Zooarchaeology of the Iron Age in Western Iberia: new insights from the Celtic oppidum of Ulaca

Verónica Estaca-Gómez¹ · Jesús Rodríguez-Hernández¹ · Raúl Gómez-Hernández¹ · José Yravedra Sainz de los Terreros¹,²,³,⁴ · Gonzalo Ruiz-Zapatero¹,⁴ · Jesús R. Álvarez-Sanchís¹,⁴

Received: 4 April 2022 / Accepted: 8 July 2022 / Published online: 9 August 2022 © The Author(s) 2022

Abstract

The Vettones were one of the most important Celtic peoples of the Late Iron Age in Western Iberia (between the Duero and Tagus Rivers). It is a period recognised from the spread of the cremation ritual in the cemeteries, the development of iron metallurgy, and the emergence of large fortified settlements—the characteristic oppida—that would finally be abandoned with the conquest of Hispania by Rome. Different types of evidence suggest that the Vetton economy was based on livestock. Palaeobotanical and carpological analyses reveal a major deforestation of the landscape, the conversion of large areas into pastures and cultivated fields, and the use of enclosures as cattle pens. The stone sculptures of bulls and pigs found throughout the mountainous areas of the region—the famous verracos—also reflect the value the Vettones placed on livestock. However, there have been very few studies devoted to the identification of faunal remains. In this text, we offer previously unpublished data on the animals found in the oppidum of Ulaca (Solosancho, Ávila, Spain), one of the largest in Celtic Iberia (third–first centuries BC), which we relate to other evidence from neighbouring sites. Thus, the state of the research into Vetton zooarchaeology is offered in the broader context of the Iberian Peninsula.

Keywords Vettones · Zooarchaeology · Verracos · Livestock · Oppida · Iron Age

Introduction

At the end of the third century BC, in the context of the conflict between Rome and Carthage, the Iberian Peninsula was a mosaic of peoples with some shared cultural traits and others specific to each region. The classical texts described the Vettones, one of the most important Celtic peoples of the time (Álvarez-Sanchís 1999, 2003; Sánchez-Moreno 2000; Salinas 2001), as occupying an extensive inland territory located on a high plateau, whose nuclear zone would have been between the Rivers Duero and Tagus (Fig. 1). They bordered to the north and east with the Vaccaei and Carpetani tribes, regions characterised by an important agriculture-based economy and high cereal yields (Torres Rodríguez 2013; Urbina 2014; Romero and Sanz Mínguez 2007; Romero et al. 2008). To the south and west, the mountain ranges separated the Vettones from the Lusitanians and other peoples in a much more rugged landscape with a marked pastoral nature (Martín Bravo 1999; Almagro-Gorbea 2009, 2014).

During the Iron Age, much of Iberia was immersed in a process of intensive land exploitation, with increasing deforestation and the conversion of large areas into pasture and farmland (Ruiz-Gálvez 1992; Álvarez-Sanchís 2003). Not only were there more and larger settlements in this period, but for the first time, many of them were occupied for several hundred years. It was also a time when the population began to systematically protect itself against war, building settlements with stone walls and towers and bastions at the entrances (Álvarez-Sanchís 2000, 2005). Sometimes these were preceded by ditches and chevaux de frise, i.e. spaces strewn with pointed, sharp-edged stones, the purpose of which was to hinder the approach of attackers. These fortified towns are known generically as castros (hillforts) and were a feature of many regions.
Vetton castros were located on high hills, at the confluences of several rivers and near excellent communication routes. They ranged in size from small villages of less than one hectare housing just a few families to towns of between 20 and 70 hectares with communities of several hundred people. This can be deduced from demographic studies carried out in settlements and cemeteries of the time (Álvarez-Sanchís and Ruiz Zapatero 2001; Rodríguez-Hernández 2019: 268–272). At the end of the Iron Age, some of the population centres were even bigger. These are the famous oppida, a term of Latin origin used by Julius Caesar in his chronicle of the Gallic Wars (58–52 BC). We use it today to designate what were virtually urban centres, the residences of the elites who controlled political territories of varying sizes (Ruiz Zapatero et al. 2020).

The foundation of these oppida had a considerable impact, and the information from the cremation cemeteries is also important for characterising the Vetton society of the time. The variety of grave goods and offerings seen in the cemeteries of Las Cogotas (Cardenosa, Ávila) and La Mesa de Miranda (Chamartín, Ávila)—consisting of 1600 and 2300 tombs, respectively—is a powerful reflection of hierarchical communities supported by a broad social base (Ruiz Zapatero 2007; Ruiz Zapatero and Álvarez-Sanchís 1995). The remains of the most prominent chiefs were laid to rest accompanied by iron weapons and the harnesses they had used for their horses. Below the equestrians in the ranking was a larger group of warriors with more modest panoplies. Finally came the mass of the population, with differing degrees of wealth and humbler grave goods. These grave goods were characteristic between the fourth and the second centuries BC.

It has been argued that the Vettons’ economy was based on livestock and, to a lesser extent, on cereal farming with different varieties of wheat and barley. The remains found in some of the houses at Las Cogotas, El Raso, and Ulaca suggest that these were the most important crops and that they were supplemented with a few legumes and acorns (Álvarez-Sanchís 1999: 154; Fernández Gómez 2003; Rodríguez-Hernández 2019: 193–196). Iron made it possible to manufacture tools that were very useful in agricultural tasks. They allowed the cultivation of the deeper soils in the lower parts of the valleys and the colonisation of as yet unoccupied areas. Palynological analyses suggest that during the Late Iron Age, there was a considerable increase in anthropic pressure on the environment in this area, with growing livestock and agricultural activity that would have led to a progressive deforestation of the landscape (López-Sáez et al. 2008). Coprophilic fungi were also detected in these analyses. This is indicative of animal excrement inside the settlements, which would confirm that some of the fortified precincts worked as cattle pens (Cabré 1930; Ruiz Zapatero and Álvarez-Sanchís 1995).

A characteristic feature of the Vettones that differentiates them from other Iron Age peoples is the stone sculptures, generically known as verracos, that represent bulls and pigs (Álvarez-Sanchís 1994, 1999; Ruiz Zapatero and Álvarez-Sanchís 2008; Berrocal-Rangel et al. 2018). More than 400 examples are known. They are between 1 and 2.5 m in length and weigh up to 8 tons. Their interpretation is controversial. However, taking into account their distribution in the landscape and their location near the gates of the oppida, it has been proposed that they fulfilled two basic functions at the end of the Iron Age: (1) as
markers of the rich pastures controlled by the towns’ elites and (2) as symbols of protection for the inhabitants and their cattle. In any case, the *verracos* reflect the economic and ideological importance of livestock among the communities of Western Iberia, an absolutely characteristic and exclusive feature of the Vettones in the context of Iron Age Temperate Europe (Ruiz Zapatero and Álvarez-Sanchís 2008).

However, it is paradoxical that we do not have good faunal records in this area of the Iberian Peninsula. Samples from a few sites have been published (Castaños 1998; López-Romero González de la Aleja 2017; Morales and Liesau 2008; Bustos et al. 1989; Chapa et al. 2013; Estaca-Gómez et al. 2017), but the information is sparse and unrepresentative. This situation contrasts with what we know of other inland regions, which has led to studies of the exploitation and use of domestic species among the Carpetani (Estaca-Gómez 2018; Yravedra and Estaca-Gómez 2014; Estaca-Gómez and Linares-Matás 2019), Vaccaei (Liesau 1998; Morales and Liesau 1995; Romero and Ramírez 1999), Lusitani (Castaños 1998; Valenzuela-Lamas and Detry 2017), and Celtiberian (Blasco Sancho 1999; Liesau and Blasco 1999) populations, as well as other neighbouring groups (Altuna 1980; Castaños 1998; Iborra 2005; Valenzuela-Lamas 2008; Estaca-Gómez et al. 2015).

In this paper, we present for the first time zooarchaeological evidence from the Ulaca oppidum, one of the few sites in Western Iberia with a sufficiently representative sample. The collection consists of 3267 fragments and comes from the archaeological excavations carried out in 2003–2004 on the northern slope of the hill on which the town stands (Fig. 2).

### The oppidum

Ulaca is located in the vicinity of the Villaviciosa district (Solosancho, Ávila, Spain) (Google Earth DMS coordinates of 40° 31′ 48.53″ N and 4° 53′ 01.04″ W) (Fig. 2). It occupies a formidable hill at an altitude of 1500 m from which it strategically dominates the Amblés Valley (Ruiz Zapatero 2005). It was occupied at the end of the Iron Age (third–first centuries BC) by a community of the Vetton people that may have numbered around 1500 inhabitants. It became the most important population centre in the region, where there were already other large fortified settlements such as Las Cogotas (Cardeñosa) and La Mesa de Miranda (Chamartín) (Fig. 1) (Álvarez-Sanchís 1999; Ruiz Zapatero and Álvarez-Sanchís 1995).
The site is of enormous historical and archaeological interest for several reasons. First of all, with its more than 70 ha and over 3000 m of walls, it is one of the largest fortified settlements on the Iberian Peninsula (Ruiz Zapatero et al. 2020). Secondly, it houses a series of very well-preserved structures, some of them exceptional in the Celtic world. They include a rock sanctuary (Ruiz Zapatero 2005), an initiation sauna carved into the rock (Almagro-Gorbea and Álvarez-Sanchís 1993), and impressive granite quarries (Rodríguez-Hernández 2012). Finally, on the northern slope of the oppidum, recent archaeological excavations discovered an area of artisan workshops and a sector of the cemetery that reveal a much more complex organisation than previously thought (Álvarez-Sanchís et al. 2008; Rodríguez-Hernández 2019) (Fig. 2).

