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# Andalusi Populations at La Dehesilla Cave (Sierra de Cádiz, Southern Iberia): An nterdisciplinary Approach to their Rural Economic Systems

Daniel García-Rivero,1 Ruth Taylor,1 Luis Gethsemani Pérez-Aguilar,1 Guillem Pérez-Jordà,2 Esteban García-Viñas,3 José Antonio López-Sáez,2 Débora Zurro,4 Leonor Peña-Chocarro2 and Eloísa Bernáldez-Sánchez3

## Abstract

Few studies have dealt with the occupation of caves during the Andalusi period in Southern Iberia. This may be explained by the attention placed traditionally on the trinomial *mudun* (cities), *ḥusūn* (fortresses) and qurà (farmsteads), in which other forms of rural occupation have been generally overlooked. In this paper we explore the sequence at La Dehesilla Cave based on the analysis of animal skeleton remains, pollen, seeds and fruits, and phytoliths with the aim to define the economic systems of its Andalusi inhabitants. Because the sequence displays two different occupation phases, the first during the Taifa Period in the second half of the 11th century and the second during the Almohad Period in the second half of the 12th century, this study characterises the ecological and economic systems of the two periods and highlights the differences between them. The data suggest that the economy of both periods was mainly based on livestock, and especially on sheep herds. However, their comparison enables us to observe a few significant differences that indicate dissimilar behavioural and economic patterns. Plant macro-remains show a larger amount of cereals and leguminous seeds, as well as of domestic fruits, in the Taifa Period than in the Almohad Period. The zoological record displays clear differences between the two periods. The Taifa Period shows a greater proportion of herds while the input from hunting increased in the Almohad Period. Also, there are proportionally opposite patterns in the age of sacrifice of sheep. The earlier period may have seen a more sedentary herding and partly farming population, while the second period may correspond to a mainly herding, perhaps mobile, population. These results are discussed within the political dynamics of the historical framework of the surrounding territory and contribute to the knowledge of the rural economic dynamics of the Andalusi period.

**Keywords**: Taifa kingdoms, Almohad period, Plant macro-remains, Palynology, Phytoliths, Zooarchaeology

## Introduction and aims

La Dehesilla Cave is located in the western foothills of the Sierra de Cádiz, near the village of Algar (Figure 1). Its entrance is on the south-facing slope of Cerro Arrayanosa, an elevation with a maximum altitude of 458.8 metres above sea level. The entrance to the cave is located at 284.4 m.a.s.l. The site is best-known in the context of studies of Late Prehistory, and the Neolithic occupation of the cave is of recognised regional importance (Acosta and Pellicer 1990). Archaeological evidence of a medieval phase, dated imprecisely between the 10th and 13th centuries AD, was however noted during the early scientific visits to the site (Viñas Vallverdú 1970, 1971; Martí et al. 1975; Acosta and Pellicer 1990).

Few studies have dealt with the occupation of caves during the Andalusi period in Southern Iberia (cf. Cara and Rodríguez 1987; Quesada 1995; Carmona et al. 1999; Bertrand 2000; Cano 2007, 2008; Carmona 2012). This may be explained by the predominant archaeological focus on urban contexts, a tendency that may have caused an important bias in the understanding of a historical period in which a large majority of the population was rural. It cannot either be disassociated from the attention placed traditionally on the trinomial *mudun* (cities), *ḥusūn* (fortresses) and *qurà* (farmsteads), in which the interest of other forms of rural occupation has been generally overlooked (Pérez-Aguilar 2013).

In August and September 2016, archaeological fieldwork was carried out in the context of "La Dehesilla Cave Project: archaeological and environmental studies for the knowledge of the Prehistoric human occupation of the Sierra de Cádiz." Two 4 x 4 metre excavation areas (C001 and C002) were opened in front of the cave entrance, and a 1.8 x 1.5 metre test trench (C003) was excavated inside the cave (Figure 2 and Figure 3). All three areas, but especially C001 and C002, yielded a large number of medieval levels and structures, and the detailed analysis of the stratigraphy and pottery assemblages has enabled us to date these very precisely. The sequence reveals the beginning of a first occupation phase in the mid-11th century AD, which lasted until the end of the century. After an interval of abandonment of approximately half a century, a second occupation of the site took place in the second half of the 12th century AD (Taylor et al., in press).

In historical terms, the earlier of the two Andalusi phases documented at the site corresponds to the period of the first Taifa kingdoms, established after the progressive decline of the Caliphate of Córdoba between 1009 and 1031. The landing of the Almoravid armies in 1086 in Algeciras marked the onset of a new chrono-cultural period, as al-Andalus fell under Almoravid rule by 1094. From the end of the 11th century to the mid-12th century, the sequence of our site displays a period of abandonment, presumably coinciding with the Almoravid Period. The second Andalusi phase corresponds to the Almohad Period, with abundant material markers dated in the second half of the 12th century, but with no evidence of occupation of the site beyond the end of the century.

La Dehesilla Cave, geographically and historically, must be inserted into the territorial context of the *kūrat Šiḏūna* or cora of Sidonia, a political and administrative unit that bordered to the north with the coras of *Išbīliya* (Seville) and *Mawrūr* (Morón de la Frontera), to the south with the cora of al-Ŷazīrat al-Ḥaḍrā (Algeciras) and to the east with the cora of *Tākurūnnā* (Ronda) (Borrego 2016, 107–108). In the mid-9th century, the *madīna* of *Šiḏūna*, probably located at the site of Doña Blanca, Puerto de Santa María (Borrego 2007; Martínez 2008, 381–382), ceased to function as the capital of the cora, which moved to *Qalsāna* (Junta de los Ríos, Arcos de la Frontera) occupying a strategic inland position (cf. Abellán 2003, 59; Martínez 2008, 380-381; Richarte and Aguilera 2003, 87–89, 97–98). Approximately 7 km to the northeast of *Qalsāna* was the *ḥisn* of *Arkuš* (Arcos de la Frontera), a fortress that acted as the head of the district (Martínez 2008, 390) with defensive and administrative functions that included the control over the territory and the collecting of taxes from the rural communities. The *ḥisn* of *Arkuš* must have been, along with that of *Ṭanbīl* (Tempul, Algar), one of the central places of the iqlīm of *al-ṣnām*, the "district of the Idols," although it remains unknown which of these two *ḥusūn* would have exerted its influence over the site of La Dehesilla.

Of course, the cora of *Šiḏūna* included all three members of the abovementioned trinomial (cf. Abellán 2003, 2004; Martín 2011, 246–265; Pérez-Aguilar 2013). While this model is useful to understand particular territorial contexts, it stands incomplete when applied to other site types (Martínez 2008, 382–392), as is the case here. Toponymy supports the idea that other rural units, for instance the *maŷāšir* (singular maŷšar), private farmsteads dedicated mainly to agricultural activities (Oliver 1945; Pérez-Aguilar 2013), appear to have been especially numerous (Abellán 2004, 78; Martínez 2008, 388). The text *Ḏikr bilād al-Andalus* makes reference to over 3000 qurà, a figure that may however be overstated for the 12th century and requires further archaeological verification (Martín 2011, 259–260).

In this paper we explore the medieval sequence at La Dehesilla Cave with the aim to define the economic systems of its Andalusi inhabitants. Our approach is based on a systematic paleoecological perspective, focusing on indicators of historical economics, and supported by a multidisciplinary framework that takes into account a number of aspects of the archaeological

record: fauna, seeds and fruits, pollen and phytoliths. The data obtained from these different fields of study are combined in order to understand the environmental conditions and the cultural processes that took place during the 11th and 12th centuries AD. Given that the medieval sequence displays two different occupation phases, the first during the Taifa Period in the second half of the 11th century and the second during the Almohad Period in the second half of the 12th century, with an occupational gap of approximately half a century in between, this study also aims to compare the data from the two phases. The objective of this study is therefore to characterise the ecological and economic systems of the two periods and to highlight the differences between them. The results are discussed within the historical framework of the surrounding territory and contribute to the knowledge of the rural economic dynamics of the Andalusi period within the context of the western foothills of the Subbaetic hill ranges of the present-day province of Cádiz (Spain).

## Materials and methods

The information regarding the stratigraphy, the archaeological structures and the ceramic assemblages of the Andalusi periods of the site is presented in detail in a concurrent work (Taylor et al., in press), and therefore only a short summary of the medieval sequence is offered here.

