Animal remains from a Moslem period (12th/13th century AD) *lixeira* (garbage dump) in Silves, Algarve, Portugal

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ABSTRACT This report describes an assemblage comprising some 3000 vertebrate bones (mainly mammals, but also birds and fish), and molluscs from a Moslem period rubbish pit (*lixeira*). The mammal bones are mostly sheep and goat in approximately equal numbers, and some cattle. Equids, both horse and donkey, as well as red deer, hare, rabbit, dog, cat, whale and many birds (most chicken and some partridge) are also present. The probable absence of pig is noteworthy and must reflect religious taboos although two large *Sus* bones may have belonged to wild boar – an animal sometimes consumed today in the Maghreb. Most of the fish are sparids, the sea breams, and two molluscs, the clam *Ruditapes* and the cockle *Cerastoderma*, are especially common. While most of the cattle were slaughtered when old, the sheep and especially the goat remains include many juveniles. Butchery patterns on the bones appear to be rather crude and there are chop and knife marks on horse and dog bones respectively. The cattle were extremely small. In contrast, the sheep were larger than those from earlier periods in southern Portugal and their size increase, presumably due to "improvement", may represent part of the 'Arab Agricultural Revolution' in the Iberian Peninsula of the 11th and 12th centuries. Osteometric methods are presented which aid in separating species of equid proximal phalanges, rabbit from hare bones and domestic from wild cat carnassials and mandibles.

RESUMO Este trabalho pretende efectuar o estudo dos restos faunísticos – mais de 3000 ossos de mamíferos, aves e peixes – e moluscos descobertos durante as escavações arqueológicas realizadas numa lixeira do período Muçulmano (almóada), localizada na zona sudeste da cidade de Silves, espaço que corresponderia ao arrabalde oriental da cidade islâmica. A maior parte dos restos pertence a espécies domesticadas, como sejam ovinos, caprinos, bovinos, equídeos, felídeos e canídeos e, também mamíferos selvagens, como coelho, lebre, veado, baleia, numerosas aves (sobretudo galo e perdiz) e peixes (principalmente da família Sparidae – dourada, pargo, etc.). Entre os moluscos, a amêijoa e o berbigão são os mais comuns. O estudo permitiu concluir que as fontes mais importantes no consumo de carne foram as ovelhas e as cabras, em iguais proporções e, também o gado bovino. Foi assinalada uma quase total ausência de restos de porco, que certamente reflectirá as conhecidas restrições religiosas, ainda mais rígidas durante o período almóada. Dois ossos do género *Sus* talvez pertençam a javali — um animal que não é considerado estritamente *harram* no Islão do Maghreb.

O padrão das idades de morte dos animais domésticos deu-nos indicação sobre o modo como seriam explorados. Por exemplo, o gado bovino era abatido em estado adulto, tratando-se, certamente, de animal aproveitado como força de tracção e produtor de leite. Em relação aos ovinos e caprinos, muitos eram abatidos jovens, sendo explorados não só pelos produtos secundários (leite, lã e pêlo) mas também enquanto fornecedores de carne.

O padrão de marcas de corte nos ossos não mostra qualquer sofisticação no concernente ao talhe, sendo possível que o tratamento das carcaças dos animais de grande porte fosse feito de forma artesanal. Também se observaram marcas de corte em ossos de cavalo e num osso de cão.

O estudo osteométrico dos ossos de gado bovino e ovino (por comparação com dados doutros sítios da parte sul de Portugal) evidencia mudanças de tamanho interessantes. Por exemplo, os bovinos são de pequeno porte, por comparação com o mesmo grupo registado na Idade de Ferro e em período Romano. Em contraste, os ossos dos ovinos de Silves mostram um aumento de tamanho que pode reflectir uma melhoria deste animal e/ou a importação de raças diferentes. Deve ainda considerar-se a hipótese de os muçulmanos terem introduzido melhoramentos nestas espécies no Gharb al-Andalus, espaço geográfico bastante considerado, reflectindo as alterações verificadas na designada Revolução Agrícola, eventualmente ocorrida nos séculos XI-XII na Península Ibérica muçulmana.

O relatório inclui ainda a apresentação de métodos osteométricos adoptados para diferenciar espécies, nomeadamente ao nível das falanges dos equídeos, bem como de outros elementos ósseos que permitem diferenciar coelhos de lebres, gatos bravos de gatos domésticos.

Introduction

Silves, known as *Xilb* in Moslem times, was once the principal cultural and political centre of Gharb al-Andalus and was famed as a city of poets and philosophers (Fig. 1a). It is situated on the once navigable River Arade, 10 km from the sea. Between 2001 and 2004, prior to the construction of a new library in the Rua Cruz de Portugal, excavations were carried out by the Silves municipality department of archaeology, directed by MJG (Gonçalves & Pires, 2006). This area is 50 m from the river in the SE part of the town, the city's waterfront area (Fig. 1b). The excavations uncovered remains of houses, silos, pits, water channels, structures related to manufacturing activities such as tanks, and a metal-foundry, all indicating that this part of the town had been an area of workshops. Perhaps the most important structural find were two "wings" of the town wall and an angle tower that defended the eastern part of the town. Excavation of the southeast margin of this area revealed a rubbish dump (*lixeira* in Portuguese). Accumulation of rubbish in this *lixeira* is thought to have commenced when the water supply system was deactivated during the first Christian invasion of the city in 1189 and continued for probably almost 50 years until the end of Moslem rule in Algarve, *i.e.,* 646 AH or 1249 AD. The *lixeira* measured approximately 20 by 1 m and was 3 m deep. Its contents date to the period when southern Iberia was under the rule of the Muwahhadi

Caliphs of the 6th century AH (end 12th-mid 13th century AD) although it probably includes some rubbish from preceding times. For example the ceramics, while all from Moslem periods, included some pieces from pre-Almohad times. A sample of some 15% of the faunal remains from the *lixeira* (one of seven crates) was the subject of a preliminary report by Gonçalves (2006). Here we describe in full the animal remains from this *lixeira* (*i.e.* all seven crates) and attempt to place them within the context of what we know about the zooarchaeology of southern Portugal during the last three millennia.

The excavation

Although the *lixeira* was excavated carefully and finds were assigned to a series of 54 natural layers, the contents of the *lixeira* are thought to be mixed and can therefore be considered as a single archaeological "entity". For this reason we treat the bone assemblage as a single one although for the sake of convenience the stratigraphic assignation of each recorded bone has been maintained in the records. Recovery of faunal remains was by hand and all soil was subsequently sieved through a 5 mm mesh. Accidental rejection of some bones as "stones" could have happened to certain items at this stage of the recovery operation. We are planning to study the animal remains from the remaining part of the excavated area in the future.

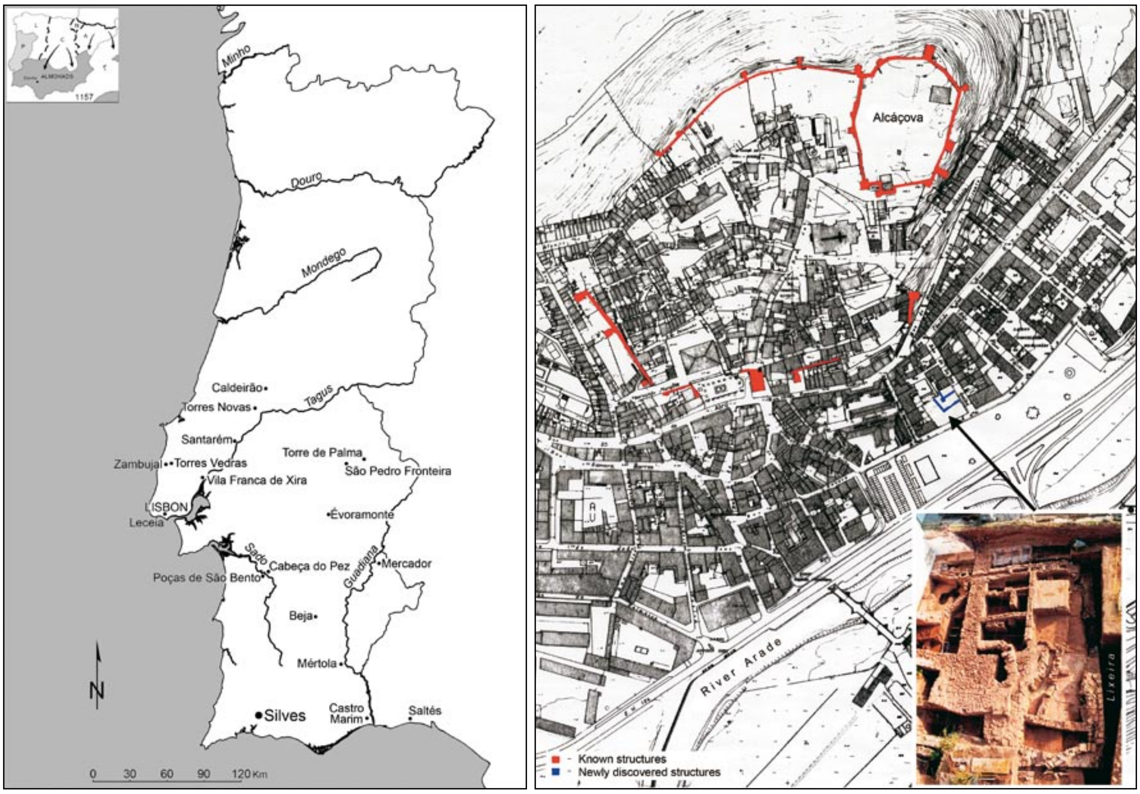

Fig. 1 a. Map of Portugal to show the location of Silves and other towns and archaeological sites mentioned herein. The inset map shows the extent of Almohad rule in the Iberian Peninsula. b. A map of the modern town of Silves to show the location (inset) of the archaeological excavation undertaken prior to construction of the new municipal library. This also shows where the *lixeira* was situated.

Some history

On April 28th 711 AD, Tariq bin Ziyad and 7000 Berbers invaded the Iberian Peninsula — a region that was to become an important centre of culture and learning. Besides song, literature, and mathematics, agriculture too flourished: the Moslems introduced new irrigation techniques such as the *acequia* and the *noria*, as well as many species of useful plants and fruit trees. These included the lemon, bitter orange, coconut, artichoke, sugar cane, spinach, and banana, to name just a few. These important developments are referred to as the 'Arab Green Revolution' (Watson, 1983; Glick, 1979; Araújo, 1983; Guichard, 2000). According to El Faïz (2000, pp. 23-49) in his introduction to Ibn al-'Awwâm's famous *Kitâb al-Filâha* (Book of Agriculture), the 11th and 12th centuries were *le moment andalou* in Hispano-Arab history. Seville became a Mecca for agronomists, and its hinterland, or *Aljarafe*, their laboratory. But while the literature speaks much of oranges and lemons, and apart from the famous Arab horses, we know little about the rest of the livestock sector at this time. For over five centuries Moslems ruled the southern part of what was to become the Kingdom of Portugal. The history of Moslem Iberia is a complex one. Regimes changed frequently and, especially in the 11th and 12th centuries, with the increased Christian threat from the north, the Almoravides and then the Almohades applied the rule of Islam very strictly. Following the fall of Lisbon in 1147, Almoravid rule was replaced by the Almohad dynasty of Berber Moslems. In 1189 Silves was taken from the Almohads by D. Sancho I with the help of members of the third crusade. Two years later in 1191 the Moslems retook the city leaving it in ruins. But their rapid re-establishment of Moslem rule throughout the southern part of the peninsula, as well as most of North Africa (Fig. 1), was relatively short-lived. Silves was again taken by the Christians under D. Paio Peres Correia between 1242 and 1249. In 1248 Seville fell to the forces of Ferdinand III of Castile. And in 1249, Dom Alphonse III of Portugal's capture of Faro marked the end of Moslem rule in Algarve. Further east, however, the small Moslem enclave around Granada survived until 1492.

In the 11th and 12th centuries, *Xilb,* was an important intellectual and administrative centre of Gharb al-Andaluz and was known as the "Baghdad of the occident". Especially after the 10th century AD, the inhabitants of Algarve were known for their high level of learning and culture (Khawli, 2002), and Silves was famed for the agricultural wealth of its surrounding countryside. For example, Abu 'Abd Allah Muhammad b. Muzayn al-Azdi wrote of the beauty and fertility of Silves, its gardens and the abundance of birds, good water, pasture, honey, pine, nuts, grapes, figs, jujubes and almonds as well as good hunting and fishing. Dried fruits were sold throughout the year — "two dirhams a quintal" (quoted in Lagardère, 2000). The River Arade was Silves' "highway" to the sea at Portimão and an important port for exporting some of this agricultural wealth. Its abundant wood made Silves an important centre of boat construction (Vallvé, 1980: 222; Coelho, 1989, p. 62; Torres, 1997, p. 443; Picard, 2001, p. 165). The Arade continued to be navigable until the second half of the 15th century (Leal, 1984, pp. 40-41; Botão, 1992, pp. 51, 62-63). By the 11th and 12th centuries, trade between Algarve and Egypt and the orient as well as the Maghreb, Christian Europe and especially Italy had all become important (Picard, 1995).

Methods

For a full description of the methods used to record and count animal bones on archaeological sites see Davis (1992, 2002). All mandibular cheek teeth and a restricted suite of "*parts of the skeleton always recorded*" (*i.e.*, a predetermined set of articular ends/epiphyses and metaphyses of girdle, limb and foot bones) were recorded and used in this study. In order to avoid multiple counting of very fragmented bones, at least 50% of a given part had to be present for it to be recorded. Individual metapodial condyles of caprines, cattle and cervids were counted as halves.

A mammal-bone epiphysis is described as either "unfused" or "fused"; "unfused" when there are no spicules of bone connecting epiphysis to shaft so that the two separate easily, and "fused" when it cannot be detached from the metaphysis. Caprine teeth were assigned to the eruption and wear stages of Payne (1973, 1987) and cattle teeth were assigned to the eruption and wear stages of Grant (1982). Measurements taken on the humerus and metapodials are illustrated in Davis (1996). In general, other measurements taken are those recommended by Driesch (1976). In order to ascertain which factor or factors were responsible for size variation, care was taken to exclude measurements of juvenile bones (*i.e.* with unfused epiphyses) from the metric comparisons.

The collection, the condition of the bones and what they may tell us (Tables 1-5)

The collection of faunal remains from the Silves *lixeira* is moderately large (3000 bones and teeth were recorded) and is contained within 7 large crates, each measuring 58 x 38 x 36 cm. The collection will be stored in the Silves Municipality Archaeology Department.

There are sufficient bones to recognise or estimate the following:

- The presence of a large number of animal species, and
- Their frequencies.
- The proportions of different age groups of many of the animals slaughtered.
- The representation of different parts of their skeleton, and
- The size of the cattle and sheep compared to earlier and later periods in southern Portugal.

Most of the bones and teeth are well preserved. Some loss may have occurred during excavation. There is, for example, a scarcity or absence of caprine terminal phalanges when compared to the numbers of their limb-bones. Tables 1 and 2 provide counts of mammal bones and teeth within each of these levels.

Table 1. Approximate numbers of bones and teeth identified and recorded in each level of the Silves-*lixeira*.

