropolis 2 contained human remains that were extremely poorly preserved, with high levels of bone fragmentation and severe taphonomic degradation of cortical surfaces of bone (Figure 5.1). In contrast, Necropolis 1 and Necropolis 4 contained many well-preserved elements that were both more complete and less subject to taphonomic destruction than the materials from Necropolis 2. For many bags of material, elements were covered with dirt to such a degree that sediment interfered with identification of elements, feature observation, and observations of pathology. In these cases, the bones were wet- or dry-cleaned, depending on degree of preservation. For the Necropolis 2 context, excavators combined numerous elements in one bag, but each bag was associated with a specific provenience (generally, one of the mortuary structures itself, e.g. Necropolis 2, C.E. 43). Multiple bags were often associated with a single structure – for example, Bags 44008, 44009, 44016,44017, and 44019 were associated with Structure 44 from Necropolis 2. These structures were treated as minimum units of analysis when cleaning bones and calculating necropolis MNIs. While the available site reports did not detail why materials from single structures were bagged separately, the volume of materials was such that it would have been impossible to combine all of the remains in a single bag, so it is likely that the excavators used separate bags so as not to overload individual bags. For the Necropolis 1 context, excavators bagged individual skeletons in discrete bags, and while there were occasionally additional superfluous or overlapping bones recovered from such bags, in general there was a great deal of agreement between the hand-drawn site maps and the organization of materials at the Museum of Jaén. In the case of Necropolis 4, the high volume of human remains (which comprised 267 bags containing 735.85 pounds of unwashed human bone and sediment) necessitated the use of a dental analysis rather than a full bioarchaeological analysis; any discussion of methods for Necropolis 4 thus refers to the dental analysis, rather than the more extensive complete bioarchaeological analyses conducted in Necropolis 1 and Necropolis 2. For Necropolis 4, each bag of material was associated with one of four Copper Age excavation units in the 2001 excavations, and information about the stratigraphic context of each bag was noted in the excavation bag registry.

Figure 5.1 Initial condition of human remains, Necropolis 2, Structure 44

Screening, Cleaning, and Sorting Procedures

In the case of Necropolis 2, human bones were cleaned by individual bag using water, toothpicks, and a toothbrush; bones were gently brushed to remove any sediment adhering to them. The remains were then dried on the museum balcony and exposed to the strong Andalucian sun for at least two full days before being rebagged. This procedure was intended to limit the potential for mold to grow in the bags, which can occur when remains are not in prime condition (Berger 2013). All teeth that could be identified were removed from each bag prior to cleaning and bagged separately. Teeth were not washed as the crown and roots tended to fragment when drying after immersion in water. Crania that were bagged individually were either washed or dry-screened and dry-brushed, depending on their preservation. Cranial bones were dry-screened with the use of an 8 mm screen, and all bone fragments > 8mm in diameter were collected and preserved.

After cleaning, bones from each structure in Necropolis 2 were spread out on large trays for an initial anatomical sort. Long bone fragments were divided into "large" and "small" categories, and large long bone fragments were distinguished from small long bone fragments based on thickness of cortex and curvature and the size of the fragments. Hand and foot bones, vertebrae, elements of the pelvic and shoulder girdles and ribs, and cranial bones were also identified to those anatomical regions (Table 5.1). Fragments that could not be identified to element were sorted into five categories: large long bone fragments (humerus, femur, tibia), small long bone fragments (radius, ulna, fibula), general long bone fragments, cranial fragments and general fragments (Table 5.2). Importantly, general fragments represent the lowest level of accuracy in identification; these are portions of elements that cannot be identified with any greater degree of specificity. The remaining fragment categories were analyzed thoroughly to attempt to identify any remaining fragments to anatomical region.

Because the Necropolis 1 materials were better preserved than the Necropolis 2 materials, bones were dry-cleaned using toothpicks in brushes, except when anomalies like pathologies or taphonomic marks demanded greater visibility, in which case the elements were washed. Crania for this necropolis were almost always bagged separately by excavators, often filled with sediment or adhering to "sediment pillars." In order to assess cranial bones for pathology and recover any loose teeth, these crania were first hand-sorted to remove large vault fragments or teeth. The resulting bone and sediment was screened using the large screen (8mm), and the resulting fill was then screened using the small hand-sieve and then sorted by hand for small cranial fragments and loose teeth.

Finally, the tremendous volume of materials in Necropolis 4 necessitated the development of a screening strategy aimed at recovery any loose teeth, articulated teeth, or fragments of alveolar bone with sockets preserved (for the calculation of the frequency of alveolar resorption). Each bag of bone and sediment was screened using a large circular sieve with diamond-shaped apertures that measured 2.5mm high and 3.5mm wide. Generally, the largest fragments of bone (e.g. femoral shafts or partial innominates) were first removed in order to facilitate screening.

Table 5.1 Anatomical regions

Region	Elements
Cranium	All bones of the cranium and articulated dentition
Mandible	The mandible and articulated dentition
Dentition	Isolated teeth, not housed in alveolar processes
Spine	Cervical, Thoracic and Lumbar Vertebrae
Thorax	Manubrium, Sternum, Ribs, Hyoid
Shoulder	Scapula, Clavicle
Arm	Humerus
Forearm	Radius, Ulna
Hand	Carpals, Metacarpals, Manual Phalanges
Pelvic Girdle	Sacrum, Ilium, Ischium, Pubis, Coccyx
Thigh	Femur
Leg	Tibia, Fibula
Foot	Tarsals, Metatarsals, Pedal Phalanges
Epiphyses	With the exception of hand and foot epiphyses, all epiphyses get an “ALT DES” categorization, listing the bone and the epiphysis.

The fragments and sediment remaining in the screen were hand-sorted on a tray for mandibular or maxillary fragments and teeth. While this process was tedious and certainly subject to human error, the recovery of teeth as small as deciduous central incisors (N = 12), and the recovery of small fragments of enamel that could be refit to broken crowns suggests that this strategy provided a reasonable rate of recovery of teeth. At this stage, artifacts (generally small ceramic sherds) and any clearly non-human bone were separated from the remaining material. While time constraints made it impossible to clean the sediment adhering to all human bone, any large cranial fragments with enough sediment adhering to them to obscure teeth were either dry-cleaned or washed in order to maximize the recovery of loose teeth.

Table 5.2 Fragment categories

Fragment Category	Description
Long Bone Fragment[1]	Unidentified long bone fragment, thickness and curvature of shaft & cortical bone suggest long bone.
Humeral Fragments	Fragments of a humerus
Forearm Fragments	Fragments of the ulna or radius.
Rib: Head and/or Neck	Identification of head of rib, curvature of shaft or articular facets suggests the posterior-most articular portion of rib.
Rib: Body	Body of rib
Vertebrae: Neural Arch Fragment[2]	Fragment of neural arch or spinous process, identified by articular facets and curvature, but not identified to category of vertebrae, OR lacking articular facets entirely.
Vertebrae: Body Fragments	Isolated fragments of body that cannot be identified to category.
Pelvis Fragments	Fragments of os coxae (no sacrum fragments) – ilium, ischium or pubis.
Cranium: Vault Fragments	Fragments of cranial vault, specifically frontal, parietals, occipital bone and squamous portion of temporal.

1. For N2.CE39 and N2.CE41, long bone fragments were only identified if they were > 31 mm in diameter. For N2.CE44, N2.CE43 and N2.CE45 long bone fragments were identified whenever possible. 2. If there were portions of both body and neural arch, preserved, then whichever is the greatest proportion of the fragments is the designation the fragment receives. For example, if a greater portion of vertebral body than neural arch was preserved, the element was designated a body fragment.

Element Recording with the Fragmentation Zonation Method

Traditional recording systems for human remains assume the recovery of a relatively complete and discrete individual skeleton (see Buikstra and Ubelaker 1994). However, these methods are less useful in contexts where human remains are fragmentary, scattered and disarticulated. As a result, bioarchaeologists have begun to rely on fragmentation-zonation methods of element recording in place of traditional recording forms, particularly when dealing with mortuary contexts like ossuaries, secondary burials, and mass graves. This method of recording divides an element into a set number of zones, each of which is accompanied by a written description of the zones and a visual representation of the element division. If any portion of a zone is identified, the zone is counted as present for the element being recorded. For example, Knüsel and

Outram's method (2004) divides the mandible into six distinct zones (Figure 5.2). The left half of the mandible 43.055 from N2.CE43 has zones 1 and 2 present (Figure 5.3).

Figure 5.2 Fragmentation-zonation method for the mandible (Knüsel and Outram 2004:88)

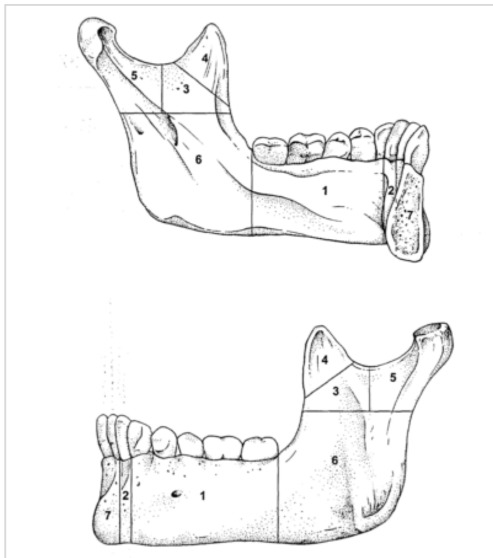


Figure 5.3 Mandible 43.055, buccal view

Working on an element-by-element basis, I scored completion for each bone in Necropolis 2 and Necropolis, using the zonation method outlined in Knüsel and Outram

(2004), and the feature-based method outlined in Stodder and Osterholtz (2010). The precise method used for each element is outlined in Table 5.3.

Fragments that could be identified to the level of element were compared to larger preserved portions of bones in order to determine whether conjoining the bones was possible. For the long bones, individual elements that could be identified to the left or right side were then compared to determine whether pair-matching was possible, to further refine MNI calculation, as outlined in Adams and Konigsberg (2004). Conjoining and pair-matching are of great utility for MNI calculations, as these strategies ensure that no individuals are duplicated when selecting samples for radiocarbon dating and isotopic analysis. Grossly observable skeletal pathologies (e.g. periostitis, fractures) and evidence of high activity levels and aging (e.g. osteoarthritis), were identified using standard reference texts (Buikstra and Ubelaker 1994; Ortner 2003), and recorded and scored according to methods outlined in Buikstra and Ubelaker (1994:54–60).

Table 5.3 Recording system used for each anatomical region

Anatomical Region	**Elements**
Cranium	All bones of the cranium and articulated teeth[1] **(KO)**[2]
Mandible	The mandible and articulated teeth **(KO)**
Spine	Cervical, Thoracic and Lumbar Vertebrae **(KO)**[3]
Thorax	Manubrium, Sternum, Ribs, Hyoid **(SO)**
Shoulder Girdle	Scapula, Clavicle **(SO)**
Arm	Humerus **(SO)**
Forearm	Radius, Ulna **(SO)**
Hand	Carpals, Metacarpals, Manual Phalanges **(KO)**
Pelvic Girdle	Sacrum, Ilium, Ischium, Pubis, Coccyx **(SO)**
Thigh	Femur **(SO)**
Leg	Tibia, Fibula **(SO)**
Foot	Navicular, Cuneiforms, Cuboid, Metatarsals, Pedal Phalanges **(KO)**; Talus and calcaneus **(SO)**

1. KO refers to Knüsel and Outram (2004), SO refers to Stodder and Osterholtz (2010). 2. Teeth for both the mandible and the maxilla were recorded separately from alveolar bone (see Chapter 5). 3. Either a superior or inferior articular facet must be present for a fragment to be recorded as category 2 or 3. Neural arch halves are sided in posterior view (i.e. left is actually the right side, in Standard Anatomical Position).

Dental Recording

At all mortuary areas, teeth were identified to level of development, tooth category, number, arcade and side (e.g. left lower third molar (LlM3), right upper deciduous first incisor (Rudi1)). Grossly observable dental insults such as enamel hypoplasias, caries, and abscesses, as well as abnormalities like supernumerary teeth were identified using standard reference texts (Buikstra and Ubelaker 1994; Ortner 2003), and recorded and scored according to methods outlined in Buikstra and Ubelaker (2004:49-53).

In order to estimate the age of individuals, all loose deciduous and loose permanent teeth were scored for root and formation and development, using the London Atlas (AlQahtani 2009; AlQahtani et al. 2010). When possible, articulated teeth were also scored for level of development, but as alveolar bone is unsurprisingly opaque, this was only possible in instances where the bone surrounding sockets had been broken or damaged to reveal roots. Finally, all teeth were scored for wear using a modification of Scott's scoring technique (1979), as outlined in Buikstra and Ubelaker (1994:52–53).

Enamel visibility was likewise noted in order to distinguish teeth for which hypoplasias or caries could be observed from teeth where hypoplasias or caries could not be observed due to taphonomic damage to or destruction of enamel. The driving force behind this classification was whether the observer would be able to determine whether pathologies were present on the tooth given the condition of the enamel. If the enamel was not obscured by calculus or taphonomic damage, it received a score of "O" or, "Enamel Observable." If the enamel was obscured, it received a score of "NO," or "Not Observable." Documenting enamel visibility therefore reduces the sample of teeth lacking visible pathologies to only those with their enamel surfaces visible, a strategy which prevents the artificial inflation of teeth "without" pathologies due to the specious inclusion of teeth for which enamel is not visible into the analysis.

Figure 5.4 Example of enamel visibility scores

Both teeth are from N2. 41.33 on the left was scored as O, 43.45 on the right was scored as NO.

Likewise, because the degree of root can be used to estimate the age of individuals, root preservation was scored to determine the number of teeth for which it was possible to estimate age. The scoring system for root preservation is outlined in Table 5.4 and Figure 5.5.

Table 5.4 Recording of root completion

Category	Designation
1	At least one entire root present (even if tip of root is broken off)
2	Root present but partially broken
3	Entire root broken below cemento-enamel junction
Y[1]	Young individual, root has not finished forming
A	Articulated tooth, root concealed by alveolar bone

1. Roots that were not finished forming were also scored for degree of development AlQahtani 2009 and AlQahtani et al. 2010.

