

# 'Animal farm': the faunal record from the Chalcolithic Ota site (Alenquer, Portugal) and its regional significance

Nelson J. Almeida<sup>1</sup>, André Texugo<sup>1,2,3</sup>, and Ana Catarina Basílio<sup>3,4</sup>

nelsonjalmeida@gmail.com

<sup>1</sup> UNIARQ, Center for Archaeology of the University of Humanities of the University of Lisbon, Lisbon, PT

<sup>2</sup> CEG, Centre for Geographical Studies, Institute of Geography and Spatial Planning, University of Lisbon (IGOT), Lisbon, PT; andrelopes@campus.ul.pt

<sup>3</sup> Foundation for Science and Technology (FCT), Ministry of Science, Technology and Higher Education, Lisbon, PT

<sup>4</sup> Interdisciplinary Center for Archaeology and Evolution of Human Behaviour, Faculty of Human and Social Sciences, University of Algarve, Faro, PT; catarinasbasilio@gmail.com

**ABSTRACT** – *This paper presents the results of the excavations carried out in the Chalcolithic contexts from the walled enclosure of Ota (Alenquer, Portugal). Six new absolute dates allow the discussion of the stratigraphical evidence and chronologically frame the zooarchaeological and taphonomical analysis of the faunal assemblage. Domesticated swine, caprine and bovine are prevalent, while wild species, most notably leporids, but also red deer, auroch and wild boar, among others, are less common. Exploitation and management of animals for the acquisition of primary and secondary products are inferred. Existing data suggests that the economic intensification that started during the previous phases was ongoing.*

**KEY WORDS** – *Chalcolithic; southwestern Iberia; zooarchaeology; taphonomy; walled enclosure*

## 'Živalska farma': favnistični zapis iz halkolitskega najdišča Ota (Alenquer, Portugalska) in njegov regionalni pomen

**IZVLEČEK** – *V članku predstavljamo rezultate izkopavanj halkolitskega konteksta v ogradi v Oti (Alenquer, Portugalska). Šest novih absolutnih datumov omogoča razpravo o stratigrafiji in kronološko zamejuje arheozoološke in tafonomske analize živalskega zbira. V njem prevladujejo udomaceni prašiči, drobnica in govedo. Manj pogoste so divje vrste, zajci, navadni jelen, tur in divji prašič. Domnevamo, da so z živalmi upravljali in jih izkoriščali za primarne in sekundarne produkte. Podatki kažejo, da se intenzivna izraba, ki se je začela v predhodnih fazah, nadaljuje.*

**KLJUČNE BESEDE** – *halkolitik; jugozahodni Iberski polotok; arheozoologija; tafonomija; ograde*

### Introduction

The third millennium BCE is a key phase of human history in the Iberian Peninsula. It is marked by an important social complexity and economic intensification that started during the Late Neolithic (~3500/3200–3000 cal BCE) and further developed during the Chalcolithic (3000–2000 cal BCE). The appearance and development of complex societies throughout the Chalcolithic (Cruz Berrocal et al. 2013) and the different social perspectives in the transition to

the Early Bronze Age (Valera 2015) are some of the important topics that have been a matter of debate among our colleagues.

The beginning of the third millennium BCE marks the emergence of new domestic architectures in the archaeological records, understood as “Walled enclosures” (Jorge 2003). Although not exclusive to this area (Gonçalves 1989; Molina, Cámara 2005;

Jorge et al. 2006; Mataloto 2010), the Portuguese Estremadura presents a high density of these types of sites. Its Western region concentrates 14 out of the 22 known walled enclosures, but the information on these is imbalanced – only four have had archaeological excavations in the last decade and a half, and only four have absolute chronologies, with the large site of Zambujal having 25 dates and the remaining three sites only having eight dates. Because they are generally placed on the top of hills that grant them wide visual control of the surrounding landscape, these sites are characterized by a new way of occupying space. They are recurrently placed near water sources that would function as a source of raw materials and subsistence, but also as a way of communication and connection to other areas and social networks. Other common characteristics are architecture and construction techniques. Structures such as 'walls', towers and doors are built with the drystone technique reaching areas with a maximum of 5ha (Kunst 2010) and structures with 200m in length (Texugo 2022). These structures are a novelty in the region, and continuously go through reformulations and changes that might bias the preservation of the archaeological record.

Fauna has also been an important part of the discussion regarding economic intensification (Valente, Carvalho 2014; Almeida, Valera 2021; Almeida et al. 2021b). The larger sites from the Portuguese Estremadura have historically been used as guidelines for palaeoeconomic debates (e.g., Driesch, Boessneck 1976; Cardoso, Detry 2001/2002), but at the same time hindered the understanding of possible variability. The publication of other assemblages from the Estremadura (Correia 2015; Moreno-García, Sousa 2015; Detry et al. 2020) and the comparison with the southern Alentejo region (Arnaud 1993; Davis, Mataloto 2012; Costa 2013; Moreno-García 2013; Almeida, Valera 2021) is only more recently being achieved. The first results for animal diet and mobility have been published (Waterman et al. 2015; Žalaitė et al. 2018; Wright et al. 2019; Valera et al. 2020b), showing differences in the management and exploitation of fauna not only between the Neolithic and Chalcolithic but also within the Chalcolithic.

In the western region, the 666m Montejunto hill is oriented NE-SW, visually impacting the area while also polarizing the surrounding landscape and cultures (Basílio, Texugo 2017; Basílio *in press*). This hill has several river springs that determine its relationship with the surrounding areas. From an ar-

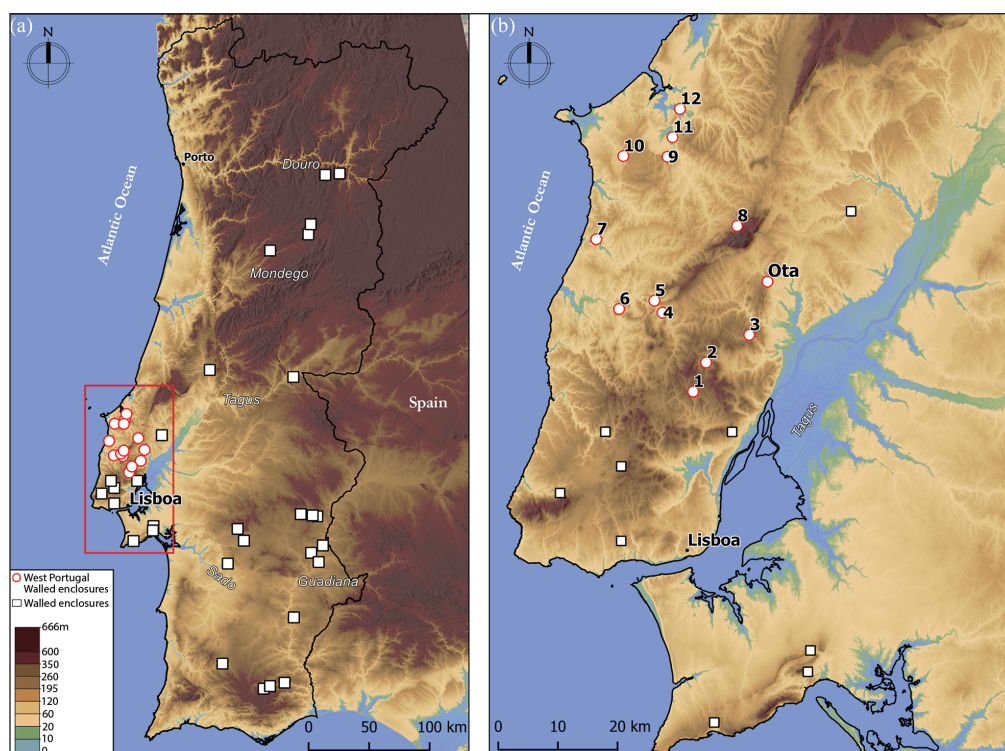
chaeological perspective, its natural caves have funerary uses dated at least from the Middle Neolithic (Carvalho et al. 2019) to the Bronze Age (Gonçalves 1992). This highlights that there seem to be different spatial relationships and meanings that might dictate how the communities were spread throughout the territory and the different cultural influences and expressions (Basílio *in press*), as is the case of the archaeological site of Ota. In this paper, we present the results of the archaeological excavation of the Ota walled enclosure (Alenquer, Portugal), located less than 10km from Montejunto hill. We will focus on the unpublished absolute dates and the faunal record aiming to contribute to debates on resource exploitation and management during the Chalcolithic in western Iberia. We will also present an in-depth taphonomical analysis of the assemblage, uncommon for the period and region under analysis, which will allow for a clearer understanding of the faunal accumulation and site use.

## Materials and Methods

### Materials

Ota site is located about 50km north of Lisbon in the heart of the Portuguese Estremadura region, and, like its 22 counterparts, belongs to the walled enclosure phenomenon (Fig. 1). It shares, along with the great majority of these, chronological synchrony in its discovery in the first half of the 19<sup>th</sup> century, by Hipólito Cabaço, when the ground visibility scenario was different, mostly due to efficient forest management and the existence of communal herds. Currently, Ota is densely populated with *Quercus coccifera*, *Olea europaea* var. *sylvestris*, *Rubus ulmifolius*, *Pinus pinaster* and, in scarce instances, *Eucalyptus globulus*. This vegetation results from thin soils, already attested in Ota during 2019, 2020 and 2021 fieldwork, reducing the surface visibility and the results of archaeological surveys. In lithological terms, the region is composed of Mesozoic sedimentary rocks and a small area of Cenozoic sediments, meaning that past communities were surrounded by limestones, sands and clays (Ramos-Pereira et al. 2020), using them as the raw materials for different architectures and artefacts. The geological framework originates in a landscape marked by small mountains, hills, interior plateaux, plains, and littoral platforms (Ramos-Pereira et al. 2020), with the western region, where Ota is integrated, being particularly relevant.

Regarding climate, paleoenvironmental reconstructions suggest that the first changes in regional vege-



**Fig. 1. Distribution of Walled Enclosures in Portugal (a) with a zoom-in at the western cluster (b), where the Ota archaeological site is located. The sea level reconstruction is based on Lord et al. (2011). 1 Moinho do Custódio; 2 Castelo; 3 Pedra d'Ouro; 4 Penedo; 5 Fórnea; 6 Zambujal; 7 Pitagudo; 8 Pragança; 9 Columbeira; 10 Paço; 11 Outeiro de S. Mamede; 12 Outeiro da Assenta.**

tation by anthropic influence, detected in pollen shifts, occurred around 5400 BCE, with the beginning of cereal cultivation (Lord et al. 2011). As for the mean sea level and coastline changes, it was observed that they remained stable between 9300 BCE and 2900 BCE (Lord et al. 2011). In this period, periodic floods were identified, a behaviour that changed with the progression of marine transgression (Lord et al. 2011). In sum, the chalcolithic climate seems close to the current Estremadura climate, characterized by a 'Csa' hot-summer Mediterranean climate (Kottek et al. 2006.Fig. 1) with average temperatures of 17°C and annual precipitation between 700mm and 900mm (Mora, Vieira 2020).