The test pits carried out in the area yielded abundant pottery remains, fragments of bronze, bones, and part of a pit dug in the ground (Fig. 3b), as well as a complex Late-Iron-Age tomb with twoburials and their respective grave goods (Fig. 3e) (Álvarez-Sanchís et al. 2008; Rodríguez-Hernández 2019). Extensive excavations were carried out in both zones (sectors A and B). The most important discovery in sector A was a rectangular pit with large pottery vessels containing abundant carbonised cereal grains (Fig. 3a). This pit, which at one point been on fire, was filled with rubbish including a large number of pottery sherds, bones, and slag (Rodríguez-Hernández...
2019). The traces of cereal found, together with the presence of several rotary mills in the area, support the possibility of grain processing on this part of the hill, near the fields, and the subsequent transfer of the ground grain to the houses in the town (Álvarez-Sanchís et al. 2008). In sector B, some 40 m to the south, two levels were documented. At the base of the stratigraphy, there were several land terracing walls (Fig. 3c) and a structure also related to craftwork (Fig. 3d). On the upper level, there was a series of tumular paving stones and a few cremation pit burials that filled the previous structure (Fig. 3f). Taken together, the evidence found so far in sectors A and B suggests that this area was in use between the second and first centuries BC (Ruiz Zapatero 2005; Rodríguez-Hernández 2019; Álvarez-Sanchís et al. 2008).

Methods

The methods used in this research were intended to identify the species of macrovertebrates present at the site, to verify the representativeness of each species and to document mortality patterns. Furthermore, based on these data and other elements, such as skeletal profiles and taphonomy, we aimed to analyse the uses and functionalities of each animal.

For taxonomic identification, Schmid (1972), Barone (1986), Prummel (1988), and Hilson (1992) were followed. Boesseneck (1969), Payne (1985), and Prummel and Frisch (1986) were also followed for the differentiation between Ovis aries and Capra hircus. Where such a differentiation was not possible, we used the designation Ovis/Capra. With regard to the suids, as we were unable to distinguish between their wild and domestic forms, we grouped them under the category of Sus sp. Those remains we were unable to identify taxonomically were categorised based on the size of the animal. Thus, large-sized species would be horses and cows, intermediate-sized animals would include deer and donkeys, and those of a small size, roe deer, sheep, and goats.

To study the representativeness of each species, we used the NISP (number of identifiable specimens) and the MNI (minimum number of individuals) quantification units. To determine the MNI, Brain (1969) was followed, taking into consideration the laterality, age, sex, and biometry of the remains. To establish the mortality profiles, we took into account tooth wear, the emergence of permanent teeth, and the degree of epiphyseal fusion according to Barone (1986). Mortality patterns were estimated by grouping the different species into three age cohorts: infants, juveniles-subadults, and adults. In the calculation of ages, the works of Pérez Ripoll (1988) and Couturier (1962) were followed in the case of ovicaprids, those of Klein et al. (1983) and Brown and Chapman (1991a, b) for deer, Rolett and Chiu (1994) and Bridault et al. (2000) for suids, and Levine (1982) and Guadelli (1998) for equids.

Similarly, the skeletal profile groupings were based on the Yravedra’s conventions (2006), according to which the cranial elements are made up of horns-antlers, the bones of the skull, mandible and maxilla; the appendicular elements by the bones of the extremities; and the axial elements by the vertebrae, ribs, scapulae, and pelvis. Together with the skeletal profiles, bone alterations were also analysed using 10X, 15X, and 20X hand loupes following Blumenschine (1995). Diagnostic criteria defined by Binford (1981), Bunn (1982, 1986) guided the identification of cut marks, whereas tooth marks were recorded following Blumenschine (1988, 1995). The presence of tooth and cut marks was recorded for the entirety of the remains, although the estimated percentages only include well-preserved bone surfaces. Furthermore, we analysed palaeopathologies following Bartosiewicz (2013), Baker and Brothwell (1980), Verstraete (2006), and Colyer et al. (1990).

The zooarchaeology of Ulaca

The 3267 remains analysed presented a high degree of fragmentation, which led to 86% of the studied sample being classed as indeterminate. Among the determinable fauna, there was a clear predominance of domestic over wild animals, the latter only being represented by deer and rabbits (Table 1). Within the domestic fauna, bovids were the most abundant taxon with 79.8% of the determinable remains and 42.9% of the MNI, followed by horses with 28.6% of the MNI and 5.5% of determinable remains. In turn, suids accounted for 6.8% of the NISP and 9.5% of the MNI, while ovicaprids were the most poorly represented domestic animals in the bone sample (Table 1). Mortality profiles showed a clear predominance of adult individuals in all taxa. In fact, only in the case of cattle and horses was it possible to document remains belonging to infant and/or juvenile individuals (Table 1).

An analysis of the spatial representation of the remains confirmed that sector A had a greater faunal representation with 61% of the studied fauna, followed by sector B with 29% and Test Pit 5 with 10% (Tables 2 and 3). In all these sectors, bovids were the main species. Sector A contained two prominent stratigraphic units (SU). SU 2 is a midden made up of 1405 bone remains, among which indeterminate fauna predominate and cow is the main taxon. SU 60 corresponds to the use level of the pit discovered in this sector. Among its 553 remains, there was also a clear predominance of indeterminate fauna, as well as bovids within determinable species (Table 4). In sector B, SU 10 stands out with 518 remains. This SU belongs to the cemetery level, which contained more than 80% of the sample from this area. However, in this sector, the determinable fauna is scarce and does not provide significant evidence, except for the role played by bovids in the strata associated with the cemetery (Table 4).
### Table 1  Taxonomic profiles according to NISP and MNI

| Taxon                | NISP | %   | % NISP | MNI | %   | Mortality profiles | Infant | Juvenile | Adult | % Adult |
|----------------------|------|-----|--------|-----|-----|--------------------|--------|----------|-------|---------|
| Bos taurus           | 364  | 11.1| 79.8   | 9   | 42.9| Infant             | 1      | 1        | 7     | 77.8    |
| Equus caballus       | 25   | 0.8 | 5.5    | 6   | 28.6| Juvenile           | 1      | 5        | 1     | 83.3    |
| Cervus elaphus       | 12   | 0.4 | 2.6    | 1   | 4.8 | Adult              | 100.0  |          |       |         |
| Ovis/Capra           | 20   | 0.6 | 4.4    | 2   | 9.5 |                    | 100.0  |          |       |         |
| Sus sp.              | 31   | 0.9 | 6.8    | 2   | 9.5 |                    | 100.0  |          |       |         |
| Oryctolagus cuniculus| 4    | 0.1 | 0.9    | 1   | 4.8 |                    | 100.0  |          |       |         |
| Large size           | 395  | 12.1|        |     |     |                    |        |          |       |         |
| Intermediate size    | 48   | 1.5 |        |     |     |                    |        |          |       |         |
| Small size           | 158  | 4.8 |        |     |     |                    |        |          |       |         |
| Indeterminate        | 2210 | 67.6|        |     |     |                    |        |          |       |         |
| Total                | 3267 | 100 |        |     |     |                    |        |          |       |         |

### Table 2  Taxonomic representation according to NISP in the different areas of the site

| NISP | Sector A | %   | % NISP | Sector B | %   | % NISP | Test Pit 5 | %   | % NISP |
|------|----------|-----|--------|----------|-----|--------|------------|-----|--------|
| Bos taurus | 223  | 11.2| 81.7   | 43   | 4.5 | 58.9  | 98  | 29  | 89.1 |
| Equus caballus | 13  | 0.7 | 4.8   | 11  | 1.2 | 15.1 | 1   | 0.3 | 0.9 |
| Cervus elaphus | 5   | 0.3 | 1.8   | 0   | 0.0 | 7  | 21  | 6.4 |
| Ovis/Capra | 17   | 0.9 | 6.2   | 1   | 0.1 | 1.4  | 2   | 0.6 | 1.8 |
| Sus sp. | 11   | 0.6 | 4.0   | 18  | 1.9 | 24.7 | 2   | 0.6 | 1.8 |
| Oryctolagus cuniculus | 4   | 0.2 | 1.5   | 0   | 0.0 |      |     |     | 0.0 |
| Large size | 267  | 13.5| 74   | 7.8  | 54  | 16  |     |     |     |
| Intermediate size | 37   | 1.9 | 3    | 0.3  | 8   | 2.4 |     |     |     |
| Small size | 106  | 5.3 | 21   | 2.2  | 31  | 9.2 |     |     |     |
| Indeterminate | 1300 | 65.6| 775  | 81.9 | 135 | 39.9|     |     |     |
| Total     | 1983 | 100 | 946 | 100 | 338 | 100 |     |     |     |
| % NR      | 60.7 | 29  |     |     |     |     |     |     | 10.3 |