Dental calculus, the calcified plaque that gathers around the base of tooth crowns, was recorded and scored using the guidelines outlined in Buikstra and Ubelaker 1994, with four distinct stages used: 0 = no calculus observable, 1 = a small amount of calculus present, 2 = a moderate amount present and 3 = a large amount present. Dental pathologies such as caries, alveolar resorption, and abscesses were also scored using a system that recorded the location, form, and extent of the insult.

Figure 5.5 Example of calculus scoring

Mandible N1.CE14.13.66 Mesial is to the right. M_3 and M_2 score 3, M_1 has a score of 2.

Odontometrics and Wear

All teeth were scored for wear using the modified Murphy and Scott system (Buikstra and Ubelaker 1994:52–53). While generally only the upper and lower molars are used to estimate the age of individuals (Miles 1962, 1969; Gilmore and Grote 2012), wear was scored for all teeth, as such data also provide a quantitative measurement of the impact of an early agricultural diet on dental health and tooth wear in Copper Age Iberian populations.

The only teeth for which odontometric measurements were taken were the lower canines, as recent research (Vodanović et al. 2007; Gonçalves et al. 2014) has emphasized the utility of this category of tooth in estimating population sex ratios in commingled prehistoric contexts. Accordingly, mesiodistal diameter and buccolingual diameter were taken for all lower canines, whether loose or articulated. While there are a number of different ways to measure teeth (see Wolpoff 1964:21-27), the guidelines outlined in outlined in Buikstra and Ubelaker (1994:61–63) were used during this analysis, as because this is the standard reference manual for bioarchaeology, these are the measurements most likely to be replicated by other bioarchaeological studies. Buikstra and Ubelaker define mesiodistal diameter as “the maximum width of the tooth crown in the mesiodistal plane," and buccolingual diameter as "the widest diameter of the tooth, measured perpendicular to the mesiodistal plane" (1994:62).

Intra-observer error associated with the measurement of mesiodistal diameter and buccolingual diameter were tested on a sample of 20 lower canines by taking repeat measurements on each tooth, following Gonçalves et al. (2014). The average difference between measurements for mesiodistal diameter was 0.04 mm, and differences ranged from 0 – 0.15 mm. The average difference between measurements for buccolingual diameter was 0.07 mm, and differences ranged from 0 – 0.23 mm. The Technical Error of Measurement (TEM) was calculated using the formula outlined in Ulijaszek and Lourie (1994:30). The TEM for mesiodistal diameter was 0.12 mm, while the TEM for buccolingual diameter was 0.23 mm.

Estimation of the Minimum Number of Individuals

Calculation of the Minimum Number of Individuals (MNI) interred in a given mortuary area is a necessary first step in examining the structure of ancient populations. Due to the different mortuary treatments, taphonomic conditions and data collection strategies pursued for each Marroquíes Bajos Necropolis, MNI was calculated separately for each necropolis.

MNE and MNI Estimation for Necropolis 2

Because it was possible to refit fragmentary elements within each mortuary structure, Necropolis 2 MNI estimates were made by individual structure. In each case, the element with the highest MNE was used to produce the structure MNI (i.e. the number of individuals interred in a given mortuary structure).

Because the volume of material was low for Necropolis 2, it was possible to carefully compare refit humeri or complete molars from both sides to calculate MNI. As a result, the use of mirroring and subsequent pair-matching guided by principles of anatomical symmetry was used to produce an adult MNI estimate for each structure.

For example, for Structure 44, principles of anatomical symmetry were used to produce an MNI estimate of eight individuals. The identification of matched pairs involves careful attention to the size and robusticity of muscle markings, formal similarities in curvature and shape, and overall taphonomic treatment (Table 5.5). However, adhering to the principle that "a picture is worth a thousand words," this system may be more easily understood by examining the pair matches themselves (Figure 5.6). The same principles of anatomical symmetry were also used to compare loose teeth by structure. A cautious approach was taken towards potential matches so as not to artificially inflate structure MNIs – if there was even a modest chance that elements or teeth could be paired, they were treated as paired for purposes of MNI calculation. Accordingly, this pair-matching strategy likely underestimates, rather than overestimates, the number of individuals buried in this mortuary area.

Table 5.5 Description of pair matching for Necropolis 2, Structure 44

Pair	Justification of pair match
(i) 44.0157 (R) and 44.0159 (L)	These are the subadult humeri, and they match because they are both distal portions of shafts (the flattened flaring just about the olecranon process is visible) and shaft size, curvature and taphonomic treatment are also commensurate;
(ii) 44.0151 (R) with 44.0160 (L)	These shafts are the two most narrow, aside from the subadults! Taphonomic treatment and overall gracility also match fairly well.
(iii) 44.0153 (R) and 44.0169 (L)	These are the most robust humeri for the structure. Overall size, shape, robusticity, curvature and taphonomic treatment match quite well.
(iv) 44.0152 (R) and 44.0168 (L)	These elements have similar taphonomic treatment and deltoid tuberosities of equal magnitude
(v) 44.0151 (R) and 44. 0161 (L)	Two very robust distal ends with distal shafts that are about the same robusticity.
Comments	The only remaining fragments that could be paired are distal ends 44.0156 (R) and 44.0165 (L), but these do not match up. The shaft of 44.0165 is smaller (as is the flaring towards the olecranon process), and 44.0156 is much more weathered and feels drier than 44.0165. This pairing produces an MNI of eight. There are five individuals represented by matched pairs and a left distal end that does not match a right distal end, meaning two additional individuals.

The subadult MNI for Necropolis 2 was calculated by examining all subadult bones and estimating their age based on epiphyseal fusion and/or overall size, using the guidelines outlined in the section of this chapter dedicated to subadult age estimation. The number and age of subadults were then compared to the elements that produced the structure MNE, to determine whether or not it was possible that any of the adult MNI elements could have come from subadults. For example, in Structure 44, the humeral pair

44.0157 and 44.0158 (shown in the top left-hand corner of Figure 5.6) were clearly subadult based on the small size of the bones, and most likely belonged an individual 1.5-3.5 years of age given the humeral shaft dimensions. However, this structure also contained an unfused distal ulnar epiphysis, two radial shafts with subadult dimensions, and an unfused distal femoral condyle. These additional fragments all came from a different subadult individual 7-18 years of age based on their size and level of development, suggesting the presence of another, slightly older subadult individual. A similar rationale to that used for Structure 44 was used to produce subadult MNI estimates for all structures at Necropolis 2, which, combined with the adult MNI estimates, produced total MNI estimates for the structure and the mortuary area as a whole.

Figure 5.6 Humeral pair matching for Necropolis 2, Structure 44

MNE and MNI Estimation for Necropolis 1

Necropolis 2 was the sole mortuary area for which individuals were buried and excavated as discrete individuals. Inhumations in this necropolis were documented by excavators with a set of detailed, hand-drawn maps, which were used to orient and guide bioarchaeological analysis. The majority of material curated by the museum fell in line with these mapped visual depictions. While the site maps document 46 human burials in six different structures, nine of these inhumations could not be located in the collections at the Museum of Jaén (four mapped individuals are missing from Structure 26, and five mapped individuals are missing from Structure 27), likely a result of the decade and a half gap between excavation and analysis and the immense volume of salvage-excavated material curated in Spanish museum collections. Bioarchaeological analysis of the remains available for study identified an additional ten individuals not depicted on the site maps, represented predominantly as individually bagged mandibles. A full bioarchaeological analysis – assessing skeletal completion, age, sex, and pathology – was subsequently conducted for the 42 individuals that could be located in museum collections. Accordingly, while bioarchaeological data are available for 47/56 individuals, it is important to acknowledge that this analysis represents an 84% sample of the documented mortuary population for this necropolis.

Finally, after completing analysis of the 42 available individuals for N1 (which were all stored in museum collections labeled as "individuals," with either one or two bags per skeleton), all of the available Necropolis 1 cases were inventoried, and any bags from the structures identified in the site report as Copper Age (Structures 13, 14, 27, and 52) were examined and screened for human remains. This inventory also produced 21 smaller bags of Copper Age osteological material, which were labeled variously as "Restos Humanos," "Huesos Sueltos" and "Cerramos" ("Human Remains," "Loose Bones" and "Closing Units," my translation), though a few contained individual faunal burials that had also been depicted on the site maps.

This inventory, combined with the overlapping elements that were occasionally recovered from the individual burials (e.g. Individual 8 from Structure 14 was bagged with two right scaphoids), produced an additional 149 human bones and 51 permanent teeth that could not be associated with distinct individuals. MNI analysis took into account the provenience of these additional bones, in regard to their structure and stratigraphic level, and the level of completion of the 42 individuals documented. In some cases, where size and age could be assessed, these bones were associated with distinct individuals.

MNE and MNI Estimation for Necropolis 4

As mentioned previously, the staggering volume of human remains recovered from Marroquíes Altos necessitated a slightly different approach to the calculation of MNI. The salvage excavation of this mortuary area in 2001 involved the partial re-excavation of Espantaleón and Unghetti's units from the 1950s (Unit 1, Unit 2, and Unit 3), as well as the excavation of new and undisturbed unit containing in-situ material (Unit 3). Importantly, the records of the 2001 excavation led by Ana Manzano Castillo and José Luis Martínez Ocaña (Chapter 4) note that the upper layers of Units 1, 2, and 4 represent disturbed backfill consisting of fragmentary human bones and sediment that derived from the excavations in the 1960s. This means that teeth recovered from these units could derive from either the *Tumba de la Columna* or the *Tumba del Niño*, as Espantaléon and Unghetti did not record the provenience of their backfill sediment; thus it is impossible to determine where any recovered loose teeth was originally buried within these two tombs. As a result of the disturbed nature of the teeth excavated from Unit 1, 2, 4, and 5 (referred to as Provenience 1) all teeth from these contexts were used to produce a dental MNI estimate. Because Unit 3 (referred to as Provenience 2) was excavated in situ, a separate MNI was produced for N1.

Subadult dental MNI was calculated by dividing subadult teeth into age categories using the level of crown and root development for loose teeth, and dental eruption sequences for articulated teeth. The remaining loose developing permanent teeth, deciduous teeth and developing deciduous teeth were divided up into developmental stages using the Atlas of Tooth Development and Eruption (AlQahtani 2009; AlQahtani et al. 2010), and a tooth MNE was calculated for each separate age category. The tooth MNE was used to calculate the MNI for that same age category. Adult dental MNI was calculated with reference to the most commonly recovered apex complete permanent tooth. The combined adult and subadult MNIs from Provenience 1 and Provenience 2 were used to estimate an overall MNI for Marroquíes Altos.

Estimation of Age

Due to the fragmentary nature of the Marroquíes Bajos human remains, a range of techniques were used to estimate individual age-at-death. This section outlines the skeletal and dental techniques used to assess the age of subadults, followed by the skeletal and dental techniques used to estimate the age of adult individuals. "Subadult" refers to an individual with a midpoint age of less than 18 years, while "adult" refers to an individual with a midpoint age greater than 18 years.

Estimation of Age for Subdults Using the Teeth

Dental development has long been considered one of the most reliable indicators of age-at-death due to its stability even in the face of somatic perturbations like ill health (Smith 1991), as well as the relatively universal and regular eruption and formation times for given tooth types. Dental development seems to be ."..under tighter genetic control" (White 2000:342) than postcranial development, and dental age shows less variability for a given chronological age than does skeletal age (Baker et al. 2005; Scheuer and Black 2004). Additionally, "[t]he timing of emergence or sequencing of the deciduous teeth appears to differ only slightly between the sexes or regions of the world" (Scheuer and Black 2004:165), making the use of dental aging techniques key for bioarchaeological studies of prehistoric populations that may have no modern reference population.

The predictability of the sequence of dental eruption and formation is likely related to the formation of the teeth *in utero*, where they are subjected to fewer disruptive environmental forces than other elements of the skeleton which are exposed to external factors like climate, nutrition, and the effects of socio-economic status for greater periods of time (Scheuer and Black 2004:16). Additionally, because enamel does not remodel after it has formed (Buikstra and Ubelaker 1994), dental defects that result from developmental disturbances experienced during childhood can provide a permanent record of early life stress, particularly stress due to starvation episodes.

Importantly, while sequences of tooth formation and eruption are more regular and predictable than most types of postcranial development, differences have been noted in the rate of maturation for males and females for specific teeth. Canines demonstrate a greater degree of sex-based variability in development and eruption than other teeth, and the third molars are extremely variable in terms of sequences of formation and eruption (White 2000; Hillson 1996). Additionally, in many individuals, third molars do not erupt at all (Lavelle, Ashton and Flinn 1970), making it essential to distinguish whether a lack of M3 eruption is due to youth or the result of agenesis. In this analysis, third molar absence was treated as agenetic if (i) all permanent teeth besides the M3 were in occlusion and there was not sufficient space on the mandibular ramus for another tooth or (ii) all permanent teeth besides the M3 were in occlusion and evinced at least moderate wear.

When multiple developing permanent and deciduous teeth were present for a single subadult, tooth formation and eruption were taken into account in order to maximize the rigor of the age estimate, as both comprise key components of the process of dental development (Smith 1991). AlQahtani (2009) and AlQahtani et al. (2010) present a visual representation of the sequence of formation and eruption of teeth among a large sample of 176 individuals ranging from 28 weeks in utero to 24 years of age. Each image indicates the level of crown formation, degree of root development, and state of eruption for all teeth in the dental arcade for a given age range. For example, the visual depiction of the 4.5 year age category (4-5 years given the midpoint of one year designation) displays all deciduous teeth fully erupted with complete roots, and the beginnings of crown formation for both premolars and permanent second molars, and the beginnings of crown or root formation for I1-M2, with all permanent teeth still in their crypts.

The visual depiction of the Atlas can be easily compared to a series of summary tables that provide a sample size for each tooth, as well as a minimum, median, and maximum stage of development. What is particularly valuable about the AlQahtani method is that all individuals are of known age-at-death, and each age category from years 2-24 is represented by a balanced sample of 12 male and 12 female individuals. The majority of individuals in the London Atlas sample are white and likely European (though half of the sample for individuals aged 2-24 years is Bangladeshi). This still provides a significantly better reference population than alternative methods, as other popular diagrams summarizing both formation and eruption, such as Schour and Massler (1941) are grounded upon “terminally ill” modern reference populations, or Native American populations (Ubelaker 1989).