The archaeological site of Ota was the target of the archaeological surveys in the framework of a more exhaustive investigation (ROSETTA project) which aims to study the Chalcolithic architectures of the western walled enclosures through remote sensing. In the case of Ota, the LiDAR survey allowed the discovery of 21 high potential archaeological anomalies through the use of the LiDAR sensor in a system mounted in a UAS (a DJI Matrice 600 Pro with a Phoenix LiDAR Scout-8). To understand, evaluate, test and confirm the results obtained by remote sensing, three excavation campaigns were carried out.

These resulted in 90 days of intervention between 2019 and 2021.

The selected excavation areas relate not only to the anomalies detected but also to potential chalcolithic structures. The strategy adopted thus aimed to determine, in the first place, a vital structure for the definition of the walled enclosures – the wall. Next, and based on the previous knowledge of Wall 1, we understood the potential use of the natural geological platforms to define an occupation made in embankments. This corresponds to Structure 9, which materializes the symbiotic relationship between the anthropic architectures and the limestone substratum. Finally, the area where more work has been carried out relates to Structure 3, not only to understand the structure itself, possibly unique within the Chalcolithic walled enclosure phenomenon, but also to understand the sites' historiography and Cabaço interventions, of which no records are available.

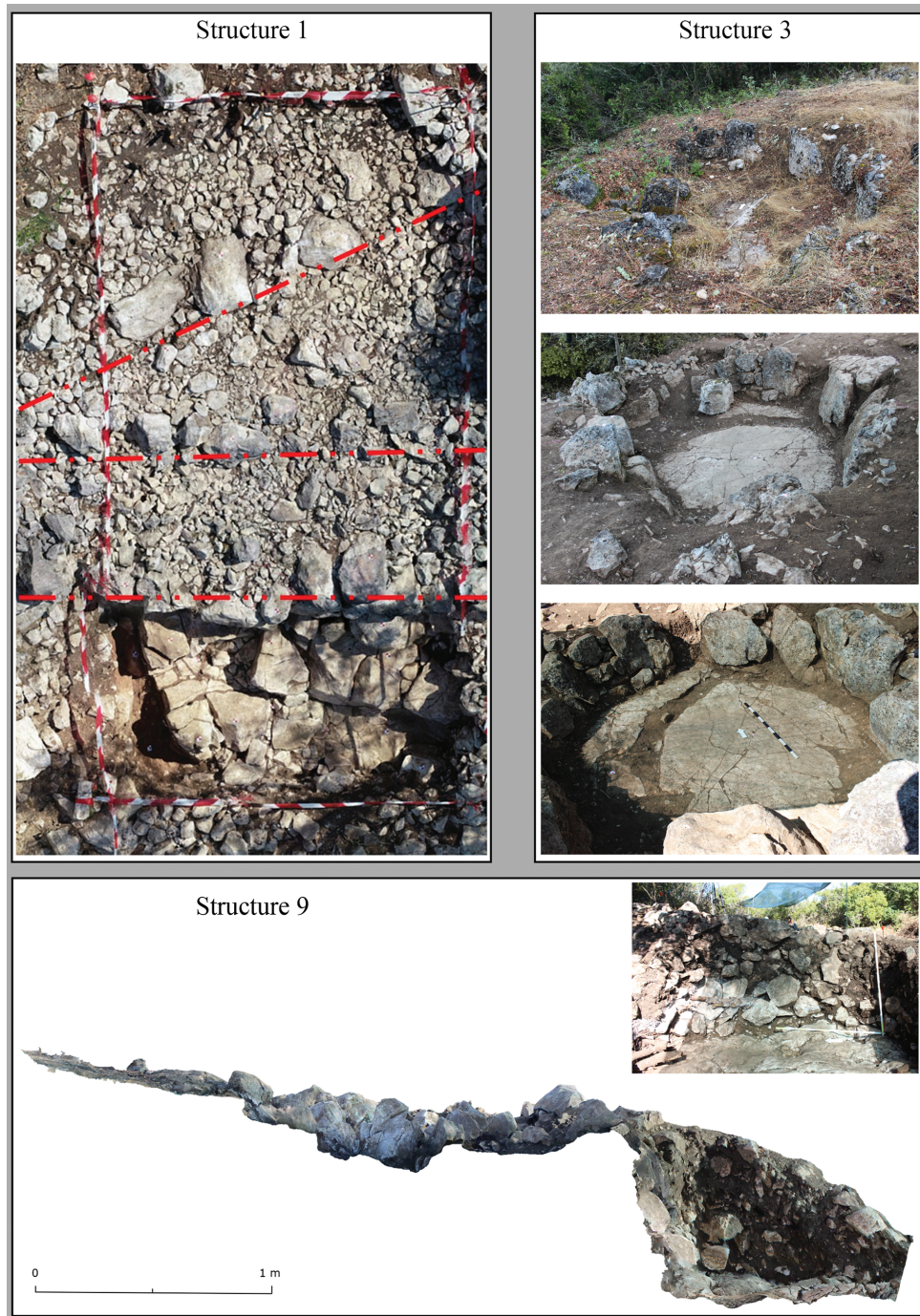
#### Structure 1

The two surveys carried out on the wall, at different points of its layout, aimed at the typological classification and clarification of its construction rhythms and temporalities. The first one is to the north end (survey 1), and the second survey is in the south

end, 150m away from the first one, giving a total of 38m<sup>2</sup> of excavated area (Fig. 2).

In stratigraphic terms, only two sedimentary deposits were intervened. The first, [1007], is also the oldest, lying directly on the limestone base platform. In this one, there were few records of fauna, ceramic and lithic artefacts. However, there was very considerable chronological homogeneity, with all

the elements pointing to prehistoric contexts. This deposit was covered and sealed by a second deposit, [1006], composed of a group of small and medium-sized stones enclosed in compact clayey sediment. The [1006] deposit contains the most significant archaeological materials from Structure 1 – the wall – in which the bone of *Ovis/ Capra* was found, providing the absolute dating of this structure.



**Fig. 2. Examples of the structures found in Ota: the final record of Structure 1 with the indication of possible wall alignments in red; different stages of the excavation process of Structure 3; final record and section of Structure 9 with the upper and lower bedrock platforms separated by the structure.**

Both the information relating to the materials and the <sup>14</sup>C information (Tab. 1) allowed for the understanding that this structure was already active during the third quarter of the third millennium BCE (the regional Middle/Late Chalcolithic), serving as a *post-quem* indicator. As such, the identified dynamics that were already broadly replicating some of the regional prehistoric behaviours seem to be chalcolithic.

### Structure 9

The approach to Structure 9 (Fig. 2) arises from two main vectors. On the one hand, following its identification through the data obtained by LiDAR. On the other, the results and information gathered at Wall 1, pointed to an occupation made through multiple platforms. These seemed to result from the nature of the base geology and the addition of structures carried out by the first communities that occupied this site. With this in mind, a 2 by 6m survey was set up between the two platforms to characterise three apparently distinct spaces: (1) the upper platform; (2) the lower platform; (3) the possible natural or artificial structure between the two platforms. The analysis determined that the bedrock was between 5 and 20cm deep and that there were no preserved deposits. However, it was clear that the top and slope of the hill had an intense prehistoric occupation, since most of the collected materials corresponded to hand-made pottery, with and without the traditional regional chalcolithic motifs, siliceous lithic materials, and even a fragment of a limestone vase.

### Structure 3

This is the only ‘negative’ structure identified so far at the Ota archaeological site (Fig. 2). It was discovered during the field surveys, but it was also recorded in the LiDAR scanning. However, it corresponds to a structure already intervened by Hipólito Cabaço, although no record or mention of its existence has been recovered. This is a reality of a circular tendency that replicates the construction strategy observed in the other structures of Ota, based on a combination between the local geology and the addition of constructive elements. This symbiosis is particularly noti-

ceable in this structure, being partially modelled on the limestone bedrock, complemented by the placement of large stone blocks that help in the definition of the apparently intended circular layout. Besides these large blocks, which cover about 40 to 50% of the circumference of the structure, a possible containment structure composed of an agglomerate of medium and small-sized limestones was detected to the west. Its functionality seems to be related to an eventual stabilization and support of the larger blocks (Texugo et al. *in preparation*). Another aspect of the manipulation of the base geology is the surface inside the structure. Relatively flattened outcrop benches were also detected at other points of the archaeological site; however, the interior of this structure is perfectly smoothed, suggesting human activity in the formation of a flattened floor.

Regarding its excavation, the sediments from this structure were entirely sieved, and there was a double approach to the fieldwork: interior and exterior areas of the circular structure, resulting in an excavated area of 98m<sup>2</sup>. As for the stratigraphic sequence, we can state that the deposits around Structure 3 come from last century’s excavations, and that the present materialities were selected with the clear obliteration of materials with greater value – the decorated ceramics and other goods of greater aesthetic value. This situation is opposite to that reflected by the materials collected by Hipólito Cabaço, where no undecorated ceramics are present. After the excavation of these superficial contexts – [1104] to [1110] – it was possible to understand that none of the deposits were preserved, either because they

Lab.	Sample	Context	BP date	Cal BCE (2σ)
Beta-561854	Ovis/Capra rib	Structure 1 [1006]	3960±30	2571–2516 (32.8%) <b>2502–2400</b> (52.7%) 2383–2347 (10%)
Beta-568786	Capra hircus horn core	Structure 3 [1103]	3970±30	<b>2575–2444</b> (87.6%) 2424–2404 (3.3%) 2379–2350 (4.6%)
Beta-612398	Sus sp. phalange	Structure 3 (exterior) [1120]	3860±30	<b>2460–2276</b> (80.5%) 2256–2206 (15%)
Beta-612399	Bos sp. phalange	Structure 3 [1115]	3990±30	<b>2576–2454</b> (93.4%) 2418–2409 (0.9%) 2369–2356 (1.1%)
Beta-612400	Sus sp. cranium	Structure 3 (exterior) [1120]	3980±30	<b>2576–2454</b> (93.4%) 2418–2409 (0.9%) 2369–2356 (1.1%)
Beta-612401	Sus sp. tooth	Structure 3 (exterior) [1120]	4000±30	<b>2578–2463</b> (95.4%)

**Tab. 1. Absolute dates obtained for Structures 1 and 3 of Ota. Calibration of <sup>14</sup>C dates using IntCal20 calibration curve (Reimer et al. 2020) and the OxCal v4.4 program (Bronk Ramsey 2009).**

were previously excavated or because they were decisively affected by intense bioturbation. Nonetheless, it is possible to conclude that the overwhelming majority of the archaeological materials in these strata belong to late prehistory. Overall, only five stratigraphic units were preserved, with coherent contextual information. Inside Structure 3, [1003] and [1115] correspond to the remains left by Cabaço, having provided a sample of a *Capra hircus* horn core with a date fitting into the Middle Chalcolithic (2574–2350 BCE) and of a *Bos* sp. phalange with a very similar date – 2577–2459 BCE (Tab. 1). The sediments outside Structure 3 were quite affected and it was only possible to record two preserved contexts in an area with strong anthropic alterations of the base lapis. In addition to this manipulation of space, the presence of several horizontally deposited faunal elements – [1120] – further corroborates the probable preservation of the deposits, with the repeated presence of human action in the organization of the elements. [1120] was on top of [1121], which, in line with what was noted in the last deposit, included various unstructured faunal elements with cohesive materials framed in regional Chalcolithic social dynamics.