Level	*Number of bones*	*Number of teeth*	*Level*	*Number of bones*	*Number of teeth*	*Level*	*Number of bones*	*Number of teeth*	*Level*	*Number of bones*	*Number of teeth*
1	143	19	14	21	5	27	–	–	40	–	–
2	1	1	15	32	18	28	36	7	41	–	–
3	81	10	16	84	19	29	4	–	42	1	1
4	104	15	17	34	10	30	53	24	43	50	18
5	27	9	18	2	–	31	61	27	44	11	5
6	48	28	19	23	9	32	20	2	45	–	–
7	7	4	20	304	114	33	22	12	46	5	–
8	12	4	21	6	3	34	519	190	47	–	–
9	92	42	22	31	8	35	42	8	48	1	–
10	25	9	23	43	9	36	118	30	49	34	22
11	5	–	24	117	23	37	2	5	50	34	6
12	–	–	25	14	2	38	16	3	51	13	2
13	16	12	26	–	–	39	8	5	52	27	1

Table 2. Numbers of teeth of the various taxa in each level at Silves-*lixeira*.
Lagomorph (hare and rabbit) teeth were not recorded, their counts represent mandibles.

Level	*Taxon*									*Level*	*Taxon*								
	O	*B*	*EQ*	*CEE*	*S*	*ORC*	*LE*	*FE*	*CAF*		*O*	*B*	*EQ*	*CEE*	*S*	*ORC*	*LE*	*FE*	*CAF*
1	7	5	5	–	–	2	–	–	–	27	–	–	–	–	–	–	–	–	–
2	1	–	–	–	–	–	–	–	–	28	5	1	–	–	–	1	–	–	–
3	3	6	–	–	–	1	–	–	–	29	–	–	–	–	–	–	–	–	–
4	14	1	–	–	–	–	–	–	–	30	19	4	–	–	–	1	–	–	–
5	6	2	–	–	–	1	–	–	–	31	22	5	–	–	–	–	–	–	–
6	25	3	–	–	–	–	–	–	–	32	1	1	–	–	–	–	–	–	–
7	4	–	–	–	–	–	–	–	–	33	10	–	–	–	–	–	–	2	–
8	4	–	–	–	–	–	–	–	–	34	145	9	–	–	–	29	–	3	4
9	33	4	–	–	–	1	–	–	4	35	8	–	–	–	–	–	–	–	–
10	7	–	–	–	–	–	–	2	–	36	18	4	1	–	–	7	–	–	–
11	–	–	–	–	–	–	–	–	–	37	5	–	–	–	–	–	–	–	–
12	–	–	–	–	–	–	–	–	–	38	–	–	3	–	–	–	–	–	–
13	12	–	–	–	–	–	–	–	–	39	3	–	1	–	–	1	–	–	–
14	5	–	–	–	–	–	–	–	–	40	–	–	–	–	–	–	–	–	–
15	12	–	1	–	–	1	–	4	–	41	–	–	–	–	–	–	–	–	–
16	16	–	1	–	–	–	–	2	–	42	–	–	–	–	–	1	–	–	–
17	10	–	–	–	–	–	–	–	–	43	18	–	–	–	–	–	–	–	–
18	–	–	–	–	–	–	–	–	–	44	5	–	–	–	–	–	–	–	–
19	9	–	–	–	–	–	–	–	–	45	–	–	–	–	–	–	–	–	–
20	86	23	2	–	–	–	–	3	–	46	–	–	–	–	–	–	–	–	–
21	3	–	–	–	–	–	–	–	–	47	–	–	–	–	–	–	–	–	–
22	8	–	–	–	–	–	–	–	–	48	–	–	–	–	–	–	–	–	–
23	8	1	–	–	–	–	–	–	–	49	21	1	–	–	–	–	–	–	–
24	21	2	–	–	–	–	–	–	–	50	5	–	–	–	–	1	–	–	–
25	–	1	1	–	–	–	–	–	–	51	1	–	–	–	–	1	–	–	–
26	–	–	–	–	–	–	–	–	–	52	1	–	–	–	–	–	–	–	–

Key: O – caprines, B – cattle, EQ – equids, CEE – red deer, S – pig/wild boar, ORC – rabbit, LE – hare, FE – cat, CAF – dog

Mammals and their numbers (Table 5a and 5b)

Identifying animal bones from archaeological sites is generally quite straightforward but certain closely related species like sheep (*Ovis*) and goat (*Capra*), and horse (*Equus caballus*) and donkey (*E. asinus*), as well as the hybrid mule, present special problems and often teeth and bones belonging to these groups have to remain as "sheep/goat" or "equid". Another problem often encountered is that of separating remains of a domestic species from those of its wild relative. One example of this is distinguishing between remains of cattle (*Bos taurus*) and wild cattle (the aurochs, *B. primigenius*), and, more problematical here in the Iberian Peninsula, pig (*Sus domesticus*) and wild boar (*S. scrofa*).

Many species of birds such as geese are also difficult to identify to species level. In the Silves *lixeira* assemblages, we present morphological and osteometric evidence indicating the presence of both ass and horse, and both sheep and goat, but two bones of *Sus,* cannot be identified as wild boar or domestic pig. Similarly several goose bones remain insecurely identified to species level.

Caprines — sheep and goat

77% of the mammalian remains belonged to caprines — here sheep and goat. (This percentage drops to 66% when birds and smaller mammals are included.) Were these remains derived from wild or domesticated animals? The wild sheep was unknown in Western Europe. Sheep arrived in the Neolithic, presumably introduced by man as domestic animals, and so it can be safely assumed that we are dealing with *Ovis aries,* the domestic sheep. In the case of the goat however, this assumption is less safe to make since a wild-goat, better known as the Spanish ibex, *Capra pyrenaica,* did (and still does) inhabit the Iberian Peninsula and only became extinct in Portugal at the end of the 19th century. The last two living animals were observed in 1892 in the Minho (Choffat, 1919). However, wild *Capra* is characterised by having long scimitar shaped horns encasing similarly shaped horn cores, while in the modern domestic goat these are generally helically twisted. All the *Capra* horn cores observed in Silves were helically twisted and it is assumed that the wild goat was rare or even absent from the Silves region in Moslem times. More problematical however is distinguishing between bones of *Capra* and *Ovis*.

Deciduous cheek teeth (dP_3 and dP_4), horn cores, distal humeri, metacarpals, calcanea, astragali and metatarsals of sheep and goat are relatively easy to identify (see for example the criteria described by Boessneck 1969; Payne 1969, 1985). These are the bones and teeth that were regularly recorded as sheep or goat. On the basis of my examination of these parts of the skeleton (Tables 3-6) it is clear that both are present in approximately equal numbers. Unfortunately the level of confidence with which these parts of the skeleton can be identified to species varies — note that many of the distal humeri and calcanea remain in the unassigned “sheep/goat” category. Where a greater level of certainty exists, it appears that there may have been a slight preponderance of sheep, though in the case of the deciduous fourth premolar teeth and the calcanea it is clear that young goats were more common than young sheep (see also below). The metric method of Payne (1969, Fig. 2) shows a clear separation of plots into two groups, and the two specimens identified morphologically as probable sheep do indeed plot out with the sheep. Of the 31 measurable distal metacarpals, 16 plot out as goats and 15 as sheep. As a general rule in archaeological sites in the Iberian Peninsula, the ratio of sheep to goat after the Neolithic appears to vary from site to site, although in most cases sheep outnumber goats. Clearly it is difficult to obtain an accurate estimate of the ratio of sheep to goats. It is worth wondering why sheep are generally more common than goats. Even today the ratios vary according to the nature of the terrain, soil fertility/vegetation. According to Orlando Ribeiro (1995, p. 356) Portuguese parishes situated in good pasture land tend to have more sheep than goats while those on poorer land with abrupt slopes have more goats. For example in the Terras de Bouro (Gerês) there are 74 sheep and 154 goats per 100 inhabitants, while in Évora there are 256 sheep and only 12 goats per 100 inhabitants (Ribeiro, 1995, p. 404). Was the land around Silves of intermediate fertility?

Table 3. Numbers of recorded mammal and bird bones in each level at Silves-*lixeira*.

Level	*O*	*B*	*EQ*	*CEE*	*S*	*ORC*	*LE*	*FEC*	*CAF*	*G*	*ALR*	*ANS*	*Others*	*(OVA:CAH)*
1	32	18	4	2	–	8	–	–	–	5	–	–	–	3:3
2	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
3	25	5	1	–	–	3	–	1	–	1	–	1	–	3:4
4	25	12	5	–	–	3	–	1	1	–	–	–	–	3:2
5	11	4	1	–	–	1	–	–	–	3	–	–	3 whale frags.	–:3
6	21	14	4	–	–	1	–	–	–	1	–	–	–	3:3
7	4	3	–	–	–	–	–	–	–	–	–	–	–	–:–
8	6	2	–	2	–	1	–	–	–	–	–	–	–	–:1
9	50	16	6	–	–	–	–	–	1	4	–	–	–	2:10
10	15	3	–	1	–	–	–	2	–	1	–	–	–	2:3
11	1	2	–	1	–	1	–	–	–	–	–	–	–	–:–
12	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
13	10	2	–	–	–	–	–	–	–	1	–	–	–	2:1
14	13	4	–	–	–	1	–	1	–	1	–	–	–	2:4
15	18	7	–	15	–	2	–	1	–	3	–	–	–	2:3
16	42	14	3	–	–	1	2	3	1	4	1	–	–	2:11
17	19	4	–	–	–	2	–	1	–	3	–	–	–	4:1
18	2	–	–	–	–	–	–	–	–	–	–	–	–	1:–
19	14	7	–	–	–	–	–	1	–	–	2	–	–	1:1
20	157	64	10	3	1	5	4	5	1	11	–	–	–	18:27
21	1	5	–	–	–	–	–	–	–	–	–	–	–	1:–
22	19	7	–	1	–	1	–	–	2	1	–	–	–	1:3
23	23	8	–	–	–	4	–	1	1	4	–	–	–	3:2
24	70	18	2	–	–	4	1	1	1	4	–	–	1 pige, 1 M.foina	13:6
25	2	–	–	–	–	4	–	–	–	1	–	–	–	–:–
26	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
27	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
28	19	14	–	–	–	2	–	–	–	1	–	–	–	1:2
29	1	1	–	1	1	–	–	–	–	–	–	–	–	–:–
30	27	14	1	1	–	3	–	1	1	2	–	–	–	5:6
31	37	11	–	1	–	2	–	–	–	3	–	–	–	3:12
32	11	3	–	–	–	5	–	–	–	1	–	–	–	2:–
33	13	3	–	–	–	2	1	–	–	1	1	–	–	3:3
34	265	71	2	–	–	84	6	9	4	52	9	1	–	38:33
35	20	4	–	–	–	6	2	–	1	3	–	–	1 wader	1:2
36	63	12	–	1	–	21	2	1	2	10	1	–	1 rat	7:5
37	–	1	–	–	–	–	–	–	1	–	–	–	–	–:–
38	6	8	–	–	–	–	–	–	–	–	–	–	–	1:1
39	4	1	1	–	–	–	1	–	–	–	–	–	–	–:–
40	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
41	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
42	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
43	31	9	–	1	–	5	1	–	–	1	1	–	–	3:2
44	6	–	–	–	–	–	–	1	–	–	–	–	–	–:3

Table 3. Numbers of recorded mammal and bird bones in each level at Silves-*lixeira* [cont.].

Level	*O*	*B*	*EQ*	*CEE*	*S*	*ORC*	*LE*	*FEC*	*CAF*	*G*	*ALR*	*ANS*	*Others*	*(OVA:CAH)*
45	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
46	*2*	–	–	–	–	–	–	–	–	*2*	–	–	–	*1:–*
47	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
48	–	–	–	–	–	–	–	–	–	–	–	–	–	–:–
49	*18*	*7*	–	–	–	*2*	*1*	*1*	–	*3*	–	–	–	*1:1*
50	*20*	*7*	–	–	–	*5*	–	–	–	*1*	*1*	–	–	*5:3*
51	*8*	*3*	–	–	–	–	–	–	–	*2*	–	–	–	*2:–*
52	*21*	*3*	–	–	–	*1*	*1*	–	–	*1*	–	–	–	*1:3*

Key: O – undistinguished sheep and goat bones, OVA – bones identified as definite or probable sheep, CAH – bones identified as definite or probable goat, B – cattle, CEE – red deer, EQ – horse and donkey, CAF – dog, FEC – cat, LE – hare, ORC – rabbit, S – pig or wild boar, VUV – fox, G – chicken and probable chicken, ALR – partridge, ANS – goose, pige – pigeon. Note that the column "O" shows the total count of sheep, goat and sheep/goat bones recorded in a particular layer. Those bones that could be identified to species are shown to the right where "OVA" = numbers of sheep and "CAH" the numbers of goat bones recorded. For example in level 31 the 37 caprine (i.e. "O") bones comprise 22 undistinguished sheep or goat, plus 3 sheep and a further 12 goat bones. Horn cores are excluded.

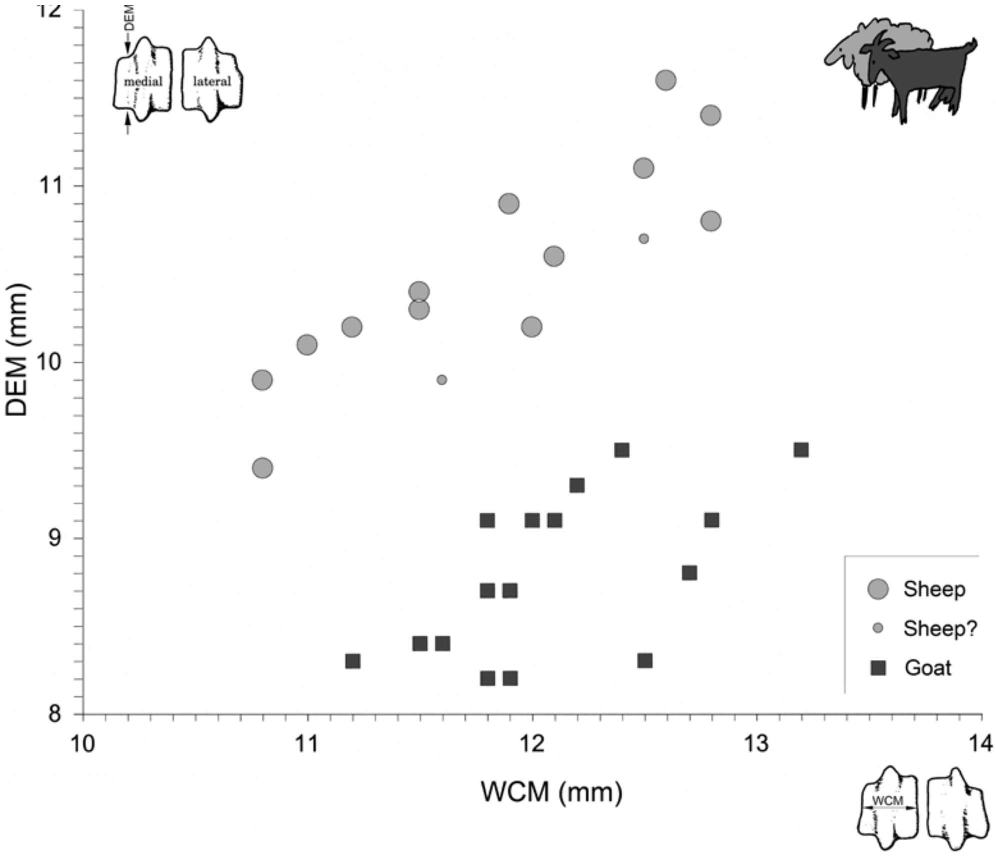

Fig. 2 Osteometric identification of sheep and goat distal metacarpals from Silves-*lixeira*. A scatter diagram of plots of the medial trochlea depth (DEM) *versus* medial condyle width (WCM) — the method suggested by Payne (1969). All specimens are from adult animals, *i.e.* with epiphyses fused to their respective shafts. There appear to be approximately equal numbers of adult sheep and adult goat metacarpals.