For loose developing deciduous and developing permanent teeth from fragmentary and commingled contexts, the AlQahtani method for aging was also employed. Each complete tooth was compared to the stages of permanent tooth formation established in Smith 1991 (Figure 3; See also Buikstra and Ubelaker 1994: Figure 23) in order to assess the stages of formation of the crown, root and apex of the tooth, a system that is completely comparable with the Moorees' stages used in AlQahtani et al. (2010). Once the tooth was coded, the resulting developmental stage was used in concert with the data tables from AlQahtani et al. (2010) in order to produce an estimated age range for the individual.

Estimation of Age for Subdults Using the Skeleton

Because "the relationship between chronological age and dental age is stronger than for chronological age and skeletal age" (Scheuer and Black 2004:3), subadult age estimates derived from the teeth are considered more precise than estimates derived from aspects of the skeleton. Long bone epiphyseal growth is more variable than dental development, with ages of fusion varying relative to individual, sex and population (White 2000). For a worthwhile visual and graphic representation of inter-individual variability in epiphyseal fusion, a brief examination of White's Figure 17.5 and Figure 17.6 is strongly recommended (White 2000:350–351).

The reduced utility of postcranial remains relative to dental remains when estimating age-at-death for subadults is largely a result of the data available for measurement in archaeological assemblages. Buikstra and Ubelaker (1994:40) underscore that "[m]ost data collected from immature remains document the various maturational systems operating during growth and development," which for juveniles involves the development or fusion of epiphyses, the unification of primary ossification centers, and the length of long bone diaphyses. In particular, epiphyseal union is a diachronic process that can be difficult to quantify in archaeological samples, for though the .”..entire process can extend over quite a considerable period of time, it can also occur quite rapidly within the space of a matter of months and so in this situation it is often difficult to capture a critical moment in dry bone specimens" (Scheuer and Black 2004:13). Such difficulties are compounded by our inability to satisfactorily sex juvenile remains, because patterns of postcranial development are greatly affected by sex-related differences in timing of the onset of the adolescent growth spurt (Scheuer and Black 2004). Accordingly, while epiphyses and metaphyses do fuse in a predictable pattern as growth ceases, females show union prior to males, which has important consequences for the accuracy of age estimates.

Sex-based and population-based variability is exacerbated by the nature of epiphyses themselves, which are prone to under-representation in archaeological data sets. Scheuer and Black have bemoaned the informational gap concerning the development of certain juvenile bony elements (particularly in the 6-12 age bracket) that has resulted from the differential preservation and incomplete excavation of archaeological samples, as well as the "sensitivity and obvious emotional consequences" (2004:12) of contemporary childhood deaths that make obtaining clinical samples difficult. Unfortunately, the vagaries of preservation and excavation of juvenile archaeological remains introduces an equifinality to subadult skeletal assemblages that makes it difficult to establish definitive lower bounds for younger individuals. Specifically, an unfused epiphysis may not be present as a result of the individual's developmental stage *or* its absence may be a result of uninformed excavation strategy and/or taphonomic destruction. Scheuer and Black highlight this difficulty, noting that the formation times of ossification centres are "of little use in the estimation of age at death of individuals forming part of a skeletal assemblage as it is unlikely that very early ossification centres would be recovered or indeed identified" (Scheuer and Black 2004:14).

Finally, "[b]oth skeletal and dental age require the individual to be compared to a known standard and this in turn will introduce areas of incompatibility. For these reasons, the establishment of age at death from juvenile remains, whilst more reliable than that for adults, is always an estimation" (Scheuer and Black 2004:3). Accordingly, while age-estimates derived from subadult teeth were given priority in assessing the age of Marroquíes Bajos individuals, the following strategies were used in instances where either (i) teeth were not available or (ii) both dental and skeletal elements were present.

1. Epiphyseal Fusion

There are two different pathways of bone development: intramembaneous ossification (where bone develops from membranous precursors, as in the bones of the skull and face) and endochondral ossification (where bone develops from a cartilage template, as in the long bones). For most elements, a primary center ossifies first, as in the humeral shaft, where the primary ossification center appears prenatally at weeks 7-8 (Scheuer and Black 2004:355). Secondary centers normally appear after the development of the primary center; when these form as separate elements they are referred to as epiphyses (Baker et al. 2005). Once epiphyses are well developed enough to be identifiable they can then be used to estimate the age of an individual based on their size and morphological characteristics (Scheuer and Black 2004). Additionally, the timing of epiphyseal fusion, though variable between the sexes and within different regions of the body, is relatively well established, and is routinely used to estimate age-ranges for individuals from archaeological contexts (Buikstra and Ubelaker 1994; Scheuer and Black 2004; Baker et al. 2005). When assessing the age of subadults in the Marroquíes Bajos population, both the presence of epiphyses and their stage of fusion was recorded, particularly with reference to the following resources.

Mackay (1961) provides an illustrative diagram which presents a visual representation of the appearance and fusion of epiphyses in the shoulder, elbow, hand and wrist, hip joint, knee joint and foot and ankle regions of the postcranial skeleton. Additionally, a specific set of age ranges for diaphyseal appearances are presented for foetal remains. For each bone or epiphysis, Mackay provides an average age of appearance for both males and females, the *range* of ages of appearance, and an age range for fusion of epiphysis and metaphysis. For example, the data he presents for the lateral epicondyle of the humerus indicate an average appearance at 12 years of age for males and 11 years of age for females, and a range of fusion from 11-14 years for both sexes. If ranges of fusion are sexually dimorphic (as they are for the trochlea), ranges of fusion are presented for each sex. Given that Mackay's research affiliation is a UK - based institution (and it is near impossible to track down any other provenience information besides that listed on the chart itself), it is likely his reference populations are of European descent, which is appropriate for the regional affiliation of the population under discussion.

In addition to Mackay's chart, Scheuer and Black's definitive volumes *The Juvenile Skeleton* (2000) and *Juvenile Developmental Osteology* (2004) can be used establish lower and upper limits for developmental events. Scheuer and Black highlight ossification events for the occipital, temporal, frontal, mandible, C1, vertebrae, clavicle, all long bones, the calcaneus, and the os coxae. By examining which developmental events have occurred it is possible to establish a lower age limit for an individual, while examining which events have yet to occur allows for the establishment of an upper limit.

For example, if the mandible is present and the symphysis has fused, it suggests that the individual has survived birth, while if *pars basilaris* and *partes laterales* are both present for the occipital but have not yet fused, the individual is likely under 5 years of age. Clearly, the more complete the skeletal remains available for an individual the more precise this age estimate can be. Importantly, Scheuer and Black's reference population is largely composed of Anglo-American children, many of whom may have suffered from particularly poor health. While this may not be readily commensurable with a sample of Copper Age subadults drawn from a disparate environmental context, the use of these individuals as a reference population is defensible given their likely European ancestry. Additionally, dental evidence suggests that while few subadults from Marroquíes Bajos displayed skeletally-preserved symptoms of illness, many did suffer from prolonged periods of malnutrition as evidenced by the presence of hypoplasias on developing permanent teeth, making Scheuer and Black's standards more applicable for this population.

2. Element Size

The size of each element was used as a criterion for age estimation when remains were (i) too fragmentary to preserve epiphyseal surfaces, but of such a small size that they were necessarily subadult or (ii) relatively complete diaphyses of subadult long-bones were preserved. An intra-observer test of replicability was performed on a sample of 10 subadult long bones (femur, tibia, humerus, radius, ulna) using a bone board – the second measurements excactly replicated the first measurements producing a Technical Error of Measurement of 0.0 cm calculated using the formula outlined in Ulijaszek and

Lourie (1994:30).

In instances of extremely fragmentary but obviously subadult remains, the to-scale diagrams provided in Baker et al. 2005 were used as benchmarks to establish broad age ranges. For example, the relatively complete left femur of subadult N1.CE13.21 fell in between the size range for the to-scale Figure 8.10 (Baker et al. 2005:113) of the 1.5 year old femur and the 5 year old figure, skewing slightly towards the higher end of the spectrum, which agreed with the dental age estimate of this individual (4.3 to 7 years of age).

Baker et al.'s to-scale figures were employed for subadults lacking sufficient well-preserved teeth because complete subadult diaphyses did not preserve frequently in any of the mortuary contexts at Marroquíes Bajos. However, when relatively complete, conjoined diaphyses were encountered, Ubelaker's (1989) chart "Correlations between Chronological Age Estimates and Maximum Diaphyseal Lengths" was employed. Ubelaker used a reference collection of protohistoric Arikara to produce a chart summarizing the correlations between chronological age estimates and maximum diaphyseal lengths of long bones. After examining all of the long bone diaphyses available in his archaeological sample, he described a mean length, standard deviation and range for each one-year age bracket. Ubelaker also lists the sample size he used to achieve his means, allowing the observer to determine the relative significance and strength of the measurements for each age bracket.

Baker et al. (2005) provide to-scale figures for all long bones, but not for the rest of the skeleton. Accordingly, in instances where subadult metacarpals, metatarsals, and manual or pedal phalanges with unfused heads or bases were preserved, maximum lengths were measured and compared to the standards outlined in Scheuer and Black's 2000 volume (e.g. Table 9.25, p.340). These tables present mean values for maximum metacarpophalangeal lengths and metarsophalangeal lengths, and these metrics provide a means of estimating approximate age-at-death based on element size. An intra-observer test of replicability using digital calipers on a subsample of 10 adult third metacarpals and third metatarsals showed an average error of 0.32 mm between measurements and produced a TEM of 0.72 using the formula outlined in Ulijaszek and Lourie (1994:30).

White has indicated that using element size or diaphyseal size to determine subadult age is a procedure that "…is not as exact as others and should always be done with reference to the same or a closely related skeletal collection" (2000:349). The genetic and environmental mismatch between Ubelaker's (1989) Arikara sample, Scheuer and Black's (2000) Nigerian sample and the Copper Age inhabitants of a large-scale settlement in southern Spain must be underscored when assessing the accuracy of subadult age estimates at Marroquíes Bajos. Unfortunately, no similarly broad-scale study of correlations between maximum diaphyseal length and chronological age currently exists for European populations, nor do age-based measurements of maximum metacarpo- and metarsophalangeal lengths.

3. Morphology of Elements

For elements with only a single primary center of ossification, such as many of the carpals and tarsals, the overall morphology of the bone is able to provide a lower limit for age-estimation. For example, Baker et al. (2005:143) note that the navicular "…has few recognizable features and cannot be readily identified in isolation" up to about age 7 to 8 years. Accordingly, the appearance of readily identifiable carpal and tarsal bones was occasionally used as a means of establishing a lower-bound for the age-range of an individual that was obviously subadult based on the size and level of development of elements.

Estimation of Age for Adults Using the Teeth

As Boldsen and Milner (2002:6) underscore, "estimating age is a critical part of the study of skeletons from archaeological or forensic contexts." Culturally, age is a crucial component of identity, and age estimates are useful when producing inferences of social, political, and economic complexity from interments (O'Shea and Svelebil 1984). Age estimates produced for a number of individuals drawn from one mortuary sample also allow for the detection of census error, and enable the archaeologist to determine whether the sample population is representative of a living community or is significantly biased with regards to expected demographic parameters (Collier 2014). Age-estimates for larger samples can also be compared to contemporary or historic demographic patterns in order to investigate local, regional, and possibly global patterns of paleodemography synchronically and diachronically. Finally, accurate age estimates can be used to provide further detail in population health comparisons, especially when investigating the impact of diseases on individuals drawn from specific age categories (e.g. DeWitte 2014).

For adult individuals from Marroquíes Bajos, age was predominantly assessed using data from dental wear. Pelvic remains were far less frequently preserved than teeth, but when present both the auricular surface of the os coxa and the pubic symphyseal face were used in order to estimate age.

1. Dental Wear

Dental wear occurs as the result of tooth-on-tooth abrasion during the process of mastication (Brothwell 1981). Much like osteoarthritis, dental wear is markedly age-progressive; enamel does not regenerate once formed (Gilmore and Grote 2012) and the continued use of the permanent teeth wears away at enamel, particularly on the occlusal surfaces of the teeth. Accordingly, the degree of dental wear can provide bioarchaeologists with information about an individual's age-at-death. Importantly, the patterning and degree of dental wear are affected by a number of factors besides individual age, including the abrasiveness of an individual's diet and the cultural prevalence of the use of teeth as tools (Brothwell 1981). While the patterning and severity of tooth wear thus varies between populations and over time, dental wear in a given individual can be used to provide age-estimates relative to other individuals drawn from the same chronological and cultural contexts (Miles 1962).

Some of the first widespread and successful applications of this technique to archaeological populations were undertaken by Miles (1962, 1969), in his analyses of the dentition of Anglo-Saxon populations dating from the 7th – 9th centuries A.D. Miles used the degree of wear on the permanent molars of subadult individuals of known ages to extrapolate rates of wear and estimate the ages of older individuals in the same population. Because the timing of lower molar eruption is relatively predictable, Miles was able to use stages of M_1, M_2 and M_3 eruption as a method for assessing subadult age, and then examined the degree of wear on any molars that had already erupted to calculate an approximate rate of wear. Miles made the important observation that not all classes of molars wear at the same rate. In particular, "…it takes only six years for M_1 to reach a state of wear that it takes M_2 and M_3 respectively six and a half and seven years to reach…[so]…if a third molar is found which matches a first molar which shows 18 years of functional age, by a simple calculation it is possible to say that the third molar is 21 years of functional age" (1962:20). By relying on the wear gradient 6:6.5:7 (M_1:M_2:M_3), starting with the wear-scores of subadults with known ages-at-death, Miles was able to estimate the age of older individuals based on the relative amount of wear on each category of tooth.