### Methods

The assemblage provenance is diverse and comprises remains from all the stratigraphical units with absolute or relative chronologies pointing to the Chalcolithic period, independently of the degrees of bioturbation recorded. A larger amount of remains comes from [1104] (n=1450, 24.1%), [1111] (n=959, 16%), [1114] (n=777, 12.9%), [1117] (n=427, 7.1%), [1120] (n=385, 6.4%), and [1113] (n=357, 5.9%). Remaining units have <5% of the NSP: [1000], [1006], [1007], [1008], [1101], [1102], [1103], [1105], [1106], [1107], [1108], [1109], [1110], [1115], [1116], [1118], [1119], and [1121].

Methodologies for the zooarchaeological and taphonomical analysis of faunal assemblages were followed (Lyman 1994; Reitz, Wing 2008). Data are presented according to the number of specimens (NSP), number of identified specimens (NISP), minimum number of elements (MNE), and minimum number of individuals (MNI) (Grayson 1984; Lyman 2008). The MNI was calculated by distinguishing stratigraphic units (MNI<sub>su</sub>) and as a general cumulative estimate not considering differences between stratigraphic units (MNI<sub>g</sub>).

Linear biometrics analysis was carried out by measuring bones and teeth with a Lux digital calliper fol-

lowing current standards (Driesch 1976; Payne, Bull 1988; Davis 1996; Albarella et al. 2005; Salvagno, Albarella 2017). The results were compared to regional 'contemporaneous' published measurements and were considered together with morphology to better characterize bovine, swine, caprine and leporids (Boessneck et al. 1964; Boessneck 1970; Callou 1997; Zeder, Pilaar 2010; Zeder, Lapham 2010). Taxonomically indeterminate remains were tentatively classified according to generic weight groups (Brain 1981; Bunn 1983; 1986): indeterminate (WG 0), <20kg (WG 1), 20–100kg (WG 2), 100–300kg (WG 3), and >300kg (WG 4). The age-at-death estimate considered bone (general ossification and epiphysis fusing) and teeth development (eruption, replacement, wear) according to data published for the main species documented in the assemblage (Payne 1973; 1987; Bull, Payne 1982; Grant 1982; Jones 2006; Zeder 2006; Lemoine et al. 2014; Zeder et al. 2015). The results were grouped in general age groups, namely perinatal, infant, juvenile, sub-adult, adult, and senile.

The assemblage breakage patterns were assessed following Henry T. Bunn (1983) and Paola Villa, and Eric Mahieu (1991). Diaphysis length (<25%, 25–50%, 50–75%, >75%) and section (<25%, 25–75%, >75%) completeness are presented in relation to the original figures. Breakage planes outline (oblique, longitudinal, transverse), angle (mixed, oblique, right), and surface (jagged, smooth) are considered according to the weight groups mentioned above. The surfaces of the remains were macroscopically and microscopically analysed to record possible BSMs (bone surface modifications) related to processing and consumption, but also the sedimentary environment. We searched for anthropogenic breakage (e.g., peeling, percussion impacts, cones, fissures), cutmarks (e.g., incisions, chop marks, scrape marks), tooth marks (e.g., pits, punctures, crenulated edges), other consumption indicators (e.g., furrowing, digestion), and thermal alteration (i.e. boiling, burning) (Binford 1978; 1981; Brain 1981; Shipman 1981; White 1992; Stiner et al. 1995; Pickering et al. 2013; Solari et al. 2015). When present, their location, disposition, relations, typology, morphology, size and intensity are described (Almeida 2017). The furrowing evaluation follows the proposal of Saladié et al. (2011; 2013) according to the intensity of tissue loss distinguishing between light, moderate, and heavy furrowing. The location of tooth marks was also recorded considering the type of tissue affected (cortical, thin cortical, cancellous – Selvaggio, Wilder 2001; Domínguez-Rodrigo, Piqueras 2003).

Weathering is presented according to the degrees suggested by Behrensmeier (1978). Other taphonomical indicators, such as the presence of vermiculations (Lyman 1994), manganese oxide precipitation (López-González et al. 2006), indeterminate chemical corrosion (Fernández-Jalvo et al. 2002), trampling (Behrensmeier et al. 1986; Shipman, Rose 1984), rodent gnawing (Shipman 1981), or concretions (Courty et al. 1989) were qualitatively recorded according to the intensity and surface altered (<25%, 25–50%, 50–75%, >75%) (Almeida 2017).

**Results**

**Anatomy and taxonomy**

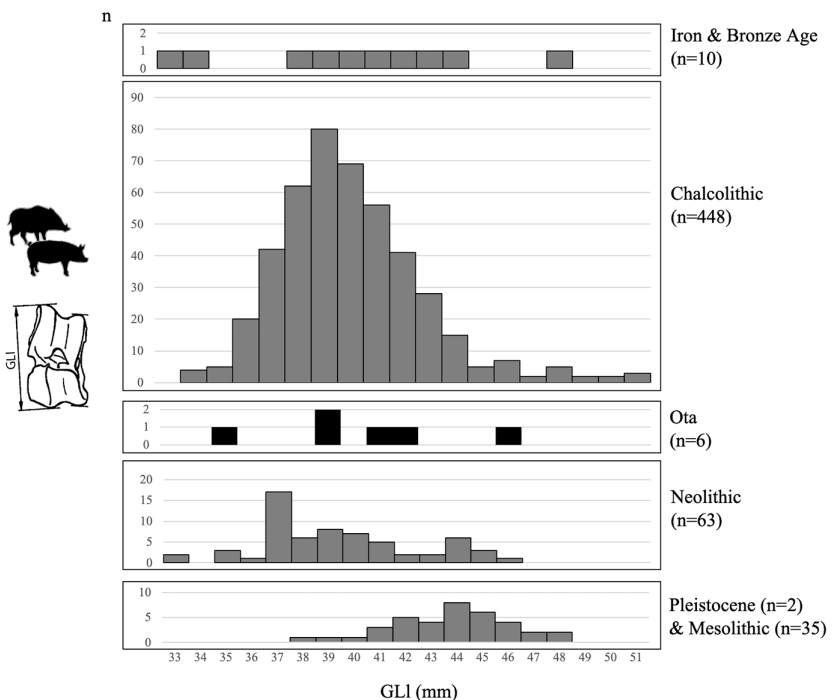
The assemblage comprises a majority of Mammalia (NISP% 96.5%) remains, with some amount of Bivalvia (NISP% 2.4%) and to a lesser extent Amphibia (NISP% 0.5%), Reptilia (NISP% 0.5%), and Aves (NISP% 0.2%) (Tabs. 2, 3, 4). Swine are prevalent, with the majority of them being specifically indeterminate, and some remains being identified as possible wild boar and pig due to morphology and size. As can be seen in Figure 3, there is some superimposition between Mesolithic wild boar and Late Prehistory (presumable) pig for the astragalus Greatest Lateral length (GLL) measurement. For the case of Ota and considering the results for other large Chalcolithic assemblages, it seems that some of the astragali correspond to small swine, and at least the larger one would probably correspond to wild boar. Still, the possible presence of hybrids in the assem-

blage must be considered, as pigs were probably bred free. Swine show an important number of isolated teeth (n=68). All parts of the skeleton are present, but vertebrae and ribs are under-represented. A higher number of anterior in comparison to posterior long bones is evident according to NISP and MNE values. The obtained MNIs indicate the presence of adult and senile wild boar; juvenile, sub/adult and adult pigs; and infant/juvenile, juvenile, and sub-adult swine that further enlarge the MNIs (Tab. 5). Hence, different age groups are represented in the assemblage.

Caprine are well represented, comprising a majority of goat/sheep and similar NISP values for remains identifiable specifically as goat or sheep. Similarly to swine, isolated teeth are also frequent in caprine remains (n=75), with the appendicular skeleton being more abundant than other body parts. The distinction between goat and sheep was achieved based on the morphology of horn core fragments, isolated teeth, humerus, radius, metapodial, calcaneus, phalanges, and both morphology and measurements of astragali following Simon J. M. Davis (2017b). Sub-adult, adult and adult/senile individuals of goats, and juvenile, sub-adult and adult individuals of sheep are countable. The goat/sheep follow this pattern even if adding one juvenile individual in the MNI<sub>g</sub>.

Bovine comprises domesticated cattle and wild aurochs. The latter are scarce in comparison to the

**Fig. 3. Histogram of results obtained for the Greatest Lateral length (GLL) of swine astragalus from the Ota site and other Portuguese and adjacent Spanish sites dated to the Pleistocene and Mesolithic (Detry 2007); Neolithic (Almeida 2017; Davis et al. 2018; Encarnação, Almeida 2017; Almeida et al. 2021b); Chalcolithic (Driesch, Boessneck 1976; Cardoso, Detry 2001/2002; Castaños 1992; 1997; Rodríguez-Hidalgo, Cabezas 2011; Davis, Mataloto 2012; Moreno-García 2013; Correia 2015; Moreno-García, Sousa 2015; Detry et al. 2020; Almeida et al. 2021a; Almeida, Valera 2021; Cardoso et al. 2021; Pereiro et al. 2021); Iron and Bronze Age sites (Davis 2006; Almeida et al. 2020b).**