### Table 3  Description and interpretation of sector A and B stratigraphic units (SU) with faunal remains

| Sector | Level | SU Description                                      | Interpretation                        | NR  |
|--------|-------|-----------------------------------------------------|---------------------------------------|-----|
| A      | Midden | Light grey sediment full of pottery sherds, bones, and slag | Dump                                  | 1405|
| A      | Workshop | 60 Black sediment with some ceramic assemblages in situ | Use and destruction level of the structure | 553 |
| A      | Workshop | 63 Black sediment with some ceramic assemblages in situ | Use and destruction level of the structure | 25  |
| B      | Surface | 1 Plant cover                                       | Modern top soil                        | 106 |
| B      | Sub-present | 4 Brown sediment with plentiful pottery fragments in secondary position | Sub-present level                      | 45  |
| B      | Cemetery | 10 A large grey stain with an abundant amount of ceramic and bone remains | Dump                                  | 518 |
| B      | Cemetery | 12 Ashy grey sediment                               | Infilling of a pit                     | 10  |
| B      | Cemetery | 13 Ashy grey sediment                               | Infilling of a pit                     | 83  |
| B      | Cemetery | 33 Rammed earth floor with pottery sherds in primary position | Offerings or remains of banquet?      | 12  |
| B      | Cemetery | 40 Ashy grey deposit with two burials and grave goods | Intact cremation tomb                  | 52  |
| B      | Cemetery | 42 Small grey-brown stain with some ceramic fragments and bones | Rubbish deposit?                      | 96  |
| B      | Workshop | 24 Dark brown sediment                              | Infilling of trench for wall           | 7   |
| B      | Workshop | 71 Rammed earth floor with pottery sherds in primary position | Use level of the structure             | 17  |
The skeletal profiles of Ulaca are biased as a result of the fracturing of the sample which, as already mentioned, led to many indeterminate remains. Therefore, only for bovids are there bones belonging to all anatomical sections, with appendicular and axial elements standing out and cranial elements being poorly represented. The latter are mainly composed of mandibular fragments and teeth (Table 5). The mandibular and tooth predominance is the same phenomenon observed in other protohistoric ritual deposits, such as the one found below the main access to the oppidum of El Molón (Camporrobles, Valencia) or in the Herrera cemetery (Guadalajara) (Yravedra 2007a; Lorrio et al. 2014; Yravedra and Estaca-Gómez 2016).

Among the bone alteration patterns, the high fragmentation stands out. In relation to alterations of anthropic origin (Table 6, Fig. 4), the high frequency of bones with cut marks is notable in all the domestic taxa. This suggests that the meat was consumed after the animals had been slaughtered.

| Taxonomic representation according to NISP by stratigraphic unit (SU) |
|--------------------------|---------------------|----------------------|---------------------|------------------|------------------|
| SU                      | Sector A            |                      | Sector B            | Work shop         | SU               |
|                         | Midden              | Workshop             | 1                   | 4                 | Cemetery         |
|                         | 2                   | 60                   | 63                  | 10                | 12               |
|                         |                     | 12                   | 13                  | 33                | 42               |
|                         |                     | 42                   | 24                  | 71                |                  |
| **Bos taurus**          | 158                 | 65                   | 20                  | 15                | 7                |
| **Equus caballus**      | 11                  | 2                    | 5                   | 6                 |                  |
| **Cervus elaphus**      | 5                   |                      |                     |                   |                  |
| **Ovis/Capra**          | 14                  | 1                    | 2                   | 1                 |                  |
| **Sus sp.**             | 4                   | 7                    | 2                   | 12                | 4                |
| **Oryctolagus cuniculus**| 4                   |                      |                     |                   |                  |
| Large size              | 162                 | 105                  | 8                   | 2                 | 63               |
| Intermediate size       | 22                  | 15                   | 1                   | 2                 |                  |
| Small size              | 52                  | 53                   | 1                   | 1                 | 19               |
| Indeterminate           | 977                 | 301                  | 22                  | 72                | 41               |
| Total                   | 1405                | 553                  | 106                 | 45                | 518              |

| Table 5 Sustainable profiles from the Ulaca site |
|-----------------------------------------------|
| **Taxon** | **Bos taurus** | **Equus caballus** | **Cervus elaphus** | **Ovis/Capra** | **Sus sp.** | **Large size** | **Intermediate size** | **Small size** |
| Cranial   | 2              | 1                  |                   |               |             |                  |                      |               |
| Maxilla   | 1              |                    |                   |               |             |                  |                      |               |
| Mandible  | 23             | 5                  | 2                  | 57             | 1           | 16               |                      |               |
| Teeth     | 87             | 17                 | 8                  | 9              | 22          | 32                | 2                    | 18             |
| Vertebræ  | 20             |                    |                   |               |             | 26                |                      | 8              |
| Scapula   | 18             |                    |                   |               |             | 4                 | 6                    | 2              |
| Rib       | 11             |                    |                   |               |             | 12                | 3                    | 14             |
| Humerus   | 44             | 3                  | 1                  | 12             | 7           | 10                |                      |               |
| Radius    | 8              | 1                  |                   |               |             | 2                 | 1                    |                |
| Ulna      | 2              |                    |                   |               |             | 2                 |                      |                |
| Metacarpal| 8              |                    |                   |               |             |                   |                      |                |
| Carpal    | 8              |                    |                   |               |             | 6                 |                      |                |
| Pelvis    | 10             |                    |                   |               |             | 7                 | 1                    | 3              |
| Femur     | 19             | 1                  |                   |               |             | 3                 | 2                    |                |
| Tibia     | 41             |                    |                   |               |             | 13                | 2                    | 17             |
| Metatarsal| 18             |                    |                   |               |             | 2                 | 3                    | 8              |
| Tarsal    | 10             | 4                  | 1                  | 1               |             | 1                 |                      |                |
| Phalange  | 14             | 1                  |                   |               |             | 1                 | 1                    | 1              |
| Shafts limbs| 22           | 2                  | 1                  | 1               | 213          | 22                | 58                   |                |
| Total     | 364            | 25                 | 12                 | 20              | 31           | 395               | 48                   | 158            |
Cows, horses, ovicaprids, and suids have marks associated with different functions, such as skinning, disarticulation, and fleshing. Disarticulation marks were observed on long bones and axial and cranial parts in the jaw condyles. Skinning marks were found on some cranial bones, while fleshing marks, which are predominant, appear on long bones and axial elements (see Supplementary File). In terms of the spatial distribution of the bones with cut marks, their preferential distribution is confirmed in sector A and Test Pit 5 (Fig. 5).

Likewise, together with the presence of cut marks, the number of burned bones found in Ulaca is also noteworthy, as 13% of the total remains had been affected by thermal alteration. However, this is normal if we take into account the fire that affected the pit in sector A. These alterations may have contributed to the fragmentation of the bone sample, thus making it difficult to identify many remains. On the other hand, the thermal alteration of the bones in the cemetery level could have been caused by the animals having been roasted for consumption in a funerary banquet or their exposure to fire as offerings placed on the funeral pyre.

Of particular note are the bones with bite marks from carnivores, undoubtedly dogs, which affected the bone sample and increased the fracturing of the faunal finds. This type

Table 6  Bones with anthropic alterations—cut marks and burned bones—and bones with tooth marks found in Ulaca. The frequency of marks was calculated on bones with well-preserved surfaces (teeth were excluded)

| Taxon            | NISP | NISP with cut marks | NISP with tooth marks | Burned bones |
|------------------|------|---------------------|-----------------------|--------------|
|                  |      | Total %             | Total %               | Total %      |
|                  | NISP |                     |                       |              |
| *Bos taurus*     | 227  | 45  19.8             | 26 11.5               | 34 15        |
| *Equus caballus* | 8    | 2  25                 | 0 0                   | 4 50         |
| *Cervus elaphus* | 4    | 0 0                   | 1 25                  | 3 75         |
| *Ovis/Capra*     | 11   | 2  18.2               | 1  9.1                | 9 81.8       |
| *Sus sp.*       | 9    | 3  33.3               | 2 22.2                | 0            |
| *Oryctolagus cuniculus* | 4 | 0 0                   | 0 0                   | 1 25         |
| Large size      | 363  | 27  7.4               | 25  6.9               | 24 6.6       |
| Intermediate size | 46  | 8  17.4               | 4  8.7                | 4 8.7        |
| Small size      | 140  | 6  4.3                | 4  2.9                | 33 23.6      |
| Indeterminate   | 2210 | 6  0.3                | 11 0.5                | 303 13.7     |
| Total           | 3022 | 99 3.3                | 74 2.4                | 415 13.7     |

Fig. 4  Bones with cut marks from sector A and Test Pit 5: A Shaft of humerus with cut marks. B Cut marks on mandible of *Bos taurus*. C Eph. Distal of humerus with furrowing and shaft with cut marks. D shaft of long bone with two cut marks. E Shaft with cut marks
of alteration is important because these marks indicate that dogs must have been present at the site. Most of the tooth marks are found at the ends of long bones, collapsing epiphyses through furrowing, and at the ends of axial elements (see Supplementary File). The bones with tooth marks were found mainly in sector A, which is logical given the presence of a midden in that area (see Supplementary File). The dogs would have intervened on the rubbish dumps, eating the remains of the fauna previously consumed by the inhabitants of Ulaca. Thus, the dogs would have undertaken a cleaning action, consuming the carrion and affecting many bones rich in fat, such as the epiphyses of long bones, ribs, and other axial elements (Fig. 4C1, Fig. 6). This would have contributed to the anatomical bias found at the site, a common phenomenon observed in many present-day societies (see Binford 1978).