While the Miles method is thus a useful strategy for estimating adult age using dental wear, it has two significant difficulties. First, it relies on samples which contain a large number of subadults with relatively complete teeth, rendering it less applicable to populations drawn from fragmentary prehistoric contexts like Marroquíes Bajos. Second, Miles based his eruption times on a combination of data derived from a slightly modified Schour and Massler chart (1941), as well as additional data collected from contemporary subjects. Fortunately, Gilmore and Grote (2012:182) anticipated this very problem, and created a modification of the method that applies specifically to samples "where juveniles and post-cranial elements are under-represented."

The Gilmore and Grote modification of the Miles method calculates the average difference in wear between an individual's M1s and M2, then sums these values for the sample population to establish a mean and standard deviation for the sample M1-M2 difference. The wear score for each class of tooth is produced by averaging all scores available for both upper and lower categories of the same tooth (e.g., for a given individual i, the M1 wear score is the average score of all quadrants for the LM_1, RM_1, LM^1 and RM^1). All individuals with extremely low M1 wear scores (where $M1i - 1 < \overline{D}_P + sd(D_p)$) are excluded from calculating the population wear rate, to avoid producing artificially constrained values based on the small M1-M2 differences that would result from very recently erupted M1s. Importantly, while these individuals are removed from the calculation of wear rate, their ages can still be estimated using this modification of the Miles method. After winnowing the sample to exclude individuals with lightly worn M1s, average wear per year is calculated for the sample population by dividing the population average difference by the number of years between the eruption of the first and second molars ($\overline{\Delta}_p \,/\, TM1 - TM2$).

An important asset of the Gilmore and Grote modification is that commensurate eruption standards can be selected by the researcher, and different standards can be used for different sample populations. Gilmore and Grote provide eruption times that result from pooled averages and standard deviations of M1, M2 and M3 eruption times, drawing upon research on non-industrialized populations where sample size was reported. These standards, rather than those derived from Miles' modern reference population, were used when calculating age from dental wear rates for the Marroquíes Bajos populations. While estimates of eruption times are drawn from a number of different, non-commensurate reference populations, these average eruption times have the advantage of being drawn exclusively from non-industrialized populations, a condition that well describes the Iberian Copper Age.

Once the population wear rate has been calculated, Gilmore and Grote follow Miles' basic strategy of adding the age of eruption to functional age to estimate age at death: "To estimate the age in years of an individual i in population p, *wear*M1$_i$ is divided by the population wear rate $R_p = \overline{\Delta}_p \,/ (TM2 - TM1)$ (in Scott's units per year) and added to the age of molar eruption (e.g. *TM1*)" (2012:185). Because M1 demonstrates the least variability in eruption times it is the preferred tooth class for age estimation. The only exceptions to this reliance on M1 are: (1) If the tooth is not present, or (2) If any M1 quadrant has a wear score of 10. In these instances, M2 is used for age estimation. M3 is used only if both M1 and M2 are absent.

One of the weaknesses of this method is that it likely underestimates age in older individuals, but as Gilmore and Grote underscore, this is a general problem for most standard methods of osteological age estimation. Importantly, when the age estimates produced by the initial test of this method were compared to age estimates produced by other skeletal indicators for a subsample (N = 22) of the larger study population, "Roughly half of the point estimates from the modified Miles method [fell] within the age category based on pelvic indicators, and in all but one case…[and] the point estimate ± 1 standard deviation range overlaps with the age category, suggesting the modified Miles method is still effectively tracking age estimated by traditional methods" (2012:186). Because so few members of the mortuary population had preserved pelves or crania, this method of age estimation relying on dental wear was the primary form of age assessment used for adults at Marroquíes Bajos.

Estimation of Age for Adults Using the Skeleton

Once all epiphyses have fused, it is possible to estimate age from morphological changes to specific regions of the adult skeleton, including specific areas of the pelvic girdle, thorax, and cranium. However, because of the fragmentary nature of the Marroquíes Bajos remains, certain popular osteological techniques like cranial suture closure (see Buikstra and Ubelaker 1994:34–36) or the morphology of the sternal end of the 4th rib (Işcan et al. 1984) were not used because these anatomical regions preserved infrequently, and were highly fragmentary when they did preserve. Accordingly, the primary post-cranial methods for age estimation in the Marroquíes Bajos sample relied on evaluating (i) the auricular surface of the os coxae and (ii) the pubic symphyseal face.

1. Auricular Surface

The auricular surface is a particularly valuable region for age estimation as it is more frequently preserved than the pubis in many archaeological collections, and the age-related changes it undergoes occur beyond the age of 50 years (White 2000). However, the systematic changes it exhibits "are more complex and difficult to score than those of the pubic symphysis" (Buikstra and Ubelaker 1994:24). Lovejoy and his colleagues summarize this methodological dilemma nicely by noting "that auricular surface aging is more difficult to master than the Todd method for the pubic symphysis, but… the potential rewards are worth the extra effort, as the method is independent of symphyseal aging but equally accurate" (quoted in White 2000:355).

The auricular surface aging method focuses on systematic age-related changes in grain and density, porosity, billowing, striations and degree of transverse organization in the superior demiface, apex, inferior demiface and retroauricular area of the auricular surface (Lovejoy et al. 1985). The authors produced a stage-based methodology which incorporates eight distinct phases, spanning < 15 to > 60 years of age-at-death. A particularly useful feature of this method is that it can be used to estimate the age of individuals when *only* the auricular region of the ilium is preserved, a frequent preservational pattern in fragmentary prehistoric contexts (Lovejoy et al. 1984; Walker 2005). Indeed, as Todd (1920:288) himself poetically notes "[the pubis] is a relatively delicate bone and is often missing in skeletons which have lain for centuries in the earth, or is so badly damaged as to be of no value in age estimation."

2. Pubic Symphyseal Face

As Buikstra and Ubelaker highlight, "[m]orphological changes of the pubic symphyseal face are considered to be among the most reliable criteria for estimating age-at-death in adult human remains" (1994:21). This utility is predominantly a result of the fact that "[a]ge related changes on this surface continue after full adult stature has been achieved and other epiphyses of the limbs have fused" (White 2000:249). Unsurprisingly, osteologists have been preoccupied with creating an accurate standard for estimating age-at-death that reflects these criteria since the early 20th century, with varying degrees of success. While two different methods for estimating the age of individuals using the pubic symphyseal face are outlined below, the Suchey-Brooks method was preferred for any individuals where sex could be estimated at death.

I. Todd

In the 1920's T. Wingate Todd formalized a method that classified age-related changes in the pubic symphysis by using a sample of 306 white males for which age-at-death was known (Todd 1920, 1921). Later, he added 47 females and 112 individuals (90 males and 22 females) of African descent to the sample, eventually producing 10 distinct phase designations for the symphyseal face, ranging from 18-19 to 50+ years of age (Todd 1921). Todd separated the symphyseal region into four distinct parts: the ventral border, the dorsal border, the superior extremity and the inferior extremity. Using dissection samples, he created a "stage method" for age estimation, in which the individual is assigned to the stage that most closely resembles it, with more advanced changes privileged due to the possibility of retention of younger symphyseal characteristics over the developmental process.

Importantly, Todd himself noted that though the symphysis acts as a "time marker" throughout adult life, it showcases chronological age "…less clearly from forty years onward than at an earlier age" (Todd 1920:288). While the method enjoyed a wide and largely unquestioned acceptance until mid-century, in 1955, "Brooks found a tendency of the Todd system to overage, especially in the third and fourth decades" (White 2000:352).

II. Suchey-Brooks

The awareness of replicability issues with the then-current methods for estimating sex from the pubic symphyses led Judy Suchey and Sheilagh Brooks to test both the Todd system and the McKern and Stewart system. The latter system was developed in 1957 from a sample of 349 "Operation Glory" Korean war dead, and produced a bias towards the over-identification of younger male individuals. By using a large sample of individuals from Los Angeles county for which age-at-death was documented, they determined that Todd's method was more accurate than the McKern and Stewart method (Brooks and Suchey 1990). Accordingly, they modified the Todd system, collapsing the ten stages into six new stages with separate standards provided for males and females, and produced very wide confidence intervals for their age ranges. Because the Suchey-Brooks method is a deliberate, sex-based modification of Todd that is explicitly more cautious in its age-range estimates, it was the preferred method used when evaluating the Marroquíes Bajos sample for individuals who had sex assessed.

Estimation of Sex

Assessing the sex of individuals recovered from archaeological contexts allows archaeologists to answer questions about the consequences of culturally specific conceptualizations of gender on expressions of status (potentially represented in mortuary ritual), as well as more biologically constrained evaluations of disease prevalence or representation that may be effected by sex ratios. When sex has been estimated using rigorous bioarchaeological methods, archaeologists are able to pursue questions pertaining to mortuary ritual and social ranking, cemetery structure, palaeodemography, residence patterning and gender studies that relate to diet and occupational specialization. Finally, while archaeologists have traditionally used grave goods to predict the sex of individuals, noticeable instances of misidentification, as in the richly accoutered

Margarita tomb at Copán belonging to a female rather than a male (Schuster 1996), and the questionable projection of modern, culturally relative gender roles into prehistoric contexts, as in the case of the "homosexual" Neolithic burial excavated recently in a Prague suburb (Johnson 2011) caution against such unscientific, subjective approaches. Accordingly, the Marroquíes Bajos bioarchaeological analysis employed multiple, complementary, and replicable scientific methods to estimate the sex of individuals whenever skeletal preservation allowed.

When available, both the pelvis and the skull were scored for positive features that indicated either a more masculine or more feminine structure. Crania and os coxae are of particular utility for estimating sex because these are some of the areas where "sex differences in humans are the most extreme" (White 2000:363), keeping in mind the normal intrapopulation variation in metric parameters that can cause ambiguity and produce "some small gracile males and some large, robust females who fall toward the centre of the distribution where sorting sex is difficult" (White 2000:363).

The os coxae are the most diagnostic bones for estimating sex as a result of their underlying evolutionary history and importance in parturition. Buikstra and Ubelaker underscore that "[t]he hip bones present the most reliable indicators of sex in the human skeleton" (Buikstra and Ubelaker 1994:16), largely because the dimensions of the pelvis become broader during adolescence in order to facilitate childbirth. White similarly emphasizes the "dramatic functional differences between male and female pelvic anatomy which extend to the bony skeleton, differences found in all modern human groups" (White 2000:366), which have been produced by selective pressures over the course of human evolution.

Accordingly, five different expressions of pelvic morphology were scored whenever innominate bones were present: the pronouncement of the ventral arch ridge, the degree of subpubic concavity along the inferior aspect of the ischiopubic ramus, the expression of the ischiopubic ramus ridge, the width of the Greater Sciatic Notch (GSN), and the presence and expression of the preauricular sulcus. Females are more likely to demonstrate positive expressions of the features for all attributes of the subpubic region, wider Greater Sciatic Notches (Walker 2005), and the presence of a preauricular sulcus. Accordingly, the first three attributes are scored on a scale of 1 – 3, with 1 indicating a positive female expression and 3 indicating the male absence of such attributes. The GSN is scored on a 5-point scale, with greater numbers indicating narrower widths, and variations of the preauricular sulcus form and depth are scored on 4 point scale, with 0 indicating an absence of the feature entirely.

The first three features scored are derived from the Phenice method of sexing the os coxae (1969), and tests performed using large samples in the early 1990s suggest that of the three, the sub-pubic concavity and ventral arc are the most successful in accurately estimating sex (White 2000:368). Phenice himself suggested that "the ventral arc is the most reliable indicator; the ischiopubic ramus ridge, the least" (Buikstra and Ubelaker 1994:16). The latter two features are thought to be slightly less diagnostic than the Phenice features. While the width of the Greater Sciatic Notch (GSN) is generally wider in females than in males (contributing to the general expansion of pelvic breadth characteristic of female reproductive morphology), Buikstra and Ubelaker indicate that the shape of the GSN is "not as reliable an indicator of sex as the conformation of the subpubic region due to a number of factors, including the tendency for the notch to narrow in females suffering from osteomalacia" (Buikstra and Ubelaker 1994:18). Additionally, the GSN may scale to body size, increasing the ambiguity in sex estimation for larger females or smaller males. Similarly, while the preauricular sulcus "assumed to be more commonly occurring in female individuals than in male individuals (Buikstra and Ubelaker 1994:18), its presence or absence may be a less reliable indicator of sex than the aspects of the pubis and ischiopubic ramus analyzed using the Phenice method.

Attributes of the cranium and mandible were also subjected to morphological scoring, based largely on the observation that male skulls tend to have a larger and more robust morphology than female skulls (White and Folkens 2005). Accordingly, five aspects of the skull were scored whenever possible: the robusticity of the nuchal crest, the size of the mastoid process, the sharpness of the supraorbital margin, prominence of the glabella and projection of the mental eminence. Many of these traits, particularly the size of the mastoid process and subraorbital ridge and shape of the mandible, have been consistently found to be reliable indicators of sex in individuals whose sex during life was known (Williams and Rogers 2006). As with the pelvic attributes, more feminine expressions of these features have lower scores and more masculine expressions have higher scores.

While certain aspects of cranial morphology can therefore be informative in regards to the likely sex of an individual, Buikstra and Ubelaker urge caution when using cranial morphology to estimate sex, indicating that "populations vary markedly...For some groups, cranial morphology provides a reliable basis for sex determination; for others, it does not" (Buikstra and Ubelaker 1994:19). White (2000) similarly stresses the importance of using comparative populations when estimating sex. In assessments of sex for the Marroquíes Bajos population, morphological scoring of the ossa coxae was accordingly weighted more heavily in final estimations of sex than morphological scoring of the skull, particularly when both pelvic and cranial elements were both preserved.