Table 4. Silves-*lixeira*: vertebrate bones and teeth recorded from all levels (including unstratified material from section cleaning) by taxon, part of skeleton and age-at-death of animal.

Bone/tooth	*F/U*	*Bos*	*O*	*(CAH)*	*(OVA)*	*S*	*CEE*	*ORC*	*LE*	*EQ*	*FEC*	*CAF*	*G*	*ALR*	*Other taxa*
Hornc./antlerfrags		30	272	(113)	(159)		21								
dP$_4$		–	56	(34)	(18)	–	–		–	2					
P$_4$		13	81			–	–		–	–		3			
P$_{3/4}$		–	–			–	–		–	3					
M$_1$		10	90			–	–		–	2	–	3			
M$_{1/2}$		13	154			–	–		–	4					
M$_2$		10	74			–	–		–	1	–	1			
M$_3$		28	125			–	–		–	3		1			
Mandible								48	–						
Scapula	U	–	24			–	–	–	–	–	–	–			
“	F	20	73			1	1	17	2	2	–	3			
“	?	4	31			–	–	–	1	–	–	–			
Humerus	UM	–	52			–	–	–	–	–	1	–			
“	UE	–	1			–	–	–	–	–	–	–			
“	F	18	117	(42)	(32)	1	–	36	4	2	11	2	31	4	2 Anser
Radius	UM	3	32			–	–		–	–	–	–			
“	UE	2	8			–	–		–	–	–	–			
“	F	21	16			–	–		–	–	–	1			1 Vulpes
M'Carpal	UM	–	29	(10)	(1)	–	–		–	–	–	–			
“	UE	–	4,5	(1,5)	(3)	–	–		–	–	–	–			
“	F	25	29,5	(14)	(15)	–	0,5		–	3	–	2			
Ischium		16	76			–	1	84	9	4	6	3			1 Rattus
Femur	UM	3	19			–	–	6	1	–	1	–			
“	UE	4	15			–	1	–	–	–	–	–			
“	F	3	11			–	–	37	1	1	–	1	54	3	
Tibia	UM	4	37			–	–	1	–	–	–	–			
“	UE	3	10			–	–	–	–	–	–	–			
“	F	34	120			–	2	4	2	4	7	2	33	7	1 Martes 1 pigeon 1 wader
Calcaneum	U	3	61	(32)	(15)	–	1	–	–	2	–	–			
“	F	14	48	(17)	(23)	–	1	–	–	–	–	1			
“	?	20	10	(4)	(1)	–	–	–	–	–	–	–			
Astragalus		34	47	(21)	(18)	–	8	–	–	1	–	–			
M'Tarsal	UM	2,5	21,5	(2)	(2)	–	–			–	–	–			
“	UE	–	2,5	(2)	(–)	–	–			–	–	–			
“	F	33	46	(17)	(29)	–	–			4	1	1	14	2	
Phalanx I	UM	2	26			–	–			–					
“	UE	–	–			–	–			–					
“	F	90	193			–	–			10					
Phalanx III		41	5	(1)	(2)	–	–			2					
M'Podial	UM	–	2,5			–	–			–					
“	UE	0,5	3	(0,5)	(–)	–	–			1					
“	F	4	–			–	0,5			3		1			

Unfused epiphyses (UE), unfused metaphyses (UM) and fused epiphyses (F) are noted separately where possible. Key: ? – state of epiphysial fusion could not be ascertained; Bos – cattle; O – sheep and goat; CAH and OVA are bones and teeth of the sheep and goat that could be identified as goat or sheep respectively; S – pig or wild boar; CEE – red deer; ORC – rabbit; LE – hare; EQ – horse or donkey; FEC – cat; CAF – dog; G – probable chicken; ALR – partridge. Additional vertebrate finds not recorded in the body of the table include 3 osteoderms of the turtle *Mauremys*, and 3 fragments of whale bone (probably vertebrae). Note that "O" includes sheep/goat, sheep and goat. For example, of the 117 fused distal humeri, 42 could be further identified as goat and 32 as sheep; leaving a further 43 unidentifiable to species level. Bird tarsometatarsi are recorded as metatarsals. Note the predominance of sheep, goat and cattle and the scarcity of pig/wild boar, as well as the large numbers of cat compared to dog. Counts of some taxa are not equivalent, for example, individual rabbit and hare teeth were not recorded, birds no longer possess teeth, and only a very restricted suite of bird bones was recorded.

Table 5a. Numbers of recorded bones and teeth from Silves-*lixeira*.

Taxon	N_{bones}	N_{teeth}	%
Sheep and goat	1456	582	77
(Sheep	303	24)	
(Goat	279	52)	
Cattle	441	74	19
Equid	39	18	2
(Horse	9	8)	
(Donkey	5	3)	
Red deer	37	–	1
Pig/wild boar	2	–	+
Hare	21	–	
Rabbit	184	48 mandibles	
Rat	1		
Dog	17	8	
Cat	31	18	
Fox	1	–	
Whale–bone frags	3		
Chicken	130		
Partridge	16		
Goose	4		
Unid. Wader	1		
Unid. Pigeon	1		
Turtle osteoderms	3		

Note that the ungulate parts of skeleton may be compared with each other since the same parts were recorded for each taxon; this is not the case for the lagomorphs, carnivores and birds. For example no bird teeth were recorded as they no longer have teeth, and individual/isolated rabbit and hare teeth were not recorded.

Table 5b. The complete *lixeira* percentages are compared to those calculated from the sample studied by Maria José Gonçalves (2006).

	Complete lixeira		*Sample of MJG*	
	N	*%*	*N*	*%*
Sheep/goat	2038	66	703	54
Cattle	515	17	355	28
Equids	57	2	10	1
Red deer	37	1	14	1
Rabbits and hares	>232	7	76	6
Canids	26	1	7	1
Felids	49	2	4	+
Birds	>152	5	121	9
TOTAL	3106		1290	

Table 6. Silves-*lixeira* — the proportions of sheep and goat deduced from the identifications of several different parts of the skeleton.

Tooth/bone	*Numbers of Sheep*	*Goat*	*Undet. Sheep/goat*
dP_4	18	34	4
Horn–core	159	113	–
Distal humerus	32	42	43
Distal metacarpal	18	16	0.5
Astragalus	18	21	8
Calcaneum	39	53	27
Distal metatarsal	29	19	0.5

The 'Undet' column represents cases where the assignation to 'sheep' or 'goat' was uncertain. This proved to be especially problematical for distal humeri and calcanea. With the large numbers of these two bones remaining unidentified, their sheep-to-goat ratios should be treated with caution. The large numbers of goat dP_4s may reflect a preference for slaughtering goats at a very young age. An age-related factor may account for the low count of goat horn-cores, due to the absence of any durable horn-core in young kids, as well as preservation factors, sheep horn-cores being more robust than those of goat. There were probably approximately equal numbers of adult sheep and goats.

Cattle

The large bovid bones and teeth are all identified as *Bos* — the genus to which both the domestic cattle and its wild ancestor, the aurochs, are assigned. However, the *Bos* measurements (Figs. 3, 4) all indicate the presence of domestic cattle only. There are no remains of any larger bovid that might signify the presence of the aurochs. Aurochsen are generally considered to have become extinct in Portugal and Spain soon after the Chalcolithic and certainly by Roman times (Castaños, 1991; Estévez & Saña, 1999; Cardoso, 2002). Cattle comprise some 19% of the large mammal remains at Silves and are therefore, after sheep and goat, the third most abundant animal.

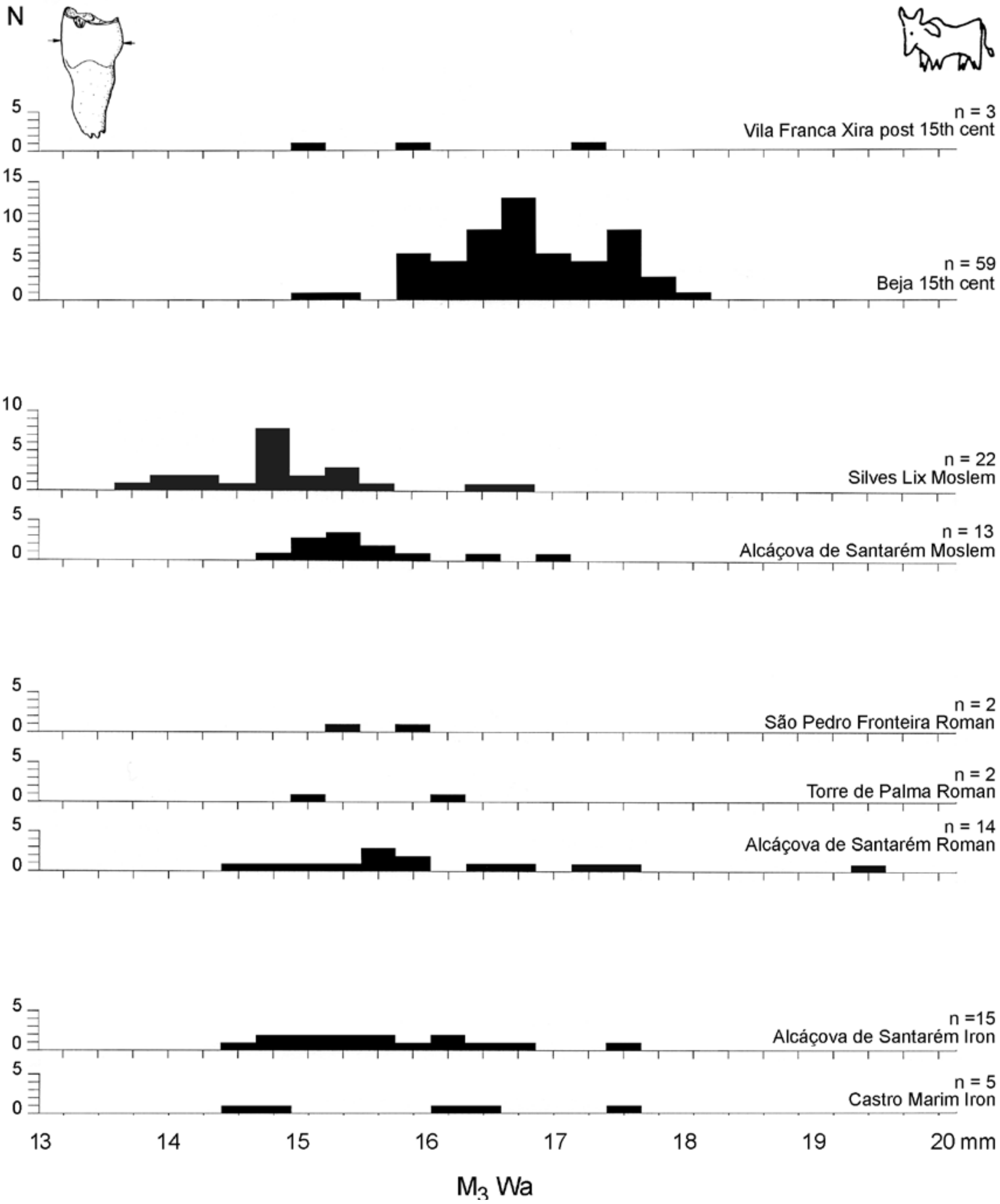

Fig. 3 Cattle size variation in southern Portugal from Iron Age to post-Medieval times — a comparison with the Silves cattle. These are stacked histograms of plots of the maximum crown width (Wa) of the anterior lobe of the lower third molar tooth, M_3. Note the absence of any significant size increase between Iron Age and Moslem times and the subsequent increase by the 15th century AD. The Silves cattle were relatively small. Artiodactyl molars are not considered to show much sexual dimorphism so that the size increase between the Moslem period and the 15th century must represent a real size change of cattle in southern Portugal and not a shift in the sex ratio.

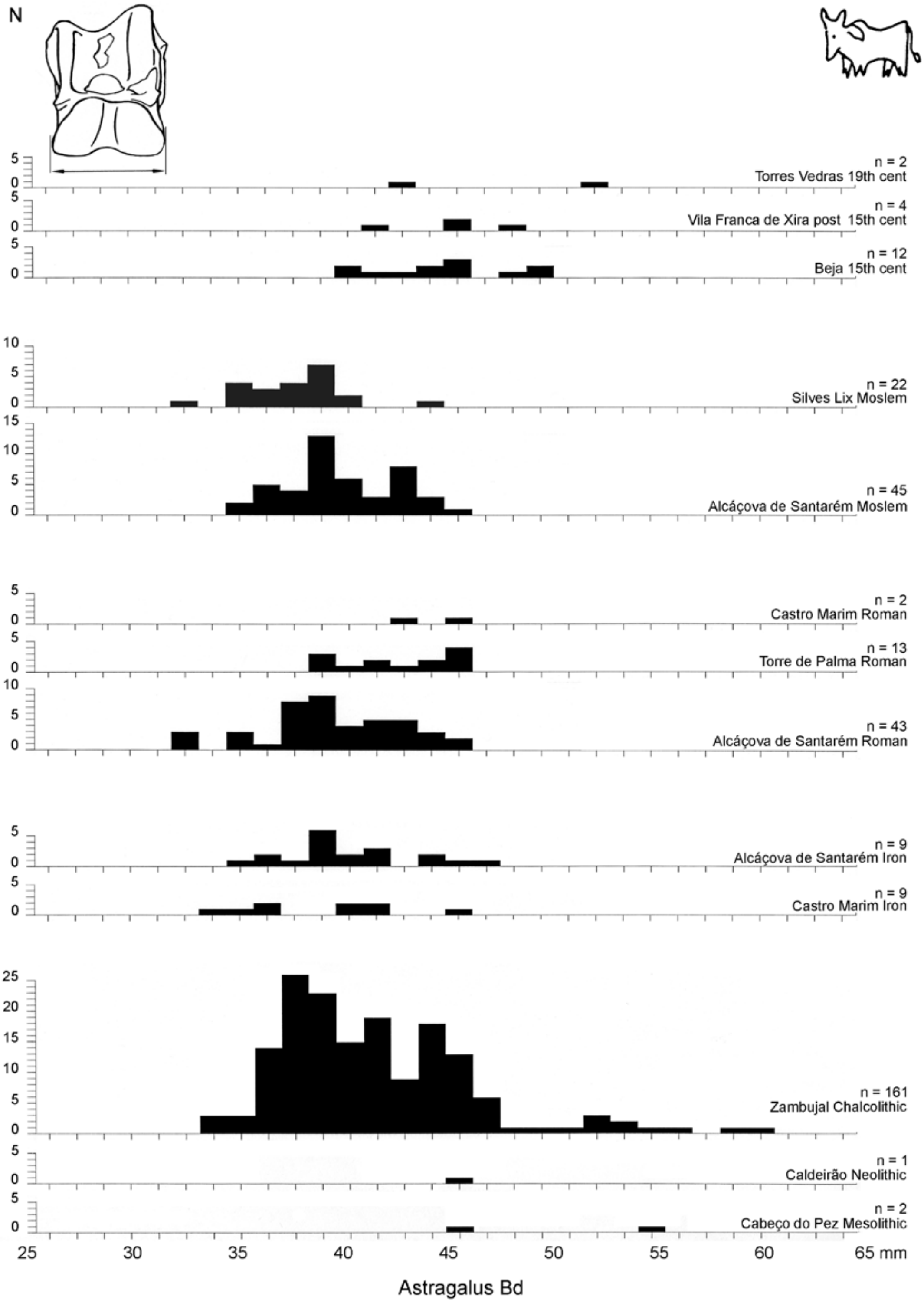

Fig. 4 Cattle size variation in southern Portugal from the Mesolithic to post-Medieval — a comparison with the Silves cattle. Stacked histograms of measurements of the distal width (Bd) of the astragalus of aurochsen (wild cattle) and cattle. The Zambujal data are from Driesch and Boessneck, 1976. Note the very large size of a small number of specimens in the Mesolithic and Chalcolithic — presumed to have belonged to aurochsen. The bulk of the specimens being of smaller size are presumed to be domestic cattle. Note too the absence of any significant size change between Iron Age and Moslem times of these presumed domestic cattle and the subsequent increase by the 15th century AD, although these did not attain the great size of the aurochs. The Silves cattle are very small.