Finally, the dog tooth marks show the presence of a taxon that is not observed in the taxonomic representation of the zooarchaeological study.

The palaeopathological analysis is also relevant, and two types of alteration were found. The first group consists of those pathologies considered to be of an oral nature. They were detected on 13 remains, affecting elements of the mouth such as teeth and jaws in the form of caries, malocclusion, and differential growth of roots or dental crowns. The jaws of several horses also showed alterations in the form of marks associated with the bit that affected the dental enamel of the lingual part of the teeth. The second group consisted of pathologies that affect postcranial elements. In this case, only a couple of remains with osteoarthritis associated with animal traction were identified (Table 7).

**Discussion**

**Zooarchaeological evidence among the Vettones**

The Ulaca bone sample is dominated by domestic animals, with bovids being the most important species, followed by equines, suids, and ovicaprids. To these we could add dogs. Although no bones from dogs were found among the analysed remains, their bite marks were identified on the bones of most of the documented animal species (Table 6). The Ulaca faunal representation coincides with what we know of other nearby Vetton sites, such as Cerro del Berrueco and Salamanca (Yravedra and Estaca-Gómez 2010; Morales and Liesau 2008), where dog bone remains have been found as well as their bite marks (Table 8).

In this way, Ulaca’s fauna matches what we know of other nearby archaeological sites, although it is very different to the faunal representations of the southernmost Vetton settlements around the Tagus Valley, such as Cerro de la Mesa (Chapa et al. 2013), Castillejo de la Orden de Alcántara (Castaños 1988), or Villasevias del Tamuja (Morales 1976; Castaños 1991; Bustos et al. 1989; Estaca-Gómez et al. 2017), where the exploitation of sheep and goats predominated. In addition, in these southernmost Vetton settlements in the Tagus Valley, cattle are the second most prominent species, ahead of suids, although the latter are well represented with frequencies above 10% (Table 8). The faunal spectrum of these sites is completed with a minor representation of equids and canids (Chapa et al. 2013; Estaca-Gómez et al. 2017).

We do not have dog remains, but we have mentioned the presence of dog tooth marks on the bones found at
Ulaca (Fig. 6). These marks are frequently found at Iron Age sites that have taphonomic analyses, whether they are from the Vetton area, such as Cerro del Berrueco (Yravedra and Estaca-Gómez 2010), Salamanca (Morales and Liesau 2008), Cerro de la Mesa (Chapa et al. 2013), and Villasviejas del Tamuja (Estaca-Gómez et al. 2017) or from other regions of the Iberian Peninsula (e.g. Liesau 1998; Iborra 2005; Valenzuela-Lamas 2008; Estaca-Gómez 2018; Estaca-Gómez and Linares-Matás 2019; Estaca-Gómez et al. 2015; González Álvarez et al. 2018). Similarly, although equids are poorly represented at the aforementioned sites (Table 8), in the cemeteries of Las...
Table 8  Faunal representation at Vetton sites with zooarchaeological information

| Taxon   | Ávila Ulaca | Salamanca Cerro del Berrueco | Salamanca | Toledo Cerro de la Mesa |
|---------|------------|-----------------------------|-----------|-------------------------|
|         | NISP % MNI | NISP % MNI | NISP % MNI | NISP % MNI | NISP % MNI | NISP % MNI |
| Bos taurus | 364 79.8 9 42.9 | 183 63.1 5 33.3 | 127 52 7 41.2 | 223 22.5 11 12.4 |
| Equus caballus | 25 5.5 6 28.6 | 15 5.2 1 6.7 | 4 1.6 1 5.9 | 25 2.5 6 6.7 |
| Cervus elaphus | 12 2.6 1 4.8 | 18 6.2 2 13.3 | 7 2.9 1 5.9 | 167 16.8 9 10.1 |
| Ovis/ Capra | 20 4.4 2 9.5 | 42 14.5 4 26.7 | 78 32 5 29.4 | 308 31 17 19.1 |
| Sus sp. | 31 6.8 2 9.5 | 30 10.3 1 6.7 | 21 8.6 2 11.8 | 91 9.2 11 12.4 |
| Canis familiaris | 1 0.3 1 6.7 | 1 0.3 1 6.7 | 149 15 17 19.1 |
| Oryctolagus cuniculus | 4 0.9 1 4.8 | 1 0.3 1 6.7 | 149 15 17 19.1 |
| Others | 24 2.4 14 15.7 |
| Total | 456 100 21 100 | 200 100 15 100 | 244 100 17 100 | 993 100 89 100 |
| Reference | Yravedra and Estaca (2010) | Morales and Liesau (2008) | Chapa et al. (2013) |

Taxon Cáceres Villasviejas del Tamuja Castillejo Orden de Alcántara

|         | NISP % MNI | NISP % MNI | NISP % MNI | NISP % MNI |
|---------|------------|------------|------------|-----------|
| Bos taurus | 105 23.2 8 21.1 | 100 31 98 22.7 | 182 19 81 39.1 |
| Equus caballus | 11 2.4 3 7.9 | 15 4.6 7 1.6 | 23 2.4 3 1.4 |
| Equus asinus | 7 2.2 4 0.9 | 7 0.7 |
| Cervus elaphus | 15 3.3 1 2.6 | 50 15.5 7 1.6 | 81 8.5 14 6.8 |
| Ovis/ Capra | 202 44.7 11 28.9 | 82 25.4 178 41.3 | 468 48.9 86 41.5 |
| Sus sp. | 87 19.2 7 18.4 | 54 16.7 89 20.6 | 140 14.6 22 10.6 |
Cogotas and La Mesa de Miranda, horse harnesses and bits have been found in the most opulent tombs (Kurtz 1986–87; Baquedano 1990, 2016). This data is relevant and indicates the important role this species may have played among the Vetton elites (Álvarez-Sanchís 1999: 301–302; Sánchez-Moreno 2005), both as a mount and as a draught animal.

Villasviejas del Tamuja is the only Vetton site at which donkey remains have been identified (Castaños 1998). This animal that was introduced to the Iberian Peninsula by the Phoenicians at the beginning of the Iron Age can be found in Carpetani and Vaccaean towns (De Miguel 1985; Estaca-Gómez 2018; Liesau 1998; De Miguel and Morales 1994; Estaca-Gómez and Linares-Matás 2019; Morales and Liesau 1995).

Mortality patterns reveal a predominance of adult individuals in all domestic species at Ulaca, as well as at Las Cogotas (López-Romero González de la Aleja 2017), Cerro del Berrueco (Yravedra and Estaca-Gómez 2010), Salamanca (Morales and Liesau 2008), Cerro de la Mesa (Chapa et al. 2013), and Villasviejas del Tamuja (Estaca-Gómez et al. 2017). However, in the last three, a large representation of infantile-juvenile individuals is detected in pigs and goats, which suggests that these species were used primarily for their meat. In terms of suids, at Villasviejas del Tamuja, there is a sparse representation of meat-bearing elements from the axial skeleton (ribs) and the upper appendicular parts (humerus-femur, linked to shoulders and hams). Therefore, it has been proposed that ribs, hams, and shoulders could have been transported and consumed elsewhere (Estaca-Gómez et al. 2017: 393). The use of pig hindquarters, probably smoked or in the form of salted hams, has been documented in ancient Iron Age contexts in Temperate Europe (Pucher et al. 2013). Salting is one of the oldest meat preservation methods; it increases palatability and ensures a well-preserved foodstuff (de Luna Dias et al. 2021). In the Hallstatt salt mines, the proportion of males and females, the ages of slaughter, the representation of anatomical parts, and the needs of a landscape for raising pigs indicate that the meat consumed by the miners must have arrived processed in portions and that it was easy to conserve in the salt mining galleries (Reschreiter and Kowarik 2019). Later, in the early Roman Empire, authors such as Strabo (III, 4, 11) and Martial (Epigr. 13, 54) praised the quality of the hams from the Pyrenees.

