Animal remains from 17th century Carnide, Lisbon, Portugal

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Excavations undertaken in 2012 by the Centro de Arqueologia de Lisboa (CAL), in Largo do Coreto (Bandstand square) in Carnide (Lisbon, Portugal), uncovered over 7,000 faunal remains. These came from 60 underground pits previously used for storage, especially cereal, and subsequently, between 1550 and 1660 AD, filled with domestic rubbish. Most remains belonged to mammals and birds, with a significant number of molluscs. They are presumably food waste which therefore tell us something about the way of life of the inhabitants of 17th century Carnide. These people clearly depended primarily on domestic animals such as cattle, pig, sheep and goat as well as chicken and goose. Large wild animal remains were strikingly absent though there were some bones of small game like rabbit and partridge. For the rabbit it is unclear if it was the domestic or wild variety. A few remains of ferret and raptors point to their possible uses for hunting. A number of whole skeletons of cats and dogs, with no trace of butchery, were probably deposited as garbage.

Key-words: Zooarchaeology, Carnide-Portugal, 17th century, storage pits

Introduction

The archaeological intervention in Carnide (Lisbon) took place between May 2012 and April 2013 and was supervised by archaeologists of the Lisbon Archaeological Centre (CAL). It took the form of archaeological monitoring of floor removal in order to replace pavements and the excavation of 62 archaeological trenches, responding to a need to open ditches to install infrastructures in the Largo do Coreto and adjacent streets.

The archaeological work recorded the considerable urban transformation that Carnide underwent in the middle of the 19th century - an extensive change of the landscape (Caessa & Mota 2013, Caessa & Mota 2014). Despite this destructive episode, it was possible to identify, in the western area of the Largo, the foundation of a medieval church dedicated to the Holy Spirit and some of the burials that date from the 17th century and continued until the 19th century, made in and around this building, (Garcia, Caessa & Mota in press). Various archaeological features were identified, and 136 storage pits, excavated in the bed rock, were found by Ana Caessa and Nuno Mota (a total of 172 of these structures have so far been identified in Carnide since the 19th century). They seem to correspond to the "covas de pão" (bread/cereal pits) mentioned in the medieval documentation available for Carnide and dated to the end of the 12th century. The complete or partial archaeological excavation of 71 of these silos brought to light a large amount of material culture indicating that throughout the Middle Ages they were used as underground pits to store cereal. Subsequently from the mid-16th to mid-17th century they served as garbage dumps (Caessa & Mota 2013, Caessa & Mota 2014, Caessa & Mota 2016). Of the 71 silos excavated only 60 provided faunal remains.

Our aim here is to describe the faunal remains recovered from these pits, associating them, as far as possible, to what other studies concerning the ceramics can tell us about the consumption of the animals' meat. Most of the remains belonged to domestic animals, as well as molluscs. It is a large collection and therefore provides useful quantitative information about post-medieval Portuguese domestic animals and seafood. The numerous cat and dog skeletons are the largest known so far from this period in Portugal.

The abundance of domestic animals indicates a level of dependence upon these - little difference from other contemporary sites in Portugal (Davis 2009, Detry 2014, Detry & Pimenta 2017).

Carnide and its storage pits

The storage and conservation of cereal in underground structures was quite common in the southern part of the Iberian Peninsula, at least since the middle ages. These structures, regularly used in Portugal, were occasionally abandoned until the late 14th century. However political and economic changes in the country in the mid/late 15th century caused a general abandonment of these structures. Thus, these holes in the ground had to be filled in transforming them into local garbage dumps. In this sense, what we find inside is a good reflection of the domestic rubbish that had been jettisoned and included broken pots, food remains, etc. The Carnide silos, it is thought, were of this kind. Studies of their contents have provided valuable information and tell us something about everyday life and the economy of the people who once lived in Carnide, a village that between the mid-16th to the mid-17th century was located in the rural outskirts of Lisbon. Pottery, glass and metals are, so far, the material remains that have been studied. Ceramic objects are mostly domestic and comprise kitchen and tableware. They include not only local and regional production, but also imports from Spain, Italy, Flanders and Germany. There are also some imported Chinese porcelain fragments (Casimiro, Boavida & Moço 2017). Glass objects (mainly fragments and bottles of different typologies) are similar to the objects found in excavations of contemporary settlements in other European countries. Local Lisbon-made glass vessels were used together with imported commodities from places including Catalonia, Italy and the Netherlands (Boavida & Medici 2018). The set of metal objects essentially reflects a domestic environment (e.g., kitchen utensils, clothing elements or objects used to produce sound) and other activities such as shepherding, typical of a rural settlement (Boavida 2017). Carnide, played an important role in the production of cereal and food to supply Lisbon. However, this was not exclusively an agricultural community. Many important religious houses were located nearby as well as those of the nobility. In this sense it is not possible to determine whether the garbage derived from the noble or peasant strata of society.

Methods

The methods used to record the bones follow Davis (1992). The parts of the skeleton always counted (POSAC's) defined by Davis (1992) give the number of identified specimens (NISP). For the minimum number of individuals (MNI) we chose the highest number of bones divided by the number of times the bone occurred in the skeleton (normally the humerus, tibia or metacarpal).

Caprine bones are generally difficult to identify to species (i.e., sheep or goat). However certain bones can be reasonably easily separated. These include the humerus, metapodials, calcaneum and astragalus (see the morphological criteria described by Boessneck (1969), Zeder & Pilar (2010), Zeder & Lapham (2010) and the metrical methods described by Payne (1969) and Davis (2016).

For molluscs, we counted the diagnostic zones described by Watson (1979). Thus, for gastropods these were the opening of the shell or for limpets the apex. And for bivalves the part counted was the hinge, which can be more reliably identified to species. Marine molluscs were identified using the manuals of Macedo (1996) and Saldanha (2003), and for terrestrial gastropods we used Matos (2014).

To record age-at-death the state fusion of long-bone epiphyses was recorded and for teeth the wear stage was recorded following Payne (1987) for caprines and Grant (1982) for pigs and cattle.

Measurements were taken following Driesch (1976), some as defined by this author, and Davis (1996) for humerus HTC (minimum diameter of the trochlea) and BT (breadth of the trochlea) and bovid metapodials.

Results and Discussion

Some 7000 bones and shells were recorded. These include remains of 4074 mammal, 631 bird, 1959 bivalves, 349 gastropods, as well as 5 cephalopods, 11 crustaceans, 4 amphibians and 1 testudine (see Table 1). Fish remains were also present and include the gilt-head bream (*Sparus aurata*), the European bass (*Dicentrarchus labrax)* and the European conger (*Conger conger*). The fish remains await detailed study. Given their considerably greater body size, mammals clearly provided the inhabitants of Carnide with the bulk of their animal protein.

Molluscs

In terms of absolute numbers, molluscs, especially bivalves, dominate the Carnide fauna (Table 2).

Gastropods are mostly represented by three taxa: the common periwinckle (*Littorina littorea*), the limpet (*Patella* sp.) and the lined top shell (*Phorcus lineatus*), all typical inhabitants of rocky seashores (Sterry & Cleave 2012, Macedo 1996). Since these kinds of resources cannot be transported great distances without spoiling, they probably came from the shores around Estoril and Cascais, a few kilometres away from Carnide. Other much rarer gastropods are the top shell (*Steromphala umbilicalis*), the cowrie (*Trivia* sp.) and the red-mouthed rock shell (*Stramonita haemastoma*) that probably came from the same kind of rocky shores (Sterry & Cleave 2012, Macedo 1996). Other molluscs like the auger shell (*Turritella* sp.) and netted dog whelk (*Tritia reticulata*), are more typical of sandy bottoms probably also present in the same beaches (Sterry & Cleave 2012, Macedo 1996). Two curious large shells included in the Carnide fauna belong to the Algarve volute (*Cimbium olla*). They may have been collected for aesthetic reasons and not as food source. This species appears in sandy bottoms and is present on the Iberian Atlantic coast (Macedo 1996).

A particularly interesting mollusc present in the Carnide silos is the money cowry (*Monetaria moneta)* – a species that never existed on the Atlantic coast, but which is common in Pacific and Indian oceans. Its name derives from its use as currency (Tiley & Buger 2002).

The Helicid, *Cornu aspersum*, a large land snail, with a globular shell is very common in Portugal and is still eaten today. This species lives in humid places under stones or vegetation in calcareous regions (Matos 2014). These animals although relatively numerous (a total of 27 shells) appeared scattered among the silos, indicating that they are probably intrusive and not part of the original diet of the inhabitants of Carnide. Only three shells of a smaller land snail were found, they are similar to the genus *Candidula* (family Hygromiidae), also a common taxon in Portugal (Matos 2014). Terrestrial gastropods are usually intrusive in archaeological contexts since they like humid and organic rich environments such as pits filled with garbage.