The excavation areas C001 and C002 enabled the reconstruction of the complete sequence in the open area just outside the cave entrance. Trench C001 displays four stratigraphic phases (Figure 4), the first two belonging to the Almohad Period (see below). During the second phase, the ground was levelled in order to create an occupation level which did not include any built structures in the excavated area. However, during the third phase a nearby building must have collapsed, covering the area in rumble and roof tiles, and this structure must have been contemporary to the occupation level documented in phase two. The area was abandoned at the end of the third phase, dated in the second half to late 12th century AD.

Trench C002 displays seven stratigraphic phases (Figure 5). The second, third and fourth phases belong to the period of the first Taifa kingdoms, while the fifth and sixth phases belong to the Almohad Period. (The Andalusi levels of Trench C001 correspond to the second medieval period documented in C002). The second and third phases of Trench C002 include the first evidences of anthropic activities, linked to the clearance, levelling and adaptation of the area in front of the cave entrance in order to create a useful habitat level. The fourth stratigraphic phase is the episode of most intense human activity, judging by the number and entity of the structures and by the volume of archaeological materials. The earliest level of this phase (Unit 18) is a horizontal layer of considerable thickness that constituted the ground upon which a building was constructed, represented in the excavation area by a stone wall 0.9 metres in width and oriented SW–NE (Unit 13) (Figure 6). Associated with this structure there are several levels resulting from the use of the area and later from the collapse of the building at the time of its abandonment. This sequence of events can be dated within a precise chronological bracket, between the middle and the end of the 11th century. The fifth phase is materialized by the reoccupation of the site, following a period of abandonment of approximately half a century, in the second half of the 12th century. This phase includes another thick horizontal level (Unit 14) with a hearth (Unit 7). After this habitat level a subsequent occupation level was formed (Unit 11), belonging to the sixth phase, upon which four post holes (Unit 10) are documented, defining part of a rectangular roofed structure (Figure 7).

Test trench C003, located inside the cave, displays several horizontal medieval units, but unfortunately their chrono-cultural assignations cannot be specified more precisely.

The stratigraphic phases outlined above have been dated by the detailed analysis of their ceramic assemblages, with a total weight of approximately 123 kg. Medieval pottery typologies are well-established in the study area, and this material category therefore serves as a reliable marker. The

two Andalusi periods documented in the sequences of La Dehesilla display pottery assemblages with exclusive characteristics deriving from different traditions of pottery production and use, thus fully supporting the material cultural differentiation between the two chronological and cultural periods. The typological classification and chrono-cultural assignation of the pottery assemblages was carried out following the descriptive classification schemes and seriation models put forward by several authors and established as references for the southwestern sector of al-Andalus (Acién et al. 1991; Aguilar et al. 1998; Montilla 2002; Beltrán 2005; Vera and López 2005; Perles and Andrades 2009; Cavilla 2012, 2014; González et al. 2015).

The pottery record of the second half of the 11th century AD, the earliest elements of which are dated in the mid-century, displays a high degree of internal chronological and stylistic coherence. It is nonetheless a formally and functionally varied assemblage (Figure 8), with a good representation of utilitarian containers (general use and table jugs and pitchers, see painted handles C2-12-2 and 3, C2-23-1 and 2, and rim sherds C2-18N-1, C2-18-6 and C2-22-3); storage jars of different sizes (including large [C2-18-4] and medium-sized [C2-22-2]); cooking pots (especially marmites, occasionally painted on the shoulder [C2-12-4, 11 and 13]); and table ware (small closed forms [C2-21-1 and C2-22-1] and crockery). Among the latter there are several reliable chronological markers: the large curved-section serving dishes (plates [C2-18S-14 and C2-23-3] and bowls [C2-12 1 and 5, C2-18S-13]), belonging to the green and manganese series (C2-17-6, C2-13/18-7 and C2-18N-2, C2-13-2 and C2-13/18-4, C2-12B-5) and to the honey overglaze and manganese series (C2-23-4), and occasional fragments of jars displaying partial cuerda seca technique with green glaze. These three characteristic surface treatments appear together for the first time in C002 in Unit 23.

The Almohad Period pottery repertoire is also abundant and diverse (Figure 9), including representatives of all of the main functional groups, but with important differences compared to the previous period. The large curved-section bowls (jofainas) remain common (C1-4-7 and C1-10-1), while new forms are introduced. The characteristic ataifor, typically with a triangular rim section and a marked carination, become common with shiny glazes ranging from green to yellow, honey and brown (C2-15-2, C2-15-18b, C1-6/10-1). This same carination is also present on earthenware cooking dishes (generally unglazed), the most common cooking pot in this period (C2-14-6 and 18, C2-15-6), in contrast to the marmites of the previous period. There are rare examples of glazed ribbed dishes, and dishes with horizontal appendages (C2-14-12, C2-14-3/S29). The repertoire of table ware is completed by occasional carafes or small bottles (C2-15-19), thin walled pitchers (C2-15-1 and 23) and lids with painted rims (C1-4-6 and C2-11- 19). Units 11 and 14 of C002 contained a large group of basins with reinforced rims (alcadafes), occasionally slipped or burnished on the inside (C2-14-7, 8 and S36, C2-15-18), and fragments of fire holders (anafres) (C2-11-37). The medium sized storage containers still display painted strokes, now mostly vertical (C2-15- 21, 24 and 20, C1-4-1). The earlier forms of unglazed spouted lamps are still present, with the first appearance of glazed pinched saucer lamps (C2-15-29, C1-6-8). The reliable chronological and cultural identification of this assemblage is possible thanks to the presence of characteristic formal and technological elements of the Almohad Period. However, the absence of the more evolved forms and styles of this period point to a date in the second half to late 12th century, indicating that the occupation of the site did not extend into the 13th century.

In our analysis, first we consider the data from the Andalusi sequence as a whole. We then consider the units assigned precisely to the Taifa or Almohad periods, and we carry out a comparison between the two. As noted previously, the data handled in this study is obtained from different biotic materials, including the study of animal remains, pollen, fruits and seeds,

and phytoliths. All of these fields of specialty have been successfully combined, but each one relies on its own specific techniques of data collection and processing.

Pollen samples were obtained from test trench C003 (Figure. 2). The stratigraphic column was sampled from base to top. For the pollen analysis, 5 samples (0.45-0.90 m, stratigraphic Units 4 to 6c) have been considered (Table 1). These units cannot be assigned precisely to either of the two Andalusi periods, but they do belong to the general chronological bracket considered in this paper. Pollen preparation (10 g per sample) followed standard methods in archaeopalynology (Burjachs et al. 2003) using treatment with HCl, 10% KOH, HF and concentration with Thoulet liquor, although acetolysis for the identification of any contamination by modern pollen was not carried out. The final residue was suspended in glycerine and counted until a pollen sum of 250 pollen grains was reached, excluding non-pollen palynomorphs (NPPs). Aster type, Cardueae and Cichorioideae with possible zoophily were also excluded (López-Sáez et al. 2003). Slides were examined with a light microscope using a magnification of 400x. Pollen taxonomy follows Valdés et al. (1987), Moore et al. (1991) and Reille (1992). Vicia faba was palynologically discriminated according to Hidalgo and Fernández (1996) and Quercus suber pollen differentiation followed Carrión et al. (2000). The majority of NPPs present on the pollen slides were identified and their nomenclature conforms to van Geel (2001). The pollen diagram was drawn using Tilia 2.0 and TGView (Grimm 1992, 2004). Pollen analysis was undertaken at the Archaeobotany Laboratory of the Institute of History of the Spanish National Research Council (CSIC) in Madrid.

The recovery of seeds and fruits was carried out through the flotation of sediments. A 1 mm mesh was placed inside the machine in order to guarantee the recovery of other dense materials such as bones and shells, as well as that of the seeds and fruits that do not float due to their density, their alteration or their adherence to foreign matter. The flot was collected in a 0.25 mm mesh. The selection of the different materials for analysis was carried out under a binocular with a magnification of 10x to 15x. The samples considered here are 25, 17 of which yielded plant remains from 14 different stratigraphic levels of the three excavation areas (Table 1). Analyzed soil sample volumes correspond to 50% of the total soil from each stratigraphic unit. The identification of remains was established through the morphological comparison with modern materials using the reference collection of the Archaeobotany Laboratory of the Institute of History of the CSIC and several specialized reference atlases. The quantification of the material follows three criteria: the absolute count of remains in each sample or group of samples, the density, and the ubiquity of each identified taxa.