There are a number of other methods that can be used to estimate the sex of human skeletons. First, just as the male skull is generally more robust than the female skull, measurable dimorphism exists in the postcranial skeleton for most populations. Accordingly, osteologists and anatomists have used clinical samples of individuals of known sex to derive discriminant functions that allow for the estimation of sex in archaeological populations (for example, in Gentry Steele and Bramblett 1998).
While White indicates that measurements of the most dimorphic limb bones "have usually been found to correctly identify the sex of between 80 and 90% of all individuals," and that "[m]any studies have been conducted on known-sex samples to derive discriminant functions capable of classifying sex accurately more than 85% of the time for a variety of elements," he also firmly underscores that "[t]hese functions are often not tested beyond (independent of) the skeletal populations on which the discriminants were based, so claims of accuracy are sometimes questionable" (White 2000:365). Additional, intrapopulation misidentification of sex can result from "size overlap between males and females in the centre of the overall range" (White 2000:365–366). Accordingly, because assessments of sex using the pelvis and skull are generally considered more reliable, and because measurements could be taken for so few adult individuals on the same element, discriminant functions were not used when assessing the sex of individuals at Marroquíes Bajos. Similarly, while discriminant function analyses of specific cranial measurements have also been used in the past to estimate the

sex of individuals recovered from historic and prehistoric archaeological contexts (Giles and Elliot 1963), the Marroquíes Bajos crania were too fragmentary for such techniques to be useful in more than a handful of cases. Finally, while osteologists also employ metrics like femoral head diameter, radial head diameter, and the epicondylar breadth of the humerus in tandem with sectioning points to assess sex, very few individuals from either Necropolis 1 or Necropolis 2 had well-preserved proximal or distal ends of long bones. Accordingly, for both Necropolis 1 and Necropolis 2, non-metric traits of the cranium and pelvis were used when assessing the sex of adult individuals.

Accelerated Mass Spectrometry Radiocarbon Dating

Accelerated Mass Spectrometry (AMS) radiocarbon dating of archaeological specimens is based on a series of relatively simple premises. ^{14}C is produced by cosmic-ray bombardment in the upper atmosphere, then oxidized and distributed throughout the Earth's atmosphere and biosphere. Living organisms take in ^{14}C in amounts that are in "approximate equilibrium" with atmospheric levels of ^{14}C. While ^{14}C does decay in living tissue, it is replaced over the course of an organism's lifetime by the consumption of other organisms like plants and animals. However, after death the cessation of metabolic processes leads ^{14}C levels to decrease at a known rate through the process of radioactive decay (Taylor 1997). Accordingly, the radiocarbon age of a sample can be estimated by measuring the amount of residual ^{14}C that it contains. Importantly, this method of dating must be calibrated to account for violations of specific theoretical assumptions – namely "that ^{14}C activity in living organisms has not remained constant over the ^{14}C time scale because of changes in ^{14}C production rates or parameters of the carbon cycle" (Taylor 1997:68).

Accelerated Mass Spectrometry (AMS) relies on measuring differences in the abundance of different isotopes of C. This is done by ionizing and accelerating C atoms and passing them through a magnetic field where they are deflected in proportion to their mass. The ion beam current at each mass is measured yielding the relative abundance of the different isotopes (Taylor 1997). On the whole AMS methods offer a means of measuring isotopic concentrations that is up to 10,000 times more sensitive than previous decay counting methods (Accelerator Mass Spectrometry Laboratory 2014).

Establishing the quantitative chronology of Necropolis 1, Necropolis 2, and Necropolis 3 represented an essential step in determining if and how mortuary practices changed over time and space during the history of Marroquíes Bajos. Qualitative artifactual and architectural evidence, including the type of ceramics, metal, and bone objects interred as grave goods, form and organization of the funerary structures, and the collective nature of the inhumations at Necropolis 1, Necropolis 2, and Necropolis 4 all strongly suggested that these mortuary areas were dated to the Late Prehistoric period. Additionally, radiocarbon dates drawn from Necropolis 3, another mortuary area with comparable forms of material culture and spatial organization, cluster at around 2531-2132 cal BC (Cámara Serrano et al. 2012) while, a *fosa commún* (mass burial, translation mine) interred in the fifth enclosure ditch and analyzed by Sánchez et al. (2005) has also been dated to the second half of the third millennium. Because the ^{14}C time scale stretches from about 300 to 40,000-60,000 years before present (Taylor 1997) AMS radiocarbon dating was deemed an appropriate quantitative method for assessing the chronological age of the burials at Necropolis 1, Necropolis 2, and Necropolis 4.

Selection of Samples for Radiocarbon Dating

In fall 2013, three samples of well-preserved post-cranial bone (three anatomically overlapping portions of femoral shafts from discrete individuals) were selected from the mortuary structures at Necropolis 2 in order to ascertain whether preservation conditions at Marroquíes Bajos would allow for the recovery of dateable osteological material. Funding for these dates was provided by the project "*Provincia metalúrgicas Euroasiática y Europeal del II milenio a.n.e.: investigación de sus interacciones a partir de métodos científico-naturales*," Principal Investigadora Dr. María Isabel Martínez Navarrete. Dates were returned in April 2014, providing quantitative evidence that these funerary structures date to the end of the 3rd millennium B.C.E., and confirming that dateable bone was recovered from the site.

Funding allowed for the collection of an additional 34 AMS radiocarbon dates from Marroquíes Bajos. The sample for radiocarbon dating was drawn from the subset of isotopic samples used in carbon, nitrogen, strontium, and oxygen analysis, with priority given to the highest-quality samples that preserved collagen. Preliminary MNI estimates in Fall 2014 suggested a mortuary population of at least 250 individuals – 56 interred in Necropolis 1 (22.4%), 33 interred in Necropolis 2 (13.2%), and 161 interred in Necropolis 4 (64.4%). Though these estimates were further refined over the course of more in-depth bioarchaeological analysis, the initial MNI assessments were used to help develop a radiocarbon dating scheme that selected samples from mortuary areas in proportion to their contribution to the overall site MNI, dividing adult and subadult samples as evenly as possible (Table 5.6). 34 of the AMS radiocarbon samples were processed at the NSF – University of Arizona Accelerator Mass Spectrometry Laboratory.

Table 5.6 Distribution of AMS radiocarbon samples by necropolis

Mortuary Area	Adult mandibles	Subadult mandibles	Post-Cranial Remains	Total
Necropolis 1	9	0	0	9
Necropolis 2	2	0	3	5
Necropolis 4	17	6	0	23
Total	28	6	3	37

Isotopic Analyses of Diet and Regional Mobility

Isotopes are atoms of specific elements that possess the same number of protons but variable numbers of neutrons, thus differing from one another solely in their atomic weight. For example, ^{12}C, ^{13}C, and ^{14}C are all isotopes of carbon, with the numeric modifier representing their atomic weight; each atom of these isotopes contains 6 protons and then 6, 7, or 8 neutrons, respectively. Isotopes can be stable, meaning that they do not decay over time, or radiogenic, meaning that they decay into isotopes of other elements over time (Tykot 2006; Waterman 2012). Isotopes of elements like carbon and nitrogen that are derived from plant and animal consumption are preserved in human hard tissues like bones and teeth, providing records of human and primate subsistence that stretch back to the Miocene (Tykot 2004). Importantly, bone collagen largely represents the protein portion of the diet, while bone and tooth enamel carbonate (conventionally known as "apatite") are produced from a mixture of dietary carbohydrates, fats, and proteins.

Accordingly, isotopic analysis of both bone collagen and bone or tooth carbonate can illuminate different aspects of prehistoric diets (Waterman et al. 2014b).

While zooarchaeological and paleobotanical research can reveal the breadth of foods consumed in ancient diets, stable isotopic research is uniquely useful to archaeologists in that it not only evaluates the range of different types of food consumed in the past, but also quantitatively assesses the relative contributions of different subsistence resources to individual diets. Similarly, while sourcing studies of material culture can be used to document the movement of materials across landscapes and the scope of prehistoric exchange networks, strontium isotopic analysis actually makes it possible to document the movement of prehistoric individuals by comparing and contrasting the geographic signatures preserved in developing bones and teeth.

Isotopic Analyses of Ancient Diets (C, N, and O)

In the mid 1960s, archaeologists focusing on early agricultural societies began to notice a curious pattern: radiocarbon dates returned from samples of preserved maize were found to be consistently younger than radiocarbon dates returned from other organic materials drawn from the same archaeological contexts (Vogel and van der Merwe 1977; Bumsted 1981). This chronological mismatch was the result of the fact that the *Zea mays* species uses the Hatch-Slack or C4 photosynthetic pathway, causing these plants to preserve different quantities of ^{14}C and ^{13}C relative to ^{12}C. In 1977, J.C. Vogel and Nikolaas van der Merwe discovered that this photosynthetic quirk made it possible to measure the relative intake of C3 versus C4 plants in prehistoric human or animal diets. Carbon isotope ratios make their way up the food chain and become preserved in the tissues of plant consumers, and because the C3 pathway depletes ^{13}C abundance to a greater degree than C4 plants, the quantity of ^{13}C preserved in the hard tissues of prehistoric animals provides a signature of their relative intake of each category of plant life. C3 plants are usually grasses that originate in arid or semi-arid environments and have $\delta^{13}C$ values between -22 to -34‰ (average -26‰), while C4 plants are typically trees, shrubs or grasses from more temperate regions and have $\delta^{13}C$ values between -9 and -16‰ (modal average -12.5‰) (Vogel and Van der Merwe 1977; Tykot 2004).

Succulents rely on a third photosynthetic pathway, Crassulacean Acid Metabolism (CAM), and have $\delta^{13}C$ values that are comparable to those of C4 plants (Tykot 2004).

The key process highlighted by early research on C3 *vs.* C4 contributions to diet is differential fractionation, which refers to the differential accumulation of isotopes during metabolic processes as a result of their different isotopic masses, where lighter isotopes generally accumulate in greater frequencies than heavier isotopes (Tykot 2006; Waterman 2012). In addition to the stable isotopes of carbon (^{12}C, ^{13}C), differential fractionation can also be used to understand the relative contribution of isotopes of nitrogen (^{14}N, ^{15}N) and oxygen (^{18}O, ^{16}O) to prehistoric diets.

In contrast to carbon, nitrogen cannot be directly derived from the atmosphere, but instead must be taken in through the consumption of plant or animal tissues. At the lowest trophic level, plants have two means of obtaining nitrogen. The first strategy, in families like legumes, involves “fixing” the element themselves using the microorganisms attached to their roots, while the second tactic involves obtaining it from the soil itself. Nitrogen isotope ratios are dependent on whether plants are N_2-fixing or whether they obtain the element directly from soil nitrates, though $\delta^{15}N$‰ is also affected by geographic and seasonal factors (DeNiro and Epstein 1981). Non N_2-fixing plants experience fractionation, resulting in a positive nitrogen signature (e.g. the $\delta^{15}N$ values are enriched above the level of atmospheric concentration due to preferential uptake of lighter isotopes). This process of fractionation occurs at every subsequent step in the food chain, leading to greater enrichment of $\delta^{15}N$ at higher trophic levels (Waterman 2012). In particular, comparisons of $\delta^{15}N$ levels preserved in human bone, relative to those preserved in coeval carnivore bone, can illustrate the amount of meat consumed by prehistoric humans (Drucker and Bocherens 2004). However, though the general relationship between trophic level and nitrogen enrichment is well demonstrated, the relationship between ^{15}N enrichment and diet in humans is less well-explored, and underlying assumptions in model parameters can greatly affect estimates of the quantity of meat consumed by prehistoric individuals (Hedges and Reynard 2007).

Nitrogen isotopic signatures also differ between organisms inhabiting terrestrial and marine environments. Human bone drawn from a population relying on a terrestrial subsistence base demonstrates lower bone collagen $\delta^{15}N$ values (in the range of 6-10‰), while human consumers who exploit a marine subsistence base exhibit higher bone collagen $\delta^{15}N$ values, in the range of 15-20‰ (Tykot 2004). Studies using diet-controlled mouse and insect models have demonstrated that the distinct signatures observed in archaeological materials are not specious, as distinguishing between the dietary contribution of legumes and non-legumes, as well as terrestrial versus marine resources, is possible in circumstances where animals' initial diets were known and documented (DeNiro and Epstein 1981).

Finally, stable isotopes of oxygen can also provide important insights into ancient diets, specifically information concerning the timing of weaning. An individual's oxygen isotopic values are derived from their source of drinking water, and such values vary relative to aspects of local environment like climate and elevation. However, in humans, young infants are the sole age category that relies on a different source of hydration; they do not drink water from their local environment, but are rather nourished solely by their mother's breast milk (Waterman 2012). The relative contribution of breast milk to a subadult diet can be measured because $\delta^{18}O$ fractionation occurs as milk containing oxygen isotopes passes between mother and child. As a result of fractionation, breastfeeding children have elevated $\delta^{18}O$ values relative to members of their community who are dependent on other subsistence resources. The narrow dental age estimates possible for subadult individuals then allow for biocultural processes like weaning and the transition to solid food to be examined quantitatively by measuring the $\delta^{18}O$ values of developing and developing permanent teeth relative to adult individuals from the same community (Wright and Schwarcz 1998; Waterman 2012).

Isotopic Analyses of Ancient Mobility (O and Sr)

As mentioned briefly in the previous section, ^{18}O isotopes in animals are a reflection of their source of drinking water and to a lesser extend water derived from foods. Animals from different regions will have consumed water from different sources, leading to different ^{18}O signatures. Accordingly, it is possible to examine mobility in ancient populations by comparing the $\delta^{18}O$ values of different individuals (Waterman 2012; Waterman et al. 2015). However, another more popular method involves examining the ratio of the isotopes of strontium ($^{87}Sr/^{86}Sr$) preserved in ancient bone collagen.

Geochemical strontium signatures arise from the local evolution of geological systems; the background ratio of $^{87}Sr/^{86}Sr$ present in a rock is a function of the ratio present at the time of formation, the baseline amounts of rubidium (as ^{87}Sr is formed by the radioactive decay of ^{87}Rb) and strontium in the rock, and the amount of time that has passed since the formation of the rock (Bentley 2006). This geological strontium "fingerprint" is inherited by soils derived from the local rocks, permeates the surrounding surface water and groundwater, and is taken up by resident flora and fauna, including humans (Waterman et al. 2014a). There is not a perfect identity between the strontium ratio preserved in human bone and the underlying geological strontium signature because there are non-geological sources of strontium, such as atmospheric deposition, that can also contribute to an individual's strontium isotope ratio. However, the $^{87}Sr/^{86}Sr$ ratio does not fractionate as it moves up the food chain, so once the expected levels of biologically-available strontium are calculated for a given region (Bentley 2006), it becomes possible to document movement over the course of an individual's lifetime using the $^{87}Sr/^{86}Sr$ isotope ratio preserved in an individual's bones and teeth (Pate 1994; Waterman et al. 2014a).