The most common species of bivalve is the common cockle (*Cerastoderma edule*) which comprised 30% of the invertebrate remains (Table 2). This inhabitant of sandy bottoms can endure low salinity (20-25 ‰) and nowadays is typically found in estuaries such that of the Tagus in the Alcochete region (Verdelhos *et al.* 2015, Rodrigues *et al.* 2006). The second most common bivalve is the grooved carpet shell (*Ruditapes decussatus*) a species still commonly eaten today, although replaced in present-day Lisbon by an invasive oriental but similar species – *R. philippinarium* (López Garaulet 2011). The autochthonous species of carpet shell (*R. decussatus*) is present in sub-littoral sandy environments (Sterry & Cleave 2012).

Almost 400 shells of the edible mussel (*Mytilus edulis*) were counted. This is a species that also endures brackish water but needs a fixed substrate, such as rocks, and occurs on rocky beaches, like the aforementioned gastropods (Sterry & Cleave 2012, Macedo 1996).

The family Ostreidae is a particularly interesting group. Most of the shells (c. 200), belong to the autochthonous species *Ostrea edulis*, an oyster with a rounded shell. A few shells (six) may have belonged to *Crassostrea angulata* and eight could only be identified to family level. The shells of these species are longer and are not striated in the hinge area of the shell indicating that they may have belonged to *C. angulata*. Mitochondrial and nuclear DNA analysis have shown that the Portuguese oyster was probably introduced to Europe from Asia in historical times and is closely related to *C. gigas*, a very common species in Japan (Foighil *et al.* 1998, Huvet *et al.* 2000). The presence of Chinese ceramics in Carnide (Casimiro, Boavida & Moço 2017) shows how commercial exchanges from the orient could explain the presence of this exotic mollusc. Are these specimens the first representatives of this species in Europe? Were 17th century Portuguese vessels responsible or did they arrive subsequently attached to ships? In other archaeological sites in the Lisbon area we have not found *C. angulata* in the Iron Age (Detry et al. 2016) and in the 13th and 15th centuries in Vila Franca de Xira (Detry & Pimenta 2017) indicating that this taxon probably arrived here after the 16th century.

The last of the most frequent species is the peppery furrow shell (*Scrobicularia plana*) a species that lives in muddy sediments and tolerates low levels of salinity in the far interior of estuaries.

Mimachlamys varia is one of the taxa present with 16 shells. It has a small shell - around 50mm, needs a fixed substrate and lives as deep as 400 m in the sea (Macedo, 1996). Three shells of *Acanthocardia* sp., and eight of *Pecten maximus* were recorded. Both are marine sandy coast species, and both have beautiful strong shells that can have other uses besides consumption.

Only nine elements belonging to *Mactra stultorum* and seven of *Venus verrucosa* (warty venus) were found. Both species prefer sand at depths no greater than 100 m (Macedo, 1996).

Anomia ephippium with only four exemplars also appears in tidal areas and needs rocky substrates to fix its shell.

The most common bivalves in this assemblage were all edible species, still very popular today in Portugal. According to contemporary cookery books the common cockle, grooved carpet shell, oyster and mussel were all commonly eaten during the 16th and 17th centuries (Casimiro, Boavida & Detry 2017).

The molluscs found in Carnide came from sandy beaches with rocks. Another group came from other areas such as the estuaries. Since Lisbon is located on the Tagus estuary and near the beaches of Cascais and Estoril with their rocky shores, it is possible that these resources could come from all of these localities.

Other invertebrates

A few other species of invertebrates, namely cephalopods and arthropods, were also found in this assemblage. Five fragments of the internal shell of the common cuttlefish (*Sepia officinalis*) were found. The internal shell of cuttlefish is very fragile, so they are rare in archaeological assemblages. In Carnide a few fragments were registered confirming its capture and consumption although no recipes for these animals were found in contemporary cookery books (Casimiro, Boavida & Detry 2017). This species inhabits the infralittoral - 200 m depth but can be caught closer to shore (Neves *et al.* 2009) - is commonly eaten today by Portuguese people.

Crustaceans are represented by only three elements attributed to *Carcinus maenas* (the green crab, a species present in estuaries) and another seven elements from *Maja squinado* (European spider crab). Both are common on the Portuguese coast and are still economically very important. These may have come from local markets and from nearby habitats. The old cookery books confirm the consumption of European spider crab (Casimiro, Boavida & Detry 2017).

The Balanidae are sessile crustaceans that attach themselves to rocks located in the mediolittoral and infralittoral. More than 35 shells were found, sometimes attached to the shells of other invertebrates. Although this species is usually consumed, most of the shells were very small indicating that they may have been introduced attached to other animals.

Amphibians and Testudines

Amphibians are scarce and most probably intrusive. They can easily become integrated in humid sediments like silos where they may hibernate and eventually die. Only one tibia of *Bufo bufo*, the common toad, was found. This species occurs throughout Portugal (Loureiro *et al.* 2008). Therefore, its presence in this assemblage is not surprising. A pelvis, femur and one tarsal bone of frog were also found. Since *Rana iberica* is not present in the Portuguese Estremadura region and is more common north of the Tagus River and in higher altitudes, it is more probable that these bones belong to *Rana perezi*, the Iberian water frog, common throughout the Iberian Peninsula (Loureiro *et al.* 2008).

Chelonians were also present, but only represented by a single fragment of the top plates/plastron. The fragment belongs to *Mauremys leprosa*, the Spanish pond turtle, an animal very dependent upon water sources. The reason for its presence in this assemblage is difficult to understand. Since no cutmarks or fire marks were observed, it may have belonged to a pet. Casimiro, Boavida & Detry (2017) refer to turtle soup and broth recipes, popular at that time, especially for sick people, indicating the possibility that this specimen was consumed.

Mammals

Mammals comprise more than half of the identified specimens (NISP = 58%) but only 12% when the minimum number of individuals (MNI) is considered. The MNI reverses the proportions as molluscs constitute 82% of the MNI sample and very little usable biomass. This is because each individual mollusc represented consists of only one or two shells and provides a very small quantity of meat compared to mammals. Each mammal comprises over 200 bones and represents a much larger amount of meat. Hence mammals constituted a very important part of the diet of the inhabitants of Carnide.

Approximately 87% of the mammals in Carnide belonged to the four domestic species most commonly exploited by humans in Europe since the Neolithic: cattle (*Bos taurus*), sheep (*Ovis aries*), goat (*Capra hircus*) and pig (*Sus domesticus*) (Table 3). The other 11% belong to animals that are generally considered as pets and not usually consumed, such as the cat (*Felis catus*) and dog (*Canis familiaris*). The remaining bones belong to equids, lagomorphs and rodents and two interesting bones of European polecat (*Mustela putorius*). Lagomorphs are the only hunted mammals in the Carnide assemblage, although some of the rabbits could have been domestic. The distribution of the seven most common species in the Carnide silos (Fig. 2) shows that the animals that were consumed appear in almost every pit, while the cats and dogs appear concentrated in a few areas. The silos with more cattle and caprines (silos nr. 24-XVI, 28-VII and 18-VIII) contained no cat remains and very few dogs. The silo with more dog bones (24-XII) had no birds and very few cattle, sheep, goat or pig. It is interesting that the contexts with more cats (29-IX and 24-XXII) had few or no dogs.

Cattle (*Bos taurus*)

The wild ancestor of cattle, the aurochs, has probably been extinct in Iberia since the Bronze or Iron Age (Castaños 1991, Cardoso 2002). Therefore, it is assumed that all remains of *Bos* at Carnide belonged to the domestic form – *B. taurus*.

In terms of numbers, cattle are second in the Carnide silos, indicating their economic importance in the 16th/17th century, although given the method of collection and urgent nature of the excavation, frequencies of different-sized taxa need to be viewed with caution. This effect might explain why bones such as metapodials, scapulae and humeri are so abundant (Fig. 3). Cattle were certainly consumed but also used for their power to transport goods and people and no doubt for ploughing. Evidence for their use for power is indicated by pathological deformations on some of the metapodials as well as their pattern of age-at-death (see below). A little more than a third of the cattle remains are teeth. This is hardly surprising given that teeth are more resistant to erosion than bones. Of the 403 teeth studied, only 14 were deciduous indicating the scarcity of very young animals.

We identified almost 100 metacarpals but only 70 metatarsals, around 50 scapulas, humerus and tibias, other long bones would be no more than 25 each. Metapodials are large and very dense, so post-mortem decay may, at least in part, be an important factor accounting for these very different numbers. Metapodials often serve as raw material in the production of utensils, since they have long robust circular or semi-circular (in cross section) diaphysis. Some had served as anvils for the production of the serrations on scythes (Aguirre *et al.* 2004, Moreno-García *et al.* 2005). The measurements taken on these bones (Appendix) show that the cattle at Carnide were more robust than those from earlier times, which corroborates previous findings (Davis 2008). The adult metacarpals from 17th century Carnide were of similar shape and size as the ones from 15th century Beja but were slightly larger and more robust than Iron Age to Moslem period Portuguese cattle (Davis *et al.* 2018, Davis *et al.* 2012). It could also be shown that there were more adult males than adult females. Davis et al. (2018) suggested that they could have belonged to fighting bulls or maybe males were more useful to carry heavy agricultural machinery and cereals. The same authors developed an osteometrical method to sex cattle metacarpals (Davis *et al.* 2012). These bones were also used to create a metrical baseline for comparing cattle metacarpals from other sites and periods in the Iberian Peninsula. For more details see Davis *et al.* (2018).