Equids — ass and horse

2% of the large mammal bones belonged to equids. Little is known about the wild equids of Portugal and if/when they became extinct. It seems that there were once two species: a horse, *Equus caballus* (well known in the Upper Pleistocene; Cardoso, 1993), and a smaller species, *E. hydruntinus* which, although first described by Ettore Regàlia (1907) as an ass, has teeth that closely resemble those of the zebra. According to Driesch (1972) horse bones became abundant during the Campaniform (also known as Bell beaker or Late Chalcolithic times) in the Iberian Peninsula. This increase could well reflect their new domestic status. It is assumed that the Silves horses belonged to domesticated animals. The date of extinction of *E. hydruntinus* is unknown, although it may be the '*zebro*' that survived in parts of the Peninsula until medieval times. The ass was not present here until its introduction as a domesticated animal — the donkey — by the Phoenicians in Iron Age times (Uerpmann & Uerpmann, 1973; Altuna & Mariezkurrena, 1986; Cardoso, 2000).

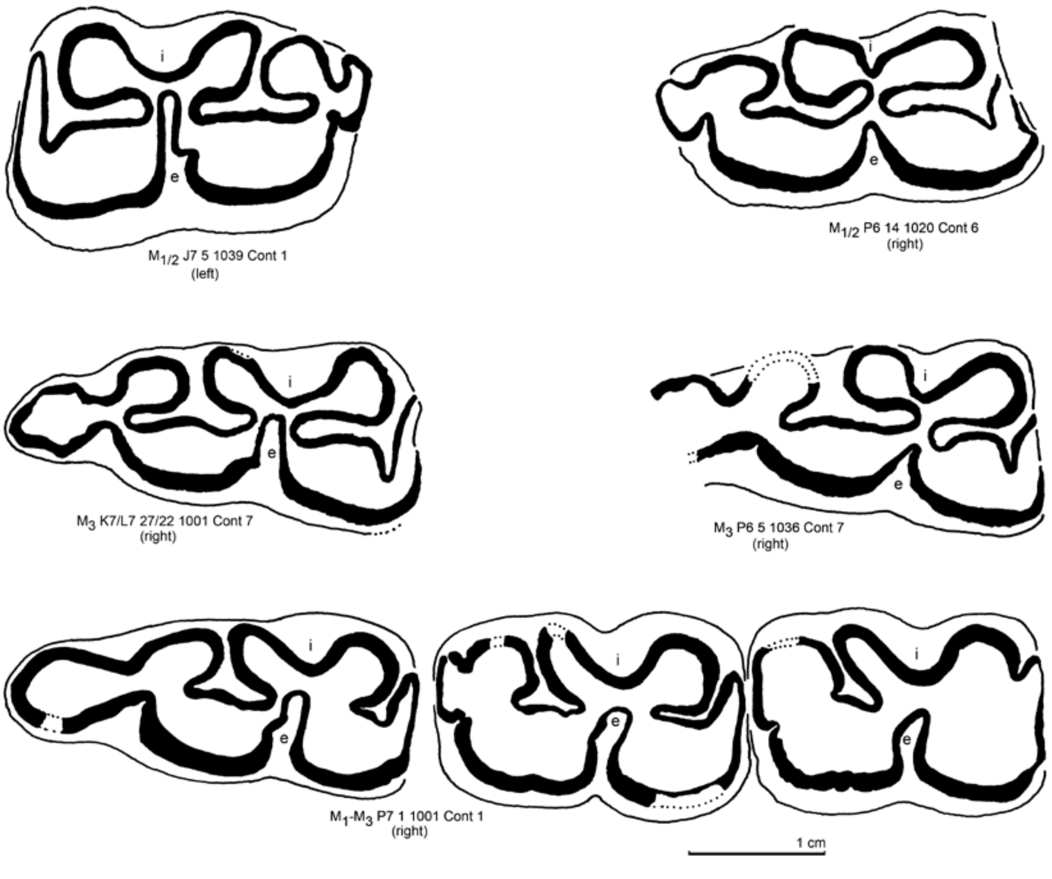

Fig. 5 Identification of seven lower molar teeth of equids from Silves-*lixeira* via the pattern of enamel folds on their occlusal surfaces. Top: first or second molars — left horse and right donkey, Middle: third molars — left horse and right donkey, and Bottom, from right to left: first, second and third molars from the same mandible of an old horse.
Note that in the **horse** lower molars the external fold (labelled "e") tends to penetrate between the flexids (but note this tendency to penetrate does not usually occur in premolars) and the internal fold (labelled "i") tends to be "U" shaped. In the **donkey** lower molars, the external fold does not penetrate between the flexids and the internal fold tends to be "V" shaped. In **zebra** and ***Equus hydruntinus*** lower molars, the internal fold is "V" shaped and the penetration of the external fold tends to be even more extreme than in the horse — often the external and internal fold touch one another. It appears that horses and donkeys were present in Silves.

A similarity between horse and donkey bones is hardly surprising given their ability to produce, admittedly infertile, offspring. Teeth, especially the lower molars, and the feet bones can usually be distinguished. Lowers molars can be identified by the shape of the enamel folds when viewed on their occlusal surface. The lingual (internal) fold tends to be 'V' shaped in donkey and 'U' shaped in horse and in the small extinct equid, *Equus hydruntinus*, as in present day zebras, the buccal (external) fold penetrates between the flexids, often touching the lingual fold (Davis, 1980). Both horse and donkey teeth could be identified in the Silves *lixeira* (Fig. 5 shows five molars with definite horse features and two with donkey features). Another method for separating horse feet bones from those of donkey makes use of the tendency for horse foot bones — phalanges and metapodials — to be wider. Note the very slender metatarsal in Fig. 6 which probably belonged to a donkey. A plot (Fig. 7) of shaft width versus relative distal breadth (*i.e.* BFd expressed as a fraction of total length) of proximal phalanges of *Equus hydruntinus*, half ass, ass and horse (data in appendix II) shows a reasonable separation of horse from the rest and within the "ass" group most *E. hydruntinus* tend to have relative slenderer distal ends when compared with the asses and half asses. What is notable is that the seven Silves phalanges fall into two groups. Five are clearly horses, and two cluster with the asses and half asses but have wider distal articulations than do those of *E. hydruntinus*. This osteometric method of identifying equid first phalanges should be treated with caution as the sizes of the comparative samples are very small. While it seems very likely that both donkeys and horses were present in Silves the question of the presence of their infertile offspring — the mule — is impossible to verify. Little is known about the osteology of the mule and few Natural History Museums have skeletons of this "artificial" animal.

Fig. 6 An equid metatarsal (L7 5 1034; crate 4). Note how slender this specimen is. It probably belonged to a donkey rather than horse, as metapodials of the latter tend to be more robust.

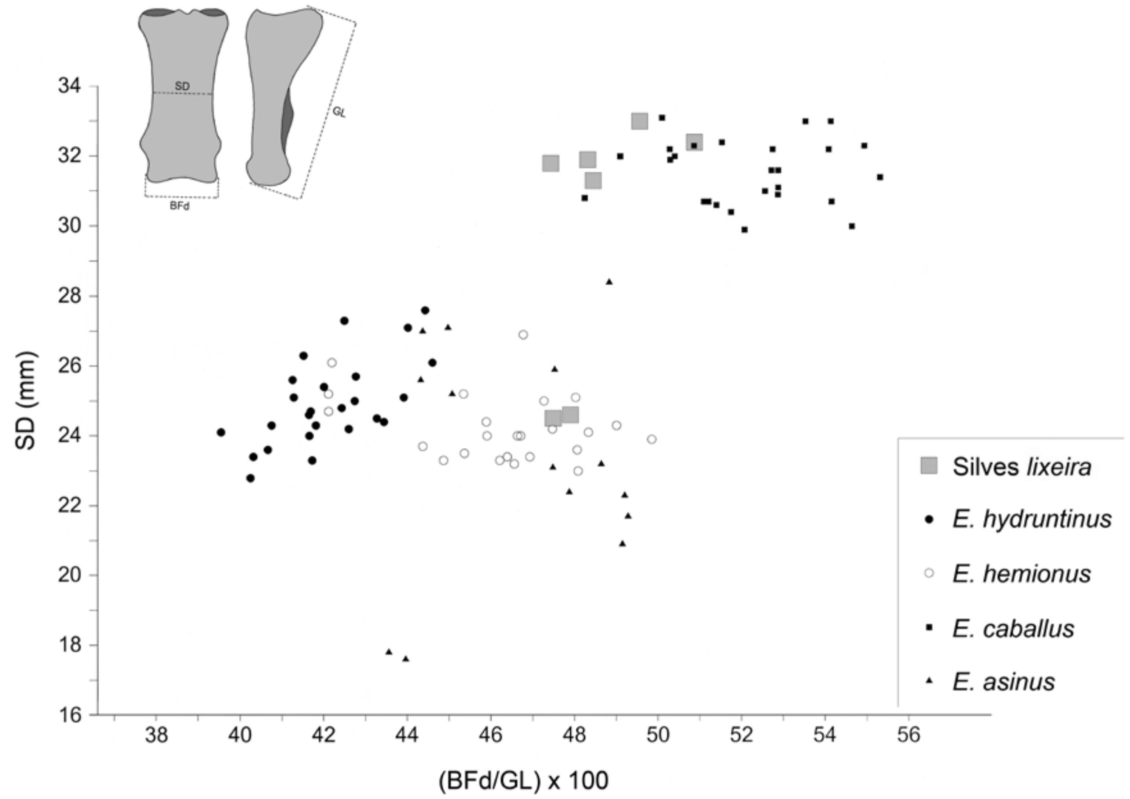

Fig. 7 Osteometric identification of the equid proximal phalanges from Silves-*lixeira*. A scatter diagram of plots of the shaft width (SD) *versus* distal width (BFd) expressed in relation to the length (GL) of this bone. The comparative measurements are of modern horse (*Equus caballus*), modern ass (*E. asinus*), modern half ass (*E. hemionus*) and late Pleistocene *E. hydruntinus* from Apulia, southern Italy (for the raw data see appendix II). Note that of the seven specimens from Silves, five cluster with the horses, and two with the asses — which corroborates the identification of two species on the basis of the dental enamel folds in Fig. 5.

Red deer

Just 1% of the large mammal bones from Silves-*lixeira* belonged to red deer — *Cervus elaphus*. This animal is common on archaeological sites in Portugal, and in the Moslem level of Alcáçova de Santarém for example it represents 4% — a higher figure than here in Silves. Red deer are usually associated with woodland. Hence their numbers in Almohad Silves may reflect the lack of trees there at that time. And it is well known that the Moslems in Silves had, as mentioned above, an important ship-building industry (Vallvé, 1980, p. 222; Coelho, 1989, p. 62; Torres, 1997, p. 443; Picard, 2001, p. 165) with the wood presumably derived from the surrounding forests. Cardoso (2002) too links red deer numbers with shipbuilding: he has suggested that this animal became scarce over time due to the increased exploitation of wood for this industry. Another rather more mundane explanation for the scarcity of red deer is simply that the inhabitants of this part of Silves were of relatively low status and did not have the opportunity to hunt this noble beast, though we note that no remains of red deer were found among the faunal remains studied so far from the Castle of Silves (Antunes, 1997).

There is little difference in terms of size between the red deer of Silves and specimens from Chalcolithic, Iron Age and Roman periods (Fig. 8).

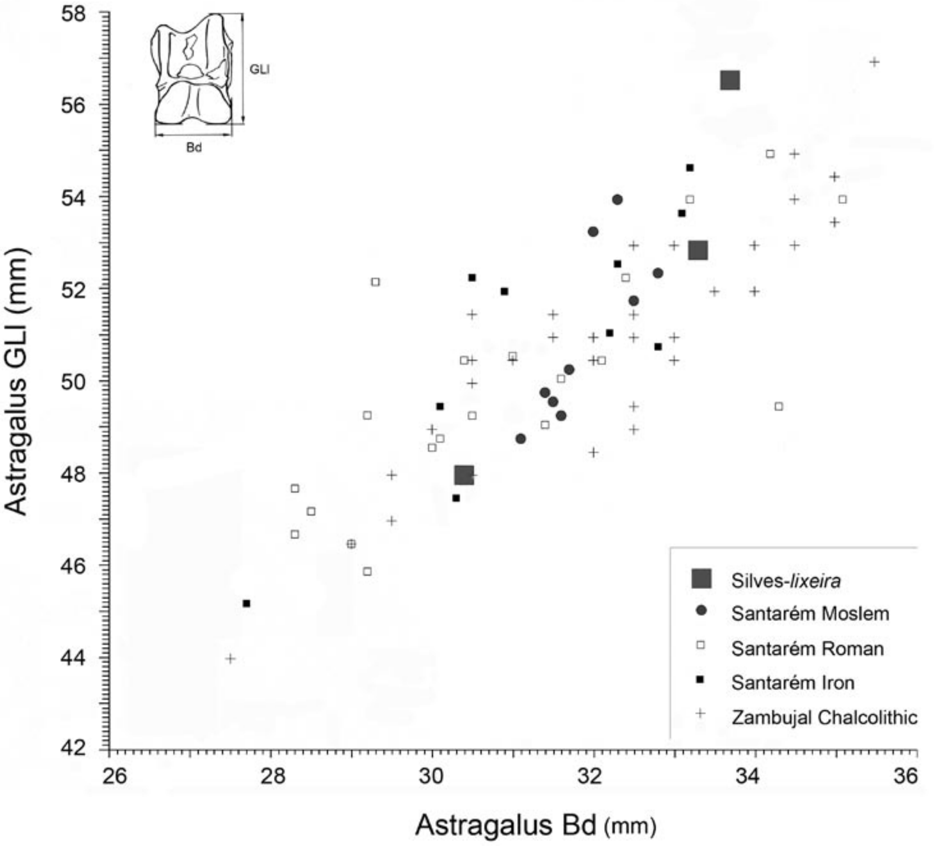

Fig. 8 Osteometric variation of red deer (*Cervus elaphus*) astragali – Silves-*lixeira* compared to Iron Age, Roman and Moslem periods at Alcáçova de Santarém – a scatter diagram of plots of astragalus greatest lateral length (GLl) *versus* width (Bd). Within this approximately 2000 years time span there is little evidence that red deer underwent any overall change in size.