The analysis of phytoliths is based on 12 samples from the Andalusi units of C002 (Table 1). Only two samples belong to the Almohad Period (Units 14 and 15, Samples A14 and A15 in the charts) while the remaining samples belong to the Taifa Period. The treatment of the samples followed a standard method in the analysis of phytoliths (Madella et al. 1998). The Phytolith Sum (the number of individuals considered representative) was established through the observation of several transects of the slide until 250 individuals were reached (Zurro 2017). In some cases, due to the very low concentration of phytoliths, the entire surface of the slide was scanned (Samples 24 and 28). In parallel, the silica skeletons (phytoliths that retain their original anatomical connection) identified during the Phytolith Sum were counted. The scan was carried out with a Leika optical microscope at a magnification of 630x, equipped with a digital camera and image processing software. The standardisation of the data was carried out following the method of Albert and Weiner (2001) for the calculation of the number of phytoliths per gram of acid insoluble fraction (AIF), i.e. the mineralogical fraction of the original sample.

The archaeozoological study considered all of the medieval units of the excavation areas C001 and C002 (Table 1). The frequency of species is estimated by the minimum number of

individuals (MNI), the number of identified specimens per taxon determined anatomically (NISP) and the number of remains (NR) including determined and undetermined fragments. MNI and NISP both present known quantification problems, related to different states of preservation of taphocoenosis (Marshall and Pilgram 1993; Lyman 2008). In this study, 65% of the bones were anatomically determined and the preservation of the bone assemblages from both periods, based on the fragmentation index (IF) defined by Bernáldez and Bernáldez (2000), was similar (around 0.4) and in accord with other contemporary Andalusian archaeological sites. For this reason, we may accept that possible differences in NISP between the two periods will not be due to bone fragmentation. In addition, because of the similarity of the bone fragmentation index, it will be possible to use MNI to compare both deposits, also using NISP values for contrast. The identification of anatomical elements (in the case of vertebrates) and species was based on reference atlases (Schmid 1972; Poppe and Goto 1991, 1993; Barone 1999; Wilkens 2003; Ruiz et al. 2006; Hilson 2009; Gofas et al. 2011) and on the bone and shell collections of the Andalusian Institute of Historical Heritage (IAPH) and the Doñana Biological Station (EBD-CSIC) in Seville.

## Results

### Pollen

An overall good state of preservation of pollen grains and NPPs was found. Total pollen and NPP percentages are provided in Figure 10. The palynological sequence from La Dehesilla Cave provides valuable data for the reconstruction of the vegetation dynamics and environmental history during the Andalusi period (specifically the 11th–12th centuries).

Quercus ilex percentages are quite low (18–27%) indicating the existence in the vicinity of site of relatively open thermomediterranean holm oak forests with a dehesa-like physiognomy (López-Sáez et al., 2010). This environment is also clearly indicated by the presence of thermophilous shrubs (*Rhamnus* 3-5%; S*milax aspera*, *Asparagus* and *Olea europaea* 1.2%–3%; *Pistacia lentiscus* and Labiatae ~6%) and relatively high percentages of Poaceae (24–28%).

The pollen proportion of *Abies pinsapo* (< 2%) and *Quercus suber* (1.2–2.4%) can be attributed to long distance ("regional") transport of pollen grains from both high- and lowland areas (Alba-Sánchez et al. 2010).

The identification of anthropogenic herbs and pastoral indicators and the continuous presence of coprophilous fungi (Figure 10) suggest the importance of grazing activities and a moderate human pressure on the environment. Pastureland during the Andalusi period was generally nutrient-rich and well grazed, as indicated by high percentages of pastoral indicators (*Plantago lanceolata* 5–7%, *Urtica dioica* 3–5%, *Polygonum aviculare* 2.5–5%) and coprophilous fungi (*Sordaria* 14–24%, *Sporormiella* 8–11.4%, *Cercophora* 4.3–5.6%) in the pollen record of La Dehesilla Cave, although areas with weaker grazing pressure, more nutrient-rich and/or in a state of regeneration were also present (indicated by Cichorioideae 8.4–14.3%, Cardueae 4.3–8.1%, Aster 4–6%, Chenopodiaceae 4.3–6.6%, Leguminosae undiff. 3–5% and Scrophulariaceae 1–3%) (Figure 10).

### Seeds and fruits

Table 2 shows the results of the carpological analysis for the Taifa and Almohad periods, as well as for the medieval levels of test trench C003 without a specific chronological assignation. Both the number of samples and the quantity of remains are small, thus constraining the possibilities of quantification. Of all samples, those from the Taifa period contain a larger number of remains but their interpretation must be cautious given the limited number of samples (6). From the Almohad period, samples are few, the number and variety of seeds is small and the seed density is low. The density of material recovered in the samples from C003 is notably lesser still.

Taken as a whole, the data indicates that most of the remains belong to cultivated species. Among these, cereals are by far the most abundant and frequent. The most common are naked wheats (*Triticum aestivum-durum*) and, to a lesser extent, hulled barley (Hordeum vulgare subsp. vulgare). The presence of einkorn (*Triticum monococcum*) is minority, but corresponds to a crop maintained in this geographic region up until recent times (Peña-Chocarro 1996; Peña- Chocarro and Zapata 2014). The samples of cereals include groups of processed caryopses. With the exception of a single rachis from barley, the remaining cereals (both hulled and naked types) appear as clean caryopses. No chaff remains have been identified, thus suggesting that only the final stages of the processing of the grains took place on-site.

The agricultural system based on cereals at La Dehesilla follows the pattern known from coetaneous settlements in the Iberian Peninsula (Peña-Chocarro et al. 2017). Legumes are rare and it has only been possible to confirm the presence of broad beans (Vicia faba) and possible bitter vetch (*Vicia* cf. *ervilia*). With regard to fruit-bearing species, the presence of the typical cultivated species can be noted: vines (*Vitis vinifera*), olive (*Olea europaea*) and fig trees (*Ficus carica*), and for the first time in the Iberian Peninsula the appearance of the quince (*Cydonia oblonga*).

A last group of crop species is constituted by plants for crafts and oilseeds, including flax (*Linum usitatissimum*), of which an important number of remains have been recovered.

Among the wild species, mastic (*Pistacia lentiscus*) drupes appear in a single concentration associated with a hearth (Unit 7 in C002). Acorns (*Quercus* sp.) are present and constitute an easily available and nutritious resource. Traditionally acorns have been consumed in the form of flour and whole (García Gómez et al. 2002; Pereira 2011). Similarly, mastic drupes can be processed in order to extract oils from the toasted fruits (Rivera Núñez and Obón de Castro 1991; Torres-Montes 2004) or following a complex process of boiling and pressing (Bui Thi Mai et al. 2014). This may explain the presence of the concentration of these fruits in the hearth. The mastic tree was also used for other purposes, including the extraction of gum and as an aromatic plant (Ibn Māsawayh, cf. Aguirre 2001).

The remaining wild taxa correspond to weeds usually associated with the cultivation of cereal crops, the remains of which are eliminated from the grain during the final phases of cleaning (sieving) before grinding (Hillman 1981, 1984; Jones 1992; Jones et al. 2010); or plant species that grow in and around the habitat areas as a result of the accumulation of residues.

**The small number of seed and fruit remains requires us to be cautious in the comparison between the Taifa and Almohad Periods. There are not sufficient differences to indicate significant changes in the management of plant resources between the two periods, although a reduction in the density of remains in the Almohad Period is detected, probably due to the smaller volume of cereals, fruits and pulses present at the site.**

## Phytoliths

The preservation of these microremains is generally good, with a low degree of abrasion and fragmentation. The proportion of taphonomized phytoliths (those which have lost their origi- nal morphology and surface features), an indicator of the overall state of preservation of the material, varies between 8,6% (Sample 14) and 32,6 (Sample 24). The two samples from the Almohad Period (Samples 14 and 15, with a proportion of taphonomised phytoliths of 8.6% and 14.8%, respectively) appear to have a better degree of preservation than those from the Taifa Period (Table 3).

The concentration of phytoliths per gram of AIF is an indicator of the original accumulation of vegetal material, and enables the identification of areas in which plants were processed or stored.