Sheep (*Ovis aries)* and Goat *Capra hircus*)

These two small bovids are the most common at Carnide in terms of number of identified specimens (NISP) and minimum number of individuals (MNI). In this respect Carnide is little different from other sites from the Neolithic onwards in southern Portugal (Davis & Mataloto 2012, Valente & Carvalho 2014, Detry & Arruda 2013, Detry *et al.* 2014, Detry & Pimenta 2017). Contemporary cookery books indicate that these species were also the most common in recipes in Post-Medieval Portugal (Casimiro, Boavida & Detry 2017).

Figure 4 is a plot of two indexes of measurements of sheep and goat astragali that may partially or completely separate sheep from goat (Davis 2016). In this figure, the astragali were first identified to species based on their morphological characters and subsequently their measurements were plotted. One astragalus identified as goat had measurements indicating sheep, showing there are some exceptions to this osteometric distinction. Davis (2016) also finds some wild and feral goats with measurements more similar to sheep. Something similar may be the case here at Carnide.

For those parts of the skeleton that could be identified to species sheep were clearly more common than goat by a factor of around two. The predominance of sheep over goat seems to be the rule in more humid regions of southern Portugal with goats being better adapted to arid areas.

The parts of the skeleton that are present in this assemblage (Fig. 3 and Table 4) indicate a probable preference for bones with more meat surrounding them. Teeth are the most common in this profile probably because they preserve better. If we observe the number of fused bones and the high level of wear of the teeth and low number of deciduous teeth we can conclude that most of these sheep and goats were older and had been exploited for their so-called secondary products such as milk or wool. Since sheep are twice as common as goats it is likely that wool was much esteemed. The age profiles obtained via the fusion of long bones are similar to those observed in the contemporary assemblage at Santa Clara-a-Velha in Coimbra (Detry *et al.* 2014).

Suids (*Sus* sp.)

We recorded 680 fragments of suids 75% of which are teeth. This probably reflects the considerable robustness of pig teeth as well as pig cranial bones. Remains of wild boar and its domestic relative, the pig, are difficult to distinguish. Generally, bones and teeth of wild boar are larger than those of the pig, but there is a substantial amount of overlap of their measurements, especially in the Iberian Peninsula where the wild boar is relatively small (Albarella *et al.* 2005). Figure 5 shows the measurements of lower third molar teeth of *Sus* from Carnide. Note they tend to be small and more similar in shape to those of the domestic form. Moreover, none of the bone measurements were compatible with those of the larger wild boar. The fact that no big game hunting of animals like red deer was undertaken by the inhabitants of Carnide makes it seem unlikely that wild boar was hunted. It is therefore likely that all the *Sus* remains belonged to pig. Their remains derive from various parts of the carcass and most of their long bones have unfused epiphyses. Unlike sheep, goats and cattle, secondary products of the pig are not exploited by man. The pig is raised primarily for its meat and fat – and so is generally slaughtered young before many of its long-bone epiphyses fuse.

Equids (*Equus* sp.)

Equids are represented by 22 identified remains. Among these, 10 could only be identified as equid; most bones and teeth of horse (*Equus caballus*) and donkey (*E. asinus*) are very similar and difficult to identify to species. However, a metacarpal and a mandible with five teeth could be identified as donkey (the internal enamel fold of the teeth form are 'V' shaped, see Fig. 6). The horse is represented by a metacarpal, a metatarsal and two distal metapodials. It is probable that both species played an important role transporting people and goods. The unidentified equid bones include a pelvis, radius and humerus. None of the remains have cut marks. Hippophagy was and still is uncommon so that equid bones, unlike those of animals like sheep, pig and cow, are scarce on archaeological sites.

Lagomorphs

Lagomorph bones are scarce in the Carnide silos. This could well reflect the problem of recovery rather than any dietary avoidance. The lagomorph bones identified include eight long bones of hare (*Lepus* sp.) and four long bones and two mandibles of rabbit (*Oryctolagus cuniculus*). The rabbit was probably domesticated in Medieval times (Callou 2003) or even earlier so we cannot be sure if they belonged to the wild or domesticated form of this animal.

Dogs (*Canis lupus familiaris*) and Cats (*Felis catus*)

A large number of skeletons of dogs and cats was found inside the Carnide silos. Most are well preserved, and the bones of each animal appeared in connection and with most parts of the skeleton represented. This indicates that they were deposited in the silos as complete carcasses. The smaller bones however are underrepresented, so most of the skeletons are represented mainly by large bones. The absence of cut and burn marks, as well as the relatively complete state of the skeletons indicates that these animals were not consumed.

The silos do not appear to have served as graves and these cat and dog skeletons were found among other animal bones that were clearly domestic refuse and suggests these animals were not a part of a ritual. The fact that dogs were of medium size, being around 45cm high at the shoulder, indicates that they had not undergone controlled breeding or artificial selection. Normally as a result of human selection, dogs display a wide variety of shapes and sizes (i.e., morphotypes or breeds).

In relation to cats, measurements of the lower first molar tooth compared with measurements of both wild and domestic cats (as in Davis et al. 2008) indicate that the Carnide cats were small and therefore domestic (Fig. 7).

The 275 and 202 bones of canids and felids, respectively, belonged to at least 25 dogs and 28 cats. The complete skeletons provided some information about their ages at death. Given their epiphysial fusion and dental eruption states, nine dogs were juvenile (under six months), the other 16 were adults, and of those, one was probably some eight months and another 12 months old at death. Knowing how normally juveniles are underrepresented because of the fragility of their bones, it seems that juvenile dogs are quite frequent. Of the cats however, only five were under six months old and 18 older, but of these as many as nine are between six and 12 months; i.e., the majority of the cats died before attaining one year, perhaps indicating that this pet was even less cared for than the dogs.

They were probably stray cats. None of the cat or dog remains proved to be from older animals.

Rodents (*Rattus* sp.)

Four bones identified as *Rattus rattus* (black rat) were found in two different silos: one femur and one humerus in stratigraphic unit [2491] and one femur and one tibia in stratigraphic unit [2467]. Another three bones of its close relative, *Rattus norvegicus* (brown rat) were also found in Carnide but in different silos, one pelvis and one femur in stratigraphic unit [4313] (Fig. 8) and a small metatarsal from a different silo [2419]. The animals were most probably intrusive since they feed on human garbage and make burrows, probably using the silos to eat and hide. Black rats are supposed to have been introduced into Europe in Roman times (Audoin-Rouzeau & Vigne 1994) and the brown rat probably in medieval times, therefore it is not surprising to find them in 16th and 17th century Carnide.

European polecat (*Mustela putorius*)

Two bones of a small mustelid, a humerus and a pelvis, probably from the same individual, were also found (Fig. 9). This is the only occurrence of this species in the whole assemblage. It was not possible to determine if they belonged to a wild (*Mustela putorius*) or domestic (*M. putorius furo*). This species can be tamed and is used to control rats or help hunting rabbits since they can easily fit into their small burrows. In the wild they are still welcome since they prey upon small rodent pests and their fur was also exploited (Thompson 1951, Vinke & Schoemaker 2012).

The origin of this particular animal in Carnide is difficult to ascertain, although appearing in this domestic context, it could have been a tamed animal used in hunting, rodent control or simply amusement.

Dolphin (*Delphinus delphis*)

One vertebra of a small cetacean (Fig. 10), probably a dolphin (cf. *Delphinus delphis*) was found in one of the silos, curiously the same silo where the polecat was found. The consumption of dolphin is attested in medieval and modern layers of the Castelo de Palmela, south of Lisbon and contemporary to Carnide (Fernandes *et al.* 2012), with the presence of vertebrae with cutmarks. In 15th century Beja, a vertebra of a small cetacean was found inside the silos of the Avenida Miguel Fernandes, also with no cutmarks (Moreno-García, personal communication). In Medieval England dolphin was a much-appreciated delicacy (Albarella & Davis 1996). The presence of dolphin in archaeological sites can also be found in the Pleistocene levels of Figueira Brava (Sesimbra) (Antunes 2000).

The Carnide dolphin bone has no cut marks but it is possible these animals were consumed, since it was appreciated in Portugal until not long ago.

Birds

More than half the bird remains belonged to chicken (Table 3) and no other domestic Galliformes were identified. Another 28% of the remains belonged to goose (*Anser* sp.), most probably the domesticated form. The rest of the birds were wild and appeared in very small numbers.
At contemporary Mosteiro de Santa Clara-a-Velha (Coimbra) and in Vila Franca de Xira (near Lisbon), the same species were preferred (Moreno-García & Detry 2010, Detry & Pimenta 2017).

Among the wild birds, two bones of red partridge (*Alectoris rufa*), a commonly hunted bird in Mediterranean habitats, were found. Other species such as pigeon (*Columba* sp.), owl (*Athene noctua*), common buzzard (*Buteo buteo*) and falcon (*Falco* sp.) are represented by very few bones. These probably bear witness to occasional additions, maybe of dead animals that occupied nearby abandoned constructions or that were living around the area and hunted. Birds of prey do eat rats which would have been common in a human environment especially in an area where food refuse and other types of garbage were found.