The predominance of adult individuals among the identified remains of cattle, horses, and sheep suggests a secondary exploitation of the cattle herd. Bovids and equids were used for their strength as beasts of burden, transport, or traction. This has been corroborated by the pathologies found in the cattle and horses from Ulaca (Table 7), a site where cart tracks are still visible on some stretches of the rocky ground leading to the town (Ruiz Zapatero 2005). Along
with these uses, cows would have been used for their dairy productivity, as would ovicaprids. The latter would also have provided manure and raw materials for textile making such as wool. In the Vetton settlements, it is common to find loom weights and spindles, even as part of grave goods (Fig. 3f), a clear reflection of the importance that textile making would have had among the Iron Age people (Blasco 2008; Marín-Aguilera and Gleba 2020). However, if we observe the faunal representation of the Vetton sites with zooarchaeological analyses (Table 8), sheep are underrepresented in the Ulaca faunal assemblage. Despite this, wool and textile production must also have been very important at this site. To date we do not have direct evidence of textile making in Western Iberia during the Late Iron Age, but the abundance of loom weights and spindles found in Vetton settlements and cemeteries and a series of testimonies from classical Greco-Latin authors indicate the importance of textile activity among the peoples who lived in the interior of the Iberian Peninsula (Sánchez-Moreno 2000: 215). Thus, for example, Strabo (III, 3, 7) and Diodorus (V, 33) allude to the famous Celtiberian *sagum*, a short cape of thick dark wool. This garment was given in large quantities by the populations of the interior of Iberia as tribute to the Roman armies during the conquest of Hispania (Diodorus, XXXIII, 16; Appian, Iber., 54). In addition to wool, linen must also have been used, as Pliny mentions (N.H., XVIII, 108; XIX, 4, 10, 26), as well as other vegetable fibres (Blasco 2008: 136).

Along with the importance of the economic uses of those adult animals, it is also possible that adult individuals played another role in pastoral societies. It is common in societies with a livestock economy for adult animals to constitute an accumulable and relatively easy-to-manage source of wealth. Thus, those persons with larger herds of livestock were wealthier (Tignor 1972; Grandin 1988; Homewood and Rodgers 1991; Bekure et al. 1991). Therefore, this pastoral behaviour may have been the most suitable management strategy for preserving wealth, while also favouring and prioritising herd survival even during harsh climatic conditions (Bollig 2006; Dahl and Hjort 1976).

Once the adult animals had fulfilled their role in life, they would have been butchered for meat. At Ulaca cows, pigs, horses, and ovicaprids present high percentages of bones with cut marks linked to skinning, disarticulation, and fleshing. This pattern is repeated at the rest of the Vetton sites with taphonomic analyses. However, neither in Salamanca nor in Cerro de la Mesa have traces of butchering been documented on the remains of equids, and it is hypothesised that horses contributed little or nothing to the diet of their inhabitants (Morales and Liesau 2008; Chapa et al. 2013). This has already been suggested for the Celtiberian and Vaccaean settlements of the Duero Valley (Liesau 2005; Morales and Liesau 1995). Nevertheless, in addition to Ulaca, traces of horse meat use have been identified at Cerro del Berrueco (Yravedra and Estaca-Gómez 2010) and Villasviejas del Tamuja (Estaca-Gómez et al. 2017), as well as at the Carpetani archaeological sites of Las Camas, Humanejos, La Gavia III, La Cuesta, Cerrocuquillo, and La Guirnaldal de Quer (Yravedra 2013; Estaca-Gómez 2017, 2018). At the last two sites, cut marks can even be found on donkey bones (Estaca-Gómez 2017). The use of equids is also commonly found in other enclaves in the interior of the Iberian Peninsula, such as Cancho Roano (Jiménez-Ávila 2012), Peña Muñoz (Estaca-Gómez and Yravedra 2015), Numancia (Yravedra 2008), Alarcos, Cerro de las Cabezas, and Villanueva de los Infantes (Yravedra 2007b). This evidence indicates that the consumption of equid meat documented in Ulaca would not have been exceptional, and it seems that the meat from these animals was taken advantage of like any other domestic species once their active lives had come to an end.

On the other hand, no cut marks have been found on dog bones at the Vetton sites, so we do not know if their meat was eaten or not. The consumption of canid meat has, however, been attested at other protohistoric sites on the Iberian Peninsula (e.g. Iborra 2005; Yravedra 2007b; Estaca-Gómez 2017).

Authors such as Morales and Liesau (2008) suggest that mortality patterns dominated by adult specimens could indicate precarious subsistence practices, in which meat would have been a scarce resource that would only be obtained when the animals had ended their economic production cycle. In this way, both in the case of Ulaca and the rest of the Vetton settlements analysed, there would have been communities with livestock herds typical of a subsistence economy, meaning they could not afford to slaughter young animals. This situation is similar to that described for most of the Iron Age sites in the interior (Castaños 1998; Estaca-Gómez 2017; Liesau 1998; Blasco Sancho 1999; Yravedra 2008; Morales and Liesau 1995; Estaca-Gómez and Yravedra 2015) and the Iberian area (Iborra 2005; Yravedra 2007b), although in the latter, a certain variability has been described, depending on the functionality of the settlements (Iborra 2005).

Finally, in relation to wild species, the presence of deer stands out at all the Vetton archaeological sites with fauna samples (Table 8). At sites such as Las Cogotas, evidence of a bone industry has also been found, particularly handles made from deer antlers (Cabré 1930; López-Romero González de la Aleja 2019). Other types of game, such as rabbits, were also important, but their meat contribution was minor. Occasionally in excavations, the remains of other wild animals have been found, including mustelids, bears, and others, although their presence is merely anecdotal (Chapa et al. 2013).

**Zooarchaeology and territory among the Vettones**

The importance of livestock in the Vetton economy can be glimpsed from the numerous representations of animals on different media found in the west of the Meseta (Alonso
Hernández and Benito López 1991–92; Álvarez-Sanchís et al. 2021). Among them, the verraco sculptures mentioned above (Fig. 7) are particularly noteworthy. Of the four hundred known examples, almost half are from the province of Ávila, with the Amblés Valley being the richest region in this type of representation, although the list of finds continues to grow (Manglano et al. 2021). We are still far from being able to evaluate the significance of the densities of sculptures by area, although it must certainly be related to differences in population density (Álvarez-Sanchís 1999; Manglano 2018; Ruiz Zapatero and Álvarez-Sanchís 2008). The concentration of sculptures in the Amblés Valley (ca. 2.1 sculptures per 10 km²) can be explained by the existence of large oppida, such as Ulaca, and other smaller population centres. Sculptures of bulls abound above all (more than 80%), and this contrasts with the south of the Vetton territory, where those of pigs prevail (Álvarez-Sanchís 1999: 257). The reasons for this difference have been related to the predominant type of livestock in each zone (Blanco Freijeiro 1984: 4). However, the data are relevant if we take into account that a large part of the bone remains recovered at Ulaca, and its neighbouring sites are also identified with cattle (Fig. 8). It is also a mountainous environment with nearby forests, more prone to the practice of transhumance and non-transhumance livestock strategies, which are more typical of sheep and goats (Sánchez-Moreno 2001).

The location of these sculptures in the landscape is also relevant. Many are found in dominant positions overlooking excellent grazing areas and near springs and water sources (Álvarez-Sanchís 1999: 215–294). Cattle need abundant pasture in summer, especially in times of drought. In the Vettonian lands, there are many areas where, due to climatic and environmental conditions, pastures endure in difficult times. These pastures would have been essential for the survival of the herds during the harshest and most arid periods. Therefore, the statues may have acted as a kind of milestone in the landscape indicating pasture areas, critical resources destined for livestock in the summer months and periods of drought. They would have been controlled by the elites of the oppida. Microlocational and visibility analyses in the Amblés Valley and around Ulaca support this hypothesis (Álvarez-Sanchís 2003: 55–63; Ruiz Zapatero and Álvarez-Sanchís 2008). The sculptures would have been one more element of the Vetton stockbreeding communities’ management and exploitation of the territory, an original way of “inhabiting” the land and marking its areas during the Late Iron Age.

**Fig. 7** Bull sculpture found in the vicinity of the oppidum of La Mesa de Miranda (Chamartín, Ávila)

**Fig. 8** Taxa values identified in the oppidum of Ulaca (Solosancho, Ávila) and their relationship to the proportion of bull and pig sculptures in the Amblés Valley. The clear predominance of bovids in the faunal remains correlates very directly with the overwhelming majority of bull sculptures

**Conclusions**

In the west of the Iberian Peninsula, palynological analyses reveal an increase in anthropic pressure on the landscape at the end of the Iron Age. This coincides with the development
of large fortified settlements such as Ulaca, which would have had a population of around 1500 inhabitants (Ruiz Zapatero 2005: 15). What these studies appear to show is a growing pressure from livestock and notable agricultural activity in the valley bottoms (Blanco González 2009). All this would have caused progressive deforestation of the landscape (López-Sáez et al. 2008). Thus, the economic base of the Vetton social elites resided in control of the land—dryland cereal farming—and especially in the heads of cattle that allowed wealth to be accumulated efficiently (Rodríguez-Hernández 2019).

The Site Catchment Analysis confirms the mixed subsistence economy vocation of the inhabitants of the territory of Ulaca. Large livestock would have been especially important, given that grassland and scrub constitute slightly more than 60% of the exploited territory. The arable land of the valley bottom located to the north accounted for almost 32%, while the Mediterranean forest areas had been reduced to 3% and unproductive areas to only 5% (Ruiz Zapatero 2005: 32) (Fig. 9).