Different geological regions have different strontium isotope ratios, and archaeologists can use the strontium signature preserved in local coeval fauna (particularly smaller animals with limited geographic ranges) to produce an "expected" signature for a given archaeological site (Waterman 2012; Bentley 2006). Once this signature has been established, the $^{87}Sr/^{86}Sr$ values for sampled human bone collagen can be compared to the local baseline strontium values, to determine whether the individuals sampled have similar signatures to local fauna, or whether their $^{87}Sr/^{86}Sr$ ratios suggest emigration from elsewhere. Importantly, bone remodels over the course of an individual's lifetime in response to stressors (a process known in osteology as "Wolff's Law) while dental enamel does not, making it possible to analyze movement over the course of individual lifetimes; strontium isotope signatures preserved in the teeth reflect the first 12-15 years of an individual's life, while those preserved in bone reflect approximately the last decade of individual mobility (Waterman 2012; Waterman et al.

2014a, 2015). As such, strontium analyses make it possible to examine whether an individual grew up in the same geographical region where they were eventually interred.

Selection of Samples for Isotopic Analysis

A dental analysis was the sole feasible analytical approach to Necropolis 4 due to the extremely high volume of human remains interred in the artificial caves. Accordingly, the most common element analyzed in this study that was represented at all three mortuary areas was the right posterior mandible and associated teeth, specifically the RlM2 for adult individuals and the Rdm_2 for subadult individuals. Selecting these mandibular samples for isotopic analysis ensured that all individuals sampled were discrete (e.g. it was impossible for any two samples to come from the same individual because of anatomical overlap). The Rdm_2 was selected for subadult individuals as this category of deciduous tooth does not remain in the dental arcade after the eruption of the second permanent molar, meaning that the subadults sampled using the Rldm2 as a criterion are too young to overlap with any mandible containing an erupted RlM2. The mandibular samples had the additional benefit of making it possible to draw samples for dietary isotopic analysis of C, N, and O, as well as AMS radiocarbon dating from alveolar bone, and strontium analysis from the RlM2 or Rldm2. This strategy was useful in that it provided a fully-fleshed portrait of sampled individuals that provided information about chronology, diet, and regional mobility. Additionally, 15 faunal samples were selected from Marroquíes Bajos and 7 faunal samples were selected from Marroquíes Altos (Necropolis 4) in order to provide a background isotopic signature for strontium studies (Bentley 2006). All right posterior mandibles present in the collection were sampled, producing a sample of 112 human mandibles and/or teeth (Table 5.7).

Because material from Necropolis 2 was so fragmentary, few mandibles were preserved, and only one deciduous tooth (a $Rldm_2$) was present in the entire necropolis. In order to increase sample size for this mortuary area, two edentulous right posterior mandibles were selected (increasing the dietary isotopic sample to 4 individuals, ~12% of the necropolis MNI) and six loose RlM2s and one loose Rldm2 were sampled (increasing the strontium sample to 9 individuals, ~27% of the necropolis MNI). Samples were sent to the Institut für Geowissenschaften at University of Tübingen in fall 2014, and processed by Dr. Marta Díaz-Zorita Bonilla. The procedures used to clean, sub-sample and analyze these samples are detailed in Chapter 8.

Table 5.7 Distribution of isotopic samples by necropolis

Mortuary Area	Adult mandibles (with RlM2)	Subadult mandibles (with Rldm2)	Mandibles (edentulous)	Loose RlM2 or Rldm2	Total
Necropolis 1	18	5	0	0	23
Necropolis 2	2	0	2	6 (1)	11
Necropolis 4	57	21	0	0	78
Total	77	26	2	7	112

Conclusions

Bioarchaeological analysis of commingled and fragmentary remains requires extensive knowledge of a battery of methods for estimating age, calculating a Minimum Number of Individuals, assessing sex, and evaluating diet, mobility, and paleopathology. Collecting data from materials excavated by different teams of archaeologists, at different points in time, with different systems of organization for museum storage, requires additional methodological considerations. However, despite the challenges posed by the prehistoric skeletal remains from Necropolis 1, 2, and 4 at Marroquíes Bajos, bioarchaeological methods still produced a significant amount of new information about life and death in this Copper Age village. The results of these analyses are outlined in Chapters 6, 7, and 8.

Chapter 6

From Dentition to Development: Bioarchaeological Analyses of Necropolis 4

> *Teeth have the great archaeological advantage of being constructed from remarkably tough materials, which can survive a century and more in the harsh environment of the mouth… They also survive in a very wide range of archaeological sites and conditions of burial. They are readily recognized during excavation and routinely recovered in a similar way to artefacts. Often, they are amongst the most numerous finds*
>
> – *Simon Hillson, Teeth, (2005:1)*

Teeth are the most long-lasting osteological material in the archaeological record, and the continuing refinement of excavation and screening techniques has made it possible to recover greater numbers of teeth from archaeological sites than ever before. However, teeth also present a unique set of problems for bioarchaeologists attempting to reconstruct prehistoric mortuary treatment, demography, and health. In order to gather representative information about prehistoric lived experiences from loose and commingled human teeth, it is first necessary to determine which methods to use in order to estimate age and assess sex, MNI, and frequencies of dental pathologies. These decisions are particularly complex when dealing with loose subadult teeth that mix developing deciduous, deciduous, developing permanent, and permanent teeth.

Because of the exceedingly high volume of fragmentary, commingled, unsorted, and unwashed human remains from Necropolis 4 (N4), this mortuary area was only subjected to dental analysis. In total, I collected data from 3873 teeth, 2957 of which were not articulated (76%). In order to analyze this mortuary population, a range of recent methodologies developed to estimate sex (Gonçalves et al. 2014), subadult age (AlQahtani 2009; AlQahtani et al. 2010), and adult age (Gilmore and Grote 2012) were employed. New strategies were developed to examine mortuary treatment using the teeth. Estimating Minimum Number of Individuals (MNI) is addressed first, followed by assessments of age, sex, pathology, and a discussion of dental completion as this relates to mortuary treatment.

When calculating MNI, the remains from Unit 3 were separated from the remains from Units 1, 2, 4, and 5 for both adults and subadults. This separation is a result of the tortuous excavation history of N4; while Units 1, 2, 4, and 5 contain intact layers, these areas of N4 were all subject to previous excavation and disturbance in the 1957 and 1959 excavations. Unit 3 represents the sole mortuary cave that was completely *in situ* when excavated in 2001, as it was never discovered by previous excavation teams. Accordingly, movement of bodies in this area is solely the result of prehistoric actions, so the remains from Unit 3 were analyzed together to produce a single MNI. In the following analyses, I combine Units 1, 2, 4, and 5 into "Area 1" and treat Unit 3 as "Area 2."

Calculation of the Minimum Number of Individuals (MNI) for Necropolis 4

The adult dental MNI for N4 was calculated separately from the subadult age-stratified dental MNI. The subadult sample was analyzed separately from the adult sample, and contained:

1. Mandibles and maxillae that were clearly subadult based on patterning of dental development and eruption;
2. All developing or complete deciduous teeth, and developing permanent teeth with age estimates of < 18 years;
3. A sample of seven mandibles or maxillae that were classed as older subadults based on lack of eruption of M3 and low levels of first and second molar wear.

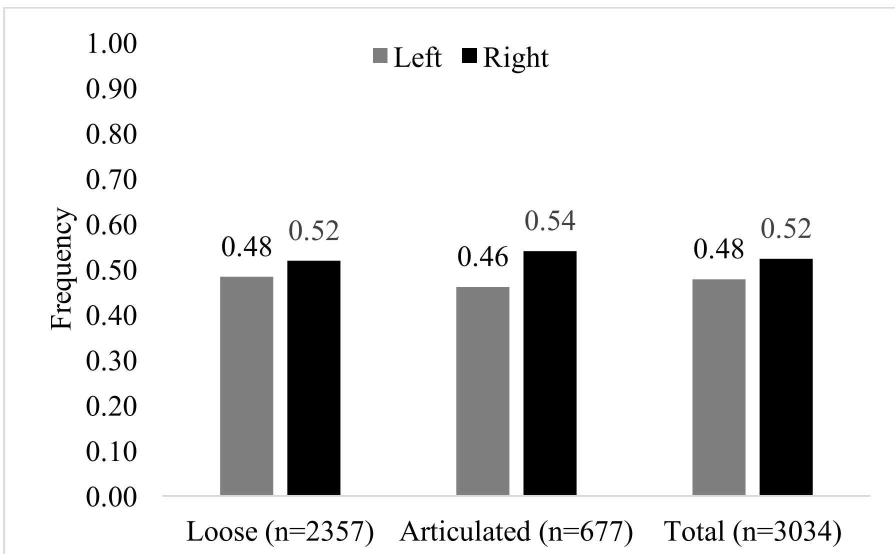
The adult sample contained three categories of teeth:

1. Permanent articulated teeth classed as probable adult teeth based on initial visual analysis of wear and number of teeth in occlusion in the alveolar processes;
2. Permanent loose teeth that had achieved the stage of apex complete;
3. Permanent loose teeth that had suffered damage to their roots but were most likely apex complete at time of death based on patterns of root breakage, thickness of surviving root, and occlusal wear;
4. Permanent developing third molars with estimated ages of ≥ 18 years.

Calculating the Dental MNI for Necropolis 4 Adults

The adult sample was composed of 3,089 teeth (2412 loose, 677 articulated in the mandible or maxilla). 55 loose teeth that could not be identified to tooth category or sided were removed from the sample as they could not contribute to the MNI estimation. This sorting left a total of 3,034 teeth (2,357 loose, 677 articulated) for calculation of the adult dental MNI. There were slightly more teeth from the right side than from the left side (Figure 6.1); however, a chi-square test of sided tooth counts showed no significant difference in symmetry between the loose and articulated contexts (x^2=1.0659, df = 1, *P* = 0.302).

Figure 6.1 Sided loose and articulated adult teeth from Necropolis 4



The most commonly recovered permanent teeth were right upper canines (N = 146), followed by right lower third premolars (N = 127), right lower first molars (N = 124), left upper canines (N = 122), and left lower first molars (N = 121) (Figures 6.2-6.3, Table 6.1-6.2).

Unlike incisors, premolars, or molars (all of which contain two to three teeth per category), there are no other teeth in the arcade that resemble canines. As such, the potential for misidentification is lower for canines than for other categories of teeth. Fortuitously, canines are also the best represented teeth in the N4 sample, and so canines were used as a baseline for estimating adult MNI at N4. However, because upper canines finish their development during adolescence, any canines that could belong to subadult individuals from N4 first had to be removed before calculating the adult MNI.

Figure 6.2 Counts of Necropolis 4 adult lower teeth

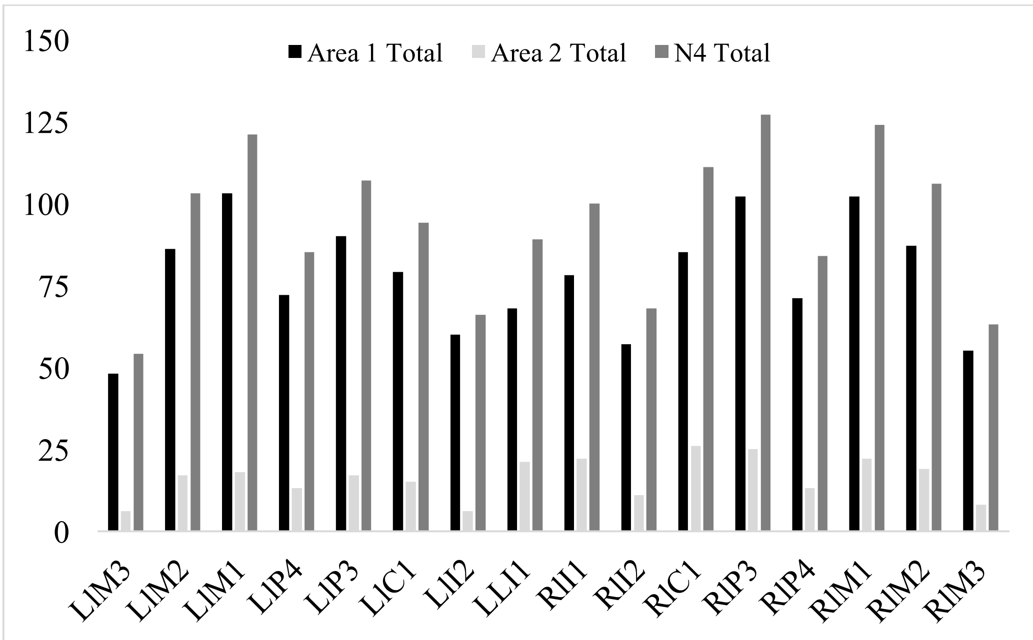


Figure 6.3 Counts of Necropolis 4 adult upper teeth

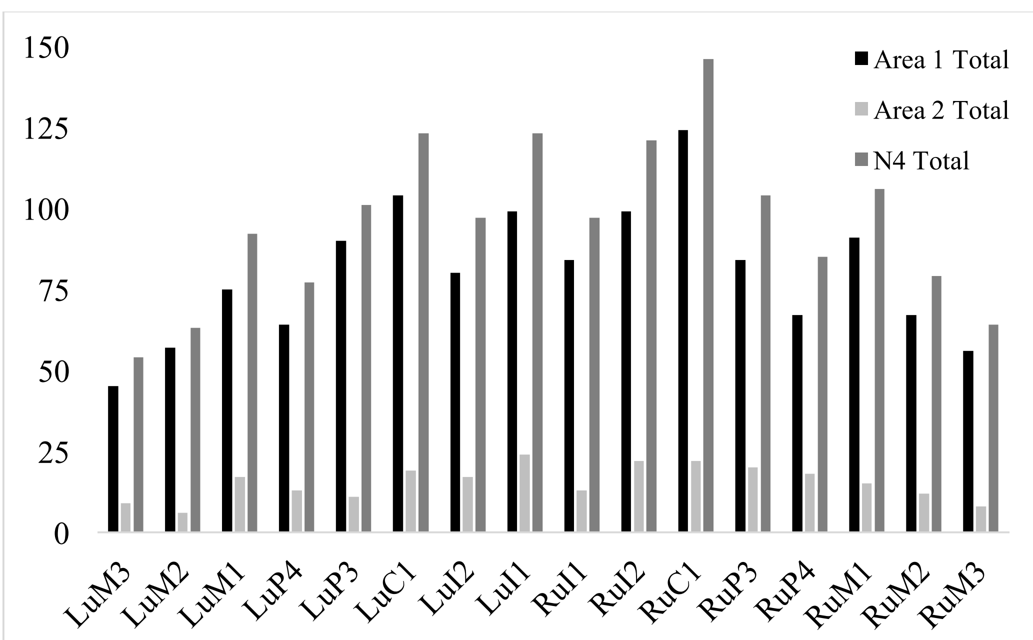


Table 6.1 Counts of Necropolis 4 adult tooth categories (left)