Six bones of the Eurasian stone curlew (*Burhinus oedicnemus)* were found. They belonged to at least two individuals. This species is not easy to hunt and has a rather low food value. Recipes for partridge, pigeon and chicken were common in 16th century cookery books, as well as the recipes for turkey too (Casimiro, Boavida & Detry 2017). This last galliform, of American origin, was brought to Europe in the early 16th century and interestingly is not present in Carnide but was found at 17th century Mosteiro de Santa Clara-a-Velha (Moreno-Garcia & Detry 2010).

Age at death

The age at death of animals can provide useful information concerning their management. Animals tend to be slaughtered at younger ages if they are reared primarily for their meat and at older ages if they are reared more for their secondary products such as milk, wool and traction power.
For cattle, the percentage of unfused bones (table 4) is very low. In other words, few young animals are represented. The scarcity of very young cattle makes it unlikely that cows were exploited exclusively for their milk. The distribution of wear stages of the cattle teeth (Fig. 11) shows two or even three peaks. One represents the young adults and a large one of older adults, and even a smaller peak of very old animals. This pattern may represent the slaughter of some young adults for consumption and the majority of the animals were slaughtered when old or very old; i.e., retired from other functions – perhaps in the case of cattle – they were used for traction. Several metapodials displayed pathological alterations probably due to excess stress in life like carrying heavy weights (Davis *et al.* 2018). Carnide was surrounded by fields that were certainly cultivated and it was also a central trading point supporting the hypothesis that cattle would be have been used for these activities (Caessa & Mota 2016).

Figure 12 shows the distribution of caprine mandibular tooth wear stages. The peak seems to be around three to six years old. A smaller peak of younger animals (one to three years) indicates, as for the cattle, that some animals were slaughtered for consumption, but the majority was kept to older ages during which time they could have provided milk and wool. The fact that we have more sheep may indicate the production of wool.

Pigs on the contrary show a peak for the very young (Fig. 14) with a gradual decline in the dental wear stages of older teeth. Since the pig is an animal kept for its slaughter products (meat and fat), it is general practice to slaughter pigs when still young, keeping only a few animals for breeding purposes.

Taphonomy

It is assumed that the animal remains that are described here are mainly the leftovers of meals and carcass processing. First, all parts of the skeleton, including those with less meat appear to be present. It is possible that the carcasses would have been prepared nearby and deposited in the same place as leftovers of domestic consumption. Butchering animals, removing the meat from the bones, cooking and eating could in fact be made in close spaces, especially in a rural environment such as Carnide where, unlike urban centres, people could deal with all the processing of animal consumption.

While cut and burn marks (table 5) are rare, there is abundant evidence for chop marks, made by coarser instruments like a cleaver. This kind of use seems more prevalent than slender cutmarks to remove meat. It is probable that carcasses were divided into smaller pieces and then cooked, since cooked meat would be very easy to detach from bones. Some bones show evidence of gnawing, probably by dogs. This is hardly surprising given the abundance dog remains in the Carnide faunal assemblage. The percentage of gnawed bones seems higher for pig, while it is strange that pig bones appear to carry fewer cut marks than the other species. Perhaps the pigs were processed or cooked differently.

Conclusion

The large number of faunal remains found in the Carnide silos is unique for this period and provides a new insight into the day-to-day life of this 16th/17th century community. The great quantity of cattle metacarpals allowed Davis *et al.* (2018) to confirm the osteometric method for identifying the sex of the cattle (Davis *et al.* 2012). It also corroborates previous findings of a size increase of cattle after the 15th century in Portugal (Davis 2008, Davis *et al.* 2012, Davis *et al.* 2013, Davis *et al.* 2018). Clearly the human population of Carnide, depended mainly upon domesticated species for meat supply and only to a very small extent on venison. They did however consume a fair amount of marine resources such as molluscs and fish. Contemporary cookery books confirm the consumption of most of the species found on this site (Casimiro, Boavida & Detry 2017).

As evidenced in other early modern sites such as the Palmela Castle, the consumption of dolphin was probably common at that time. The presence of ferret represents a first occurrence in Portugal. The absence of any cutmarks in the bones of this animal does not allow to conclude if it was used as a food resource or a pet. The Carnide faunal assemblage also includes the largest collection of cat and dog remains from this period in Portugal , most likely stray animals that would share the streets. As mentioned, the storage pits with more cattle and caprine bones has fewer dogs and cats, indicating that these were not domestic garbage and possibly did not share the household with people.

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FIGURES:

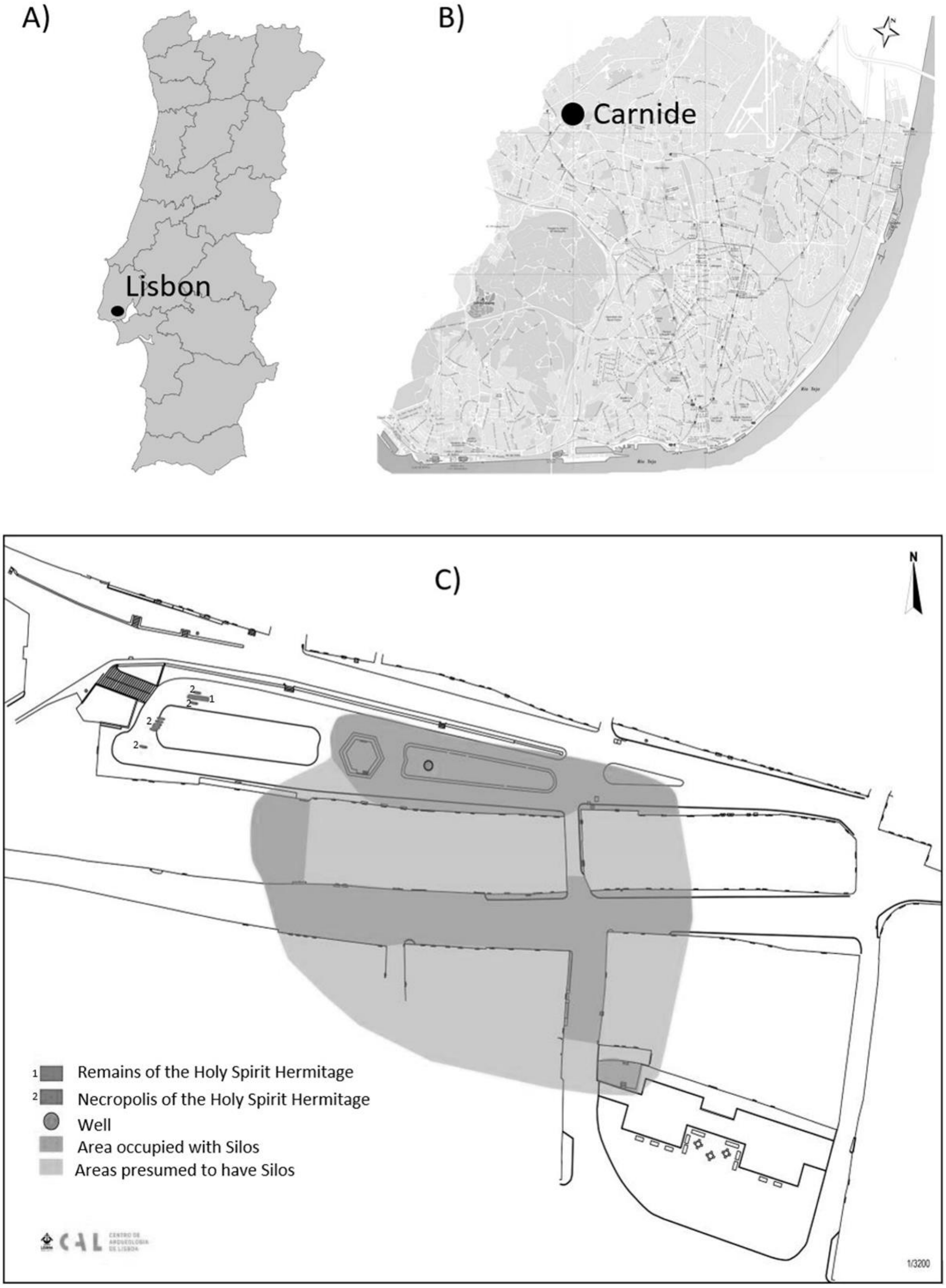

Figure 1 – Location of the site. A) Map of Portugal with the location of the Lisbon city council; B) Map of Lisbon showing the location of the archaeological site at Carnide. C) Map of the area excavated in the old part of Carnide.