This indicator displays highly variable values (Figure 11) between the different analysed samples, from over three million (Sample 14) to just over 14000 (Sample 24).
The phytological spectrum identified corresponds mainly to Gramineae/herbaceous plant phytoliths, with a larger proportion of dicotyledon phytoliths (Figure 12). Samples 22, 24 and 29 display the largest proportions of the latter. However, the production of monocotyledon phytoliths is much greater than that of the dicotyledons (Albert and Weiner 2001), and therefore the proportion of dicotyledons must always be interpreted as the result of a greater original weight (in terms of the volume of the vegetal material contributed to the deposit). Specifically, Samples 22 and 24 not only display the largest number of dicotyledons but also the highest count of silica skeletons. These were not found at all in many of the samples, while over 20 were identified in Samples 22 and 24 (see Table 4 and Figure 12).
Of the dozen analysed samples, only two belong to the Almohad Period (Samples 14 and 15) while the other ten correspond to the Taifa Period. The comparison between both phases is therefore not equitable in the number of samples. Regarding the distribution and concentration of the phytoliths per categories, the results of the sampling and analysis do not permit the identification of patterns specific to either period (Figure 13). It is interesting to note, however, that dicotyledons decrease in the Almohad levels. Also the Almohad levels display less concentration and variability in the phytological assemblages, and fewer silica skeletons, generally interpreted as an indicator of the original vegetal input and the existence of stable conditions in the archaeological deposits.

**Fauna**

The zoological assemblage is composed by a NR of 1.710 (713 shell and 1.697 bone fragments). The bone NISP is 1.159 belonging to a MNI of 103 (Table 5) and at least 13 species: *Bos taurus, Equus caballus, Cervus elaphus, Sus scrofa/Sus domesticus, Ovis aries/Capra hircus, Capreolus capreolus, Felis* sp., O*ryctolagus cuniculus, Rattus rattus, Gallus domesticus*, an undetermined bird, *Timon lepidus* and an undetermined fish. The graph in Figure 14 shows the relative proportion of spe- cies of the macro-ungulates and meso-ungulates with a body mass above 50 kg using MNI data (Bernáldez 2002; 2011). Caprinae (composed by sheep and goats) is the most common family using both MNI and NISP. Sheep is the best represented species in terms in MNI (11 sheep, 1 goat and 23 sheep/goats). The proportions of cattle, deer and swine are similar in MNI. 713 invertebrate individuals belonging to 8 species have been identified: T*heba pisana, Otala lactea, Cornu aspersum, Xerosecta promissa/Cernuella virgata, Rumina decollata, Cochlicella acuta, Pecten maximus* and *Glycymeris* sp. The most common species are terrestrial, of non-anthropic origin, and are counted in small numbers. Exceptionally, an assemblage of white snails (*Theba pisana*) from Unit 12 in Trench C002 includes 270 individuals. The average size of these snails is larger than that registered in deposits collected for consumption. However, their random distribution in a level of stones is indicative of a natural deposit (Bernáldez and García-Viñas 2010). The shells of two marine bivalves were identified as *Pecten maximus* and *Glycymeris* sp. The limited number and the fragmentation of these elements make it impossible to determine their use, which may not have been alimentary.
If we compare the ungulate assemblages of the Taifa and Almohad Periods (Figure 15), cattle and swine maintain similar relative proportions in MNI. Using NISP it is possible to detect a small increase of bones of these species in the Almohad period. However, the relative proportion of sheep/goats ascended to nearly two thirds of the total of MNI and NISP in the Taifa Period and dropped to less than half of the total in the Almohad Period. Although sheep is the best represented taxon overall, the sample size allows us only to consider the following results as preliminary. There is some suggestion of differences related to the age at slaughter. Figure 16 illustrates the preference for very young individuals (0–5/9 months) in the Taifa Period, while

subadult animals (24–60 months) are slightly more common in the Almohad Pe- riod. The relative proportion (NISP and MNI) of deer also increases in the second period, with the occasional appearance of taxa not previously identified, for instance the horse and the roe deer.

## Discussion and conclusions

The earlier phase of occupation of the site coincided with the end of the Caliphate of Córdoba and the emergence of the first Taifa kingdoms. In our study area the revolts against the Caliphate were instigated by the Berber ethnic groups, and especially the Banū Jizrūn family, whose influence upon the cora of *Šiḏūna* led to the conformation of this territorial unit as an independent Taifa (Richarte and Aguilera 2003, 91–92; Viguera 2003, 45). Between August 1011 and July 1012, Muḥammad b. Jizrūn rose up against the central power from *Qalsāna*, taking control of *Arkuš*, that would become the head of the *Jizrūni* Taifa. He was succeeded by his sons ʿAbdūn and Muḥammad al-Qāʾim, to which *Qalsāna* remained loyal. Soon conflicts with the cora of Seville would arise, and in 1053 ʿAbdūn was kidnapped and assassinated by the Ab-badies. His brother assumed power and attempted to face up to the Sevillians with the support of the Taifa of Granada, which sent military support. However, they were defeated by the Ab- badies in 1069 near *Arkuš*, and the territory was annexed to the kingdom of *Išbīliya* (cf. Borrego 2016, 111; Martín 2011, 234–235; Richarte and Aguilera 2003, 91; Viguera 2003, 45–46). Possibly in this mid-11th century context is when the *madīna* of *Qalsāna* was destroyed (Richarte and Aguilera 2003, 92), perhaps as an exemplary punishment for the unconditional support that it had shown to the Jizrūni dynasty.

During the existence of the taifa of the Banū Jizrūn the role of *Arkuš* as the capital may have implied functions linked to the political and economic administration, although this is not indicated by the written sources (Viguera 2003, 34–35). We may, however, note that *Arkuš* functioned as a military stronghold, and is also mentioned in the sources as a madīna (Viguera 2003, 37–38). The consolidation of *Arkuš* as a madīna and as the capital of the taifa cannot be dissociated from the rural occupation of the surrounding territory, in economic terms, with regard to the catchment of both resources and taxes (Martínez 2008, 391). In the context of this economic dynamic between the rural and the urban populations is where we must place the occupation of La Dehesilla Cave. The annexation of the area to the Taifa of *Išbīliya* does not appear to have affected this rural site, which would remain occupied until the arrival of the Almoravids at the very end of the 11th century.

Historical references to the Almoravid Period in our study area are scarce. It is known, for example, that the emir Yūsuf b. Tāšufīn stopped at *Arkuš* on his way from a*l-Ŷazīrat al-Ḥaḍrā* (Algeciras) to *Zallāqa* (Sagrajas, Badajoz) (Viguera 2003, 43). The scarcity of data, and the abandonment of our site during this period, allows us to infer that the expansion of the North African Empire to the Iberian Peninsula had a negative impact on our study area. Although al-Muʿtāmid and his family were exiled to Tangier (Riu 1999, 194–195), one of his sons stayed on in Arkuš, where he resisted until 1095 (Martín 2011, 235). It is possible that within this context, if not earlier, the southeastern sector of the city was walled. This enclosure is dated archaeologically between the 11th and the early 12th century (cf. Alonso-Ruiz and García-Pulido 2013; García-Pulido and Alonso-Ruiz 2013). It is unclear to what extent the absence of written accounts for the region and the abandonment of the site of La Dehesilla Cave may have been linked to the destruction or the possible sanctions imposed by the Almoravid on the head of the district. As would be recorded later by al-Ḥimyarī in the 14th century, this old ḥisn was destroyed and repopulated in different moments (cf. Abellán 2003, 59). To this we may add the consequences of the religious policy leading to the expulsion of Jews and Mozarabs (Riu 1999, 196), which may have affected the communities that still remained in the region. The Andalusi social unease with regards to the Almoravid is materialised in the fact that a number of cities and

territories proclaimed themselves in rebellion against them. This was the case of *Arkuš* and *Šarīš* under the influence of Abū l-Gamr ibn ʿAzzʾz (Viguera 2003, 46), which briefly formed independent Taifas and would eventually be taken under the control, in the mid-12th century, of the new North African Empire of the Almohads. Abū l-Gamr swore allegiance and recognised the sovereignty of the Almohads, and thus his realms received preferential tax treatment (Martín 2011, 236). The Almohad Period would bring great splendour to the areas of Jerez, Arcos and Ronda (Viguera 2003, 46–47), and the site of La Dehesilla Cave would be reoccupied during this period.