	NSP	%	MNE	%	MNI <sub>su</sub>	%	MNI <sub>g</sub>	%
<b>MAMMALIA</b>								
Artiodactyla	17	1.7	0	0.0	0	0.0	0	0.0
<i>Bos taurus</i>	78	7.6	63	10.1	16	12.5	3	6.5
<i>Bos cf. primigenius</i>	13	1.3	11	1.8	7	5.5	2	4.3
<i>Bos sp.</i>	92	8.9	48	7.7	1	0.8		
<i>Capra hircus</i>	22	2.1	15	2.4	7	5.5	1	2.2
<i>Ovis aries</i>	16	1.6	15	2.4	8	6.3	6	13.0
<i>Ovis/Capra</i>	177	17.2	81	13.0	6	4.7	1	2.2
<i>Cervus elaphus</i>	72	7.0	50	8.0	12	9.4	2	4.3
<i>Sus cf. scrofa</i>	7	0.7	4	0.6	5	3.9	2	4.3
<i>Sus cf. domesticus</i>	21	2.0	17	2.7	9	7.0	5	10.9
<i>Sus sp.</i>	271	26.4	157	25.2	7	5.5	6	13.0
<i>cf. Equus sp.</i>	1	0.1	1	0.2	1	0.8	1	2.2
Herbivore	28	2.7	0	0.0	0	0.0	0	0.0
<i>Canis sp.</i>	3	0.3	3	0.5	2	1.6	1	2.2
<i>Felis silvestris</i>	1	0.1	1	0.2	1	0.8	1	2.2
<i>Oryctolagus cuniculus</i>	151	14.7	120	19.2	28	21.9	9	19.6
Leporidae	25	2.4	16	2.6	0	0.0	0	0.0
Sub-total Mammalia	995	96.8	603	96.5	0	0.0	0	0.0
<b>AVES</b>								
Aves ind.	1	0.1	1	0.2	1	0.8	1	2.2
Sub-total Aves	1	0.1	1	0.2	0	0.0	0	0.0
<b>AMPHIBIA</b>								
Amphibia	2	0.2	1	0.2	1	0.8	0	0.0
Anura	2	0.2	2	0.3	1	0.8	1	2.2
Sub-total Amphibia	4	0.4	3	0.5	0	0.0	0	0.0
<b>REPTILIA</b>								
<i>cf. Mauremys leprosa</i>	3	0.3	3	0.5	2	1.6	1	2.2
Sub-total Reptilia	3	0.3	3	0.5	0	0.0	0	0.0
<b>BIVALVIA</b>								
Bivalvia ind.	7	0.7	4	0.6	3	2.3	0	0.0
<i>Ruditapes decussatus</i>	4	1.4	7	1.1	6	4.7	1	2.2
<i>Cerastoderma edule</i>	2	0.2	2	0.3	2	1.6	1	2.2
<i>Pecten sp.</i>	2	0.2	2	0.3	2	1.6	1	2.2
Sub-total Bivalvia	25	2.4	15	2.4	0	0.0	0	0.0
Sub-total identified	1028	100	625	100	128	100	46	100
<b>Indeterminate</b>								
Weight group ind.	2294	46.1						
WG <20kg	81	1.6						
WG <100kg	294	5.9						
WG 20-100kg	1421	28.5						
WG <300kg	231	4.6						
WG 100-300kg	102	2.0						
WG >100kg	281	5.6						
WG >300kg	276	5.5						
Sub-total indeterminate	4980	100						
Total	6008							

**Tab. 2. Absolute and relative values obtained for the taxonomically identified and unidentified faunal remains according to the number of identified specimens (NSP), minimum number of elements (MNE), and minimum number of individuals by stratigraphic unit (MNI<sub>su</sub>) and minimum number of individuals general (MNI<sub>g</sub>).**

large number of remains identified as *Bos taurus* and *Bos sp.*, the latter generally also have smaller sizes and probably corresponded to the domesticated form as well. The most abundant measurable bone used for this distinction are proximal phalanges, which in the case of the Ota assemblage are generally coincident with the sizes considered to correspond to cattle, even if a larger specimen falls within the admitted variability of the much larger auroch (Fig. 4). One astragalus allowed for the measurement

some of them are considered taxonomically indeterminate (n=7, 28%), the grooved carpet shells are abundant, and the scarce common cockle and scallop are present.

### Taphonomy

The assemblage is composed by a majority of remains with maximum dimensions <5cm (n=5242, 87.3%), others between 5 and 10cm (n=727, 12.1%) and only a few with 10–15cm (n=32, 0.5%) or 15–

of the GLL, which also showed its small size (Fig. 5). Bovines have all body parts, but the higher frequency of phalanges and carpal/tarsal bones is of interest. Older individuals, *i.e.* adult or adult/senile, and several sub-adult/adult individuals are present. Noteworthy is the presence of one infant/juvenile cow and one juvenile/sub-adult auroch.

Leporids correspond mostly to the European wild rabbit and also have an important number of remains. Except for one sub-adult, all individuals are adults. Both the cranial and appendicular body parts are well represented, mainly mandibles, innominate, femur and tibia. The smaller bones from the extremities are underrepresented, but it is not clear if this relates to the selection, survival or recovery bias since sieving was implemented in the area containing the majority of the assemblage. Red deer are the second more numerous species representing wild game, and the different bones, teeth and antlers seem to correspond to adults. Canids are represented by two metapodial and one phalange, with a possible equid phalange and a wild cat phalange recovered.

One must emphasize the recovery of some Bivalvia shell fragments (Fig. 6). Although



**Tab. 3. Values of the number of identified specimens (NISF) per body part. Legend: AR artiodactyl, BT Bos taurus, BP Bos cf. primigenius, BOS Bos sp., CH Capra hircus, OA Ovis aries, O/C Ovis/Capra, CEE Cervus elaphus, SS Sus cf. scrofa, SD Sus cf. domesticus, SUS Sus sp., EQ cf. Equus sp., HE herbivore, CAN Canis sp., FS Felis silvestris, ORC Oryctolagus cuniculus, LEP Leporidae, AV Aves ind., AMP Amphibia ind., AN Anura, ML cf. Mauremys leprosa, BIV Bivalvia, RD Ruditapes decussatus, CE Cerastoderma edule, PE Pecten sp., IND indeterminate.**

	AR	BT	BP	BOS	CH	OA	O/C	CEE	SS	SD	SUS	EQ	HE	CAN	FS	ORC	LEP	AV	AMP	AN	ML	BIV	RD	CE	PE	IND	Total	
<b>axial cranial skeleton</b>																												
horn core/antler				2	7	1		20																		18	48	
cranium (maxilla)	1					2	1		5	8						11	1										159	188
mandible	3			7		5	1	1	1	9		1			18											32	78	
isolated incisor	1					9				19						1										1	31	
isolated canine									3	14																0	17	
isolated pre-molar	2	1	6	3		11	3			10																4	40	
isolated molar	7	1	22	1	1	50	3		3	18		24			8											4	142	
isolated tooth									1	2						1										61	65	
<b>axial post-cranial skeleton</b>																												
vertebra				6		2			9						5	5											203	230
rib																											124	124
sacrum				2		1										2											5	10
<b>appendicular skeleton</b>																												
scapula	1	1	1	1		4	1		4	12						12	2										24	62
humerus	2	1	1	1	1	6	3		2	20						8	1										13	59
radius	1	1	1	1	1	10	2		2	12						6											20	58
ulna	4		3			6	2		11							7	1										2	36
metacarpal	1		4	1	1	4	1		7					1												0	20	
ilium																				1							0	1
pelvis	2		2		2	2			1	13						22											13	57
femur	1		1		1	1			11							17	5										16	53
patella						2			3																		0	5
tibia	1		3		3	2			2	6						14	5										4	40
fibula									6																		3	9
tibio-fibula																			1								0	1
tarsal-metatarsal																			1								0	1
metatarsal	4		2	1		9	2		9					1		11	1									0	40	
metapodial	15	4	4			24	4	1	15			1														6	75	
astragalus	3	1	2	6	2	4	1	1	4																	2	26	
calcaneus	2			1		2	2		10							9										3	29	
carpal/tarsal	7	5	3			8	5		6																	10	44	
sesamoid																											1	11
phalange 1	1	18	1	5	3	2	5	7	1	14	1	1	1	1	1											5	67	

continue

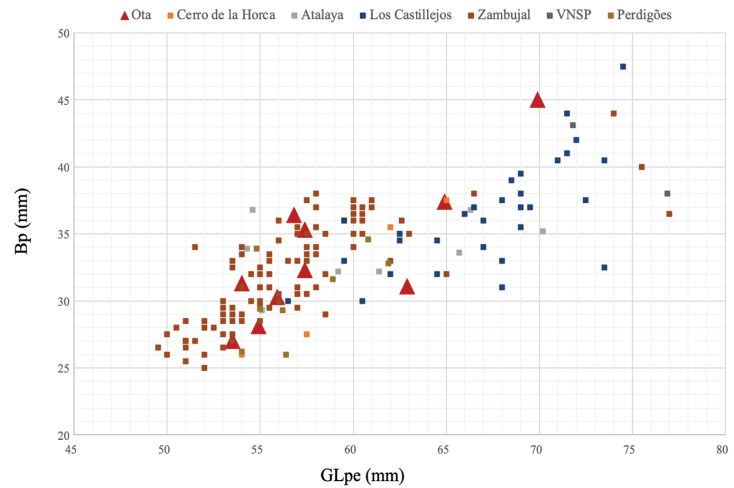
phalange 2	8	1	1	1	2	3	4	14																		2	36				
phalange 3	5	1	5	1	6	2	10																			0	30				
phalange																										6	6				
other																										1292	1292				
long bone																										1587	1589				
flat bone																										1360	1360				
indeterminate bone																										0	3				
carapace/plastron																										7	14	2	2	0	25
total	17	78	13	92	22	16	177	72	7	21	27	1	28	3	1	15	25	1	2	2	3	7	14	2	2	4980	6008				

Tab. 4. Values of the minimum number of elements (MNE) per body part, excluding loose teeth. Legend: BT Bos taurus, BP Bos cf. primigenius, BOS Bos sp., CH Capra hircus, OA Ovis aries, O/C Ovis/Capra, CEE Cervus elaphus, SS Sus cf. scrofa, SD Sus cf. domesticus, SUS Sus sp., EQ cf. Equus sp., HE herbivore, CAN Canis sp., FS Felis silvestris, ORC Oryctolagus cuniculus, LEP Leporidae, AV Aves ind., AN Anura, ML cf. Mauremys leprosa, BIV Bivalvia, RD Ruditapes decussatus, CE Cerastoderma edule, PE Pecten sp.

	BT	BP	BOS	CH	OA	O/C	CEE	SS	SD	SUS	EQ	CAN	FS	ORC	LEP	AV	AMP	AN	ML	BIV	RD	CE	PEC	Total				
<b>axial cranial skeleton</b>																												
horn core/antler			2	4	1		6																					
cranium (maxilla)	1					1	1	4	4					10														
mandible	3		4			4	1	1	1	7				15														36
<b>axial post-cranial skeleton</b>																												
vertebra			5			2			8					5	4													24
rib																												0
sacrum			1			1																						4
<b>appendicular skeleton</b>																												
scapula	1	1	1			4	1	4	7					11	2													32
humerus	2	1	1	1	1	5	3	2	9					7	1													33
radius	1	1	1	1	1	7	2	2	10					6														31
ulna	3	1	1			6	2		9					7														28
metacarpal	1	3	3	1	1	4	1		7					1														19
ilium																						1						1
pelvis	2	2	2			2	2	1	10					18														37
femur	1	1	1			1	1	9	9					6	3													22
patella						2		3	3																			5
tibia	1	3	3			2	2	2	4					13	3													30
fibula								3	3																			3
tibio-fibula																												1
tarsal-metatarsal																												1

*continue*

metatarsal	3	1	1	1	4	2	2	9	1	11									32
metapodial	4				11	3	1	4		1									24
astragalus	3	1	2	6	2	4	1	4											24
calcaneus	2				2	2		7		9									23
carpal/tarsal	7	5	3		8	5		6											34
sesamoid								10											10
phalange 1	16	1	4	3	2	4	7	13	1	1		2							56
phalange 2	7	1		1	2	3	3	14											31
phalange 3	5	1	5		1	6	2	10											30
other																			
flat bone																			1
carapace/plastron																			3
shell																			15
total	73	13	61	19	16	129	55	7	20	199	1	3	1	121	16	1	1	1	756



**Fig. 4.** Scatterplot showing the breadth of the proximal end (Bp) and the greatest length of the peripheral half (GLpe) measurements obtained for bovine phalange 1 from Portuguese and adjacent Spanish Chalcolithic assemblages (Driesch, Boessneck 1976; Castaños 1992; 1997; Rodríguez-Hidalgo, Cabezas 2011; Detry *et al.* 2020; Almeida, Valera 2021).