The faunal analyses in this area show the importance of bovids and oviscaprids, although pigs and horses would also have played a significant role. In the case of Ulaca, the faunal representation shows a very high predominance of domestic fauna over wild fauna, with cattle being the most important. This is consistent with what is observed at other Vetton sites in the province of Salamanca. It can also be linked to the predominance of bull-shaped verracos in the province of Ávila, as well as to the prevalence of cattle breeding in this area today.

Thus, Ulaca is one more example of the existence of two different livestock strategies among the peoples of the Vetton region. Those to the north focused on cattle farming, while in the south, there was a greater diversification of resources in which sheep and goats stand out, accompanied by cattle and pigs. However, although these assessments of Vetton livestock husbandry practices appear conclusive, in reality they are only approximations that should be qualified in future studies. This is because the evidence shown for Ulaca

![Fig. 9 Zooarchaeology and territory in Ulaca. Site catchment analysis modified after Ruiz Zapatero 2005: 32](Image)
and the other Vetton area sites is still sparse compared to the large number of known settlements in Western Iberia.

New studies will enable a better understanding of Vetton stockbreeding and its evolution throughout the Iron Age. In this regard, one of the key sites in the future could be Las Cogotas, whose abundant faunal remains from a rubbish dump are currently being studied. This new research will also be able to confirm the regional evaluations described in this paper, which allow us to relate the stockbreeding of this area to that of the neighbouring areas. Thus, the faunal samples from the Vetton archaeological sites in the provinces of Ávila and Salamanca are similar to the faunal representation of the Duero Valley—Vaccacaen territory—where bovines were also important (Liesau 1998; Morales and Liesau 1995). Similarly, the Vetton sites located to the south in Extremadura and Toledo province are more like some of the Lusitani or Carpetani sites where ovicaprids were more abundant than bovines (Castaños 1998; Estaca-Gómez 2017, 2018; Valenzuela-Lamas and Detry 2017).

The faunal sample analysed at Ulaca has the added value of coming in part from a sector of the cemetery. Its similarity to those of the rest of the sites in the Western Iberian Peninsula appears to indicate that the fauna did not receive special treatment in the context of the burial rites, unlike the situation in certain contexts in the Iberian south (Jiménez-Ávila 2012). However, we need more studies of animal remains from cemeteries to compare them with those from the settlements and corroborate or refute the similarity detected at Ulaca.

Finally, some generalities observed at these sites and others in the interior of the Peninsula allow us to evaluate the Vettons’ use of fauna. On the one hand, the mortality patterns show that they took advantage of the resources the animals were able to contribute during their lives, e.g. their working power, dairy production, and wool. On the other, the taphonomic analyses shed light on the use of the animals’ meat after their productive potential had ended. Finally, the predominance of adult individuals at all the sites is indicative of a subsistence economy with a certain degree of precariously among the pre-Roman communities of Western Iberia. In any case, more detailed studies are needed for an in-depth exploration of the processing of fauna at the end of the Iron Age in Western Iberia. They will be able to reveal aspects not addressed in the region, such as the proportion between animal and vegetable diet. In the case of bovids, they will allow an approach to the understanding of day-to-day livestock management, including aspects such as the importance of dairy farming, the determination of the calf birthing season, and the provision of fodder. These studies will combine archaeological and archaeobotanical data with multi-isotope analyses (Groot et al. 2021). Research into the exploitation of animal resources in the Iron Age with modern analytical techniques is taking its first steps in Western Iberia, and this contribution aims to stimulate more and better research in this study area.

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s12520-022-01627-x.

**Acknowledgements** This study was carried out within the framework of the project “Vettones: estudios de urbanismo y sociedad mediante técnicas no destructivas” (HAR2015-65994-R), financed by the Spanish Ministry of Economy and Competitiveness. The authors would like to thank the anonymous reviewers for their constructive comments.

**Funding** Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature.

**Declarations**

**Competing interests** The authors declare no competing interests.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

**References**

Almagro-Gorbea M (2009) Lusitanos y Vettones. In: Sanabria Mar- cos PJ (ed) Lusitanos y vettones Los pueblos prerromanos en la actual demarcación. Beira Baixa - Alto Alentejo - Cáceres. Junta de Extremadura, Cáceres, pp 15–43

Almagro-Gorbea M (2014) The Lusitanians. In: Almagro-Gorbea M (ed) Iberia. Protohistory of the Far West of Europe: From Neolithic to Roman Conquest. Universidad de Burgos-Fundación Atapuerca, Burgos, pp 183–194

Almagro-Gorbea M, Álvarez-Sanchís JR (1993) La “Sauna” de Ulaca: saunas y baños iniciáticos en el mundo céltico. CAUN 1:177–253

Almagro-Gorbea M, Álvarez-Sanchís JR (1994) Zoomorphic Iron Age sculpture in Western Iberia: symbols of social and cultural identity? Proc Prehist Soc 60:44–45

Altuna J (1980) Historia de la domesticación animal en el País Vasco desde sus orígenes hasta la romanización. Munibe 1 and 2:1–400

Álvarez-Sanchís JR (1994) Zoomorphic Iron Age sculpture in Western Iberia: symbols of social and cultural identity? Proc Prehist Soc 60:403–416

Álvarez-Sanchís JR (1999) Los Vettones. Real Academia de la Historia, Madrid

Álvarez-Sanchís JR (2000) The Iron Age in Western Spain (800 BC-AD 50): an overview. Oxf J Archaeol 19(1):65–89

Álvarez-Sanchís JR (2003) Los señores del ganado. Arqueología de los pueblos prerromanos en el occidente de Iberia. Akal, Madrid, Sapien