During the 12th and 13th centuries, *Arkuš* became subordinate to *Šarīš*, but did not lose importance due to its geostrategic location. Thanks to the traveller Ibn Yubayr we know that Arkuš was on the route that connected Jaén with Tarifa (Viguera 2003, 43–44). Also, in 1190, the Almohad caliph Abū Yūsuf al-Mansūr stationed his troops in *Arkuš* during the conflict against Portugal (Viguera 2003, 43, 48), thus suggesting the importance of the fortification in the military actions of the period.

As we suggested in the introduction, the *ḥisn* of *Arkuš* must have been, along with that of Ṭanbīl (Tempul, Algar), one of the headplaces of the iqlīm of al-Aṣnām or the district of the Idols. It is difficult to establish precisely which one of these two ḥusūn may have exerted its influence over La Dehesilla. The existence of *Ṭanbīl* is recorded only in the treatise *Mucŷam al-buldān* by Yāqūt al-Hamawī, the Assyrian geographer who lived between the late 12th and the early 13th centuries (cf. Abellán 2004, 26) and it remains unclear to what extent the Andalusi fortress of Tempul may be earlier than the 12th century AD. Were it to be a new Almoravid or Almohad creation, it would be possible to suggest that La Dehesilla may have belonged to the territory of *Arkuš* during the period of the first Taifas, while it may have been directly subordinate to Ṭanbīl during the Almohad Period. But this must be taken as a mere hypothesis. After the Castilian conquest of Arcos (1253 and 1264), and the conquest of Tempul (1309), this stronghold and its surrounding territory, including Algar, remained in Muslim hands until they became property of the council of Jerez de la Frontera in 1309 (cf. Martín 2003a, 170–175; Martín 2003b, 294). The site of La Dehesilla had by then been abandoned. Indeed, the last phase of occupation appears not to have extended past the end of the 12th century AD.

The political dynamics of the historical context outlined above certainly had a great influence on the evolution of the economic patterns and the forms of occupation of La Dehesilla, as well as on other rural sites within this territory. In the Islamic period, most of the pollen diagrams for the Southwestern sector of the Iberian Peninsula show the maximum extent of grasslands, a notable phase of deforestation and a clear rise in the level of livestock indicators such as anthropozoogenous taxa and coprophilous fungi. This process is illustrated in the pollen diagrams from the castle of Aracena (López-Sáez et al. 2015), the archaeological site of Pocito Chico (López-Sáez et al. 2002), and in several pollen records from the marshland areas located in the Doñana National Park (Jiménez-Moreno et al. 2015).

At La Dehesilla, the existence of farming activities is indicated through the presence of pollen of broad beans (*Vicia faba*, 0–3.1%), but no cereal pollen has been identified. Although cereals are autogamous, and therefore have low pollen production and dispersal (López-Sáez et al. 2003; López-Sáez and López-Merino 2005), if they had grown in situ near the archaeological site it is likely that would have appeared in the palynological record. Maybe no cereal crops were grown during the Andalusi period near the site or, since the samples considered by the pollen analysis came from inside the cave, the presence of cereal crops outside may not have left any record. The archaeobotanical record at La Dehesilla is very similar to that documented at most sites in the Iberian Peninsula. Cereals are predominant, accompanied by lower amounts of legumes, fruit trees, oil seeds and wild fruits. It is unclear if all of these species belonged to a context of

production or consumption, or to a local or regional trade network (cf. Abellán 2004, 136–137; Martín 2011, 269; Martínez 2008, 386). With regard to cereal crops, it has been suggested that in the cora of Šiḏūna the cereal fields were mainly located in the area of Lebrija, Jerez, Medina Sidonia and the inland wetland of La Janda (Abellán 2004, 134–136; Martín 2011, 267), approximately 40 km from La Dehesilla Cave. However, the seeds recovered in our sequence may have come from cereal fields nearer the site, perhaps related to one of the *qurà* or *maŷāšir* of the immediate area (cf. González 1951, 70 and 75; PGOU 2009, 59–60).

The phytolith analysis indicates the overall predominance of monocotyledon remains (Gramineae), but also provides information on particular contexts, and shows that the data is variable between the different samples. The sample with the greatest concentration of phytoliths, although with a similar distribution of morphotypes as in other samples, comes from Unit 14, the Almohad level on which a structure with an organic roof was built. Due to the nature of archaeological knowledge (cf. Friesem et al. 2014), the interpretation of this type of context is problematic, due to the impossibility of discriminating between the materials fallen from the roof, those belonging to the occupational level and those derived from the human activities that took place.

At present, and in the absence of further data on the medieval occupation of the area, it is hard to determine if the residents of La Dehesilla Cave cultivated the legumes and cereal, fruit and oil seed crops identified in the archaeological sequence, or if these agricultural activities took place elsewhere and the products were transported to the site during its phases of occupation. This type of record is habitual for habitat contexts, to which cereals usually arrived partially processed, requiring only a fine sieving in order to remove the remaining small sized contaminants (glumes, weed seeds).

The results of the archaeozoological analysis indicate a meat portion of the diet based exclusively on vertebrates. Among the macro- and meso-ungulates, the sheep/goats are the most common, representing almost half of the total assemblage. They are the most common species in the majority of Andalusi sites in southern Spain (Bernáldez and Bernáldez 2003; García-Viñas et al., in press) and in the rest of the Iberian Peninsula (Moreno-García 2013; Morales et al. 2011). The remaining 50% of the assemblage displays a balanced distribution of cattle, deer and swine. The latter are found in up to 10 different Units. Pigs are regularly documented in Andalusi period deposits, but unlike other Andalusian sites at La Dehesilla Cave their number equals that of cattle and deer. The explanation for this relative abundance may be linked to the regular practice of hunting activities. The distinction between wild boar and domestic pig based on skeleton remains was not possible. It is known that the Andalusi aristocracy practiced big game hunting of boar, although the animals appear not to have been destined for consumption (García-Viñas et al., in press). However, there are present-day communities in the Moroccan Rif that approve the consumption of wild boar meat, as long as the animal has been slaughtered following the norms of the Quran (Moreno-García 2004). The presence of swine remains at La Dehesilla, rather than a breach of the Islamic doctrine, may be explained in this way. The importance of hunting is also supported by the noteworthy presence of deer (17%). Usually this species appears only in low frequencies and it therefore seems likely that the ecosystem surrounding the site may explain this higher proportion.

In similar proportions to pig and deer, cattle make up almost a fifth of the total assemblage (18% of the MNI). The remaining species with a body mass over 50 kg are the horse and the roe deer. The scarcity of these species indicates, however, either that they were not consumed or that their populations were in regression in the paleoecosystem. Horse has only been identified in a single calcaneus with no cut or butchery marks. Although there is a tradition of horse meat consumption in some parts of the Islamic world, in specific contexts and/or situations (cf.

García-Viñas et al., in press; Lewicka 2011, 175 and 179–180), some jurists, such as Mālik ibn Anas (translation 2009, 276), considered this practice abominable or illicit. Given the notable influence of the Maliki School of jurisprudence in al-Andalus, it is likely that the consumption of horse meat was not a generalised practice (García-Viñas et al., in press). The recovery of horse shoes and a number of metal rings, perhaps belonging to horse tack, suggest that the main use of horses was probably as working animals, for draft and transportation.

The data presently available suggests that the economy of the Andalusi populations at La Dehesilla Cave was mainly based on livestock, and especially on sheep herds. The differential success of sheep may perhaps be explained by their ideal adaptation to grasslands, these pastures being simultaneously the best-suited grazing grounds for sheep; as well as by their nutritional and wool contributions. Evidence of the transformation of wool is provided by several spindle whorls recovered throughout the Andalusi sequence at the site.

The pollen analysis indicates that intense grazing pressure was a constant throughout the diagram. The viability and success of the simultaneous exploitation of cattle and sheep herds perhaps required the planning of the use and the differential allocation of the forage areas. It is known that sheep and goat herds have a greater mobility and cover a greater extension of land than cattle in the processes of grazing and manuring (García-García and Moreno-García, in press). The written sources of the period are informative about the importance of livestock in the cora of *Šiḏūna*, and both Ibn Gālib and the anonymous author of the *Ḏikr bilād al-Andalus* mention the renown and quality of the pastures (Abellán 1996, 85; Martín 2011, 265–266).