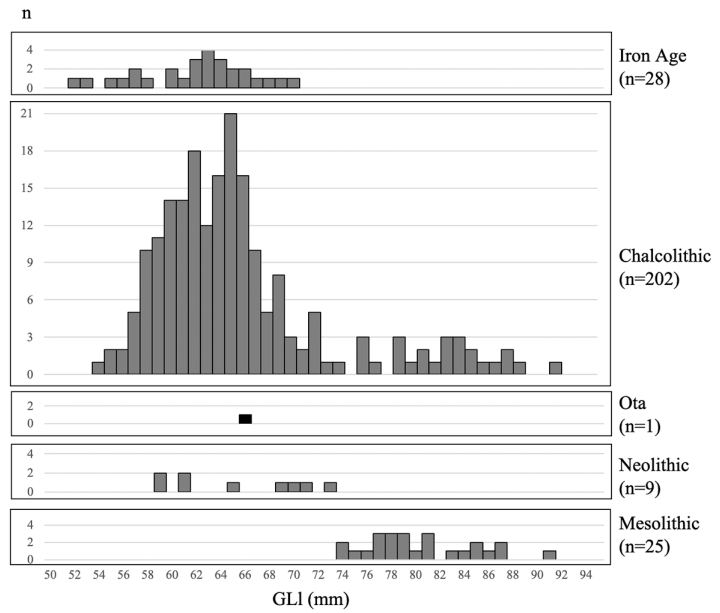
18cm (n=7, 0.1%) (Fig. 7). The results obtained for the diaphysis completeness are interesting, with clear differences between long bones of WG 1 and 1/2 and the remaining WGs. In the latter, both WG 2+2/3+3 and WG 3/4+4 show higher frequencies of length and section <25% of the original, while in WG 1+1/2 the length of 25–50% and 50–75%, and the 25–75% section are better represented. It thus seems that the long bones of smaller animals, which correspond mostly to leporids or animals of similar size, are better preserved in comparison to larger animals, from the size of caprine, swine, cervids and bovinds.

To better understand this data, we looked at the breakage planes (Fig. 7). Longitudinal outlines are abundant in the different samples, followed by oblique outlines, but these have values between around 28–35%. Angles and edges show a similar pattern, with right degrees and smooth surfaces always above 66%. These patterns together with the diaphysis completeness and the indicators of anthropogenic breakage suggest that although fragmentation occurred, an important amount of green breakage exists. The different degrees of preservation occurring with the smaller size animals can also relate to the breakage of near to epiphysis portions commonly occurring with human-induced breakage to access marrow that can result in shaft cylinders.

Complete remains (3.2%) comprise mainly 49 teeth (23.4%), 60 carpal and tarsal bones (31.1%), 65 phalanges (33.7%) and 10 metapodia (5.2%). Body parts with greater nutritional value are rarely complete, but this can also relate to density-mediated attrition.

Indicators of thermal modification are present (Tab. 6). Burning damage (2.9%) is more common than other human-related indicators, and is present mainly in taxonomically indeterminate re-

**Fig. 5.** Histogram of the results obtained for the Greatest Lateral length (GLI) of bovine astragalus from the Ota site and other Portuguese and adjacent Spanish sites dated to the Mesolithic (Detry 2007; Valente 2008; 2013); Neolithic (Davis et al. 2018; Almeida et al. 2021b); Chalcolithic (Driesch, Boesneck 1976; Castaños 1997; Rodríguez-Hidalgo, Cabezas 2011; Davis, Mataloto 2012; Moreno-García 2013; Correia 2015; Moreno-García, Sousa 2015; Aleixo 2018; Davis et al. 2018); Iron and Bronze Age sites (Davis 2006; 2017a).



mains, of which we must emphasize WG2 and larger animals. When present in identified remains (n=19), they are mostly in rabbits (n=7) and bovines (n=4). The body parts altered are generally elements from the appendicular (n=93, 54.1%) skeleton or indeterminate (n=68, 39.5%), although some axial bones (n=19, 5.8%) and a scallop shell were also burnt. The degrees are generally low, with degrees 1 (n=5, 2.9%) and 2 (n=91, 52.9%) being prevalent, but degrees 3 (n=32, 25%), 4 (n=27, 15.7%) and 5 (n=6, 3.5%) are also present. Double colourations occur in 14.5% (n=25) of the cases. Possible boiling is almost entirely restricted to indeterminate fragments (n=110, 91.7%), half of which are from 20–100kg animals. The axial skeleton (n=2, 1.7%) has lower frequencies in comparison to the appendicular (n=78, 65%) or indeterminate (n=40, 33.3%), and indeterminate long bones are prevalent (n=68, 56.7%).

Butchering practices are recognizable in the collection (Tab. 7), with cutmarks comprising chop marks

(n=14), incisions (n=116), zigzag marks (n=2) and complete sectioning (n=2) of bones. All main butchering phases are present, including dismemberment, skin removal, evisceration, segmentation of the axial skeleton, disarticulation and filleting. Among anthropogenic breakage, impact points (n=63) are the most abundant type of stigma, followed by cortical extractions (n=24) and impact cones (n=18). Other percussion stigmas (n=28) such as fissures, possible counterblows, pitting, anvil abrasions and adhering flakes, are recorded.

Considering consumption, the majority of remains with taphonomical indicators were associated with carnivore action (n=127, 77.9%), with possible human tooth marks (n=20, 9.8%) being almost entirely circumscribed to leporid remains (n=18), and some considered indeterminate (n=16, 12.3%). Taxonomically identified tooth-marked bones (n=78) are mostly from swine (n=30), leporid (n=25) or caprine (n=12), whilst indeterminate bones (n=71) are

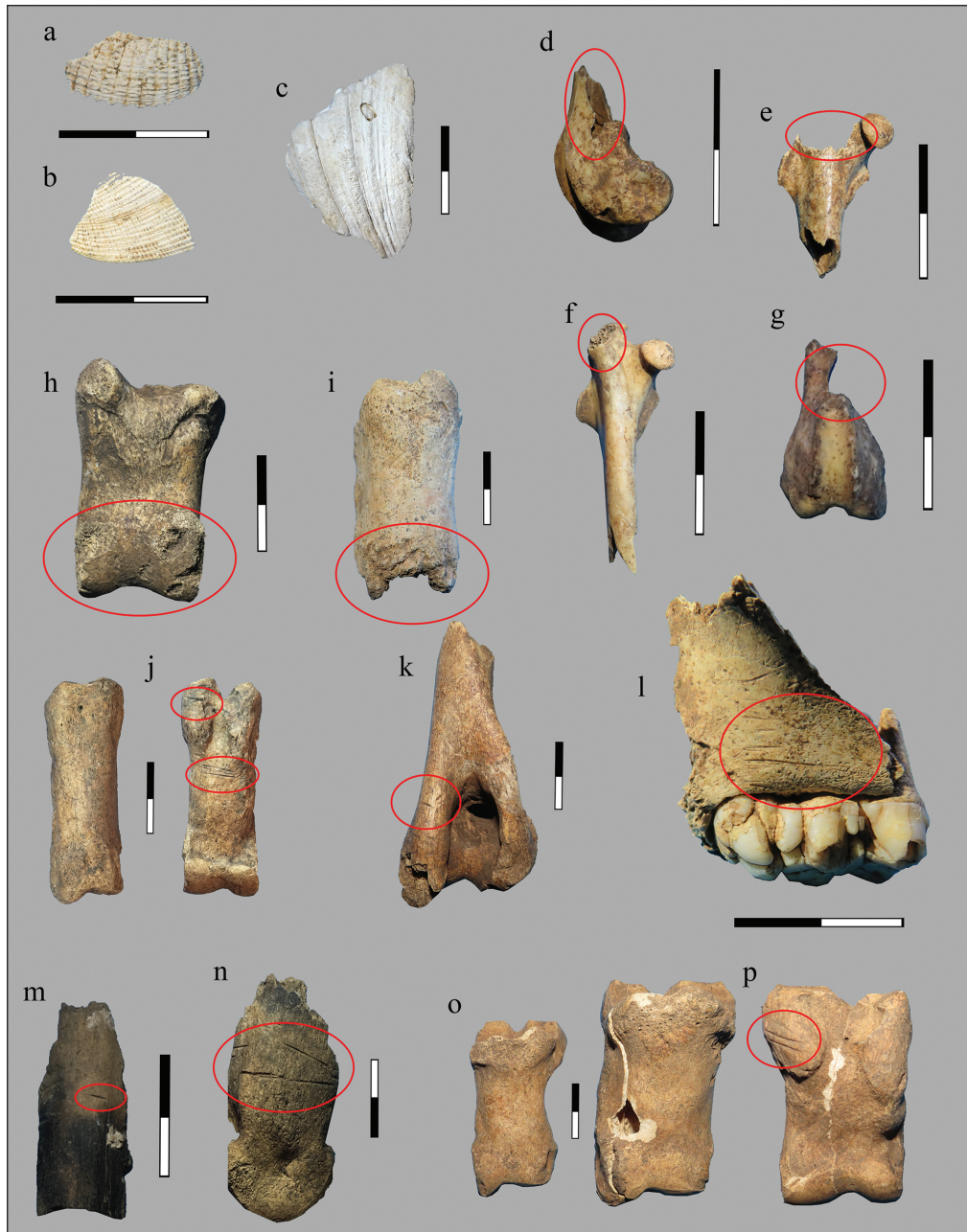
	IN/JU	JU	JU/SU	SU	SU/AD	AD	AD/SE	SE	MNI <sub>su</sub> /MNI <sub>g</sub>
<i>Bos taurus</i>	1–1	0–0	0–0	0–0	9–0	6–2	0–0	0–0	16–3
<i>Bos cf. primigenius</i>	0–0	0–0	1–1	0–0	5–0	0–0	1–1	0–0	7–2
<i>Bos sp.</i>	0–0	0–0	1–0	0–0	0–0	0–0	0–0	0–0	1–0
<i>Capra hircus</i>	0–0	0–0	0–0	0–0	1–0	5–0	1–1	0–0	7–1
<i>Ovis aries</i>	0–0	1–1	0–0	0–0	1–0	6–5	0–0	0–0	8–6
<i>Ovis/Capra</i>	0–0	0–1	2–0	1–0	1–0	2–0	0–0	0–0	6–1
<i>Sus cf. scrofa</i>	0–0	0–0	0–0	0–0	0–0	4–1	0–0	1–1	5–2
<i>Sus cf. domesticus</i>	0–0	3–2	0–0	0–0	3–1	3–2	0–0	0–0	9–5
<i>Sus sp.</i>	2–2	1–0	0–0	0–0	4–4	0–0	0–0	0–0	7–6
<i>Oryctolagus cuniculus</i>	0–0	0–0	0–0	1–1	0–0	27–8	0–0	0–0	28–9

**Tab. 5.** Minimum number of individuals calculated distinguishing between stratigraphic units (MNI<sub>su</sub>) and considering the entire assemblage (MNI<sub>g</sub>). Legend: IN infant, JU juvenile, SU sub-adult, AD adult, SE senile.