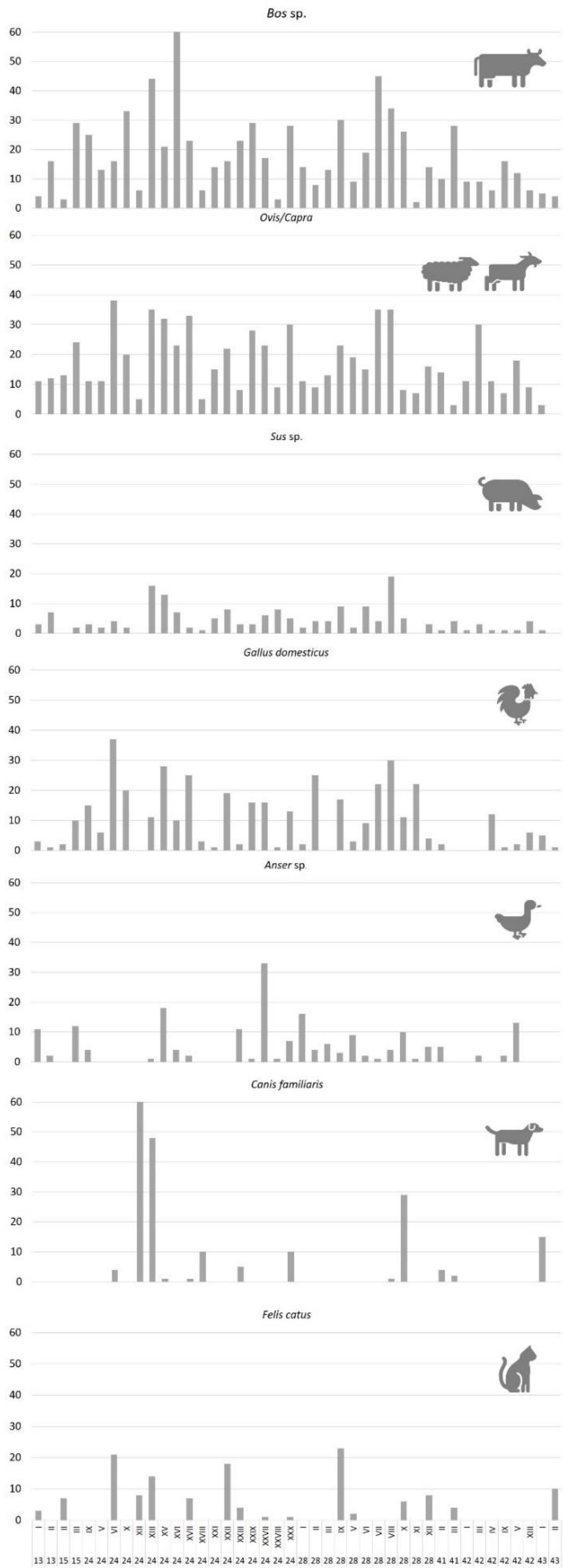

Figure 2 – Distribution of the Number of Identified Specimens by taxa in selected silos with more abundant remains (>100 NISP).

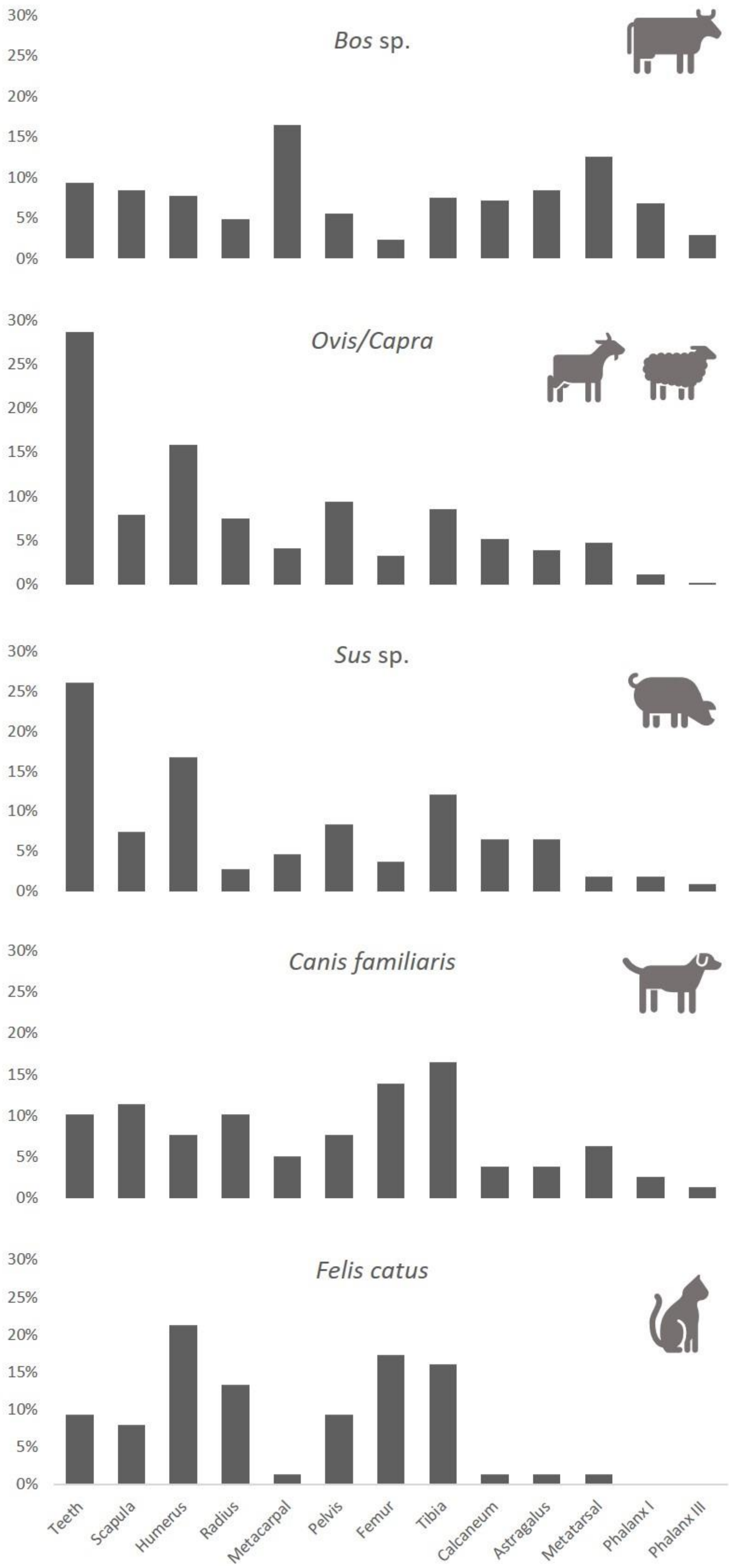

Figure 3 – Distribution (in %) of the Minimum Number of Individuals by parts of the skeleton for cattle (*Bos taurus*), sheep and goat (*Ovis aries* and *Capra hircus*), pig (*Sus* sp.), dog (*Canis familiaris*) and cat (*Felis catus*).

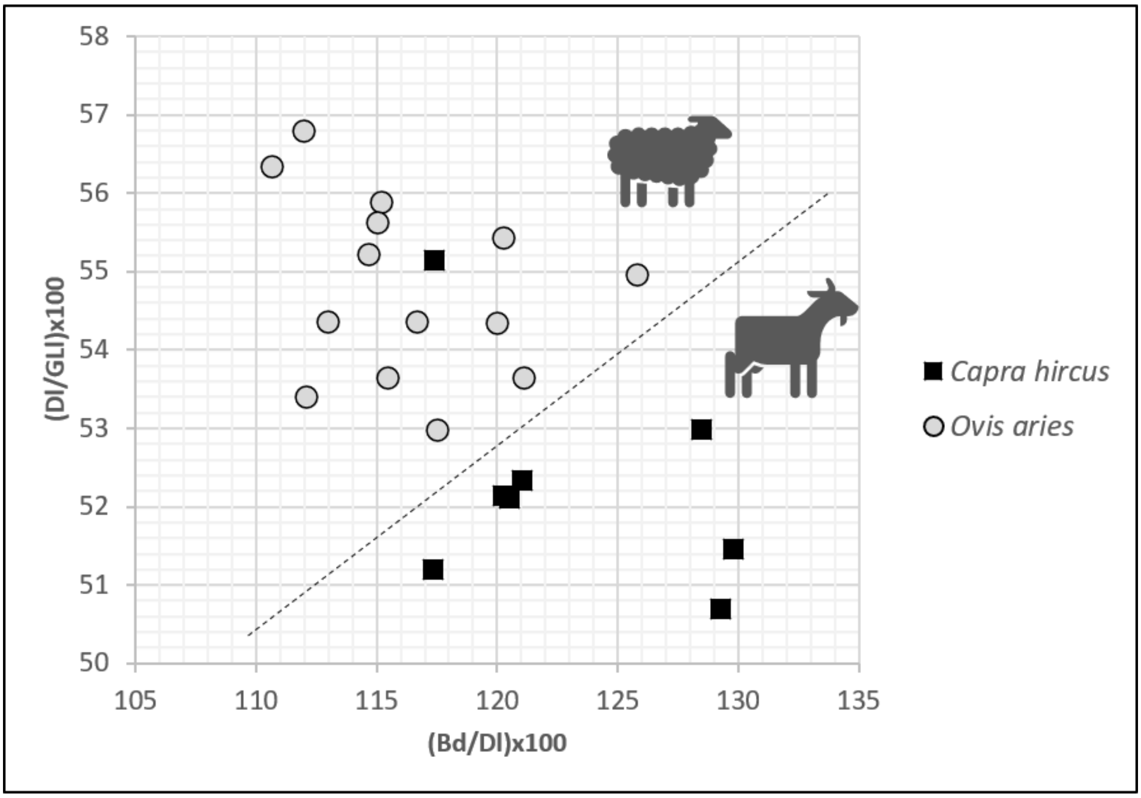

Figure 4 – Measurements of the astragalus of *Capra hircus* and *Ovis aries*, in millimeters. Measured by C. Detry.