The comparison between the two Andalusi periods enables us to observe some significant differences. Plant macro-remains indicate the larger amount of cereals and legumes, as well as of domestic fruits, in the Taifa Period than in the Almohad Period, although the sample available for the second phase is small. The analysis of phytoliths also indicates that the Taifa Period samples are richer and more varied, with a greater number of silica skeletons and the greater presence of dicotyledons.

The archaeozoological analysis displays clear differences between the two periods. The Taifa Period shows a higher proportion of herds while the input from hunting increased in the Almohad Period. Another significant difference is the detection of proportionally opposite patterns in the age of sacrifice of sheep. The Taifa population indicates a preference for younger animals, while the Almohad population tends towards juvenile and subadult individuals. This may be linked to the importance of sheep as a source of meat and milk, but also of hides and wool. The presence of the horse only in the Almohad Period is coherent with the presence of horse shoes exclusively in these levels.

In consideration of these relatively dissimilar economic patterns, it is possible that the functional nature of the occupation of the site was also different in the two periods. The earlier period may correspond to a more sedentary herding and partly farming population; the second period to a mainly herding, perhaps mobile, population. The presence of horses in the Almohad Period, probably used for draft and transportation, may be linked to the practice of a partially nomadic form of herding. In contrast, the evidences of probable agricultural activities in the Taifa Period may indicate a resident population at the site, with a medium to long term work investment and future projection. The archaeological structures themselves dated in the Taifa Period support this hypothesis, not only their number throughout the sequence but also their nature. Indeed, the Taifa Period constructions (clearance pits and contention structures for the creation of a large platform prior to the construction of buildings of a certain scale, with thick stone walls) required a much greater investment than those of the Almohad Period, for which only the collapse of a stone structure with a tiled roof and a wooden shelter with an organic roof have been documented. There is also a notable contrast between the pottery records of the two periods, with

formal characteristics exclusive to each assemblage. All of these evidences, which indicate relatively dissimilar behavioural and economic patterns in the two periods of the Andalusi archaeological record, in addition to the intermediate abandonment phase of the site, support the existence of two different populations.

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## References

Abellán, J. 1996. El Cádiz islámico a través de sus textos. Cádiz: Universidad de Cádiz.

--- 2003. "Arcos de la Frontera en el poblamiento de la cora de Sidonia." In Actas I Congreso de Historia de Arcos de la Frontera, 55–73. Arcos de la Frontera: Ayuntamiento de Arcos de la Frontera.

--- 2004. Poblamiento y administración provincial en al-Andalus. La cora de Sidonia. Málaga:

Sarriá. Acién, M., F. Castillo, M.I. Fernández, R. Martínez, C. Peral and A. Vallejo. 1991. "Evolución de los tipos cerámicos en el S.E. de Al-Andalus." In Actes du Vème Colloque International sur la céram- ique médiévale en Méditeerranée Occidental, 125–139. Rabat.

Acosta, P. and M. Pellicer. 1990. La Cueva de La Dehesilla (Jerez de la Frontera). Las primeras civilizaciones productoras en Andalucía occidental. Jerez de la Frontera: CSIC.

Aguilar, L., R. González and F. Barrionuevo. 1998. "El asentamiento prealmohade de Jerez de la Frontera (Cádiz)." Spal 7: 163–173. https://doi.org/10.12795/ spal.1998.i7.10

Aguirre, L. F. 2001. "Uso terapéutico de sustancias aromáticas en al-Andalus." Dynamis. Acta Hispanica ad Medicinae Scientiarumque Historiam Illustrandam 21: 93–132.

Alba-Sánchez, F., J.A. López-Sáez, B. De Benito, J.C. Linares, D. Nieto and L. López-Merino. 2010. "Past and present potential distribution of the Iberian Abies species: a phytogeographic approach using fossil pollen data and species distribution models." Diversity & Distributions 16: 214–228. https://doi.org/10.1111/ j.1472-4642.2010.00636.x

Albert, R. M. and S. Weiner. 2001. Study of phytoliths in prehistoric ash layers using a quantitative approach. In Phytoliths, Applications in Earth Sciences and Human History, edited by J.D. Meunier, and F. Coline, 251–266. A.A. Balkema.

Alonso-Ruiz, M. M. and L. J. García-Pulido. 2013. "Estudio histórico-arqueológico de la muralla sureste de Arcos de la Frontera (Cádiz)." Arqueología de la Arquitectura 10: e004. https://doi.org/10.3989/arq.arqt.2013.005

Barone, R. 1999. Anatomie comparée des mammifères domestiques, vol. 1, Ostéologie. Paris: Vigot.

Beltrán, J.M. 2005. "Registros cerámicos de época taifa en Madina Labla (Niebla, Huelva): Un acercamiento tipológico." Huelva en su Historia 12: 53–76.

Bernáldez, E. 2002. “Bioestratimony of terrestrial mammals in Doñana National Park (Spain).” In Current Topics on Taphonomy and Fossilization, edited by M. De Renzi et al., 314–324. Valencia: Ayuntamiento de Valencia.
--- 2011. “Biostratinomy applied to the interpretation of scavenger activity in paleoecosystems.” Quaternary Interna- tional 243: 161–170. https://doi.org/10.1016/j.quaint.2011.06.023
Bernáldez, E. and M. Bernáldez. 2000. “La basura orgánica de Lebrija en otros tiempos: Estudios paleobiológico y tafonómico del yacimiento arque- ológico de la calle Alcazaba de Lebrija.” Boletín del Instituto Andaluz del Patrimonio Histórico 32: 134–150.
--- 2003. “El vertedero islámico del Hospital de las Cinco Llagas. Historias orgánicas en la basura.” In Arqueología y rehabilitación en el Parlamento de Andalucía. Investigaciones arqueológicas en el antiguo Hospital de las Cinco Llagas de Sevilla, edited by M.A. Tabales, 288–318. Seville: Secretaría General del Parlamento de Andalucía.
Bernáldez, E. and E. García-Viñas. 2010. “Indirect detection of Seville population studying size of oysters?.” Munibe 31: 208–215.
Bertrand, M. 2000. “Cuevas d’al-Andalus et cuevas chrétiennes. Origines et évolution d l’habitat troglodytique des Hauts Pla- teaux de Grenade.” In Maisons et espaces domestiques dans le monde méditerranéen au Moyen Âge, edited by A. Bazzana and É. Hubert, 27–52. Rome andMadrid: École Française de Rome y Casa de Velázquez.
Blackmore, S., A. Le Thomas, S. Nilsson and W. Punt. 1992. Pollen and Spores: Terminology. Utrecht: Universidad de Utrecht.
Borrego, M. A. 2007. “La ciudad andalusí de Šidūna (Siglos VIII–XI).” Al-Andalus Magreb 14: 5–18.
--- 2016. “Arcos andalusí y la revuelta mudéjar.” In Arcos y el nacimiento de la frontera andaluza (1264–1330), edited by M. González and R. Sánchez, 107–122. Seville: Editorial UCA and Editorial Universidad de Sevilla.
Bui Thi Mai, M. Girard, and F. De Lanfranchi. 2014. “Uses of the mastic tree (Pistacia lentiscus L.) in the West Mediterranean region: An example from Sardinia, Italy.” In Plants and People: Choices and Diversity through Time, edited by A. Chevalier, E. Marinova, and L. Peña-Chocarro, 293–298. Oxford: Oxbow Books.
Burjachs, F., J. A. López Sáez and M. J. Iriarte. 2003. “Metodología Arqueopalinológica.” In La recogida de muestras en Arqueobotánica: objetivos y propuestas me- todológicas. La gestión de los recursos vegetales y la transformación del paleopaisaje en el Mediterráneo occidental, edited by R. Buxó, and R. Piqué, 11–18. Barcelona: Museu d’Arqueologia de Catalunya.
Cameron, C. M. and S. A. Tomka, eds. 1996. The Abandonment of Settlements and Regions: Ethnoarchaeological and Archaeological Approaches. Cambridge: Cambridge University Press.
Cano, E. 2007. “Formas cerámicas representativas de la ocupación de cuevas naturales, durante la Edad Media andalusí, en el entorno de Madinat Baguh (Priego de Córdoba).” Antiqvitas 18–19: 141–168.
--- 2008. La ocupación de cuevas naturales durante la Edad Media andalusí en el entorno de Madīnat Bāguh (Priego de Córdoba). Granada: Alhulia.
Cara, L., and J.M. Rodríguez. 1987. “Introducción al estudio de las cuevas artificiales medievales de la provincia de Almería.” Boletín del Instituto de Estudios Almerienses 7: 25–48.
Carmona, R. 2012. “Ascetas, devotos y misticismo islámico: nuevas perspectivas sobre la ocupación de cuevas naturales en madīnat Bāguh (Priego de Córdoba).” Antiqvitas 24: 223–264.
Carmona, R., A. Moreno, J.C. Vera, D. Luna, B. Gavilán, and A. Molina. 1999. “La cueva de Los Mármoles (Priego de Córdoba): Análisis de resultados de una prospección arqueológica superficial.” Antiqvitas 10: 5–24.