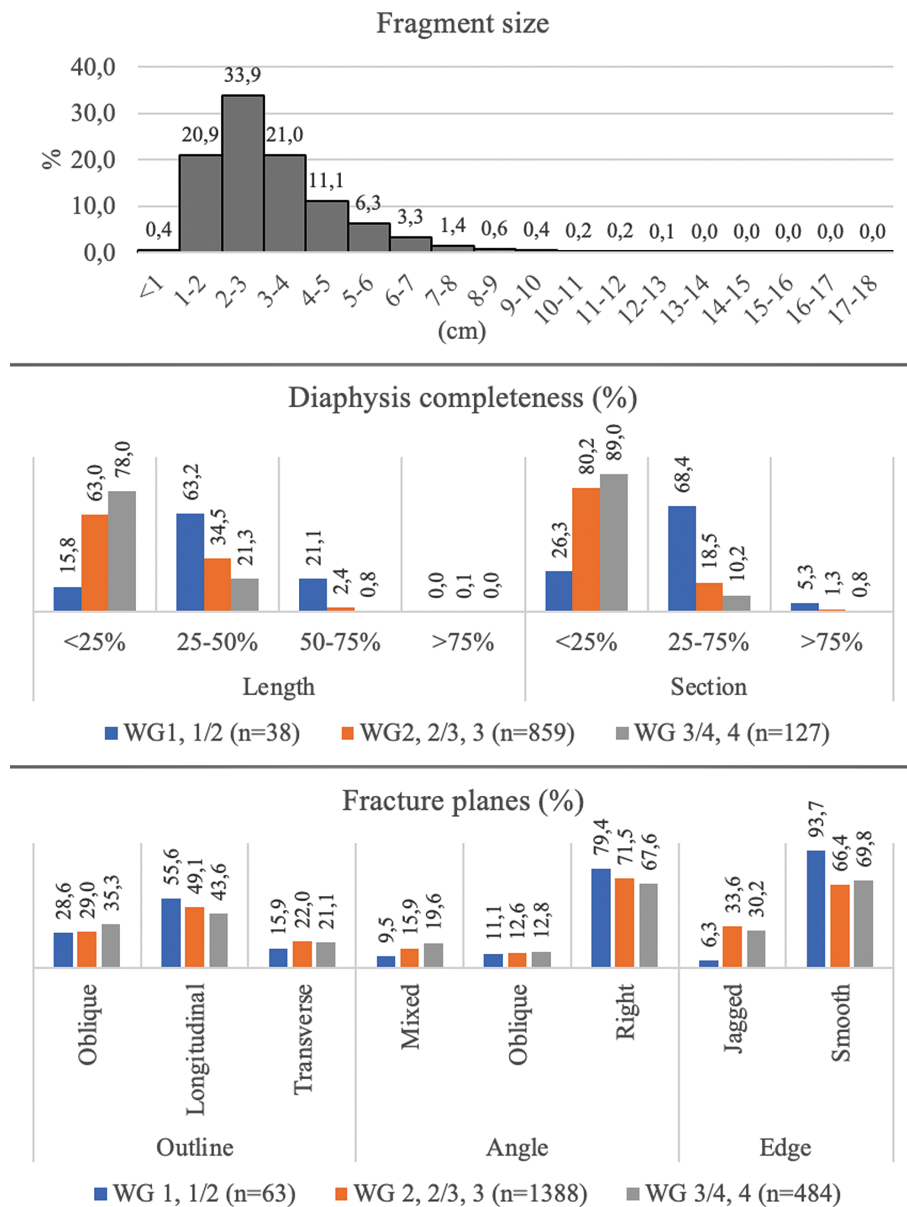
mainly from small (20–100kg) animals, thus very small animals with tooth marks are almost uniquely leporids. Consumption indicators are present in appendicular (n=117, 71.8%) bones, and comparatively less in axial (n=12, 7.4%) or indeterminate bones (n=34, 20.9%). Among indicators of consumption, pits (n=48, 23.6%), punctures (n=46, 22.7%) and furrowing (n=37, 18.2%) are more frequent than crenulated edges (n=24, 11.8%), digestion (n=21,

10.3%), notches (n=18, 8.9%), scores (n=4, 2%), chipped back-edge (n=3, 1.5%), crushing (n=1, 0.5%) and shaft cylinders (n=1, 0.5%). Furrowing is mainly in heavy degrees (n=22, 59.5%) compared to moderate (n=11, 29.7%) and light (n=4, 10.8%) degrees.

The larger number of measurements obtained for pits/punctures are presented in Table 8. Not considering the data from very small animals (WG 1) due



**Fig. 6.** Selection of materials from Ota: a shell fragments from common cockle, b grooved carpet shell and c scallop; d, e, f, g different rabbit long bones with mechanical damage in the form of notches in fracture planes and crenulated edges; h, i bovine proximal phalanges with mechanical damage by carnivores; j caprine proximal phalange; k swine humerus and l maxilla; n bovine distal metapodial and p proximal phalange with cutmarks; m bone fragment with burning damage and cutmarks; o proximal phalange from cattle and p auroch showing large size differences between specimens.



**Fig. 7. Assessment of breakage per weight group in the assemblage considering: a fragment size, b diaphysis completeness, and c fracture planes.**

to sample size, we present a comparison of the remaining results with published experimental and actualistic measurements obtained for wolf, dog, wild boar, pig and humans (Delaney-Rivera et al. 2009; Saladié 2009; Andrés et al. 2012; Saladié et al. 2013). Results for cancellous tissues show similarities with canids, swine and humans, while cortical/thin cortical data is better framed within the variabilities of canids and swine (Fig. 8). We cannot discard the possibility that some smaller and shallow tooth marks could relate to human consumption. At the same time, the absence of the characteristic scores made by swine while feeding suggests that they were not preponderant in the modification of these remains. Canids, probably dogs, seem to fit better

with the taphonomical patterning recorded and the different types of behavioural consumption indicators.

Finally, other indicators are present in the faunal assemblage. Trampling, chemical corrosion and concretions are scarce. The higher frequencies of weathering (10%), manganese oxide precipitation (10%) and vermiculations (10%) are noteworthy (Fig. 9). Weathering occurs mostly in initial degrees 1 and 2, but this together with the identification of degrees 3 and 4 suggests that while the exposition of the remains before sedimentation was small, some remains were subjected to larger exposure or at least some moments of re-exposure. Vermiculations are relat-

able with the provenance of remains from low-depth stratigraphy and/or high bioturbation areas, since these normally occur in the top horizons of the stratigraphy. The presence of manganese oxide in degrees 1 and 2 accompanied by some amount of degree 3 and the little degree 4 can relate to humidity and decomposition of organic matter. Overall, the low incidence of weathering, vermiculations and scarcity of trampling suggests that although the site shows important bioturbation and disturbance of deposits due to previous historical archaeological works, the faunal remains are fairly preserved.

## Discussion

### *The faunal record in the Ota site during the Chalcolithic*

The fauna profile identified so far in the Ota site shows the importance of swine in the economy of these groups during the Chalcolithic. Although it was impossible to further separate the majority of the remains due to the lack of metrical or morphological characteristics, wild boar and pig seem to have been present and, probably, hybrids. The generally small size of measurable and unmeasurable bone and teeth is suggestive of a small input from larger individuals, presumably wild boars. Caprines are also noteworthy in terms of NISP and MNE, with

Indicator	n	%
Cutmark	133	2.2
Anthropogenic breakage	126	2.1
Burning damage	172	2.9
Boiling	120	2.0
Tooth marks, digestion	170	2.8
Rodent marks	3	0.0
Vermiculations	624	10.4
Weathering	592	9.9
Trampling	9	0.1
Concretions	9	0.1
Manganese oxide	624	10.4
Chemical corrosion	5	0.1
Complete remains	193	3.2
Recent breakage	954	15.9

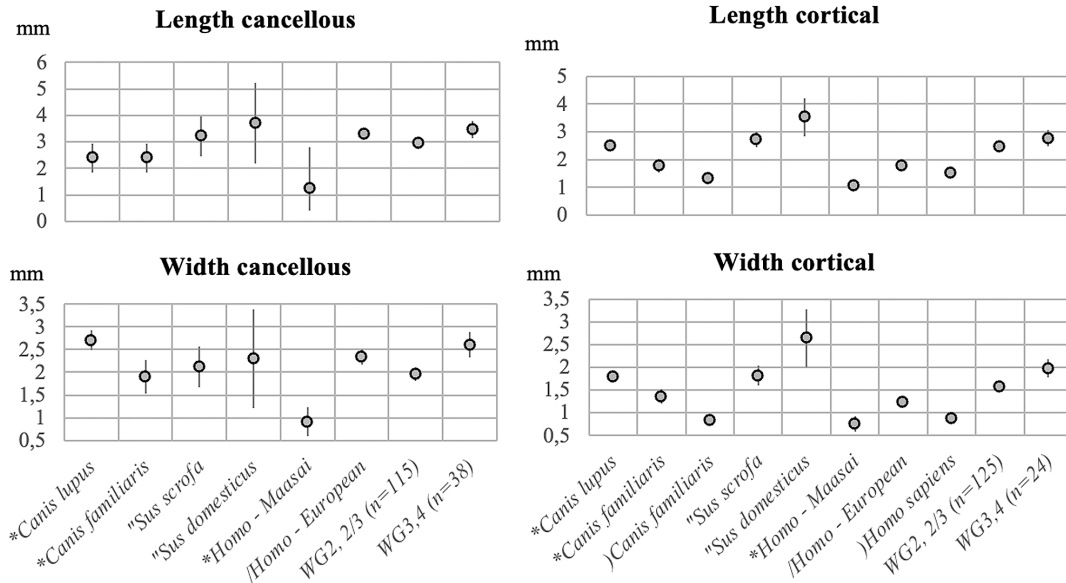
**Tab. 6.** Main taphonomical indicators identified in the Ota faunal assemblage.

both goat and sheep present, and a majority of remains classified as goat/sheep. The triad of domesticated species is completed with the bovine, for which a small number of remains was classified as probable auroch due to their large size. Still, the majority of evidence is from smaller individuals of cattle and other bovines that probably correspond to cattle due to their small size.