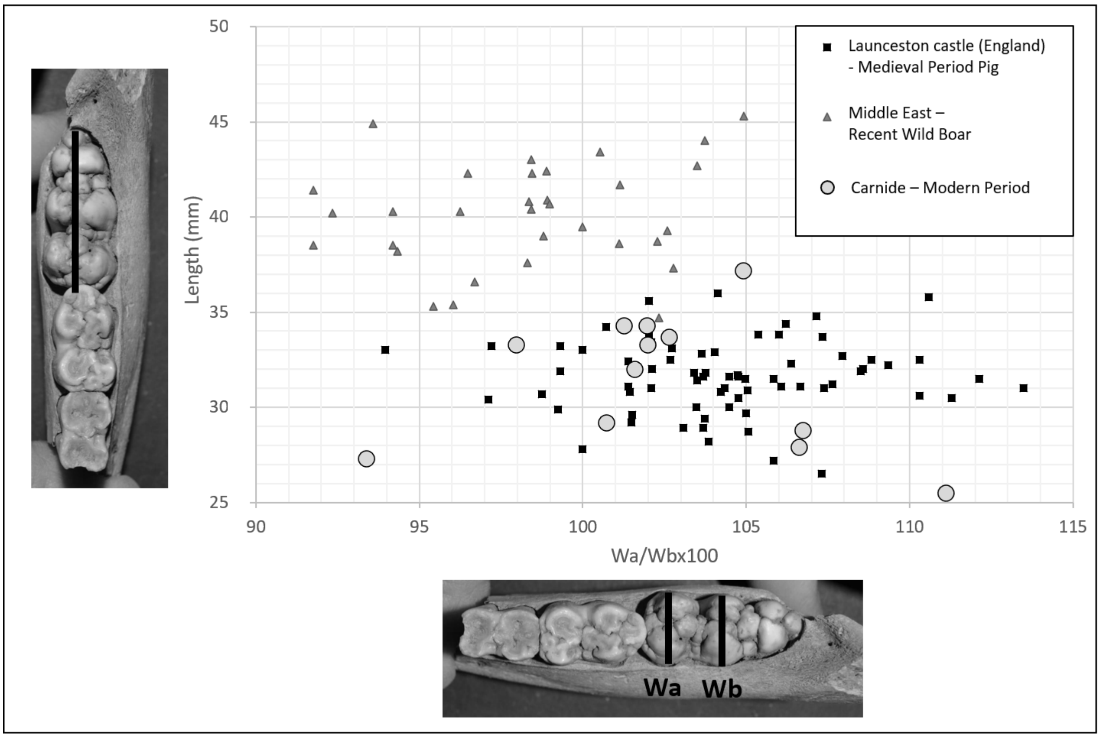

Figure 5 – Measurements of the inferior third molar of suids recovered in Carnide measured by C. Detry. The pig measurements from Launceston castle are from Albarela & Davis (1996) and the measurements of wild Boar were taken by U. Albarella.

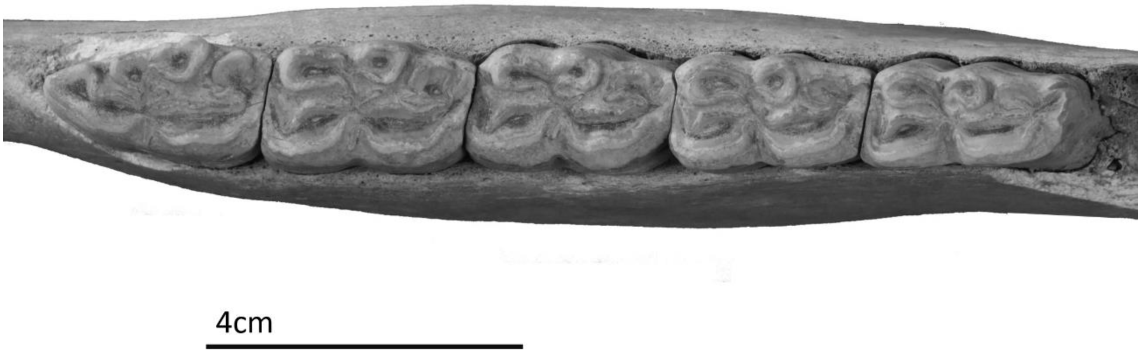

Figure 6 – Equid mandible, probably *Equus asinus* (donkey). Photograph Guilherme Cardoso.

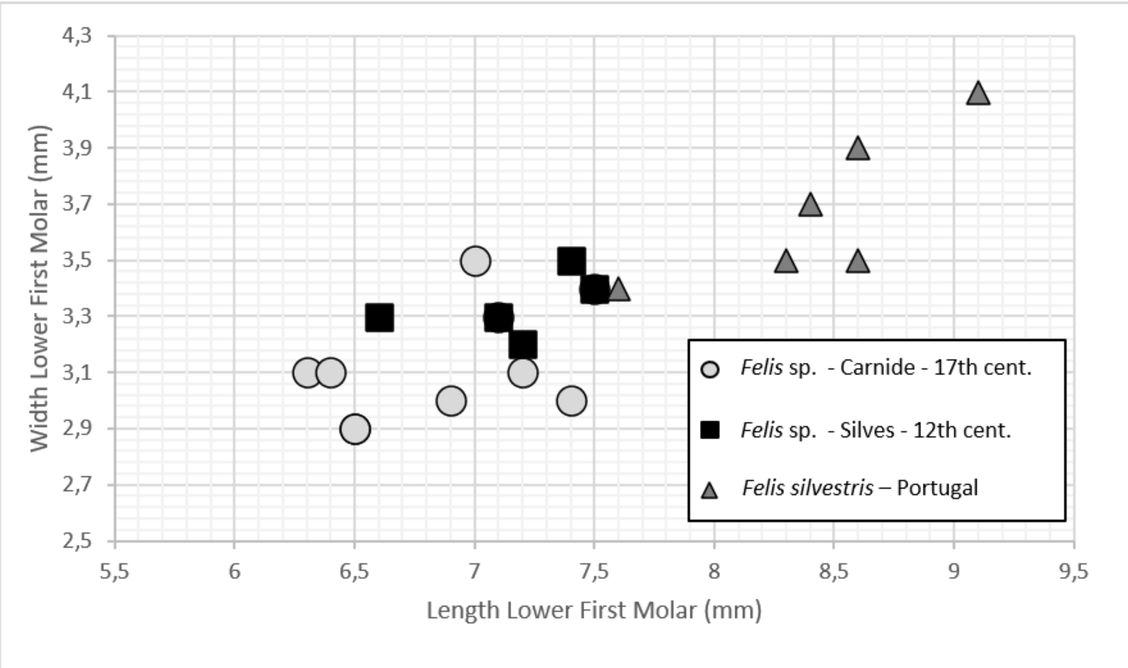

Figure 7 – Measurements of the lower first molar of *Felis* sp (in mm). Measurements from Silves archaeological site and from the reference collection of wild and domestic cats were taken by Simon Davis (Davis et al. 2008). The measurements of the Carnide cats were taken by C. Detry.

Figure 8 – Pelvis (left) and complete femur (right) belonging to *Rattus norvegicus* (brown rat) recovered in Carnide silos in stratigraphic unit [4313]. Photograph by Guilherme Cardoso.

Figure 9 – One complete pelvis (left) and one complete humerus (right) identified as *Mustela putorius* (ferret) found in stratigraphic units [2855] and [2861] both in the same silo and possibly belonging to the same individual. Photograph by Guilherme Cardoso.

Figure 10 – Vertebra of a small cetacean, probably a dolphin, recovered in stratigraphic unit [2873] of the Carnide silos. Photograph by Guilherme Cardoso.