Álvarez-Sanchís JR (2004) Los vettones. In: Almagro-Gorbea M, Mariné M, Álvarez-Sanchís JR (eds) Celtas y Vettones. 4th edn. Institución Gran Duque de Alba-Real Academia de la Historia, Ávila, pp 258–277
Álvarez-Sanchís JR (2005) *Oppida* and Celtic society in western Spain. e-Keltoi 6:255–285. https://dc.uwm.edu/e- keltoi/vol6/iss1/5
Álvarez-Sanchís JR, Ruiz Zapatero G (2001) Cementerios y asentamientos: bases para una demografía arqueológica de la Meseta en la Edad del Hierro. In: Berrocal-Rangel L, Gardes P (eds) Entre Celtas e Iberos. Las poblaciones protohistóricas de las Galias e Hispania. Real Academia de la Historia-Casa de Velázquez, Madrid, pp 61–75
Álvarez-Sanchís JR, Marín C, Falquina A, Ruiz Zapatero G (2008) El oppidum vettón de Ulaca (Solosancho, Ávila) y su necrópolis. In: Álvarez-Sanchís JR (ed) Arqueología Vettona. La Meseta Occidental en la Edad del Hierro. Museo Arqueológico Regional, Alcalá de Henares, pp 338–361
Álvarez-Sanchís JR, Rodríguez-Hernández J, Ruiz Zapatero G (2021) El askos de Ulaca (Solosancho, Ávila) y el simbolismo del toro entre los vettón. Trab Prehist 78(2):356–365
Baker J, brothwell D (1980) Animal diseases in archaeology. Academic Press, Londres
Baquedano I (1990) Elementos relacionados con el caballo en tumbas. Álvarez-Sanchís JR, Rodríguez-Hernández J, Ruiz Zapatero G (2001) Cementerios y asentamientos sobre los celtíberos. Necrópolis celtibéricas. Institución «Fer- nando el Católico», Zaragoza, pp 279–286
Baquedano I (2016) La necrópolis vettona de La Osera (Chamartin, Ávila, España). Museo Arqueológico Regional, Alcalá de Henares
Barone R (1986) Anatomie comparée des mammifères domestiques. 1. Ostéologie. Paris Laboratoire d’Anatomie, Ecole Nationale Vétérinaire, Paris France
Bartosiewicz L (2013) Shuffling nags, Lame ducks. The archaeology of animal disease. Oxbow Books, Oxford
Bekure S, de Leeuw PN, Nyambaka R (1991) The long-term productivity of the Maasai livestock production system. In: Bekure S, de Leeuw PN, Grandin BE, Neate PJH (eds) Maasai herding: An analysis of the livestock production system of Maasai pastoralists in Eastern Kajiado District, Kenya. ILCA, Addis Ababa, pp 127–140
Berrocal-Rangel L, García-Giménez R, Manglano GR, Ruano L (2018) When archaeological context is lacking. Lithology and spatial analysis, new interpretations of the “verracos” Iron Age sculptures in Western Iberian Peninsula. J Archaeol Sci Rep 22:344–358
Binford LR (1978) *Nunamiut ethnoarchaeology*. Academic Press, New York
Binford LR (1981) Bones: ancient men and modern myths. Academic Press Inc, New York
Blanco Freijeiro A (1984) Museo de los verracos celtibéricos. Bol R Acad Hist CLXXXI, cuaderno I:1-60
Blanco González A (2009) Tendencias del uso del suelo en el Valle de la Península Ibérica. En Burillo F. (coord) IV simposio sobre los celtíberos. Economía. Universidad de Zaragoza
Blanco González A (2009) Tendencias del uso del suelo en el Valle de la Península Ibérica. En Burillo F. (coord) IV simposio sobre los celtíberos. Economía. Universidad de Zaragoza
Bollig M (2006) Risk management in a hazardous environment. A comparative study of two pastoral societies. Springer, New York
Brain CK (1969) The contribution of Namib desert Hotentots to an understanding of Australopithecine bone accumulations. Scientific Papers in Namibian Desert Research Station. Transvaal Museum Pretoria 39:13–22
Bridault A, Vigne JD, Horard Herbin MP, Pelle E, Fiquet P, Mashkour M (2000) Wild boar-age at death estimates: the relevance of new modern data for Archaeological skeletal material. 1. Presentation on the corpus. Dental and epiphyseal fusion ages. Iber.J M Edc 5:11–18
Brown WAB, Chapman NG (1991a) Age assessment of red deer (Cervus elaphus): from a scoring scheme based on radiographs of developing permanent molariform teeth. J Zool 225:85–97
Brown WAB, Chapman NG (1991b) The dentition of red deer (Cervus elaphus): a scoring scheme to assess age from wear of the permanent molariform teeth. J Zool 224:519–536
Bunn HT (1982) Meat eating and human evolution: studies on the diet and subsistence patterns of Plio-pleistocene hominids in East Africa. PhD Thesis. University of California, Berkeley
Bunn HT (1986) Patterns of skeletal representation and hominid subsistence activities at Olduvai Gorge, Tanzania and K Cobb Fora, Kenya. J Hum Evol 15:673–690
Bustos V, Molero G, Brea P (1989) Estudio faunístico del yacimiento de Villasviejas (Botija, Cáceres). In: Hernández Hernández F, Rodríguez López MD, Sánchez Sánchez MA (eds) Excavaciones en el castro de Villasviejas del Tamuja (Botija, Cáceres). Editora Regional de Extremadura, Mérida, pp 143–153
Cabrè J (1930) Excavaciones de Las Cogotas, Cardénos (Ávila). I. El Castro. Junta Superior de Excavaciones y Antigüedades, Madrid
Castaños PM (1988) Estudio de los restos óseos del poblado prero- mano de «La Villavieja del Castillejo de la Orden» (Alcántara, Cáceres). Extremad Arqueol 1:109–112
Castaños PM (1991) Animales domésticos y salvajes en Extremadura. Origen y evolución. Rev Estud Extremenios 47(1):9–66
Castaños PM (1998) Evolución de las faunas protohistóricas en Extremadura. In: Rodríguez Díaz A (coord) Extremadura protohistórica: paleoambiente, economía y poblamiento. Universidad de Extremadura, Cáceres, pp 63–72
Chapa T, Pereira J, Cabrera C, Moreno-García M, Ruiz Alonso M, Pérez-Díaz S, López-Sáez JA, Araujo R (2013) Una fosa-vertedero de época vettona en el Cerro de la Mesa (Alcolea de Tajo, Toledo). Trab Prehist 70(1):140–165
Colyer F, Grigson C, Miles AEW (1990) Colyer’s variations and systematic variation. A comparative study of two pastoral societies. Springer, New York
De Miguel FJ, Morales A (1994) Informe sobre los restos faunísticos recuperados en el yacimiento de “El Cerrón”, Illescas (Toledo). Scielo. Accessed 31 July 2022
De Miguel FJ, Morales A (1994) Informe sobre los restos faunísticos recuperados en el yacimiento de “El Cerrón”, Illescas (Toledo).
In: Valiente S (ed) Excavaciones Arqueológicas en “El Cerrón”. Illescas (Toledo). Publicaciones Junta de Comunidades Castilla-La Mancha, Toledo, pp 206–211

Estaca-Gómez V (2017) La zooarqueología durante la Edad del Hierro en el Valle Medio del Tajo. AUDEMA, UCM, Madrid

Estaca-Gómez V (2018) Prácticas socioeconómicas de la fauna doméstica en la Edad del Hierro en el Valle Medio del Tajo. Complutum 29(2):387–406

Estaca-Gómez V, Linares-Matás GJ (2019) Husbandsry practices among Iron Age communities in the centre of the Iberian Peninsula. Archaeol Antropol Sci 11:5009–5022

Estaca-Gómez V, Yravedra J (2015) Informe Arqueozoológico del Yacimiento Celtibérico de Peña Muñoz (Molina de Aragón, Guadalajara). Inédito

Estaca-Gómez V, Yravedra J, Gener JM, Navarro-García MA, Pajuelo JM, Torres-Ortiz M (2015) Zooarqueología de los macrovertebrados del yacimiento fenicio del Teatro Cómico (Cádiz). SPAL 24:55–76

Estaca-Gómez V, López-Cisneros P, Yravedra J (2017) Informe zooarqueológico del Castro de Villaviescas del Tamaja. In: Hernández H, Martín F, Bravo AM (eds) Las necrópolis de El Romazal y el conjunto arqueológico de Villaviescas del Tamaja (Botija / Plasenzuela, Cáceres). Ediciones de La Ergástula, Madrid, pp 381–395

Fernández Gómez F (2003) La Edad del Hierro. In: Mariné M (coord) Historia de Ávila. I. Prehistoria e Historia Antigua, 3rd edn. Institución Gran Duque de Alba-Caja de Ahorros de Ávila, Ávila, pp 105–280

González Álvarez D et al (2018) El Castru (Vigaña, Balmonte de Illescas (Toledo). Publicaciones Junta de Comunidades de Castilla-La Mancha, Salamanca, pp 381–395

Grandin BE (1988) Wealth and pastoral dairy production: a case study from Maasailand. Hum Ecol 16(1):1–21

Groot M, Albarella U, Eger J, Evans J (2021) Cattle management in Iron Age/Roman settlements in the Netherlands: Archaeozoological and stable isotope analysis. PLoS ONE 16(10):e0258234

Guadalajara). Inédito

Iborra MP (2005) La ganadería y la caza desde el bronce final hasta el ibérico final en el territorio valenciano. Servicios de Investigación Prehistórica. Valencia, Sapin. N° 103, 408p

Jiménez-Avila J (2012) Muerte y transfiguración. Cremaciones, hachotones y sacrificios en el final de Cancho Roano (Zalamea de la Serena, Badajoz). Menga. Revista de Prehistoria de Andalucía // N° 03. 2012. pp 187–207

Klein RG, Allwoodm K, Wolf C (1983) The calculation and interpretation of ungulate age profiles from dental crown heights. In Bailey G (ed) Hunter gatherer economy in prehistory: a European Perspective. London Cambridge University Press, Reissue edition (2 April 2009), 256p

Kurtz WS (1986–87) Los arreos de caballo en la necrópolis de Las Cogotas (Cardellosa, Avila). Zephyrus 39–40:459–472

Levine MA (1982) The use of crown height measurements and eruption-wear sequence to age horse teeth. In: Wilson B, Grigson C, Payne S, (eds): Aging and sexing from archaeological sites. BAR Oxford Ltd109, pp 207–215

Liesau C (1998) El Soto de Medinilla: Faunas de mamíferos de la Edad del Hierro en el Valle del Duero (Valladolid, España). Archaeofauna 7:11–210

Liesau C (2005) Ganadería. In: Jimeno A (ed) Los celtilberos. Tras la estela de Numancia. Junta de Castilla y León. Excma. Diputación de Soria, Salamanca, pp 301–306

Liesau C, Blasco MC (1999) Ganadería y aprovechamiento animal. In: Burillo F (Ed) IV Simposio sobre celtilberos. Economía. Zaragoza, Universidad de Zaragoza, Spain, pp 119–147

López-Romero González de la Aleja E (2017) Preliminary study of faunal remains from a rubbish pit of Las Cogotas (Cardeńsia, Ávila, España). In: Valente MJ, Costa C, Detry C (eds) Book of Abstracts of the Encontro de Zooarqueología Ibérica 2017 (EZI2017) and 5ª Reunião Científica de Arqueomalacologia da Península Ibérica (SRCAPI). 26–29 April 2017, Faro – Portugal. Universidade do Algarve, Faro. p 18

López-Romero González de la Aleja E (2019) Worked antler at the Vettonian (Iron Age) settlement of Las Cogotas (Cardeńsia, Ávila, España). CPAG 29:133–151

López-Sáez JA, López-Merino L, Pérez-Díaz S (2008) Los vettovones y sus paisajes: paleoambiente y paleoeconomía de los castros de Ávila. In: Álvarez-Sanchís JR (ed) Arqueología Vettona. La Meseta Occidental en la Edad del Hierro. Museo Arqueológico Regional, Alcalá de Henares, pp 140–152

Lorrio AJ, Ibarra MP, Sánchez de Prado MD (2014) Depósitos rituales de fauna en el oppidum prerromano de El Molón (Camporrobles, Valencia). APL XXX:213–238

Manglan GR (2018) Los verracos vettovones: origen, litologías, entronque popular, procedencia y dispersión natural en el territorio español. Ediciones Universidad Autónoma de Madrid, Madrid