Carrión, J.S., I. Parra, C. Navarro and M. Munuera. 2000. “Past distribution and ecology of the cork oak (Quercus suber) in the Iberian Peninsula: a pollen-analytical approach.” Diversity & Distributions 6: 29–44. https://doi.org/10.1046/j.1472-4642.2000.00070.x
Cavilla, F. 2012. “Cerámicas musulmanas procedentes de la Calle Liebre de Jerez de la Frontera (Cádiz).” Estudios sobre Patri- monio, Cultura y Ciencias Medievales 13–14: 19–68.
--- 2014. “Cerámicas islámicas de los siglos XI y XII procedentes de hallazgos subacuáticos en la zona de Sancti-Petri (Cádiz).” Estudios sobre Patrimonio, Cultura y Ciencias Medievales 16: 21–48.
Friesem, D.E., G. Tsartsidou, P. Karkanas and R. Shahack-Gross. 2014. “Where are the roofs? A geo-ethnoarchaeological study of mud brick structures and their collapse pro- cesses, focusing on the identification of roofs.” Archaeological and Anthropological Sciences 6:1: 73–92. https://doi.org/10.1007/s12520-013-0146-3
García-García, M. and M. Moreno-García. In press. “De huertas y rebaños: perspectivas históricas y ecológicas sobre el papel de la ganadería en la agricultura andalusí.” III Seminario de la Sociedad Española de Historia Agraria (Madrid, 28 de noviembre de 2014).
García Gómez. E., J. Pereira and A. Ruiz. 2002. “Aportaciones al uso de la bellota como recurso alimenticio por las comunidades campesinas.” Cuadernos de la Sociedad Española de Ciencias Forestales 14: 65–70.
García-Pulido, L. J. and M. M. Alonso-Ruiz. 2013. “Fábrica de tierra encofradas asociadas a la muralla sureste de Arcos de la Frontera (Cádiz).” In Construcción con tierra. Pasado, presente y futuro, edited by F. J. Sandoval, and J. L. Sáinz Guerra, 37–52, Valladolid: Universi- dad de Valladolid.
García Rivero, D., J. A. Barrera, F. Díaz, C. Borja, G. Álvarez, F. Sancho, J. L. Escacena, R. Taylor and J. Pérez. In press. “El Proyecto Cueva de La Dehesilla (Jerez de la Frontera, Cádiz): Primeros resultados tras las interven- ciones de 2015.” In Los cambios económicos y sus implicaciones sociales durante el Neolítico de la Península Ibérica, edited by G. Martínez and J. A. Afonso. Granada: Universidad de Granada.
García-Viñas, E., E. Bernáldez and L. G. Pérez-Aguilar. In press. “Uso y consumo de animales en el sur de al-Andalus: Una primera aproximación a través del registro paleobiológico.” In Economía y trabajo. Las bases materiales de la vida en al-Andalus, edited by M. M. Delgado Pérez and L. G. Pérez-Aguilar. Seville: Alfar.
Gofas, S., D. Moreno and C. Salas. 2011. Moluscos marinos de Andalucía. Málaga: Universidad de Málaga, and Junta de Andalucía.
González, J. 1951. Repartimiento de Sevilla, vol. I. Madrid: CSIC. González, R., L. Aguilar and F.J. Barrionuevo.
--- 2015. Los colores del poder. La cerámica verde y manganeso de Jerez de la Frontera (Cádiz). Jerez: Peripecias Libros.
Grimm, E. C. 1992. Tilia, version 2. Springfield. IL 62703. Springfield: Illinois State Museum, Research and Collection Center.
--- 2004. TGView. Springfield: Illinois State Museum.
Hidalgo, R., and I. Fernández. 1996. “Contribución al estudio morfológico del polen de plantas hortícolas cultivadas en Andalucía.” Lagascalia 18: 151–162.
Hillman, G. C. 1981. “Reconstructing crop husbandry practices from charred remains of crops.” In Farming Practice in Prehistoric Britain, edited by R. Mercer, 123–162. Edinburgh: Edinburgh University Press.
--- 1984. “Interpretation of archaeological plant remains: the application of ethnographic models from Turkey.” In Plants and ancient man: studies in palaeoethnobotany, edited by W. van Zeist and W. Casparie, 1–41. Rotterdam: A.A. Balkema.

Hilson, S. 2009. Mammal Bones and Teeth: An Introductory Guide to Methods of Identification. Routledge: Institute of Archaeology Publications.
Ibn Anas, Mālik. 2009. Al-Muwatta, translated by H.A.G. Melara. Granada: Madrasa Editorial.
Jiménez-Moreno, G., A. Rodríguez, J. N. Pérez-Asensio, J. S. Carrión, J. A. López-Sáez, J.J.R. Villarías, S. Celestino, E. Cerrillo, A. León and C. Contreras. 2015. "Impact of late-Holocene aridification trend, climate variability and geodynamic control on the environment from a coastal area in SW Spain." The Holocene 25(4): 607–617. https://doi.org/10.1177/0959683614565955
Jones, G. 1992. "Weed phytosociology and crop husbandry: Identifying a contrast between ancient and modern practice." Review of Palaeobotany and Palynology 73(1): 133–143. https://doi.org/10.1016/0034-6667(92)90051-H
Jones, G., M.P. Charles, A. Bogaard and J. G. Hodgson. 2010. "Crops and weeds: the role of weed functional ecology in the identification of crop husbandry methods." Jounal of Archaeological Science 37(1): 70–77. https://doi.org/10.1016/j.jas.2009.08.017
Kamp, K. A. 1987. "Affluence and image: Ethnoarchaeology in a Syrian village." Journal of Field Archaeology 14(3): 283–296. Lewicka, P. B.
--- 2011. Food and Foodways of Medieval Cairenses. Aspects of Life in an Islamic Metropolis of the Eastern Mediterranean. Leiden: Brill. https://doi.org/10.1163/ej.9789004194724.i-626
López-Sáez, J. A., F. Alba Sánchez, L. López Merino and S. Pérez Díaz. 2010. "Modern pollen analysis: a reliable tool for discriminating Quercus rotundifolia communities in Central Spain." Phytocoenologia 40: 57–72. https://doi.org/10.1127/0340-269X/2010/0040-0430
López-Sáez, J. A., F. Alba-Sánchez, S. Pérez-Díaz, S. Núñez De La Fuente and E. Romero. 2015. "Análisis palinológico del alcázar del castillo de Aracena (Huelva)." Ligustinus. Revista Digital de Arqueología de Andalucía Occidental 4: 39–49.
López Sáez, J. A., P. López García and F. Burjachs. 2003. "Arqueopalinología: Síntesis crítica." Polen 12: 5–35. López-Sáez, J. A., P.
López-García and M. Martín-Sánchez. 2002. "Palaeoecology and Holocene environmental change from a saline lake in South-West Spain: The proto- historical and prehistorical vegetation in Cádiz Bay." Quaternary International 93–94: 197–206. https://doi. org/10.1016/S1040-6182(02)00018-6
López-Sáez, J. A. and L. López-Merino. 2005. "Precisiones metodológicas acerca de los indicios paleopalinológicos de agricultura en la Prehistoria de la Península Ibérica." Portugalia 26: 53–64.
Lyman, R. L. 2008. Quantitative Paleozoology. Cambridge: Cambridge University Press. https://doi.org/10.1017/ CBO9780511813863
Madella M., A. Power-Jones, and M. Jones. 1998. "A simple method of extraction of opal phytoliths from sediments using a non-toxic heavy liquid." Journal of Archaeological Science 25: 801–803. https://doi.org/10.1006/jasc.1997.0226
Marshall, F. and T. Pilgram. 1993. "NISP vs. MNI in quantification of body-part representation." American Antiquity 58(2): 261–269. https://doi. org/10.2307/281968
Martí, F., E. Sanmartí and R. Viñas. 1975. "La cueva de 'La Dehesilla' en Jerez de la Frontera." In Miscelánea Arqueológica. XXV Aniversario de los Cursos Internacionales de Prehistoria y Arqueología en Ampurias (1947–1971), edited by E. Ripoll and M. Llongueras, 13–47. Barcelona: Diputación Provincial de Barcelona.
Martín, E. 2003a. "Relaciones entre Arcos y Jerez de la Frontera (siglos XIII–XV)." In Actas I Congreso de Historia de Arcos de la Frontera, 161–194. Arcos de la Frontera: Ayuntamiento de Arcos de la Frontera.
--- 2003b. "Análisis de la toponimia y aplicación al estudio del poblamiento. El alfoz de Jerez de la Frontera durante la Baja Edad Media." Historia. Instituciones. Documentos 30: 257–300.