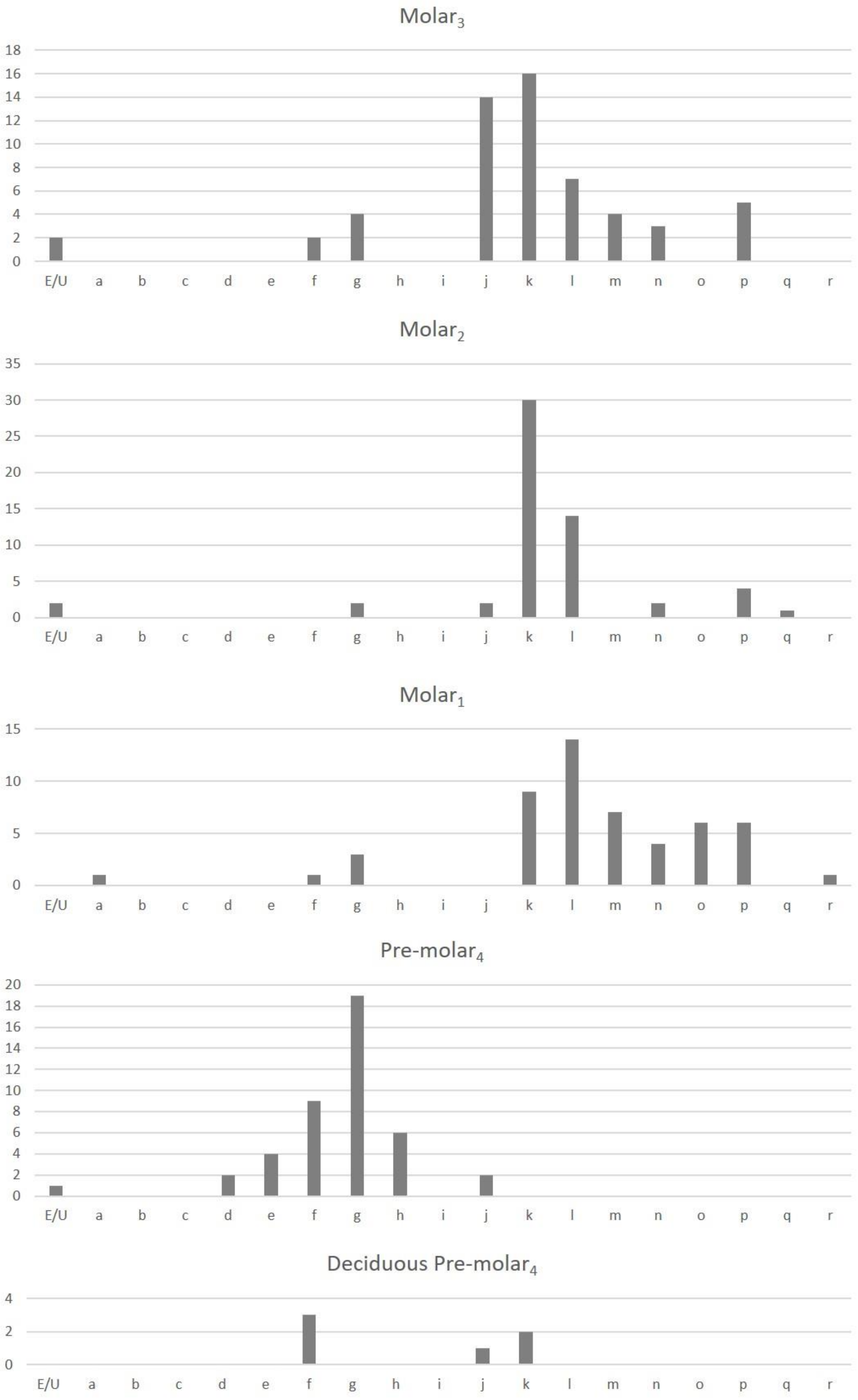

Figure 11 – Tooth wear-stage frequencies for *Bos taurus* (cattle) lower teeth found in Carnide. The wear stages follow Grant (1982).

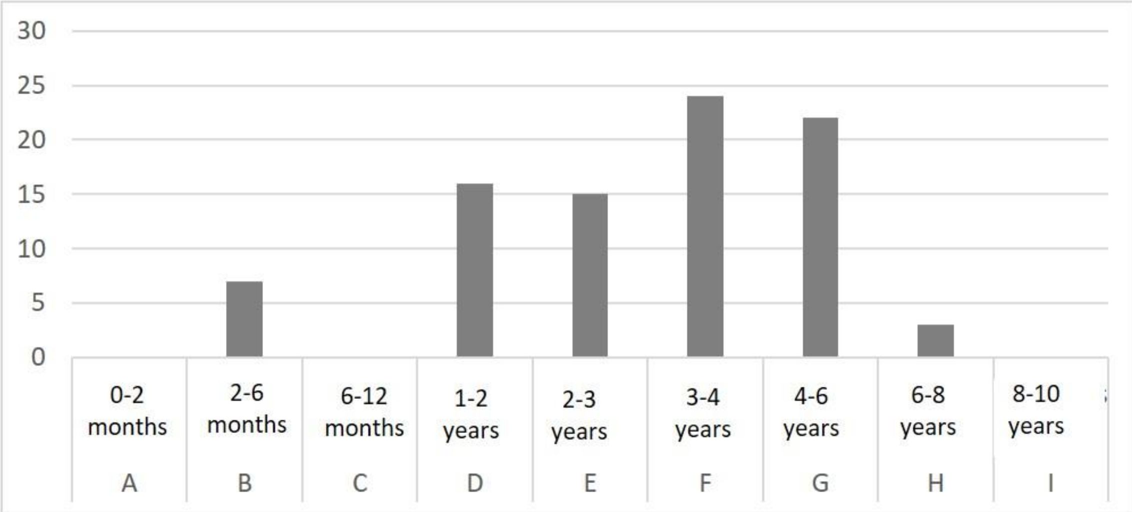

Figure 12 – Carnide *Capra/Ovis* mandible wear stages as defined by Payne (1973).

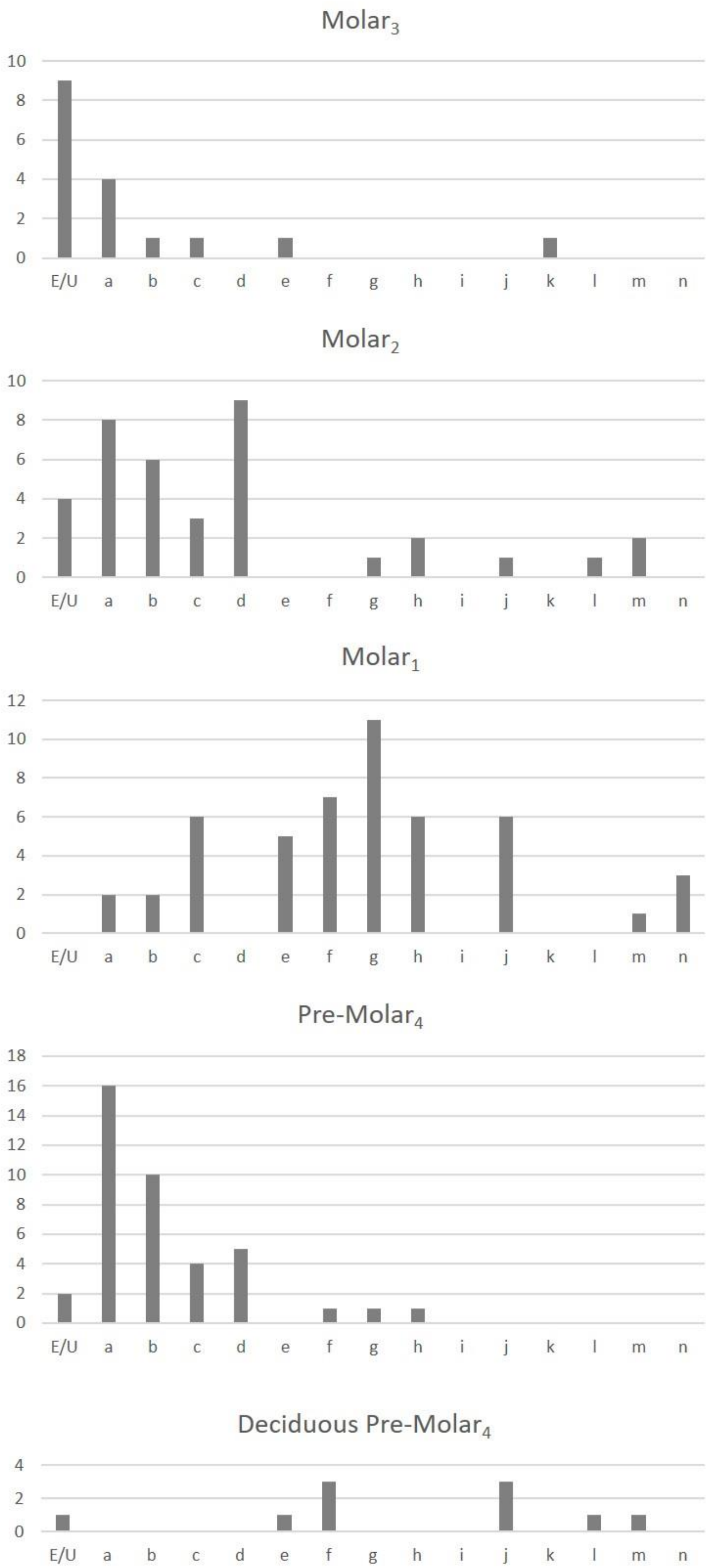

Figure 13 – Tooth wear stage frequencies for *Sus* sp. (pig) mandibular teeth found in Carnide. The teeth wear stages follow Grant (1982).

TABLES:

Table 1 – Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) of the different classes of animals.