Wild boar and/or pig

Perhaps the most striking characteristic of the Silves-*lixeira* fauna is the extreme scarcity of pig/wild boar (the two are difficult to distinguish in the Iberian Peninsula – see Albarella & al., 2005). Two bones, one the distal part of a humerus and the other a scapula fragment (Fig. 9), are from adult animals and are large. However, given the amount of overlap in size between pig and wild boar it is not possible to identify with certainty these two bones, though they are more likely to have belonged to the wild boar rather than pig. The complete absence of pig from Silves-*lixeira* would be easy to understand given the strict nature of the Islam practised by the Muwahadin. Indeed, as Gonçalves (2006) has pointed out, the scarcity of *Sus* in the *lixeira* stands in contrast to two post-Moslem localities excavated in this city (Table 7). They are a 15th-16th century well and a 15th century house where *Sus* bones comprised 23% and 12% of the faunal remains respectively (Cardoso & Gomes, 1996; Gomes & al., 1996). Clearly the Silves environment was not adverse to pig breeding! But what of other contemporary sites in southern Portugal?

In most, though not all, Moslem sites in Iberia remains of pig are indeed scarce. For example at a site in Moslem Mértola, Morales Muñiz (1993) remarked upon the total absence of *Sus*, which he suggested reflects the then current religious practises. In the Moslem period assemblage at Alcácer do Sal, there were only 2% pig, at the Convento de São Francisco, Santarém, there were no pig bones (Moreno García & Davis, 2001) and in three Moslem contexts in the Rua dos Correeiros,

Fig. 9 Religious transgression in Almohad Silves? The two bones of *Sus* — wild boar or pig. A scapula (SC M7 (N) 10 1020; crate 5) and a distal humerus fragment (K7 12 1029; crate 6), both belonged to large adults, and both have small cut marks. Did these belong to pork consumed illegally or did they belong to wild boar hunted and eaten as is often done today in the Maghreb?

Lisbon, pig comprised 2% of the faunal assemblage (Moreno García & Gabriel, 2001). In contrast, Gabriel (2003) found that of the animal bones from silo 1 at Paços do Concelho de Torres Vedras (12th century AD Moslem), 19% were pig. She suggests they were accumulated by local Christians. At another site in Mértola also from the Moslem period, Antunes (1996) did find a few *Sus* bones, which he suggested belonged to wild boar. Similarly at the 8th-10th century site at Castelo de Silves, Antunes (1991) reports an absence of *Sus*. At Alcáçova de Santarém the frequency of *Sus* in the Moslem level was lower than in the Roman levels, but not very markedly so. And from Moslem Spain: in the fauna from the period preceding the Cathedral construction in Granada, Riquelme (1992) found no pig remains; at Castillo de la Mola (Alicante) Benito Iborra found that *Sus* constituted 6% of the bones; in 16th century Plaza España, Motril (Granada), Riquelme (1993) found *Sus* constituted 4%; and less than 1% of the bones from Calatrava la Vieja belonged to *Sus* (Morales Muñiz & al., 1988).

The pig is considered unhealthy in Islam, and the consumption of pork is strictly forbidden — it is *harram*. However, this prohibition is less strictly applied to the pig's wild relative — especially in the Maghreb today. In Morocco wild boar liver is consumed to gain the animal's strength and its flesh is said to be bracing for children, a remedy for syphilis and renders humans insensitive to pain (Simoons, 1994, p. 341; Moreno García, 2004). Perhaps, therefore, the abundance of wild boar as opposed to pig is not so surprising. Perhaps too the religious regime of Moslem Santarém and Torres Vedras was less severe than for example in Almohad Silves — a city that became very Arab. For example, al-Edrísi (12th century) writes of Silves:

> … os seus moradores, assim como os habitantes das aldeias em volta são árabes do Iémen e de outras partes. Falam uma língua árabe pura. E são versificadores. E são eloquentes e bem falantes, tanto a boa gente come a gente do povo. Os moradores do campo são em extremo generosos como nenhum outro povo … (Domingues, 1945, pp. 45-46).

Neither Santarém nor Torres Vedras came under Almohad rule (Fig. 1) so it is possible that the inhabitants (perhaps many were Christians in any case) had a more 'relaxed' attitude towards what was *harram* and what was *halal*.

Table 7. Percentages of large mammals (including cats and dogs) at several Moslem period sites in the southern half of Portugal arranged from north to south.

	Cattle	*Sheep/ Goat*	*Red deer*	*Pig/ wild boar*	*Equids*	*Dog*	*Cat*	*Number of bones*
Convento S. Francisco Santarém (Moreno García & Davis, 2001)	*10*	*84*	*6*	*0*	*+*	*0*	*0*	*80*
Alcáçova de Santarém (Davis, 2006)	*28*	*54*	*4*	*9*	*3*	*1*	*+*	*2842*
Silo 1 Paços do Concelho, Torres Vedras (Gabriel, 2003)	*10*	*38*	*0*	*52*	*1*	*0*	*0*	*200*
São Pedro Canaferrim (Davis, 2005)	*8*	*71*	*17*	*2*	*0*	*2*	*1*	*169*
Rua dos Correeiros, Lisbon (Moreno García & Gabriel, 2001)	*20*	*72*	*2*	*2*	*3*	*0*	*0*	*94*
Mértola (Morales Muñiz, 1993)	*18*	*79*	*2*	*0*	*+*	*+*	*0*	*228*
Mértola – casa II (Antunes, 1996)	*13*	*74*	*1*	*2*	*8*	*1*	*1*	*180*
Mértola – Alcaria Longa (Antunes, 1996)	*15*	*79*	*3*	*0*	*0*	*3*	*0*	*67*
Mértola – Bairro almóada (Moreno García & al., in prep)	*0*	*95*	*5*	*0*	*0*	*0*	*0*	*58*
Mértola – Castelo, fossa 2 12th Cent AD (Moreno García & al., in prep)	*1*	*98*	*0*	*1*	*0*	*0*	*0*	*765*
Mértola – Castelo, palco 12th Cent AD (Moreno García & al., in prep)	*3*	*91*	*2*	*3*	*0*	*1*	*1*	*160*
Mesas do Castelinho, Almodôvar (Cardoso, 1993)	*2*	*46*	*52*	*0*	*0*	*0*	*0*	*195*
Silves – Castelo layer 8, 711-870 AD (Antunes, 1997)	*2*	*98*	*0*	*0*	*0*	*0*	*0*	*244*
Silves – Castelo layer 3, end 11th Cent & 12th Cent (Antunes, 1997)	*11*	*89*	*0*	*0*	*0*	*0*	*0*	*85*
Silves – lixeira (this study)	*19*	*75*	*1*	*+*	*2*	*1*	*2*	*2723*
Alcaria de Arge (Portimão) 12th-13th Cent AD (Moreno García & al., 2008)	*64*	*33*	*3*	*+*	*–*	*+*	*–*	*534*

The count of red deer bones at Mesas do Castelinho is inflated due to the inclusion of numerous red deer cranial fragments. At Alcaria de Arge (Moreno García & al., 2008) 135 bones belonging to a partial dog skeleton are counted as a single find as are 50 bones derived from a partial skeleton of a piglet. The percentages from Paços do Concelho de Torres Vedras were calculated excluding the unidentified fragments. This is the only Moslem period site with an abundance of pig which Gabriel (2003) attributes to the large Christian community living there at that time.

Islam *versus* Christianity. Percentages of large mammals at two 15th-16th century AD sites in Silves.

	Cattle	*Sheep/ Goat*	*Red and Roe deer*	*Pig/ wild boar*	*Equids*	*Dog*	*Cat*	*Number of bones*
15th Cent AD house, Silves (Gomes & al., 1996)	*13*	*71*	*2*	*12*	*1*	*0*	*1*	*179*
15th/16th Cent AD well deposit, Silves (Cardoso & Gomes, 1996)	*17*	*57*	*1*	*23*	*1*	*1*	*1*	*461*

Note the increased representation of pig/wild boar in Christian times.

Lagomorphs — hare and rabbit

Some remains of hare were easily distinguished from those of rabbit by their considerably larger size. Note the clear separation of the measurements taken on the distal humerus in Fig. 10 and the two peaks of the measurements of the scapula and tibia (the latter less distinct due to the small sample size) in Fig. 11. The rabbit was apparently not domesticated until later times in Spain/southern France (Callou, 2003). Thus both these lagomorphs were presumably hunted to provide wild meat supplementary to the red deer venison. The presence of cut marks, sometimes only visible under the microscope, indicates that the rabbits were indeed consumed.

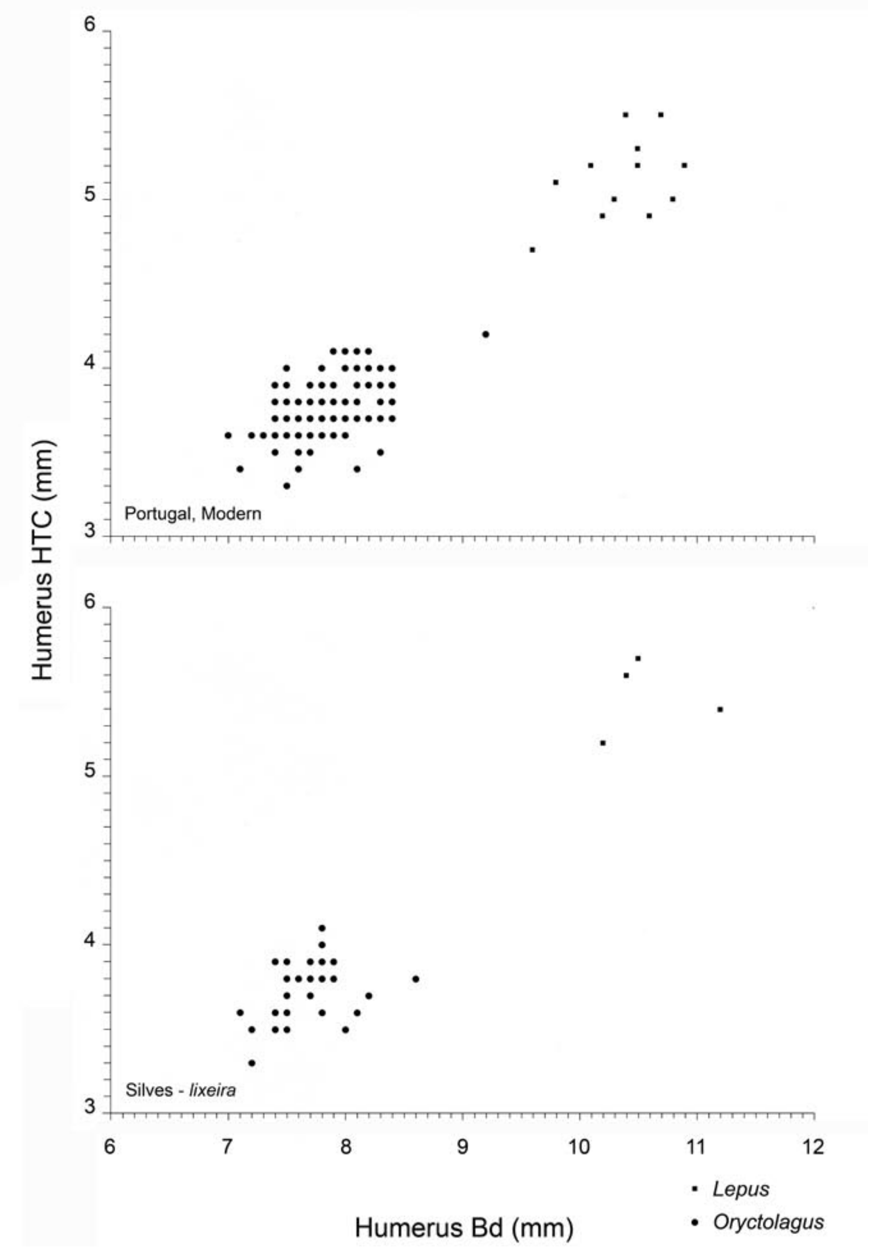

Fig. 10 Osteometric distinction between hare and rabbit humeri. A scatter diagram of plots of the minimum diameter of the trochlea (HTC) *versus* the distal width (Bd) to show the substantial difference in size between these two taxa. Above are modern rabbits and hares from southern Portugal and below are the specimens from Silves-*lixeira*.