Left side teeth									
Area	**I1**	**I2**	**C1**	**P3**	**P4**	**M1**	**M2**	**M3**	**Total**
Maxilla									
Area 1	99	80	104	90	64	75	57	45	614
Area 2	24	17	18	11	13	17	6	9	115
Total	123	97	122	101	77	92	63	54	729
Mandible									
Area 1	68	60	79	90	72	103	86	48	606
Area 2	21	6	15	17	13	18	17	6	113
Total	89	66	94	107	85	121	103	54	719
Grand Total	212	163	216	208	162	213	166	108	1448

Table 6.2 Counts of Necropolis 4 adult tooth categories (right)

Right side teeth									
Area	**I1**	**I2**	**C1**	**P3**	**P4**	**M1**	**M2**	**M3**	**Total**
Maxilla									
Area 1	84	99	124	84	67	91	67	56	672
Area 2	13	22	22	20	18	15	12	8	130
Total	97	121	146	104	85	106	79	64	802
Mandible									
Area 1	78	57	85	102	71	102	87	55	637
Area 2	22	11	26	25	13	22	19	8	146
Total	100	68	111	127	84	124	106	63	783
Grand Total	197	189	257	231	169	230	185	127	1585

In total, 26 right upper canines from N4 are unworn or lightly worn (the equivalent of a Smith score of 1)[28] (Table 6.3). According to AlQahtani et al. (2010), the upper canine achieves a median stage of apex complete at age category 15.5. As a result, some of the canines demonstrating wear scores of 1 may belong to individuals in the 15.5-17.5 range in the subadult dental MNI, and should not be included in the adult MNI.

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[28] Only counts for wear at level 1 were examined here, as in the adult dental wear analysis all stages of right upper canine wear > 1 (N = 10) belonged to individuals of > 22 years of age.

The subadult dental MNI was built using the right lower arcade, and I estimated that there was at least one individual from Area 1 that fit this age category. Accordingly, I reduced the adult MNI based on the RuC1 by one individual, leaving an adult MNI estimate of 145 individuals, 123 from Area 1, and 22 from Area 2.

Table 6.3 Counts of right upper canines

Area	Total count	Articulated level 1 wear	Loose level 1 wear
Area 1	124	3	20
Area 2	22	0	3
Total	146	3	23

Comparing Different Strategies for Calculating a Dental MNI for Subadults from Necropolis 4

Two broad considerations must be addressed before developing a strategy to estimate subadult MNI. First, there are multiple methods that can be used to estimate the minimum number of subadult individuals buried in a given area. A Minimum Number of elements (MNE) approach is traditionally used for adult individuals, where the most frequently recovered category of tooth is treated as an estimate of the MNI. For example, if there are 15 left lower second molars recovered from a site, at least 15 individuals were buried there. However, the more precise age estimates recoverable from subadult teeth are another line of evidence that can be used in an age-stratified approach, where the MNE for each age category is used to build the MNI. For example, if there are 15 left lower apex complete second molars recovered, and an additional five right upper first molars at stage crown complete, there were at least 20 individuals buried at the site, because these two developmental stages could not occur in the same person.

Additionally, there is the question of which strategies to use to avoid double-counting individuals in an Age-Stratified (AS) MNI. Should all teeth be included, with MNI calculated based on whichever tooth is most predominant for a given age category? Should only upper or lower teeth be incorporated into the assessment? Should only teeth from either the right or the left side be used? Finally, what is the impact of calculating separate MNIs for the sample from Area 1 relative to the sample from Area 2?

Subadult MNI was estimated with reference to midpoint age for each tooth category. The AlQahtani et al. (2010) age categories for individuals older than 12 months of age reflect the median of one year intervals. For example, stage 3.5 reflects an individual between 3 and 4 years of age. Accordingly, the age-stratified subadult MNI was divided into 18 stages of one-year intervals, ranging from the minimum of 0.0-0.9, to the maximum of 17.0-17.9. All teeth that were categorized as being older than the 17.5 age category were reclassified as adults. Only 13 developing permanent teeth fit this category, all of them molars, and these are included in the adult tooth counts listed in this chapter.

The MNI for each age stage was calculated with reference to the most commonly encountered tooth. For example, in Area 2, four right lower second molars showed a level of development indicating that they belonged to an individual between 8.0-8.9 years of age, producing the MNI of 4 for that area and age stage. Unsurprisingly, the total MNE method produces the lowest MNI estimate, while the age-stratified (AS) maximum method produces the highest MNI estimate (Table 6.4).

Table 6.4 Estimates of Subadult MNI for Necropolis 4 using age-stratified methods

Method	Area 1	Area 2	Separated * Total	Collapsed** Total
Total MNE	31	7	38	37
AS Maximum	73	27	100	86
AS Maximum Lower	56	19	75	67
AS Maximum Upper	65	23	88	77
AS Maximum Lower (L)	50	14	64	60
AS Maximum Lower (R)	42	18	60	54
AS Maximum Upper (L)	42	19	61	52
AS Maximum Upper (R)	57	16	73	57
Minimum	31	7	38	37
Maximum	73	27	100	86
Range	**42**	**20**	**6.2**	**49**

* "Separated Total" = Area 1 + Area 2. *

*Collapsed Total = Calculated using entire N4 sample, regardless of area.

The pattern of results in Table 6.4 is partially related to assigning midpoint age ranges to teeth. The total MNE method likely under-estimates MNI because it makes no age-based distinctions between teeth. In contrast, the age-stratified maximum approach likely over-estimates MNI, because of the potential for the tooth of one person to fall in two or more age categories. Thus, loose or articulated teeth that fell within more than one AlQahtani age category were assigned to the midpoint age of all categories for the purpose of constructing an Age-Stratified MNI. While this ensured that the majority of the sample could be used in the subadult MNI analysis, it also meant that the 18 age strata described above are not absolute. For example, using the AlQahtani system, a crown complete lower second incisor (e.g. T.2.298.48) is expected to achieve this level of development in either the age category 3.5 or 4.5, a two-year range (3 years minimum – 5 years maximum). This potential variability is concealed by the use of the midpoint age (3.0-3.9) in this approach, which is the main way by which the age-stratified maximum system has the potential to over-estimate or under-estimate the age of subadults.

Calculating a Final Dental MNI for Necropolis 4 Subadults

Because of the potential breadth in age range concealed by the use of the AlQahtani midpoint estimates, the more restrictive right mandibular MNI calculation was used to estimate a final subadult MNI. Mandibular MNI estimates had the lowest variance and standard deviation of all of the methods tested, and the right mandibular sample produced the largest sample size (Table 6.5). Accordingly, teeth from the right mandibular arcade were used to estimate subadult MNI for N4. This strategy helped to avoid double-counting individuals with potentially overlapping age ranges, and restricted the source of possible errors to the presence of observations with age ranges > 1 year. This strategy produced an estimated MNI of 60 subadult individuals (Figure 6.4-6.5, Table 6.6).

Table 6.5 Sided subadult tooth counts for Necropolis 4

Area	Lower		Upper	
	Left	Right	Left	Right
Area 1	30	41	38	33
Area 2	128	138	115	136
Total	158	179	153	169

Figure 6.4 Subadult dental MNI for Necropolis 4

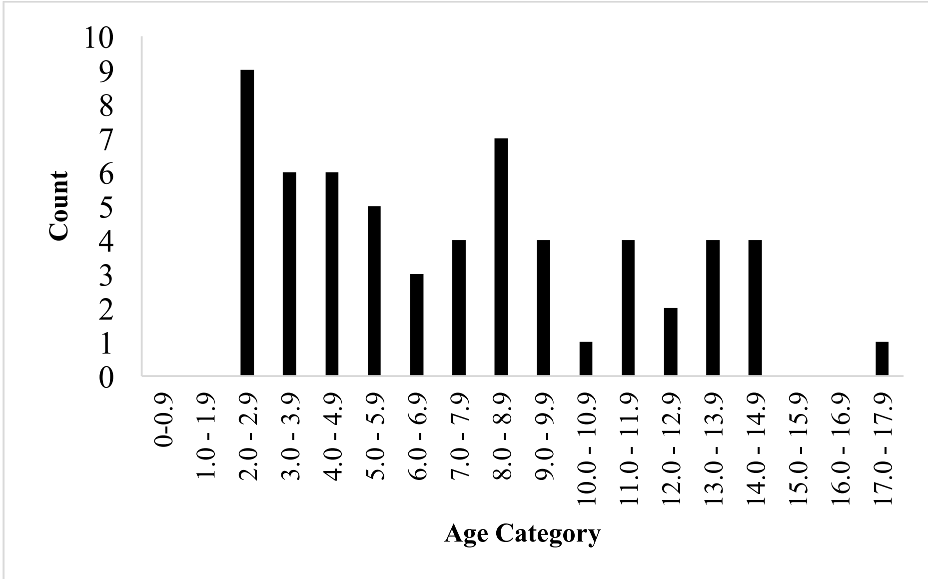
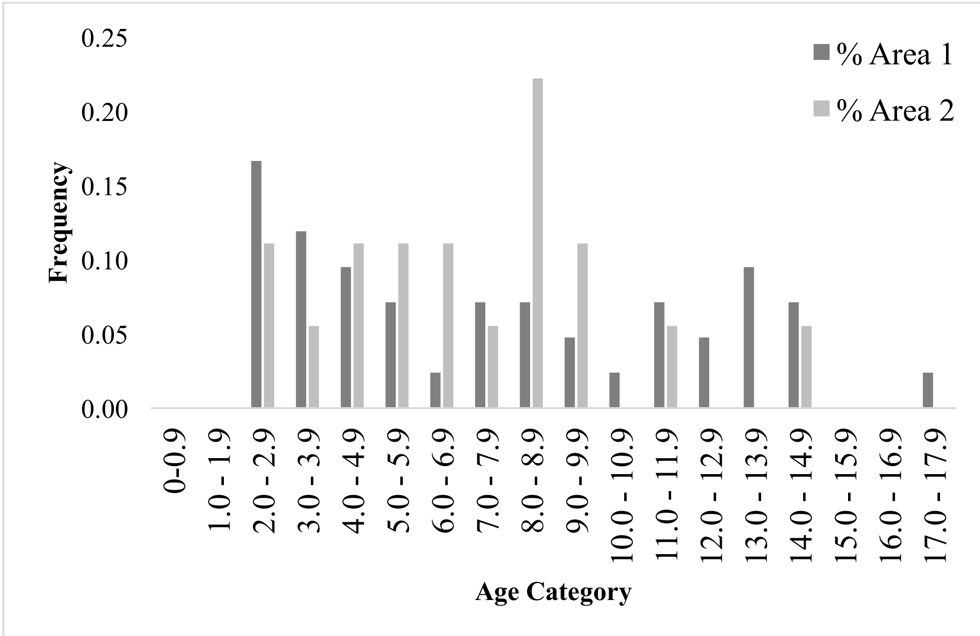


Table 6.6 Subadult dental MNI for Necropolis 4 by age category, all teeth from the right mandibular arcade

Age category	Area 1	Area 2	Total
Birth - 0.9	0	0	0
1.0 - 1.9	0	0	0
2.0 - 2.9	7	2	9
3.0 - 3.9	5	1	6
4.0 - 4.9	4	2	6
5.0 - 5.9	3	2	5
6.0 - 6.9	1	2	3
7.0 - 7.9	3	1	4
8.0 - 8.9	3	4	7
9.0 - 9.9	2	2	4
10.0 - 10.9	1	0	1
11.0 - 11.9	3	1	4
12.0 - 12.9	2	0	2
13.0 - 13.9	4	0	4
14.0 - 14.9	3	1	4
15.0 - 15.9	0	0	0
16.0 - 16.9	0	0	0
17.0 - 17.9	1	0	1
Totals	**42**	**18**	**60**

Figure 6.5 Subadult MNI for Necropolis 4 by age category



Assessment of Sex for Necropolis 4

A method for estimating sex based on canine metrics was developed by Gonçalves et al. (2014) using postcranial metric studies conducted by Albanese (2003) and Albanese et al. (2005) as a basis. This method was of particular interest for Marroquíes Bajos because Gonçalves et al. applied their dental strategy to a commingled Late Prehistoric Iberian sample. The authors underscore three important assumptions outlined by Albanese et al. (2005) that must be met in order for the method to be applied:

1. N > 40;
2. Sample includes both sexes;
3. Sample has a balanced sex ratio (using normality of metric distribution as a proxy)

The appropriateness and utility of this odontometric sexing method was tested for the Marroquíes Bajos sample. Odontometric data were collected for all permanent and developing permanent canines from N1, N2, and N4, including articulated canines. Lower canines were preferred following the protocol outlined in Gonçalves et al. (2014), and buccolingual diameter (BL), mesiodistal diameter (MD), and canine area (BL*MD) were examined as potential metric indicators of sex. These measurements were taken following the guidelines outlined in Buikstra and Ubelaker (see Chapter 5, "Odontometrics and Wear"). MD was evaluated even though Gonçalves et al. indicate that for canine MD "tooth wear may prevent measurements from being taken due to the obliteration of the required dental landmarks..." (2014:186). In contrast to their study, MD could be measured for the majority of the canines sampled, so it was also tested as a possible metric here. As the method "allow[s] for the quite successful sex estimation of subadult individuals because mineralization of the crown of the permanent canine is complete long before adulthood is attained" (Gonçalves et al. 2014:186), all lower canines that had achieved the stage of at least crown complete (Crc) were used in this analysis. The degree to which the Marroquíes Bajos data meet the assumptions outlined by Gonçalves et al. (2014) are addressed separately below.