	NISP		MNI	
	N	%	N	%
Gastropoda	349	5%	349	21%
Bivalvia	1959	28%	1018	61%
Cephalopoda	5	0,1%	1	0,1%
Crustacea	11	0,2%	3	0,2%
Amphibia	4	0,1%	2	0,1%
Testudines	1	0,01%	1	0,1%
Mammalia	4074	58%	206	12%
Aves	631	9%	85	5%
Total	7034,1		1665	

Table 2 – Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) of the various species of invertebrates.

	NISP		MNI	
	N	%	N	%
Mollusca				
Gastropoda	1	0,04%	1	0,1%
***Patella* sp.**	83	4%	83	6%
Steromphala umbilicalis	11	0,5%	11	0,8%
Littorina littorea	130	6%	130	9%
Monetaria moneta	2	0,1%	2	0,1%
Phorcus lineatus	78	3%	78	6%
Stramonita haemastoma	2	0,1%	2	0,1%
Tritia reticulata	10	0,4%	10	0,7%
***Turritella* sp.**	1	0,04%	1	0,1%
Theodoxus sp.	1	0,04%	1	0,1%
Cymbium olla	2	0,1%	2	0,1%
Cf. *Cornu aspersa*	27	1%	27	2%
Cf. *Candidula*	3	0,1%	3	0,2%
Bivalvia	1	0,04%	1	0,1%
Mytilus edulis	375	16%	188	14%
Cf. *Mimachlamys varia*	16	0,7%	8	0,6%
Cf. *Aequipecten opercularis*	1	0,04%	1	0,1%
Pectinidae	1	0,04%	1	0,1%
***Acanthocardia* sp.**	3	0,1%	2	0,1%
Anomia ephippium	4	0,2%	2	0,1%
Pecten maximus	8	0,3%	4	0,3%
Ostreidae	8	0,3%	4	0,3%
Ostrea edulis	213	9%	107	8%
Cf. *Crassostrea angulata*	6	0,3%	3	0,2%
***Laevicardium* sp.**	2	0,1%	1	0,1%
Cerastoderma edule	710	30%	355	26%
Mactra stultorum	9	0,4%	5	0,4%
Venus verrucosa	7	0,3%	4	0,3%
Circe rugifera	3	0,1%	2	0,1%
***Venus* sp.**	1	0,04%	1	0,1%
Ruditapes decussatus	471	20%	236	17%
Scrobicularia plana	120	5%	60	4%
Cephalopoda		0,0%		0,0%
Sepia officinalis	5	0,2%	1	0,1%
Crustacea	1	0,04%	1	0,1%
Carcinus maenas	3	0,1%	1	0,1%
Cf. *Maja squinado*	7	0,3%	1	0,1%
***Balanus* sp.**	35	1%	35	3%
Total	2361		1375	

Table 3 - Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) of the different species of vertebrates.

	NISP		MNI	
	N	%	N	%
Amphibia + Testudines				
Bufo bufo	1	20%	1	33%
***Rana* sp.**	3	60%	1	33%
Mauremys leprosa	1	20%	1	33%
Total Amphibia + Testudines	5		3	
Mammalia				
***Bos* sp.**	1128,5	28%	50	24%
Ovis/Capra	1361,5	33%	68	33%
Ovis aries	253	6%	21	10%
Capra hircus	123	3%	12	6%
***Sus* sp.**	679,5	17%	28	14%
***Equus* sp.**	10	0,2%	2	1%
Equus asinus	7	0,2%	1	0,5%
Equus caballus	9	0,2%	1	0,5%
Lepus sp.	8,2	0,2%	2	1%
Oryctolagus cuniculus	8	0,2%	1	0,5%
Rattus rattus	4	0,1%	1	0,5%
Rattus norvegicus	3	0,1%	1	0,5%
Canis lupus familiaris	275	7%	9	4%
Felis catus	202,4	5%	8	4%
Mustela putorius	2	0,05%	1	0,5%
TOTAL MAMMALS	4074,1		206	
AVES	5	1%	1	1%
Burhinus oedicnemus	6	1%	2	2%
cf. Athene noctua	2	0%	1	1%
Columba sp.	3	0%	1	1%
***Falco* sp.**	1	0%	1	1%
Buteo buteo	4	1%	1	1%
***Anas* sp.**	2	0%	1	1%
***Anser* sp.**	177	28%	22	26%
Alectoris rufa	2	0%	1	1%
Gallus domesticus	429	68%	54	64%
TOTAL AVES	631		85	
TOTAL VERTEBRATA	4705,1		291	

Table 4 – Parts of the skeleton of each species of mammal found in the Carnide silos. B – *Bos taurus*; O/C – *Ovis/Capra*; OVA – *Ovis aries*; CAH – *Capra hircus*; S – *Sus* sp.; EQ – *Equus* sp.; EQC – *Equus caballus*; EQA – *Equus asinus*; LEP – *Lepus* sp.; ORC – *Oryctolagus cuniculus*; RAR – *Rattus rattus*; RAN – *Rattus norvegicus*; CAF – *Canis lupus familiaris*; FEC – *Felis catus*; MUP – *Mustela putorius*. Number of teeth in brackets are included in the mandible. Bone Fusion status: F – Fused, UE – Unfused epiphysis, UM – Unfused metaphysis, FV – Fusion visible, U – Undetermined.

	Bone Fusion	***B***	***O/C***	***OVA***	***CAH***	***S***	***EQ***	***EQC***	***EQA***	***LEP***	***ORC***	***RAR***	***RAN***	***CAF***	***FEC***	***MUP***
Teeth																
Incisors		1		1		(6)10										
Canine						(4)										
Deciduous Pre-molar $_2$		(4)	(11)3	(36)	(18)	(11)								(3)		
Deciduous Pre-molar $_3$		(5)	(22)2	(41)3	(23)	(16)								(5)	(10)	
Deciduous Pre-molar $_4$		(4)	(32)4	(34)	(21)1	(15)								(3)	(10)	
Incisors		34	(8)29			(75)25	1							(6)	(3)	
Canine						(42)12								(12)	(11)	
Pre-molar$_1$														(2)		
Pre-molar $_2$		(33)2	(47)3		(3)	(30)1								(5)		
Pre-molar $_3$		(47)7	(74)			(51)	1		(1)					(7)	(13)	
Pre-molar $_4$		(43)2	(82)10			(52)			(1)					(12)	(13)	
Molar$_1$		(52)	(130)1	(26)	(10)	(56)			(1)					(14)1	(14)	
Molar $_2$		(57)	(133)3	(5)	(4)	(50)			(1)					(10)		
Molar $_3$		(47)	(106)32	(1)		(28)2			(1)					(1)		
Molar $_{1/2}$		12	(7)61			(2)7										
Molar		(2)1	(2)			0			1		(4)					
Total teeth		**403**	**834**	**167**	**88**	**510**	**2**	**5**	**6**	**0**	**4**	**0**	**0**	**81**	**74**	**0**
Bones																
Scapula	F	49	61			13	2							11	8	
	UM		8			1								5	3	
	U	3	6													
Humerus	F	46	29	39	16	30	1			1	1	1		8	15	1
	UM	2	4			5								4	13	
	UE	1				1										
	FV		1												2	
Radius	F	25	26				1							8	10	
	UM	2	41											8	7	

	UE	2	5			6										
	FV	2	1												2	
Metacarpal	F	98,5	7	3	2	5,5		1	1					18	1,4	
	UM	2	14	2		3								13		
Pelvis	F	19	59			8	3			3	2		1	9	9	1
	UM		5			1								2	3	
	U	14	22			8									1	
Femur	F	10	7							2	1			8	7	
	UM	1	20			5				1		2		14	13	
	UE	3	7			7								1		
	FV		1										1		4	
Tibia	F	37	64			7	1					1		10	7	
	UM	5	41			15				1				17	14	
	UE	3	5			2										
	FV	1	4			2									2	
Calcaneum	F	17	4	8	5	1								2	2	
	UM	2	8	5	2	7								4		
	U	27	2	2	1	5										
Astragalus	F	51	2	22	9	11								5	1	
	U		1	1		1										
Metatarsal	F	70	13	3		1,5		1		0,2			1	24	2	
	UM	8	21	1		2								14		
	UE	2														
Metapodial	F	6,5						2							2	
	UE	3	3,5			1,5										
	UM					4								1		
	U	1														
Phalanx I	F	158	25			7								6		
	UM	5	7			7								1		
	UE	1														
	FV		2			1										
Phalanx III	F	67	1			1								1		
Total Bones		**725,5**	**527,5**	**86**	**35**	**169,5**	**8**	**4**	**1**	**8,2**	**4**	**4**	**3**	**194**	**128,4**	**2**
TOTAL		**1147**	**1361,5**	**253**	**123**	**679,5**	**10**	**9**	**7**	**8,2**	**8**	**4**	**3**	**275**	**202,4**	**2**
MNI		**50**	**68**	**21**	**12**	**28**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**9**	**8**	**1**

Table 5 – Percentages of parts of the skeleton showing anthropic and animal marks.

	Bos taurus	*Ovis/Capra*	*Sus* sp.
Knife-cut	1%	1%	1%
Chopped	6%	6%	2%
Sawed	0%	1%	0%
Gnawed	2%	2%	7%
Punctures	0%	3%	1%
Burn	1%	0%	1%