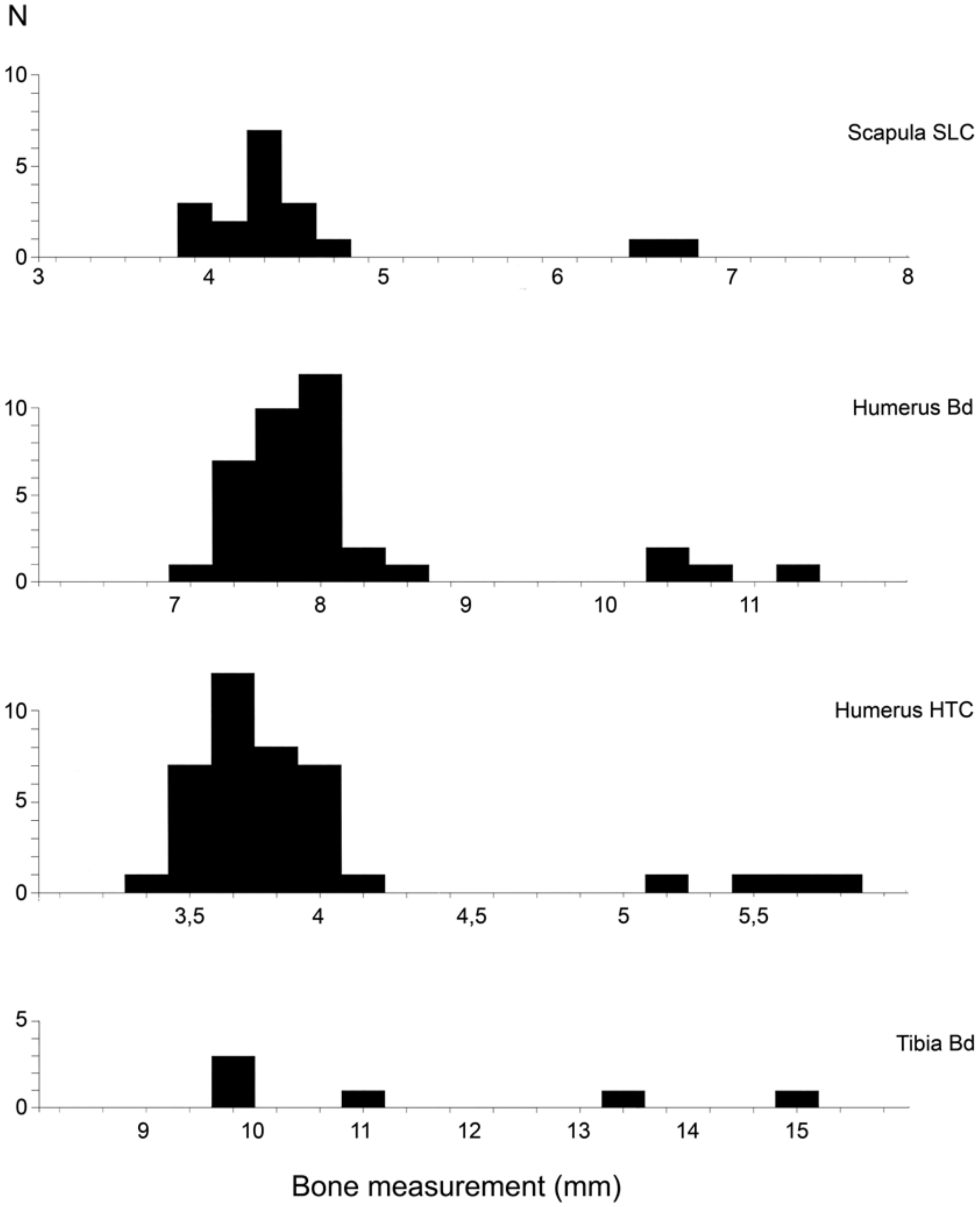

Fig. 11 Osteometric distinction between hare and rabbit scapulae, humeri and tibiae at Silves-*lixeira*. A series of histograms of various measurements (Scapula SLC, Humerus Bd, Humerus HTC, Tibia Bd) taken on these bones from Silves-*lixeira* showing the presence of two separate peaks presumed to belong to rabbits (smaller) and hares (larger).

Carnivores

Remains of three species of carnivores, cats, dogs and fox were identified. It is interesting that unlike most archaeological sites, cats here are rather more common than dogs. The dog is considered unclean in Islam and this may explain their low numbers. Cats however are looked upon with greater favour and the prophet Muhammad is said to have especially liked them. There is a well known tale that Muhammad, who owned a cat, called Muezza, once found his cat asleep on the sleeve of his robe and when called to prayer, cut off the sleeve rather than disturb the cat (Chittock, 2001).

Were the cats of Silves wild or domestic? Wildcat, *Felis silvestris*, is still found in Portugal and there is little morphological difference between bones and teeth of the wildcat and its descendant the domestic or house cat. However it is generally assumed that, today at least, the domestic cat is smaller than its wild relative, although the size reduction of domestic lineages of cats may be a fairly recent occurrence. A large corpus of measurements of wild, domestic and feral cats from Europe, the Near East and Africa (Figs. 12, 13) appears to corroborate this size difference between wild and domestic cats, though there is a considerable amount of overlap (see Fig. 12, a plot of the carnassial tooth, M_1, crown length against crown width and Fig. 13, stacked histograms of the

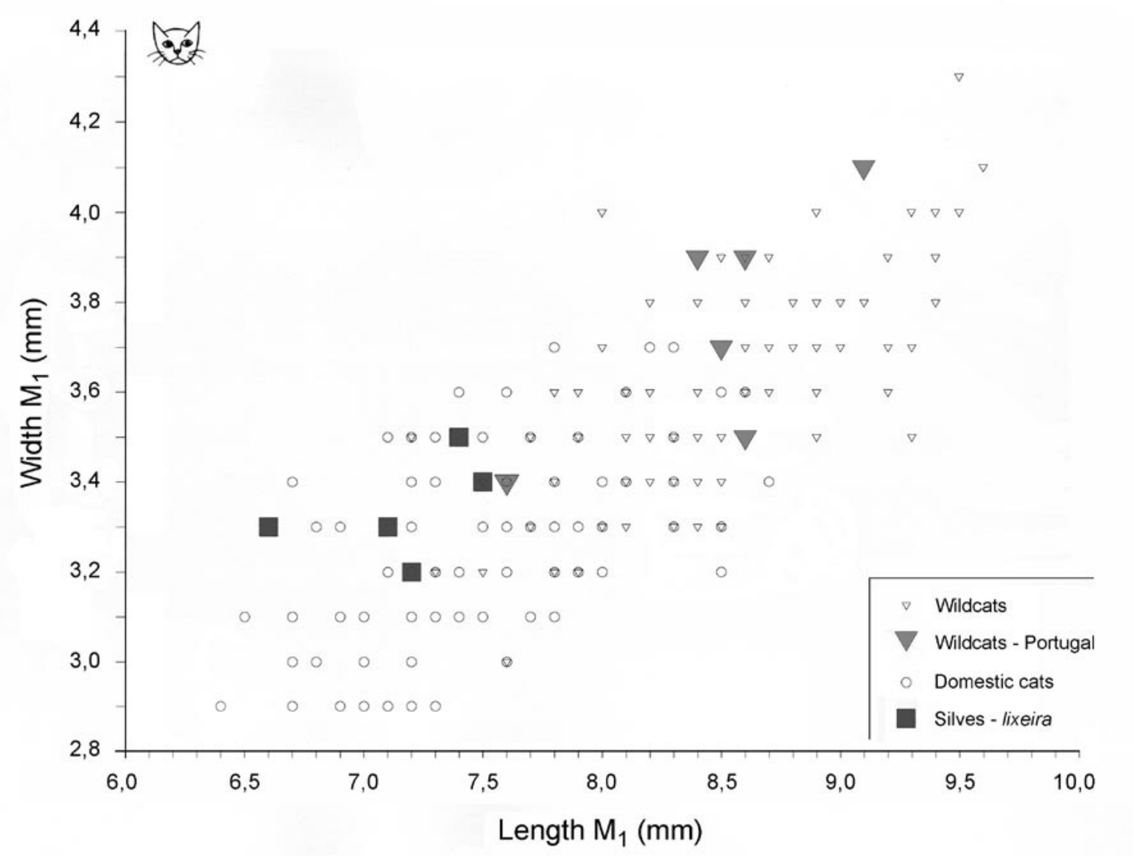

Fig. 12 Osteometric distinction between wild and domestic cat. Scatter diagram of the crown width *versus* crown length of the carnassial tooth (M_1) in wild and domestic cats. Note the tendency for wildcats to be larger than the modern domestic ones although there is considerable overlap. Some of the overlap may be due to mis-identification of specimens as well as interbreeding between the two forms. Most, if not all, of the Silves-*lixeira* cat carnassials probably belonged to domestic cats.

alveolar lengths P_3-M_1 of various populations of wild and domestic cats). Note that the five cat carnassials and the nine mandible measurements from the Silves-*lixeira* appear to be smaller than the wild ones, though given the overlap between wild and domestic, the possibility that the Silves-*lixeira* sample includes one or two wildcats cannot entirely be excluded.

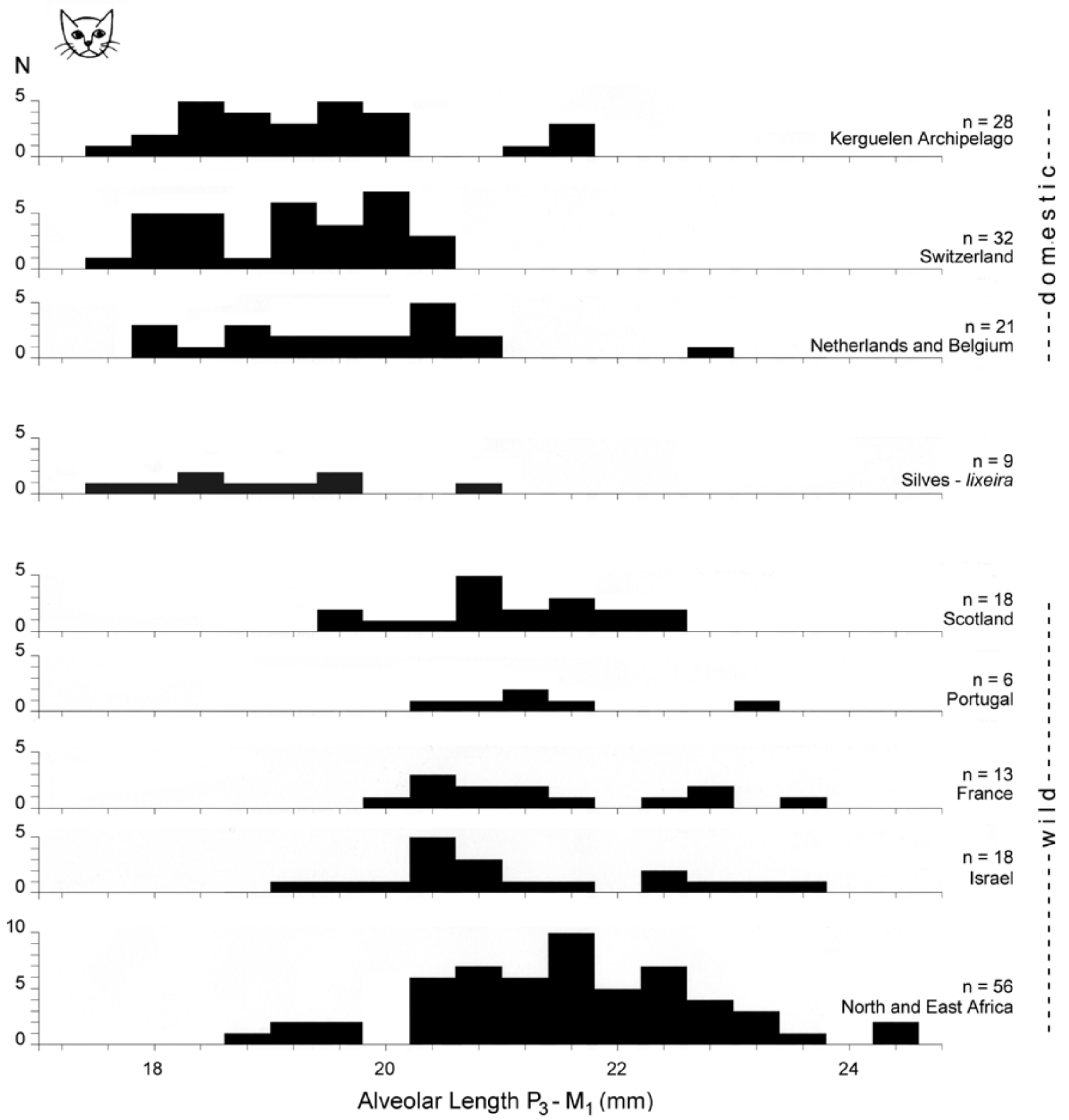

Fig. 13 Osteometric distinction between wild and domestic cat. Stacked histograms of measurements of the alveolar length of the mandibular cheek teeth P_3 - M_1. From top to bottom: feral domestic cats from the Kerguelen Archipelago and from the Bern region of Switzerland, domestic cats from the Netherlands and Belgium, nine *Felis* mandibles from Silves-*lixeira*, wild cats from Scotland, Portugal, France, Israel, and Africa (Ethiopia, North and East Africa combined). Today wildcats tend to be somewhat larger than domesticated ones although there is considerable overlap. The Silves cats are small and probably therefore belonged to the domestic form. Specimens of domestic cats are from the following collections: Musée d'Anatomie comparée, Paris; and the Bern; Leiden and Amsterdam Natural History Museums. Specimens of wildcats are from various collections in Europe and Israel.

Whale

Several large fragments of bone, probably parts of vertebral centra, are identified as having belonged to whale (Fig. 14). One has cut marks on it and perhaps it was used as a chopping board. Whales were known in ancient times — they were described in the Bible — and as early as 350 BC Aristotle recognised that they are mammals and not fish. The actual hunting of whales also extends back many centuries; whales were caught by Norwegians off the Tromsö coast as early as the 9th or 10th century AD (Ellis, 1991, p. 41). While it is likely that the fragments from Silves-*lixeira* derive from beached animals, the possibility that whaling was already practised in Algarve at that time cannot be excluded — indeed the city's first charter or *foral*, of D. Afonso III dated 1266 (Silva, 1993, p. 23) mentions this activity. He wrote as follows: "*Também conserve para mim e todos os meus sucessores o direito de … e a baleação* [= whale hunting]*; e em tudo o mais excepto o sobredito dou e concede-vos foro, …*". This activity continued at least until the 16th century as the Manueline charter of 1504 mentions that all whales and other "royal fish" when caught are the property of the King (Silva, 1993, p. 194).

Fig. 14 A fragment of a large bone, probably a whale vertebra, with a chop mark (K7 24 1005; crate 5). Were people in Moslem Portugal hunting whales, or did this bone derive from a beached specimen?

Birds

Two species of bird dominate the avian fauna. One belongs to the *Gallus/Numida/ Phasianus* (*i.e.* chicken/guinea fowl/pheasant) group of closely related galliformes. The other, far less common, is the partridge. Most bones of the former group are difficult to identify to species (see for example MacDonald, 1992), although a number of tarso-metatarsals lack a posterior continuous keel and have an attached spur — typical of the chicken. No definite guinea fowl could be identified. This species was known to the ancient Greeks and Romans in Europe but was apparently forgotten in the Middle Ages and subsequently re-introduced by Portuguese explorers of the African coast at the end of the 16th century (Zeuner, 1963, p. 457). No definite pheasant, introduced into Europe by the Romans (Blank, 1984), could be identified via the criteria described by Cohen and Serjeantson (1986) and MacDonald (1992). For example, of 38 chicken-size proximal femora, none have foramina, so that the presence of pheasant seems very improbable. It is assumed that all the fowl-like bones belonged to chicken. No doubt the chicken was exploited for both its flesh and its eggs. The ratio of chicken to large mammal remains is similar to that found in the Moslem level at Alcáçova de Santarém. A histogram of distal widths of the humeri is skewed (Fig. 15) presumably due to the presence of a greater number of adult females than males. This kind of distribution may reflect an interest in egg production, and several of the broken femora and tibiae contained medullary bone — a characteristic of laying hens — suggesting an interest in egg production. The Moslems in Silves killed most of their cocks while still young and osteologically immature for eating, while hens were kept well into adulthood for both reproduction and for their eggs, and only subsequently killed for consumption. Today in the Maghreb and the Arab world in general eggs are much appreciated. In Moslem Andalusia eggs were consumed in great quantities by all strata of society, and Moslem physicians there also recommended eggs poached, soft-boiled or fried in olive oil (García Sánchez, 1996).