Kill-off patterns among the main domesticated taxa show the prevalence of adult individuals indepen-

	Burning		Boiling		Cutmark		Breakage		Tooth mark		Digestion	
	n	%	n	%	n	%	n	%	n	%	n	%
Artiodactyla	0	0.0	0	0	0	0.0	0	0.0	2	2.6	0	0
<i>Bos taurus</i>	1	5.3	0	0	12	17.9	0	0.0	0	0.0	0	0
<i>Bos primigenius</i>	0	0.0	0	0	3	4.5	5	19.2	3	3.8	0	0
<i>Bos sp.</i>	3	15.8	0	0	6	9.0	10	38.5	2	2.6	0	0
<i>Capra hircus</i>	1	5.3	0	0	3	4.5	1	3.8	0	0.0	0	0
<i>Ovis aries</i>	0	0.0	0	0	3	4.5	0	0.0	0	0.0	0	0
<i>Ovis/Capra</i>	1	5.3	1	10	8	11.9	0	0.0	12	15.4	2	20
<i>Cervus elaphus</i>	1	5.3	1	10	7	10.4	3	11.5	4	5.1	0	0
<i>Sus cf. scrofa</i>	0	0.0	0	0	1	1.5	1	3.8	0	0.0	0	0
<i>Sus cf. domesticus</i>	0	0.0	0	0	5	7.5	0	0.0	4	5.1	0	0
<i>Sus sp.</i>	2	10.5	3	30	19	28.4	6	23.1	26	33.3	6	60
Herbivore	2	10.5	0	0	0	0.0	0	0.0	0	0.0	0	0
<i>Oryctolagus cuniculus</i>	7	36.8	4	40	0	0.0	0	0.0	23	29.5	1	10
Leporidae	0	0.0	1	10	0	0.0	0	0.0	2	2.6	1	10
<i>Sub-total identified</i>	19	100	10	100	67	100	26	100	78	100	10	100
Weight group 0 ind.	48	31.4	22	20.0	24	36.4	9	9	12	16.9	6	54.5
WG 1 (<20kg)	2	1.3	0	0.0	0	0.0	0	0	1	1.4	1	9.1
WG 1/2 (<100kg)	7	4.6	8	7.3	1	1.5	1	1	1	1.4	0	0.0
WG 2 (20-100kg)	62	40.5	55	50.0	14	21.2	54	54	37	52.1	4	36.4
WG 2/3 (<300kg)	10	6.5	8	7.3	8	12.1	6	6	8	11.3	0	0.0
WG 3 (100-300kg)	6	3.9	3	2.7	2	3.0	4	4	1	1.4	0	0.0
WG 3/4 (>100kg)	6	3.9	5	4.5	8	12.1	9	9	6	8.5	0	0.0
WG 4 (>300kg)	12	7.8	9	8.2	9	13.6	17	17	5	7.0	0	0.0
<i>Sub-total indeterminate</i>	153	100	110	100	66	100	100	100	71	100	11	52
<b>Total</b>	<b>172</b>		<b>120</b>		<b>133</b>		<b>126</b>		<b>149</b>		<b>21</b>	

**Tab. 7.** Different taphonomical indicators' absolute and relative values per species and weight groups.



**Fig. 8.** Comparison of results (in mm) obtained for the maximum (length) and minimum (width) axis of pits/punctures recorded in the Ota assemblage according to the type of bone tissue. Values presented are the mean and CI 95%. Legend: \*Andrés et al. 2012; “Saladié 2009; /Saladié et al. 2013, )Delaney-Rivera et al. 2009.

dently of the MNI calculated. Considering swine, it is not easy to understand age patterns due to the superimposition of wild and domesticated specimens. All the larger size individuals identified as possible wild boar are adult or senile, with the possible pigs comprising juvenile, sub-adults/adults and adults, and the wild boar/pig adding infant/juvenile individuals. These omnivorous animals were being slaughtered while the meat was tender, but older individuals are also present and they could relate to reproductive purposes. Caprine are represented by different individuals, from juvenile to adult/senile individuals, with a clear higher proportion of adults and even one case of one adult/senile goat. More information is needed to better understand the kill-off

pattern in caprine, but a focus on older individuals is clear. The large majority of the assemblage comes from contexts that were sieved so we do not expect a bias against small teeth (including deciduous teeth). An infant/juvenile cattle individual was identified based on the presence of scarce unfused elements and low ossification bones, but teeth that could allow for a better age estimate were not recovered. The presence of younger bovine can relate to the acquisition of primary and secondary products, since the slaughter of calves can relate to the need to reduce the amount of fodder needed and no further need for milk exploitation, or the use of one calf to stimulate several cows (Vigne, Helmer 2007). The slaughter of older cattle after they started to be

	N	Mean	SD	C.I. +95%	C.I. -95%	Min	Max	95%CI
length WG 1 cortical/thin cortical	2	4.89	0,45	5.50	4.27	4.57	5,20	0.62
length WG 2, 2/3 cortical/thin cortical	125	2.46	0,83	2.61	2.31	1.02	5,29	0.15
length WG 3, 4 cortical/thin cortical	24	2.77	0,74	3.06	2.47	1.67	4,27	0.30
width WG 1 cortical/thin cortical	2	2.59	0,60	3.42	1.75	2.16	3,01	0.83
width WG 2, 2/3 cortical/thin cortical	125	1.58	0,55	1.67	1.48	0.51	3,76	0.10
width WG 3,4 cortical/thin cortical	24	1.98	0,48	2.17	1.79	1.24	3,22	0.19
length WG 1 cancellous	7	2.52	0,86	3.15	1.88	1.64	4,25	0.64
length WG 2, 2/3 cancellous	115	2.95	1,21	3.17	2.73	1.31	7,49	0.22
length WG 3,4 cancellous	38	3.48	1,03	3.80	3.15	1.83	5,64	0.33
width WG 1 cancellous	7	1.89	0,48	2.25	1.53	1.32	2,73	0.36
width WG 2, 2/3 cancellous	115	1.96	0,75	2.10	1.82	0.59	4,83	0.14
width WG 3,4 cancellous	38	2.60	0,91	2.89	2.32	0.83	5,07	0.29

**Tab. 8.** Descriptive statistics for the length and width (in mm) of pits and punctures on cortical/thin cortical and cancellous tissues recorded on identified and indeterminate remains identified to weight group (SD standard deviation, CI confidence interval).

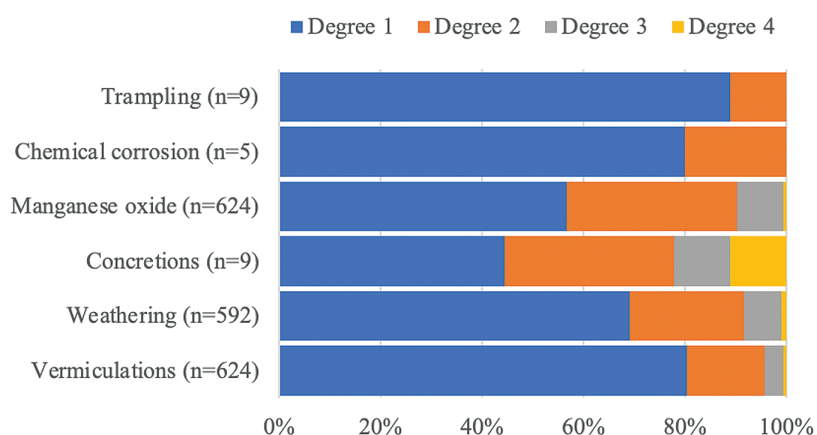


less productive is a common practice, especially if older individuals are not needed for use as traction (*Pérez Ripoll 1999*).

Clear hunting practices are recorded. Besides the smaller amount of red deer adult individuals, leporids, probably only consisting of the European rabbit and almost entirely adult individuals, show important NISP, MNE and MNI results. Other taxa comprise a possible equid bone, carnivores, Aves, amphibia ind. and Anura for which the scarcity of available data hinders further discussion. One must emphasize that sieving was implemented in Structure 3, corresponding to 97% of the total assemblage under study. Finally, some bivalves were recovered; the grooved carpet shell is more frequent, but the common cockle and scallop are present.

The assemblage has several indicators of anthropogenic processing of animal body parts, with cutmarks related to the different stages of butchering and anthropogenic breakage indicators recognizable. Burned and possible boiled remains are present with similar frequencies and can potentially relate to the higher longitudinal outlines and right or mixed angles of the breakage planes in the small to large weight groups. The frequency of double colourations and the larger number of degrees 2 and 3 might result from the culinary practices, more than another type of natural or non-culinary anthropogenic action. Overall, the fragmentation as well as modern breakage that affected the collection is also evident.

Regarding leporids, they have higher preservation of diaphysis in comparison to other species. Nonetheless, complete long bones are absent – only isolated teeth and bones from the extremities are complete, and modern breakage is infrequent (n=9). At the same time, consumption indicators on leporid bones and burning are present. The former comprises notches and punctures in appendicular bones (n=16), and crenulated edges (n=12) in innominate (n=8), scapula (n=1), femur (n=2) and mandible (n=1). Morphologically, the majority of these remains seem to lack the typical characteristics of carnivore gnawing tooth marks, showing similarities with human consumption. One must consider the possibility that other carnivores, such as canids, could have had access to the remains. Wolves, for



**Fig. 9. Other indicators identified in the assemblage and their assessment based on degrees of modification.**

example, are known to completely consume rabbit remains, thus this would result in a large, digested sample (*Lloveras et al. 2020*) but this is not found in the assemblage, and the implementation of sieving certainly diminished recovery bias. The importance of dogs in Late Prehistory contexts is noteworthy, since they probably ate human-abandoned waste, resulting in a different patterning of body parts, besides distinguishable tooth marks and digestion degrees, but data is lacking for better comparison (*Almeida et al. 2022*). Other carnivores, as is the case of foxes (*Sanchis 2000; Lloveras et al. 2012*) and the Iberian-lynx (*Lloveras et al. 2008a; Rodríguez-Hidalgo et al. 2013; 2015*), have slightly different patterns of consumption, but leave tooth marks that can be distinguishable from human chewing. Beak/talon marks created by birds of prey (e.g., *Sanchis 2000; Lloveras et al. 2008b; 2009*) are absent in the collection. Measurable tooth marks on leporid bones were scarce, because pits are less prevalent than crenulated edges and tooth notches. Moreover, a lower breakage of leporid bones compared to that seen with larger animals was observed. The lack of young leporids could relate to the natural dead's *latu senso*, or the lack of anatomical connections that could hint at predation, together with the abovementioned data, lead us to suggest a largely anthropogenic origin for the leporids in the assemblage. Hence, carnivores seem to not have contributed substantially to the faunal accumulation of the Ota site for smaller specimens, but we cannot entirely discard secondary access to them, for example, by dogs. The secondary access and modification of remains are well characterized regarding larger taxa. In these cases, it is not clear if all consumption damage should be related to carnivore action, because some smaller and more shallow tooth marks could be produced during human chew-

ing. While swine do not seem to be of relevance in the consumption due to a lack of diagnostic tooth marks, the morphologies, types and size of tooth marks are consistent with a large canid, also identified in the assemblage.