--- 2011. “Medina Sidonia en la época medieval.” In Historia de Medina Sidonia, vol. 1, edited by D. Caro Cancela, 195–367. Cádiz: Diputación de Cádiz.
Martínez, V. 2008. “Un país ‘que reporta todo tipo de bienes’. Sobre el sentido histórico de la cora de Sidonia.” Revista Atlántica- Mediterránea de Prehistoria y Arqueología Social 10: 375–398. https://doi.org/10.25267/Rev_atl-mediterr_pre- hist_arqueol_soc.2008.v10.12
Montilla, I. 2002. “Aportaciones para una tipología de la cerámica islámica en Jaén (ss. XI–XIII).” Arqueología y Territorio Medi- eval 9: 181–208.
Moore, P. D., J. A. Webb and M. E. Collinson. 1991. Pollen Analysis. London: Blackwell Scientific Publications.
Morales, A., M. Moreno-García, E. Roselló, L. Llorente and D. C. Morales. 2011. “711 AD: ¿El origen de una disyunción alimentaria?.” Arqueología e Historia entre dos mundos 15: 303–322.
Moreno-García, M. 2004. “Hunting practices and consumption patterns in rural communities in the Rif mountains (Morocco) – some ethno-zoological notes.” In Behaviour Behind Bones. The Zooarchaeology of Ritual, Religion, Status and Identity, edited by S. J. O’Day, W. Van Neer, and A. Ervynck, 327–334. Oxford: Oxbow Books.
--- 2013. “Gestión y aprovechamiento de cabañas ganaderas en al-Andalus: aportaciones desde la arqueozoología.”Debates de Arqueología Medieval 3: 75–98.
Oliver, J. 1945. “Maŷšar—Cortijo. Orígenes y nomenclatura árabe del cortijo sevillano.” Al-Andalus 10(1): 109–126.
Peña-Chocarro, L. 1996. “In-situ conservation of hulled-wheat species: the case of Spain. In Hulled Wheat: Proceedings of the First Inter- national Workshop on Hulled Wheats, edited by S. Padulosi, S. Heller, K. Hammer, and J. Heller, 129–146. Rome: IPGRI.
Peña-Chocarro, L. and L. Zapata. 2014. “Versatile hulled wheats: Farmer’s traditional uses of endangered crop species in the western Mediterra- nean.” In Plants and People: Choices and Diversity through Time, edited by A. Chevalier, E. Marinova and L. Peña- Chocarro, 276–281. Oxford: Oxbow Books.
Peña-Chocarro, L., G. Pérez-Jordá, N. Alonso, F. Antolín, A. Teira-Brión, J. P. Tereso, E. M. Montes and D. López Reyes. 2017. “Roman and medieval crops in the Iberian Peninsula: A first overview of seeds and fruits from archaeological sites.” Quaternary International. First online.
Pereira, J. 2011. “Paleoetnografía del consumo de bellotas en las comunidades prerromanas peninsulares.” In Arqueología, sociedad, territorio y paisaje. Estudios sobre prehistoria reciente, protohistoria y transición al mundo romano, edited by P. Bueno, A. Gilman, C. Martín Morales and F. J. Sánchez-Palencia, 279–289. Madrid, CSIC.
Pérez-Aguilar, L. G. 2013. “Problemas metodológicos en el estudio del mundo rural andalusí.” Medievalista 14. Internet Edition, http:// medievalista.revues.org/398
Perles, B. and E. M. Andrades. 2009. “Estudio tipológico de un conjunto cerámico del siglo XII en la Avenida de la Marina de Algeciras.” Caetaria 6–7: 179–204.
PGOU 2009. Carta Arqueológica del término municipal de Arcos de la Frontera, vol. 1. Arcos de la Frontera: Ayuntamiento de Arcos de la Frontera.
Poppe, G. and Y. Goto.1991. European Seashells,vol. 1: Polyplacophora, Caudofoveata, Solenogastra, Gastropoda. Hackenheim: ConchBooks. 1993. European Seashells,vol. 2: Scaphopoda, Bivalvia, Cephalopoda. Hackenheim: ConchBooks.
Quesada, T. 1995. “Formas de poblamiento en un área rural de al-Andalus: el valle del río Jandulilla (Jaén).” Arqueología y Ter- ritorio Medieval 2: 5–24.
Reille, M. 1992. Pollen et Spores d’Europe et d’Afrique du Nord. Marseille: Laboratoire de Botanique Historique et Palynologie.

Richarte, M. J. and L. Aguilera. 2003. “La ciudad de Qalsana (Junta de los Ríos, Arcos de la Frontera) desde una perspectiva histórico-arqueológi- ca.” In Actas I Congreso de Historia de Arcos de la Frontera, 87–101. Arcos de la Frontera: Ayuntamiento de Arcos de la Frontera.
Riu, M. 1999. Edad Media (711–1500). Madrid: Espasa Calpe.
Rivera Núñez, D. and C. Obón de Castro. 1991. La guía INCAFO de las plantas útiles y venenosas de la Península Ibérica y Baleares (excluidas medicinales). Madrid: INCAFO.
Ruiz, A., A. Carcaba, A. I. Porras and J. R. Arrébola. 2006. Guía de los Caracoles Terrestres de Andalucía. Seville: Junta de Andalucía.
Schmid, E. 1972. Atlas of Animal Bones for Prehistorians, Archaeologists and Quaternary Geologists. Amsterdam: Elsevier.

Taylor, R., L.G. Pérez-Aquilar, and D. García Rivero. In press. “La secuencia arqueológica de época islámica en la Cueva de La Dehesilla (Jerez de la Frontera, Sierra de Cádiz.” Arqueología y Territorio Medieval.
Torres-Montes, F. 2004. Nombres y usos tradicionales de las plantas silvestres en Almería. Almería: Instituto de Estudios Almerienses, and Diputación de Almería.
Valdés, B., M. J. Díez and I. Fernández. 1987. Atlas polínico de Andalucía Occidental. (Instituto de Desarrollo Regional 43). Seville: Universidad de Sevilla, and Diputación de Cádiz.
Van Geel, B. 2001. Non-pollen palynomorphs. In Tracking Environmental Change Using Lake Sediments, vol. 3, Terrestrial, Algal and Siliceous Indicators, edited by J. P. Smol, H.J.B. Birks and W. M. Last, 99–119. Dordrecht: Kluwer.
Vera, M. and P. López. 2005. La cerámica medieval sevillana (siglos XII al XIV). La producción trianera. British Archaeological Reports International Series 1403. Oxford: Archaeopress.
Viguera, M. J. 2003. Arcos en al-Andalus: notas sobre su historia islámica. In Actas I Congreso de Historia de Arcos de la Frontera, 31–54. Arcos de la Frontera: Ayuntamiento de Arcos de la Frontera.
Viñas Vallverdú, R. 1970. “La Cueva de La Dehesilla en Jerez de la Frontera (Cádiz).” In I Congreso Espeleológico Nacional. Barcelona.
--- 1971. “Prospecciones espeleo-arqueológicas en la cueva de La Dehesilla, Jerez de la Frontera.” Información Arque- ológica 6: 176–177.
Wilkens, B. 2003. Archeozoología. Sassari: Universitá degli studi di Sassari.
**Zurro, D. 2017. “One, two, three phytoliths: Assessing the minimum phytolith sum for archaeological studies.” Archaeological and Anthropological Sciences. First online.**