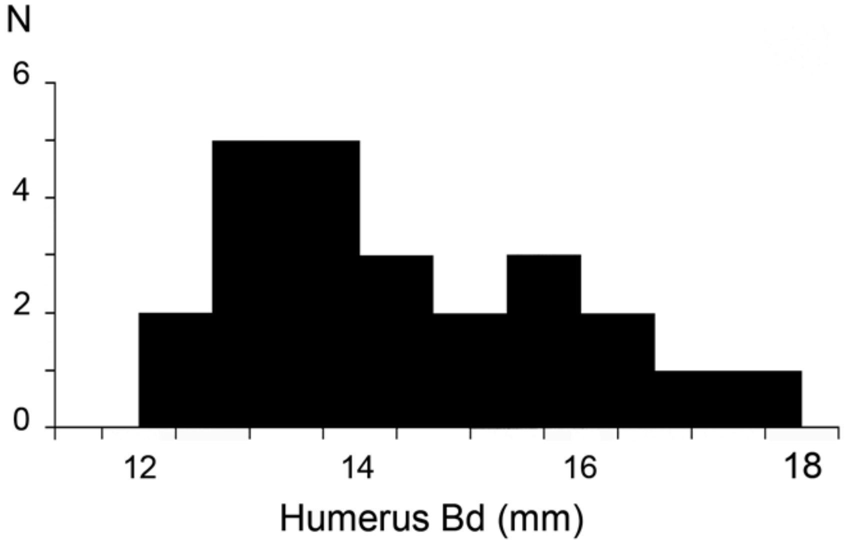

Fig. 15 The Silves chicken bones. A histogram of distal widths (Bd) of the humerus. Note the skewed distribution indicating a predominance of smaller specimens — presumably hens — were these retired egg-layers?

Among the bird bones are two distal humeri (Fig. 16) of a species of goose. They are possibly from the same animal. According to Zbigniew Bocheński of the Polish Academy of Sciences they are most probably *Anser anser* although *Anser fabalis* cannot be excluded. It is not possible to say whether the fragments belonged to a wild or domestic goose because the two forms overlap in size and the fragments are within the zone of overlap. A fragment of the shaft of a goose ulna that contains medullary bone was also noticed. Did this belong to a goose killed during her egg-laying period?

Like in many archaeological sites in Portugal, the partridge is well represented and is the second most abundant bird.

Fig. 16 Two goose distal humeri (K7 26 1003; crate 7 and L7 5 1034; crate 4). They are respectively from left and right side, and being similar in size and shape, could derive from the same bird. According to Bocheński (pers. comm.) they probably belonged to *Anser anser* or *A. fabalis*. If *A. anser* it is not possible to say whether they belonged to wild or domestic goose because the two forms overlap in size and the fragments here are within the zone of overlap.

Body-parts present (Table 8 and Fig. 17)

The caprine body-part frequencies show considerable variation. Horn cores are especially common and, as on most archaeological sites, the denser parts of the skeleton such as teeth, distal humeri, and distal tibiae are also well represented. The femur, a rather delicate bone and full of marrow, is generally scarce on archaeological sites presumably having been smashed to pieces beyond recognition. This certainly seems to be the case at Silves. In the case of the cattle body-part frequencies the discrepancies are less marked, although the femur and terminal phalanx is rather poorly represented. For both cattle and the caprines, there seems little evidence for any selection of particular parts of the carcass. All are there if in different proportions, and it is most probable that whole animals were brought in (one would assume alive) to the city for slaughter rather than being slaughtered at some distance and being brought in as prepared joints of meat.

Most of the discrepancies in the frequencies of different parts of the skeleton can be explained in terms of preservation and recovery biases (Brain, 1967, 1969; Payne, 1972). Greater variation in the caprine body-part profile may be explained in these terms. For example many more of the caprine smaller elements like phalanges are missed on excavation and even in the sieve (SD personal experience). Note especially the extreme scarcity of caprine terminal phalanges. Moreover, dogs which are known to swallow and often completely digest the small bones of sheep and goat (Payne & Munson, 1985) are less likely to swallow those of cattle — most of which are too big. The abundant horn cores, especially those of sheep and goat, probably represent the waste from a nearby horner's workshop (see below).

Table 8. Body-parts of cattle and sheep/goat present in the Silves-*lixeira*.

		Cattle		*Sheep/Goat*	
	Body part	***n***	**%**	***n***	**%**
Head	*Horn–core*	15	8	136	19
	Teeth	14	8	80	11
Fore-limb	*Scapula*	12	7	64	9
	Humerus	9	5	85	12
	Radius	12	7	24	3
	Metacarpal	14	8	30	4
Hind-limb	*Ischium*	8	4	38	5
	Femur	4	2	15	2
	Tibia	19	10	79	11
	Calcaneum	19	10	60	9
	Astragalus	17	9	24	3
	Metatarsal	20	11	35	5
Phalanges	*Phalanx I*	12	7	28	4
	Phalanx III	6	3	1	+

Each count in the "n" columns represents the minimum numbers of animals represented by that bone as given in table 4. Thus, for cattle there are 21 fused distal radii, 2 unfused epiphyses and 3 unfused distal metaphyses. Hence the maximum possible number of cattle represented by the distal radius is 21+3 divided by the number of radii per animal *i.e.* 24/2 which equals 12. Since some metapodials could not be identified as metacarpals or metatarsals, the "metapodials" counts are divided by 2 and the resulting number added to both the metacarpal and metatarsal counts. Many of the discrepancies between the frequencies of different parts of the skeletons represented are probably due to differential destruction and recovery (or recognition by excavators during excavation). No doubt scavenging animals like dogs also played a role. The low numbers of femora and third phalanges is quite common in zooarchaeological assemblages. It appears that all parts of the cattle skeleton are more or less equally present. The same probably applies to the sheep/goat, though here the discrepancies appear more marked. To some extent this may be due to greater *post-mortem* destruction of their smaller bones as well as removal of some of these by dogs. Both bones with less meat around them such as the metapodials and phalanges as well as those that have abundant meat such as the scapula, humerus, ischium and tibia are well represented. Did the *lixeira* serve both the wealthy and the poor? There is some indication of an over-abundance of sheep and goat horn cores. Perhaps the *lixeira* served not only as a domestic urban refuse pit but it also accepted waste from a local horner's workshop.

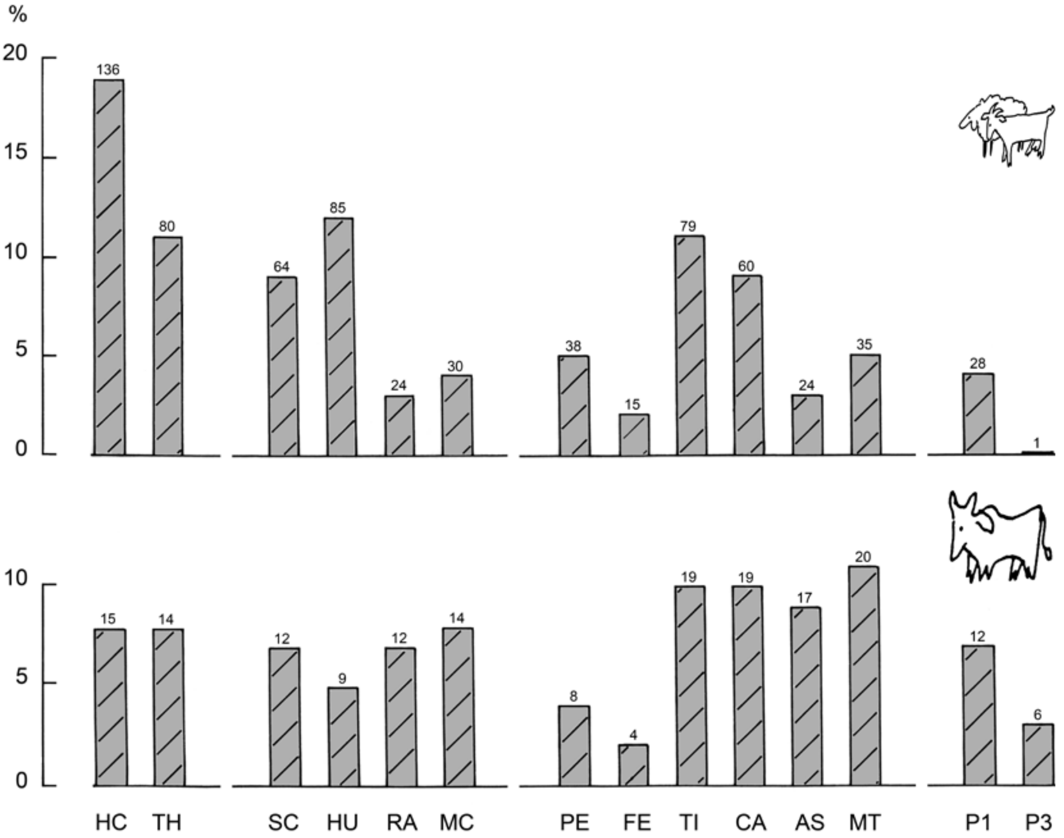

Fig. 17 Body part frequencies. The percentages of different parts of the skeleton of the caprines (sheep and goat) and cattle from Silves-*lixeira*. Data are given in tables 4 and 8; the latter also explains how these percentages are calculated. The numbers above each column are the minimum numbers of animals represented by that particular bone.
The frequencies of individual animals that can be accounted for by each bone are shown as vertical bars, labelled as follows: Head: HC – horn core, TH – teeth. Shoulder girdle and fore limb: SC – scapula, HU – humerus, RA – radius, MC – metacarpal. Pelvic girdle and hind limb: PE – pelvis, FE – femur, TI – tibia, CA – calcaneum, AS – astragalus, MT – metatarsal. Phalanges: P1 – proximal (first) phalanx, P3 – terminal (third) phalanx.
If all bones were to be present or to have suffered equal rates of *post mort*em destruction and loss during excavation then the bars would be of equal height. Variations of the heights of the bars may therefore reflect preferences for different parts of the animal carcass in antiquity, and/or differences in the preservation and recovery of the various bones. The patterns, overall, do not seem to be easily interpretable in terms of the first of these possibilities. Note some rather large differences in frequencies of bones that articulate with one another, especially for the caprines. This suggests that preservation and recovery played the major role in determining body-part representation. Discrepancies between different body parts are greater in the smaller caprines than in the cattle which could reflect poorer recovery of some of the smaller parts of the caprine skeleton like the terminal phalanges and astragali.

Burned, gnawed and partially digested bones

Almost 50 bones (caprine, cattle, chicken and an equid) show clear signs of burning and of these 12 were calcined and must have been burnt to a high temperature. These burnt bones come from various parts of the skeleton. Six bones of caprines and three of cattle had been gnawed — perhaps by dogs, and three chickens, one dog and a rabbit bone were punctured — perhaps by cat canine teeth. Five bones, all caprine, show signs of acid etching reminiscent of the kind of damage produced by stomach juices. These "partially digested" bones (an astragalus shown in Fig. 18, a distal femur, an unfused distal metacarpal epiphysis, a distal metatarsal and a calcaneum) may have been swallowed by dogs and subsequently survived passage through the gut (see Payne & Munson, 1985). Two caprine proximal phalanges show signs of rodent gnawing.

Fig. 18 A sheep astragalus (L7 5 1034; crate 4) showing clear signs of acid etching — probably the result of partial digestion in an animal's (perhaps a dog) stomach.

Age at slaughter (Tables 9 to 14)

There are few remains of calves. Most cattle were kept to old age and were probably therefore valued more for their so-called secondary products — power, dung and milk. Note, for example, the absence of milk dP_4 teeth and the small numbers of unfused limb-bone epiphyses. Rosenberger (1999), writing on Arab cuisine, mentions that:

> "beef was not much liked or widely eaten. Cows and oxen that gave milk or laboured in the fields had tough dry flesh. When young, they were of some gastronomic interest, but people were reluctant to sacrifice them."

The data for cattle contrast rather clearly with those for the sheep/goat — many of which were slaughtered quite young — especially the goats. Thus while there are no cattle dP_4s, 41% of the caprines were slaughtered while still in possession of this milk tooth. The other sheep/goat limb bones indicate a similarly high proportion of juveniles. For the few parts that can be identified to species level, it seems that goats were slaughtered young and sheep at a somewhat more advanced age. Of the 52 dP_4s that could be identified to species, 34 were goat and only 18 sheep and there are 32 unfused and 17 fused goat calcanea but 15 unfused and 23 fused sheep calcanea. A similar picture emerges from the counts of metapodials. It would appear then that the slaughter strategy for these two animals was quite different. In Portugal kid meat is much valued and perhaps this was already the case in Moslem times. No doubt the mature female goats were milked and perhaps their hair used for making carpets.

In the case of the red deer there are very few juvenile remains represented. This is characteristic of hunted wild ungulates, most of whose young fall victim to other predators besides man such as wolves and the larger felids. Domestic animals, of course, are less likely to suffer from carnivore predation as they are protected by their human owners!

Table 9. Silves-*lixeira*; wear stages of the cattle mandibular teeth (following Grant, 1982).

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*P*	*Total*
dP_4:	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
P_4:	–	–	1	–	–	2	10	–	–	–	–	–	–	–	–	–	–	13
M_1:	–	–	–	–	–	–	–	–	–	–	2	4	1	–	2	1	–	10
$M_{1/2}$:	–	–	–	–	–	–	2	2	–	1	2	4	1	–	–	–	1	13
M_2:	–	–	–	–	–	–	1	–	–	1	3	–	4	–	–	–	–	9
M_3:	–	1	–	–	–	1	3	1	–	5	6	5	3	1	–	–	2	28

These wear stages extend from teeth just erupted with unworn enamel (i.e., no dentine exposed) in stage “a” to teeth from very old animals with hardly any crown left. “P” includes teeth that could not be assigned to a wear stage. [Note the absence of dP_4 teeth.]

Table 10. Age at slaughter of the caprines at Silves-*lixeira* compared with caprines from the Iron Age, Roman and Moslem periods at Alcáçova de Santarém (Davis, 2006).

Stage:	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***n***
Months:	***0–2***	***2–6***	***6–12***							
Years:				***1–2***	***2–3***	***3–4***	***4–6***	***6–8***	***8–10***	
Silves:	–	11	3	13	**33**	20	15	2	3	66
Santarém Moslem	1	2	7	**26**	15	16	18	12	2	124
Santarém Roman	–	5	5	14	**27**	**27**	5	14	3	37
Santarém Iron Age	–	–	–	15	**26**	**26**	21	6	6	34

These are the percentages of mandibles assigned to Payne’s (1973) dental eruption and wear stages. Maxima are shown emboldened. [Note that the very young mandibles are predominantly goat. Thus 4 of the 5 mandibles in stage B, the 2 in stage C and 1 of the 8 mandibles in stage D were identified as definite goat. Unfortunately none of the mandibles, unlike isolated teeth as in table 11, could be identified as definite sheep.]

Table 11. Silves-*lixeira*; wear stages of the sheep/goat mandibular teeth (following Payne, 1987).