Assumption 1: N > 40

There were 278 permanent and developing permanent lower canines from Marroquíes Bajos. As a result of age or taphonomic destruction affecting the rigor of metric measurements, 49 canines were removed from the BL sample, 42 canines were removed from the MD sample, and 73 canines were removed from the area sample (Table 6.7).

Table 6.7 Sample sizes for buccolingual diameter, mesiodistal diameter, and area for all lower canines from Necropolis 1, 2, and 4

Mortuary Area	State	Total		BL		MD		Area	
		Left	Right	Left	Right	Left	Right	Left	Right
N1	Loose	2	3	2	3	2	2	2	3
	Articulated	15	15	15	13	12	14	12	13
N2	Loose	6	4	6	4	4	4	4	4
	Articulated	2	0	2	0	0	0	0	0
N4	Loose	84	97	69	77	83	93	69	77
	Articulated	23	26	19	19	10	12	9	12
Sided Total		133	145	113	116	111	125	96	109
Grand Total			277		229		236		205

This produced a minimum sample size of 96 (area of LlC) to a maximum of 125 (MD of RlC), meaning that all BL, MD, and area samples meet the first assumption of the method.

Assumption 2: Sample Includes Both Sexes

The second assumption must be approached with reference to the meager postcranial evidence available at Necropolis 1 and Necropolis 2. The available sex distribution for Necropolis 1 was 7 males or probable males (22%), 10 females or probable females (31%), and 1 indeterminate individual (3%). Sex could not be assessed for the remaining 14 adult individuals (44%) as skeletal preservation was not sufficient to estimate sex. The available sex distribution for Necropolis 2 was limited by poor preservation; sex could only be estimated for 12% of the adult sample, and only with reference to non-metric cranial traits. This produced a sex distribution of 1 male/probable male (0.04%), 1 female/probable female (0.04%), and 1 indeterminate individual (0.04%). Though these estimates of sex are crude as a result of the extremely fragmentary nature of the skeletal collections, they indicate that both males and females were buried at N1 and N2.

At Necropolis 4, mandibular traits were scored in order to provide a potential estimate of sex. Necropolis 4 contained 360 mandibles or mandible fragments. Of these, 109 observations preserved enough of the mandibular body or ascending ramus that the mental eminence could be scored (as outlined in Buikstra and Ubelaker 1994) or the gonial angle could be evaluated. Mandibles were identified to side (L, R, or L+R for elements with symmetrical or partially symmetrical preservation). In order to avoid potentially double-counting individuals, only observations for which the mental eminence was preserved were counted (Region 7 in Knüsel and Outram 2004). The mental eminence could be scored for 89 mandibles for which Region 7 in Knüsel and Outram was preserved. Three observations received intermediate scores for the mental eminence which were rounded up to their higher scores so as to be commensurate with the rest of the observations. Recording of mandibular zones present was done with respect to side; as it was possible to score the mental eminence for a higher proportion of mandibles preserving the right side than the left side (98% relative to 94%), the right was used during the following assessment of sex.

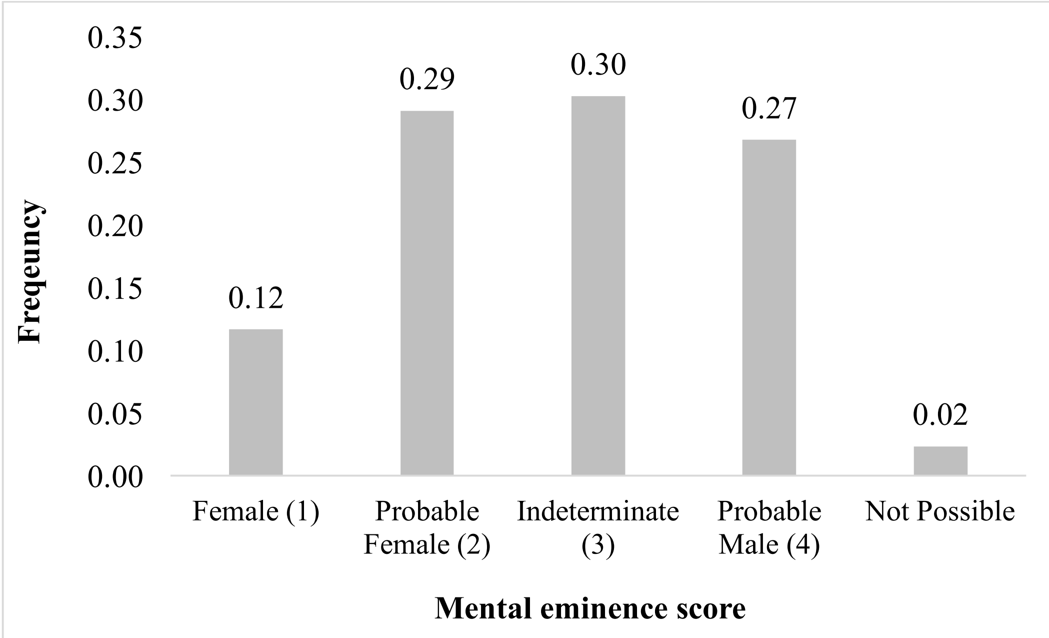
Ten right mental eminences showed scores of “1.” Because mandibular gracility can be related to age as well as sex, this sample was examined for evidence that could be used to assess age. Unfortunately, only two mandibles with mental eminence scores of 1 were associated with teeth, and the edentulous and fragmentary nature of the sample made age estimation problematic. In the absence of any clear indicators of subadult status (e.g. small size, open crypts for permanent teeth) all of these more gracile mandibles were considered to be adult.

Overall, 84 of the 86 mental eminences from the right, or left and right combined could be scored –10 received a score of 1, 25 received a score of 2, 26 a score of 3, and 23 received a score of 4. The distribution indicates that 41% of the sample consists of females/probable females, 30% of the sample are of indeterminate sex, and 27% of the sample are probable males (Figure 6.6). Sexual dimorphism in the mental eminence is not particularly pronounced for N4 adults; as no mandibles received a score of 5, it is likely that this population is relatively gracile, and that some of the mandibles classed as “indeterminate” are thus likely probable males. Despite the female skew, this distribution does indicate the presence of both males and females at N4.

Far fewer mandibles and mandibular fragments preserved large enough portions of the ascending ramus to estimate gonial angle –14 preserved the right ascending ramus, while 13 preserved a left ascending ramus (Zones R6 and L6 from Knüsel and Outram 2004). Of the right mandibles, 9 (64%) demonstrated male characteristics (gonial angles were 90˚, close to 90˚, or showed mandibular eversion), while 5 (36%) demonstrated more female characteristics (obtuse or more obtuse). Of the left mandibles, 7 (54%) demonstrated male characteristics and 6 (46%) demonstrated female characteristics. One left mandible (MN.2.286.01) demonstrated an obtuse gonial angle and pronounced eversion; this was considered female in the sample of left gonial angles.

Evidence from Necropolis 1, Necropolis 2, and Necropolis 4 thus indicates that the Marroquíes sample conforms to the assumptions made by Gonçalves et al. concerning sample size and the presence of both sexes within the sample.

Figure 6.6 Sex distribution for Necropolis 4 based on mental eminence scores



Assumption 3: Balanced Sex Ratio

The third assumption of the Gonçalves et al. (2014) method is that the sample contains a balanced sex ratio, using the normal distribution of the data as a proxy for a balanced ratio. Accordingly, the normality of the distribution of BL, MLD and area measurements was investigated using Shapiro-Wilks test, with p=0.05. Significant values are indicated with an asterisk in Table 6.8 below.

Table 6.8 Tests of normality for distributions of all lower canines from Necropolis 1, 2, and 4

Metric	Sample	N	Shapiro-Wilks W	***P***
BL	Total	228	0.975*	0.001
	LlC*	113	0.985	0.240
	RlC**	115	0.951*	0.000
MD	Total	235	0.988*	0.045
	LlC	110	0.979	0.083
	RlC	125	0.983	0.132
Area	Total	205	0.969*	0.000
	LlC	96	0.972	0.037
	RlC	109	0.960*	0.002

*LlC = Left lower canine, **RlC = Right lower canine.

Five distributions violated the assumption of normality. However, the left and right MD measurements, the left BL measurements, and the left area measurements did not depart significantly from a normal distribution.

Bilateral Symmetry

While not a requirement of the method, Gonçalves et al. also indicated a desire to test bilateral symmetry of canine metrics in order to ensure that right and left teeth would provide commensurate estimates of sex-based differences. Twenty-one canines in the total sample (N1, N2, N4) were articulated, or could be re-associated due to the presence of alveolar bone. BL measurements were possible for sixteen of these paired observations. The average absolute difference in BL between the left and right canines was 0.19 mm.

MD measurements were possible for 11 paired observations. MD showed even less metric asymmetry between right and left canines than BL, with an average absolute difference of 0.17 mm. One individual (N1. CE14.13) was an outlier for both BL and MD measurements, demonstrating side asymmetries of 0.9 mm (BL) and 1.0 mm (MD). When this outlier was removed from the sample, the average absolute difference in BL dropped to 0.14, and the average difference in MD dropped to 0.09 mm.

Eleven paired canines preserved BL and MD measurements on both sides, and so canine area could be calculated. The absolute average difference in area was higher than either MD or BL at 2.54 mm^2. However, when the outlier N1.CE14.13 is removed, the average difference drops to 1.2 mm^2. N1.CE14.13 is listed as having heavily worn canines which have some calculus adhering to their enamel. This likely contributed to the disparate calculations of canine area on the left and on the right.

Testing the Method Against Non-Metric Assessments of Sex

In order to assess this strength of the Gonçalves et al. method for assessing sex, estimates of sex using lower canine MD, BL, and area were compared to available cranial and post-cranial estimates of sex for individuals from N1 and N2. Following the guidelines of Gonçalves et al. (2014), two different methods of canine sex estimation were compared:

1. A cut-off (CO) method, whereby observations with values greater than the sample mean were categorized as male and observations with values less than the sample mean were categorized as female (Table 6.9). For example, in the sample of MD measurements, observations of MD < 6.3mm were classed as female, while observations of MD > 6.3mm were classed as male. Observations of exactly 6.3mm were classified as indeterminate (M?/F?).
2. A confidence interval (CI) method, whereby a 99% confidence interval was calculated using the sample standard error. Using this method, all observations that fell within the interval were classed as indeterminate, with a tendency (M? or F?) recorded following Gonçalves et al (2014:188). For example, in the MD sample from N1, N2 and N4, the interval stretched from 6.2-6.4mm. Observations with an MD of 6.2mm were categorized as probable female (F?), observations with and MD of 6.4mm were categorized as probable male (M?) and observations with the mean MD value of 6.3mm were categorized as indeterminate (M?/F?).

Table 6.9 Sample means for all canine MD, BL and area (N1, N2, N4)

Tooth Category	Summary statistic	MD	BL	Area
Left lower canines	N	110	113	96
	Mean	6.2	7.3	45.48
Right lower canines	N	124	116	109
	Mean	6.3	7.3	46.54
All lower canines	N	234	229	205
	Mean	6.3	7.3	46.09

Metric estimates of sex for left or right lower canines were compared to all available estimates of sex based on traits of the cranium or pelvis in order to assess methodological congruence. Individuals sexed as indeterminate based on non-metric traits of the cranium and pelvis were considered to agree with canine metric estimates if they fell within the indeterminate range (for MD, 6.2-6.4 mm, for BL, 7.2-7.4 mm, for area 45.08-47.10 mm^2). For the CI method, individuals sexed as probable males and probable females based on non-metric traits of the cranium and pelvis were considered to agree with canine metric estimates if they fell within the probable female or probable male range as appropriate. For the CO method, individuals sexed as probable males, probable females, or indeterminate based on non-metric traits of the cranium and pelvis were considered to agree with canine metric estimates if their measurements were the same as the population mean. For both the CO and CI methods, probable males identified based on non-metric traits of the cranium or pelvis were also considered to agree with “male” metric estimates, and probable females were considered to agree with “female” metric measurements.

Both the CO and CI methods for MD and BL measurements showed comparable levels of agreement of nearly 70% when compared to estimates of sex based on pelvis features, which produce the most rigorous assessments (Table 6.10). However, this agreement is still markedly lower than the 100% success rate reported by Gonçalves et al. (2014). These results suggest that the size of their comparative non-metric sample (N = 8) was likely too small to accurately assess the efficacy of their method.

Because agreement between non-metric and metric estimates of sex using the lower canine was lower than expected, the Gonçalves et al. (2014) method was only applied to the sample of individuals from N4, and cranial and post-cranial estimates of sex were used for the samples from N1 and N2.

Table 6.10 Agreement between metric and non-metric estimates of sex from Necropolis 1, 2, and 4

Measurement	Method	Agreement		Disagreement		N
		No.	%	No.	%	
MD	CO*	19	54	16	46	35
	CO(pelvis)	11	69	5	31	16
	CI**	19	54	16	46	35
	CI (pelvis)	11	69	5	31	16
BL	CO	25	46	29	54	54
	CO (pelvis)	13	68	6	32	19
	CI	26	48	28	52	54
	CI (pelvis)	13	68	6	32	19
CI	CO	16	47	18	53	34
	CO (pelvis)	10	62	6	38	16
	CI	17	50	17	58	34
	CI (pelvis)	10	62	6	38	16

*CO=Cut-off; **pelvis = only sex estimates from pelvis used; ***CI = Confidence interval.

Applying the Method to the Necropolis 4 Sample

The first step in applying the Gonçalves et al. method to the Necropolis 4 canines was to re-test assumptions 1 and 2 on the smaller sample of canines drawn from N4. In regards to assumption 1, sample size was greater than 40 observations for BL, MD, and