The presence of molluscs in Iberian Late Prehistory contexts is common and associated with merely economic or an ideological and symbolical dimension of their consumption or the use of shells. Regarding scallops, for example, the circulation of their shells is recurrent even in inland sites, while others, such as the grooved carpet shell, could be consumed or circulated in conditions that would allow their consumption in farther regions (Valera, André 2016/2017). The few bivalves identified do not allow for further considerations, since they were scattered in several stratigraphical units and not related to specific contexts that could further reveal their purpose. On the one hand, they could be consumed and thus represent a small portion of these groups' diet due to their bromatological value, on the other hand, they could be part of the existing interaction and circulation networks where shells are commonly interpreted (e.g., Coelho 2006; 2008; 2013; Soares 2013; Delicado et al. 2017; Valera, André 2016/2017; Almeida et al. 2020a; Almeida, Valera 2021).

### ***The data from a wider perspective***

An important amount of Chalcolithic faunal records is published for central and southern Portugal (Fig. 10). Focusing on Estremadura, it is clear that equids are almost absent from the assemblages and, when recovered, their NISP is <1%. Clear hunting strategies are represented by the presence of cervids, mainly red deer and the occasional roe deer, but besides Columbeira (14%) and Ota (9%), these species have values of <5% in Chibanes, Zambujal, and especially Leceia and Penedo do Lexim. Swine dominate the assemblages of Ota (39%) and Chibanes (48%), showing frequencies similar to caprine in Columbeira and Zambujal. Caprine are even more frequent than swine in Penedo do Lexim and Leceia. In all cases, bovines are proportionally less common than swine and caprine, although the values obtained in the Ota site (24%) are similar to Zambujal (25%) and a bit less to Leceia (20%). The small frequency of equids and cervids is maintained during the end of the Chalcolithic, even if Vila Nova da São Pedro shows 8% of cervids. This site is the only one where bovines have important values (30%), but are still lower than swine, which are prevalent in all these assemblages, even reaching 58% in the Chibanes IC collection. Further results are expected to be

published for VNISP that could allow for a better understanding of this pattern and if it is fully representative of the site.

It is not clear how observed differences in proportions between the larger faunal groups for these sites relate to environmental and archaeological factors and how this change regarding chronology and context. The lack of contextual and fine-grain chronological information, especially for older studied and published collections, hinders the proper discussion and assessment of possible patterns that could help explain these differences.

These results have some disparities from the ones obtained for the Alentejo region with its penneplains that differ from the Estremadura region. The difference between these two regions is currently seen not only in the archaeological records themselves but also in the faunal spectra that have been recovered (Valente, Carvalho 2014; Almeida, Valera 2021). While equids are slightly more abundant than in the Estremadura, cervids have much higher values, reaching 3–12% during ~3000–2400 BCE, with one case of 36% in the S. Pedro site, in Redondo. Later, between ~2400–2000 BCE, the two ditched enclosures of Porto Torrão and Perdigões show that cervids were an important part of these economies with 23% and 29%, respectively. In the Alentejo, swine are the most frequent group in all sites with exception of the Perdigões collection dated to ~3000–2400 BCE from where caprine reaches 39%. Caprine has values similar to bovine in S. Pedro, but the latter is less frequent in Monte da Tumba, Perdigões, Mercador and the older Torrão study by Driesch in Arnaud (1993). During ~2400–2200 BCE, the rise in cervids is accompanied by a similarity in abundance between caprine and bovine, always between 14–19% to both groups, with a prevalence of swine.

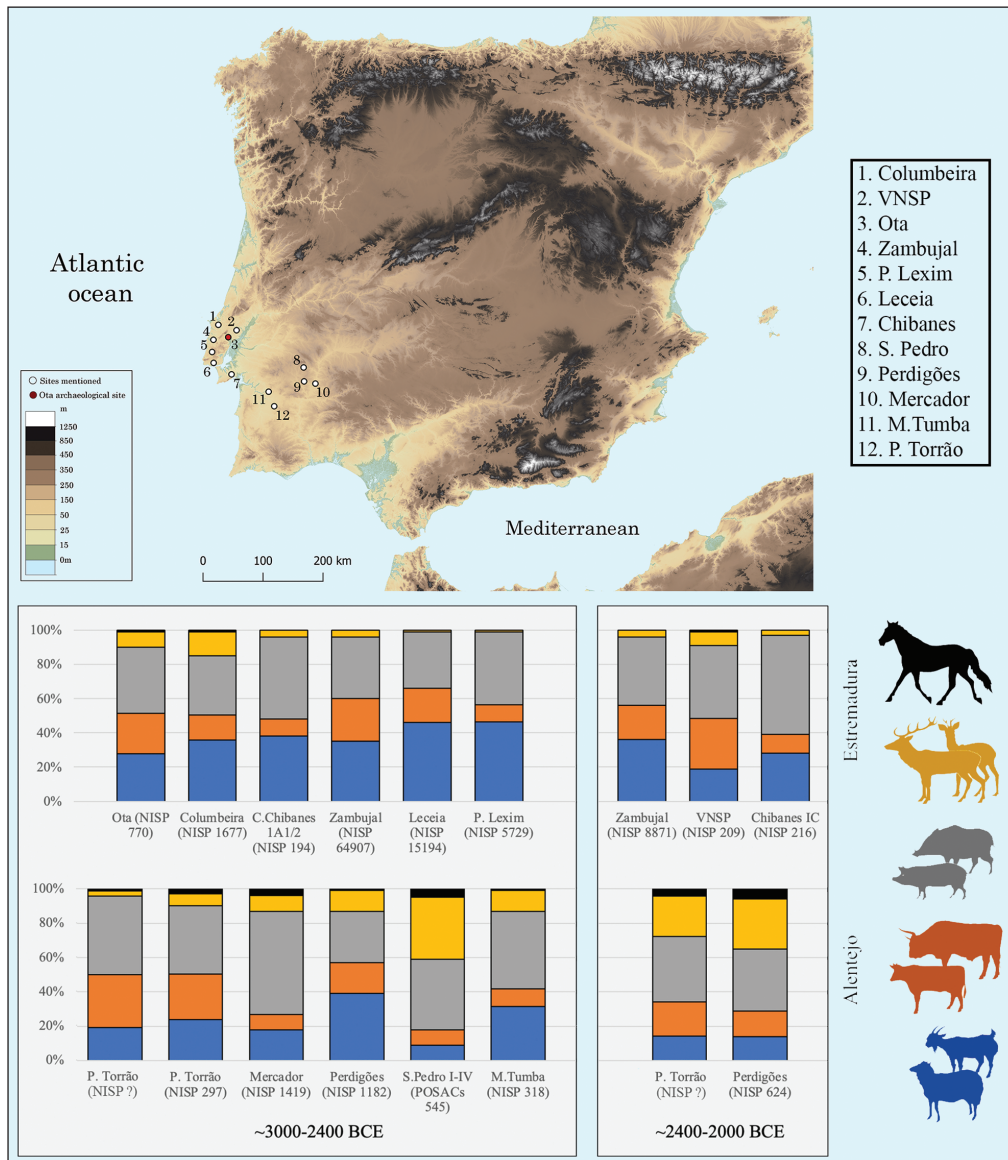
The lower dependency on red deer hunting in the Estremadura compared to the Alentejo might relate to availability and the type of sites. The Estremadura records of larger settlements, more dependent on domesticated animals, could result in a higher anthropization of the surrounding areas leading to less availability of the large wild game. While the archaeological data (type of sites, material culture) can point in this direction, the scarce archaeobotanical data does not allow for further discussion of this hypothesis, a human impact on the landscape was already observable during the Chalcolithic (and previously) in several regions (e.g., Lord et al. 2011).

Equids and mainly cervids are scarce in the Estremadura regional records with higher frequencies in the Alentejo, thus similar to other roughly contemporaneous records from Spanish Extremadura, such as Atalaya (Rodríguez-Hidalgo, Cabezas 2011), Hornachuelos (Castaños 1998), Cerro de la Horca (Castaños 1992), Cerro I (Castaños 1991; 1997) and Cerro II de Los Castillejos (Castaños 1991).

### Conclusions

With its 170m AMSL and an occupational chronology ranging from the Neolithic to the Islamic period,

Ota is exposed to various climatic actions that result in a generalized lack of sedimentation (Texugo et al. *in preparation*). This is a reality shared by its congeners in Extremadura, resulting in a cultural phenomenon – the walled enclosure– that is mainly based on palimpsests, very difficult to disentangle and securely study. These problems were taken into consideration during the excavation campaigns that occurred from 2019 up to 2021 at Ota (Texugo et al. *in preparation*). To reduce their impact and help in the excavation and interpretative process of the identified archaeological units, the taphonomical study of the faunal assemblage of this site was promptly



**Fig. 10.** Map with location of sites mentioned in the text and histogram comparing the %NISP of equids, cervids, swine, bovine, and caprine between the Portuguese Estremadura and Alentejo regions during the Chalcolithic (after Antunes 1987; Arnaud 1993; Davis, Mataloto 2012; Costa 2013; Moreno-García 2013; Correia 2015; Pereira 2016; Pereira et al. 2017; Cardoso et al. 2021; Driesch, Boessneck 1976; Cardoso, Detry 2001/2002; Moreno-García, Sousa 2015; Valera et al. 2020a; Detry et al. 2020; Almeida, Valera 2021). VNSP Vila Nova de São Pedro. PoSACs Parts of the Skeleton Always Counted.

carried out. It allowed us to characterize the consumption patterns of these communities, which included both hunting and local production, and the networks to which they might have been connected, due to the presence of exogenous shells. However, it also allowed us to empirically corroborate the existence of paedogenic processes, to which the anthropic influence, through the intense architectonic reformulations, is added.

Nonetheless, and summing up, it seems that Ota replicates the patterns found in neighbouring regional sites, with a fauna profile highlighting the importance of domestic species, namely swine, goat/sheep and cattle. Hunting practices are complementary, as is suggested by the less common red deer, auroch and possibly wild boar. Of added interest are the leporids, mostly composed of rabbits, that after a taphonomical assessment seems to relate mainly to human consumption, even if occasional indicators of other predators are recorded. As noted earlier, we do not discard access to these remains by carnivores, which is also demonstrated in the larger animal remains. However, this would mainly have been secondary access to human food refuse. The assemblage has several indicators of anthropogenic pro-

cessing, with cutmarks derived from butchering, anthropogenic breakage, and thermal alteration with culinary proposes. The kill-off patterns are suggestive of secondary product exploitation in caprine and bovine, possibly milk, to produce cheese, materialized in the presence of cheese makers in the archaeological record. The analysis of taphonomical indicators of the sedimentary environment reinforced the interpretation based on fieldwork observations concerning stratigraphies, further supported by new absolute dates. This allowed for the presentation and discussion of zooarchaeological information from a current perspective, one still uncommon for this region and period.

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