Manglan GR, Ruano L, García-Giménez R, Berrocal-Rangel L (2021) Sobre verracos vettovones. Nuevas esculturas zoomorfas de la Edad del Hierro en la meseta occidental. CUPAUM 47(2):237–260

Marín-Aguilera B, Gleba M (eds) (2020) Interweaving traditions: clothing and textiles in Bronze and Iron Age Iberia. Universitat de València, València

Martin Bravo AM (1999) Los orígenes de Lusitania: el milenio a.C. en la Alta Extremadura. Real Academia de la Historia, Madrid

Morales A (1976) Contribución al estudio de las faunas mastozoológicas asociadas a yacimientos prehistóricos españoles. Universidad Complutense de Madrid. http://eprints.ucm.es/52043/1/12767.pdf. Accessed 28 November 2020

Morales A, Liesau C (1995) Análisis comparado de las faunas arqueológicas en el valle Medio del Duero (prov. Valladolid) durante la Edad del Hierro. In: Delibes G, Romero F, Morales A (eds) Arqueología y medio ambiente. El primer milenio a.C. en el Duero Medio. Junta de Castilla y León, Valladolid, pp 455–514

Morales A, Liesau C (2008) La fauna recuperada en Salmantica. In: Álvarez-Sanchís JR (ed) Arqueología Vettona. La Meseta Occidental en la Edad del Hierro. Museo Arqueológico Regional, Alcalá de Henares, pp 154–161

Payne S (1985) Morphological distinction between the mandibular teeth of young sheep, ovis and goats, capra. J Archaeol Sci 12:139–147

Pérez Ripoll M (1988) Estudio de la secuencia del desgaste de los molares de Capra pyrenaica de los yacimientos prehistóricos. APL 18:83–128

Prummel W (1988) Distinguishing features on postcranial skeletal elements of cattle, Bos primigenius f. taurus, and red deer, Cervus elaphus. En Schichten, aus der Archaeologish-Zoologischen Arbeistgruppe. Schleswig-Kiel Heft 12:5–52

Prummel W, Frisch HJ (1986) A guide for the distinction of species, sex and body side in bones of sheep and goat. J Archaeol Sci 13:567–577

Pucher E, Barth FE, Seemann R, y Brandstätter F eds (2013) Bronzezeitliche Fleischverarbeitung im Salzbergtal bei Hallstatt. Österreichische Akademie der Wissenschaften, Viena; 2013
Reschreiter H, Kowarik K (2019) Bronze age mining in Hallstatt. A new picture of everyday life in the Salt Mines and beyond. Arch Austr 103:99–136

Rodríguez-Hernández J (2012) Los procesos técnicos de la cantería durante la Segunda Edad del Hierro en el occidente de la Meseta. Zephyrus 70:113–130

Rodríguez-Hernández J (2019) Poder y sociedad: el oeste de la Meseta en la Edad del Hierro. Institución Gran Duque de Alba, Ávila

Rolett BV, Chiu MY (1994) Age stimation of prehistoric pigs (Sus scrofa) by Molar eruption and attrition. J Archaeol Sci 21:377–386

Romero F, Ramírez ML (1999) Estrategias de subsistencia en la cuenca media del Duero durante la Edad del Hierro. In: Burillo F (coord) IV Simposio sobre los Celtíberos, Economía. Institución -Fernando el Católico-, Zaragoza, pp 453–465

Romero F, Sanz Mínguez C (2007) Trigo, adobes, hierro y ciudades. Los vacceos en los inicios de la Historia. In: Sanz Mínguez C, Romero F (eds) En los extremos de la región vaccea. Caja España, León, pp 15–41

Romero F, Sanz Mínguez C, Álvarez-Sanchís JR (2008) El primer milenio a.C. en las tierras del interior peninsular. In: Gracia Alonso F (coord) De Iberia a Hispania. Ariel, Barcelona, pp 649–731

Ruiz-Gálvez M (1992) La novia vendida: orfebrería, herencia y agricultura en la Protohistoria de la Península Ibérica. SPAL 1:219–251

Ruiz Zapatero G (2005) Castro de Ulaca. Solosancho, Ávila. Institución Gran Duque de Alba, Ávila

Ruiz Zapatero G (2007) Imágenes de la sociedad prerromana: vettones. In: Barril M, Galán E (eds) Ecos del Mediterráneo: el mundo ibérico y la cultura vettona. Institución Gran Duque de Alba, Ávila, pp 67–72

Ruiz Zapatero G, Álvarez-Sanchís JR (1995) Las Cogotas: Oppida and the Roots of Urbanism in the Spanish Meseta. In: Cunliffe BW, Keay SJ (eds) Social Complexity and the Development of Towns in Iberia: From the Copper Age to the Second Century AD. British Academy, London, pp 209–235

Ruiz Zapatero G, Álvarez-Sanchís JR (2008) Los verracos y los vettones. In: Álvarez-Sanchís JR (ed) Arqueología Vettona. La Meseta Occidental en la Edad del Hierro. Museo Arqueológico Regional, Alcalá de Henares, pp 214–231

Ruiz Zapatero G, Álvarez-Sanchís JR, Rodríguez-Hernández J (2020) Urbanism in Iron Age Iberia: Two Worlds in Contact. J Urban Archaeol 1:123–150

Salinas M (2001) Los vettones: indigénismo y romanización en el occidente de la Meseta. Ediciones Universidad de Salamanca, Salamanca

Sánchez-Moreno E (2000) Vetones: historia y arqueología de un pueblo prerromano. Ediciones de la Universidad Autónoma de Madrid, Madrid

Sánchez-Moreno E (2001) Cross-cultural Links in Ancient Iberia: Socio-economic Anatomy of Hospitality. Oxf J Archaeol 20(4):391–414

Sánchez-Moreno E (2005) Caballo y sociedad en la Hispania celtíca: del poder aristocrático a la comunidad política. Gladis 25:237–264

Schmid E (1972) Atlas of animal bones for prehistorians, archaeologist and quaternary geologist. Elsevier Publishing Company, Amsterdam, London, New York

Tignor RL (1972) The Maasai Warriors: pattern maintenance and violence in colonial Kenya. J Afr Hist 13(2):271–290

Torres Rodríguez J (2013) La tierra sin límites. Territorio, sociedad e identidades en el valle medio del Tajo (s. IX-I a.C.). Museo Arqueológico Regional, Alcalá de Henares

Urbina D (2014) Tierras, huesos, semillas y personas. Economía y sociedad en la Carpetania. In: 1er Simposio sobre los carpetanos. Arqueología e historia de un pueblo de la Edad del Hierro. Museo Arqueológico Regional, Alcalá de Henares, pp 176–199

Valenzuela-Lamas S (2008) Alimentación i ramaderia al Penedès durant la protohistoria (segles VII-III ac). Societat Catalana d’Arqueologia, Premi Josep Barberà, Barcelona

Valenzuela-Lamas S, Detry C (2017) Romanización y Arqueozoología en el limes del Imperio. El caso de Lusitania entre la Edad del Hierro y el Bajo Imperio (s. VIII a.C.-V d.C.). Archaeofauna 26:39–51

Verstraete FJM (2006) Self-assessment colour review of veterinary dentistry. Manson/Veterinary Press, London

Yravedra J (2006) Zooarqueología aplicada a Tafonomía. Aula Abierta, Madrid, Spain. UNED, Madrid, Spain, 416p

Yravedra J (2007a) Fauna de macromamíferos de las fases III y IV de la necrópolis celtibérica de Herrería (Molina de Aragón, Guadalajara). In: Cerdeño ML, Sádgadoy T (eds) La necrópolis celtibérica de Herrería III y IV (Guadalajara). Centro de Estudios Celtíbericos de Segeda, Zaragoza, pp 197–240

Yravedra J (2007b) Memoria zooarqueológica y tafonómica en el alto Guadiana y el Júcar durante la época ibérica. Los yacimientos de Alarcos, Villanueva de los Infantes, los Toriles, Cerro de las Cabezas. Informe Inédito, Universidad Castilla la Mancha

Yravedra J (2008) Informe Zooarqueológico y tafonómico de Numancia (Soria). Informe inédito, Universidad Complutense de Madrid, Spain

Yravedra J (2013) Zooarqueología y Tafonomía en los comienzos de la Edad del Hierro, el Yacimiento de las Camas (Villaverde, Madrid). MzooArq Audema Serie Protohistoria. Audema Edit, 166p

Yravedra J, Estaca-Gómez (2010) Informe Arqueozoológico del yacimiento del Cerro del Berrueco. Inédito. Gipsia Arqueología. Madrid, Spain

Yravedra J, Estaca-Gómez V (2014) Implicaciones de la zooarqueología en la economía de la Edad del Hierro. ZA 17:361–375

Yravedra J, Estaca-Gómez V (2016) Anexo 3. La fauna de macromamíferos. In: Cerdeño ML, Sádgadoy T (eds) La necrópolis de Herrería I y II. Las fases culturales del Bronce final II-III. La Ergástula, Madrid, pp 275–296

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.