	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*P*	*Total*
dP4:																										
(CAH	–	–	–	–	–	–	–	–	2	2	2	2	1	8	–	–	6	4	3	1	2	–	–	–	1)	34
(OVA	–	–	–	1	–	2	–	1	–	1	–	–	–	6	2	–	2	1	1	–	–	–	1	–	–)	18
O	–	–	–	1	–	2	–	1	2	4	2	2	1	14	2	–	8	5	4	1	2	–	1	–	4	56
P_4:	6	2	2	4	5	4	2	4	15	4	–	1	21	–	1	6	–	–	–	–	–	–	–	–	4	81
M_1:	9	–	–	–	2	–	–	1	3	44	5	2	9	2	–	10	–	–	–	–	–	–	–	–	3	90
$M_{1/2}$:	3	2	3	–	4	11	3	22	20	66	2	–	3	–	–	1	–	–	–	–	–	–	–	–	15	155
M_2:	3	–	2	1	–	8	3	11	7	29	–	–	1	–	1	1	–	–	–	–	–	–	–	–	7	74
M_3:	18	3	19	5	6	9	2	3	8	4	7	22	1	–	–	–	1	1	–	–	–	–	–	–	17	126

These wear stages extend from teeth just erupted with unworn enamel (*i.e.*, no dentine exposed) in stage “0” to teeth from very old animals with hardly any crown left. “P” includes teeth that could not be assigned to a wear stage. Many of the deciduous fourth premolars could be identified to species. These are shown in parentheses, “CAH” goat and “OVA” sheep. “O” includes these and the 4 unidentified caprine dP_4s.

Table 12. Age at slaughter of the cattle at Silves-*lixeira*.

	Juv	*Adult*	*%juv*
Proximal phalanx	*2*	*90*	*2*
Tibia	*4*	*34*	*11*
dP_4/P_4	*0*	*13*	*0*
Calcaneum	*3*	*14*	*18*
Metapodials	*3*	*62*	*5*
Radius	*3*	*21*	*13*
Average			*6%*

Estimates of the percentages of juvenile animals calculated from the proportion of *deciduous fourth premolars* (dP_4) and unfused limb-bone epiphyses — *calcaneum/tuber calcis* (CA); *distal tibia; distal metapodials* (metacarpals and metatarsals combined); *proximal phalanx* and *distal radius*. For the estimates of juvenile tibia, metapodials, phalanges and radii, the larger of the two numbers — unfused epiphyses or metaphyses — is given. Clearly very few young cattle were slaughtered.

Table 13. Age at slaughter of the caprines (sheep and goats) at Silves-*lixeira*.

	Juv	*Adult*	*%juv*
Proximal phalanx	*26*	*193*	*12*
Tibia	*37*	*120*	*24*
dP_4/P_4	*56*	*81*	*41*
Calcaneum	*61*	*48*	*56*
Metapodials	*53*	*75½*	*41*
Radius	*32*	*16*	*67*
Average			*33%*

Estimates of the percentages of juvenile animals calculated from the proportion of *deciduous fourth premolars* (dP_4) and unfused limb-bone epiphyses — *calcaneum/tuber calcis*; *distal tibia; distal metapodials* (metacarpals and metatarsals combined); *proximal phalanx* and *distal radius*. For the estimates of juvenile tibia, metapodials, phalanges and radii, the larger of the two numbers — unfused epiphyses or metaphyses — is given. Although the samples are small, many caprines were slaughtered young.

Table 14. Silves-*lixeira*; the age at slaughter of the cattle, sheep and goat.

	Cattle			*Sheep and goat*			*Sheep*			*Goat*		
	Juv	*Adult*	*%juv*	*Juv*	*Adult*	*%juv*	*Juv*	*Adult*	*%juv*	*Juv*	*Adult*	*%juv*
P1	*2*	*90*	*2%*	*26*	*193*	*12%*						
TI	*4*	*34*	*11%*	*37*	*120*	*24%*						
dP_4/P_4	*–*	*13*	*0%*	*56*	*81*	*41%*	*18*	*?*	*?*	*34*	*?*	*?*
CA	*3*	*14*	*18%*	*61*	*48*	*56%*	*15*	*23*	*39%*	*32*	*17*	*65%*
MP	*3*	*63*	*5%*	*53*	*75,5*	*41%*	*3*	*40*	*7%*	*12*	*41*	*23%*
RA	*2*	*21*	*9%*	*32*	*16*	*67%*						

Estimates of the percentages of juvenile animals calculated from the proportion of *deciduous fourth premolars* (dP_4), and unfused limb-bone epiphyses — *calcaneum/tuber calcis* (CA), *distal tibia* (TI), *distal metapodials* (MP; metacarpals and metatarsals combined), *proximal phalanges* (P1), and *distal radius* (RA). For the estimates of juvenile tibia, metapodials, phalanges and radii, the larger of the two numbers — unfused epiphyses or metaphyses is given. Data for the dP_4s, calcanea and metapodials are subdivided to species for the caprines. Although the samples are small, it appears that few cattle were slaughtered young, while many more sheep and goat were slaughtered as young animals. This tendency to slaughter young caprines was even more pronounced for goats than sheep. The epiphyses and teeth are ordered according to their age-at-fusion. For example in sheep the epiphysis of the proximal phalanx is the earliest to fuse while the distal epiphysis of the radius is the last (see Silver, 1969; Hatting, 1983; Moran & O'Connor, 1994; Davis, 2000). The discrepancies (for example one should expect the proportions of juveniles to increase as we descend the list) are probably due to the vicissitudes of recovery and preservation.

Osteometry (measurements are provided in appendix I)

One important aspect of zooarchaeology is the investigation of animal bone and tooth size. Variations of size in the course of time may be extremely interesting. Besides registering the beginnings of animal domestication, size increases within lineages of domesticated animals like sheep and cattle are generally assumed to reflect artificial selection, *i.e.,* their "improvement" to increase meat yield, and in cattle, power. Whether a size change was caused by local selection or the introduction from afar of new breeding stock is usually difficult to determine. With its abundance of well preserved and therefore measurable bones, the Silves-*lixeira* collection contributes towards an understanding of the development of cattle and sheep in this corner of the Iberian Peninsula (Davis, 2008).

Cattle

Figures 3 and 4 show M_3 and astragalus size variation of *Bos* (cattle and aurochs) in southern Portugal since Mesolithic times. As mentioned above, the aurochs was larger than cattle by so great a margin that measurements of its bones generally form a separate peak in the histograms. The Chalcolithic astragali with widths greater than 50 mm must have belonged to aurochsen. Most of the specimens in the Chalcolithic (and subsequent periods) are smaller; they plot further to the left. These are assumed to have belonged to domestic cattle. The absence of the large-sized specimens after the Chalcolithic corroborates the finding of Castaños (1991) and others indicating that the aurochs disappeared from the western part of the Iberian Peninsula during or soon after the Chalcolithic.

Leaving aside the small numbers of very much larger specimens identified as aurochsen, the series of stacked histograms for each dimension of the domestic cattle indicate little change of size between Chalcolithic and Moslem periods. Indeed the sample from Silves appears to be even smaller than many of the others, and if anything indicates that this animal may have been somewhat neglected at that time in the Silves area. For a size increase or "improvement" of cattle we have to wait for the Christian invasion — the so-called *Reconquista*. Note the considerable size increase between the Moslem period and the 15th century. Figure 19 shows an astragalus and calcaneum which articulate and therefore probably belonged to the same animal. These are set besides an astragalus and calcaneum from a present-day Holstein dairy cow to illustrate the considerable size differences observable within cattle.

Fig. 19 Size variation within the species *Bos taurus*. On the right are a calcaneum and astragalus from Silves-*lixeira* (M7/N7 24/23 1001; crate 7), probably from the same animal, alongside, on the left, a calcaneum and astragalus from a modern adult Holstein cow (from a dairy herd in the Alentejo; CIPA reference collection N.º 1894). This shows just how small the Silves cattle had become.

Sheep

From the data collected to date from archaeological sites in the southern half of Portugal (Figs. 20, 21), it is clear that there was little substantial change in sheep bone size between Chalcolithic and Roman times. However, the Moslem period samples from Alcáçova de Santarém and Silves-*lixeira* show a marked and significant ($p < 0.1$) increase in size of the sheep. The measurements where this is clearest include humerus BT and HTC, astragalus GLl, Bd and Dl. One possible explanation is that this size increase reflects a shift in the sex ratio of these samples of adult sheep bones, with fewer of the larger males in the Roman period and more males in the Moslem period "causing" an increase in the average size of the sheep bones. But the degree of sexual dimorphism in the sheep (unlike many other artiodactyl species like goats, fallow deer and cattle) is small and especially small for certain measurements considered here such as humerus HTC and Astragalus GLl (Davis, 2000). Take the measurement 'Humerus HTC'. Since the increase between Roman and Moslem periods of 'humerus HTC' is far greater than the 1% inter-sex size difference in Shetland sheep today (Davis, 2000), we can infer that the Roman-Moslem size increase is a real one and not one due to a change in the sex ratio. The "t" tests (see Table 2 in Davis, 2008) indicate that the average differences between Moslem and pre-Moslem samples of sheep bones are statistically significant. Following the Moslem period there was a further increase in size. The modern Churra da Terra Quente ewes, for example, are large by Roman standards, and the Merino ewes are similar in size to the sheep from 15th century Beja.

If we accept the assumption that a size increase in a lineage of domesticated animals signifies their improvement, we need to ask why this happened to the sheep in Moslem times. Can we link this change to what we know about the Moslems of the Iberian Peninsula and with Moslem preferences and farm animal exploitation? An improvement of sheep by the Moslems is hardly a great surprise given their well known contributions to Iberian agriculture (Watson, 1974; 1983; Glick, 1979; Guichard, 2000 and see above) and the esteem with which they held, and still hold, mutton. Perhaps in part because Islam forbids the consumption of pork, the Arabs have a strong preference for mutton (Khayat & Keatinge, 1959; Benkheira, 1999). In his review of early Arab cuisine, Rosenberger (1999) writes that beef was not much liked and cows and oxen gave milk or laboured in the fields. Most meat came from the vast flocks of sheep. The Arabs liked the taste of mutton and the abundant fat that it provided, and Arab physicians regarded the meat of the yearling lamb as being close to perfection. Glick (1979, p. 66) notes that in 400 years the pattern of agriculture that emerged in al-Andalus included an increase, over Roman times, in the economic significance of sheepherding. Glick's interesting remarks concerning Moslem versus Christian attitudes are relevant here. He writes (p. 103):

> To a society of town-dwellers and agriculturalists the sheep was an animal primarily raised for meat; its wool was a by-product. The Christians of the later middle ages turned the equation around: they cared only for wool and ascribed a low value to the meat.

This corroborates what "Old Fernando" (quoted in Luard, 1984, p. 117) had to say about mutton:

> Old Fernando, who told me the Moors were the best thing that ever happened to Spain, had at the same time the common Andaluz prejudice against eating lamb on the grounds that it was 'Moors' food' and therefore not worthy of Christians.

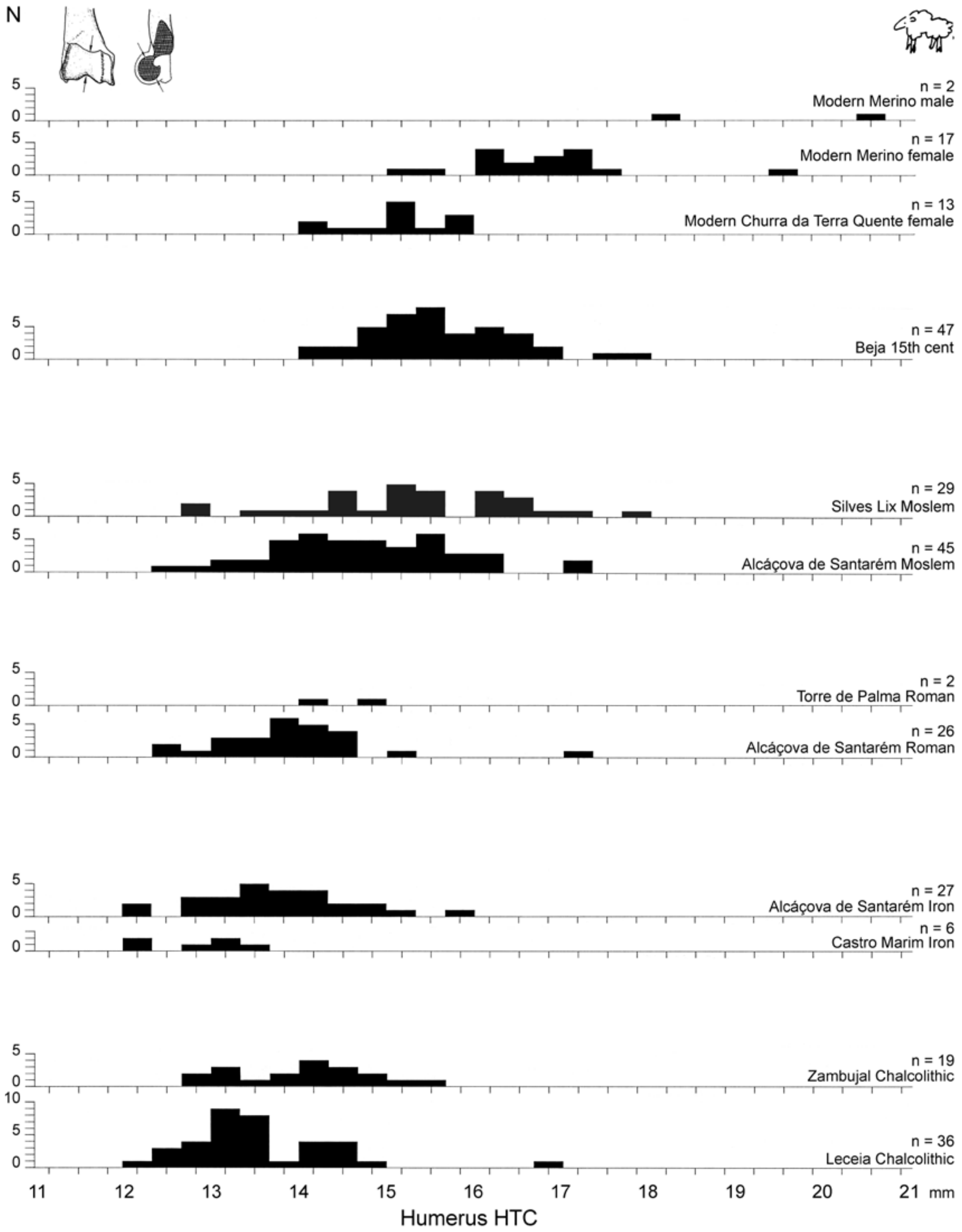

Fig. 20 The increase in size of sheep in southern Portugal since Chalcolithic times — a comparison with the Silves sheep. These are stacked histograms of measurements of the sheep humerus minimum trochlea diameter (HTC) from bottom to top as follows: Chalcolithic, Iron Age, Roman, Moslem, 15th century AD Beja, and modern Churra da Terra Quente ewes, Merino ewes and two Merino males. Note the increase in size between Roman and Moslem periods. Humerus HTC is a measurement that shows almost no sexual dimorphism in unimproved Shetland sheep (Davis, 2000) so the increased size of this part of the humerus must reflect a real increase in size of the sheep and not a change in the sexual composition of the samples.

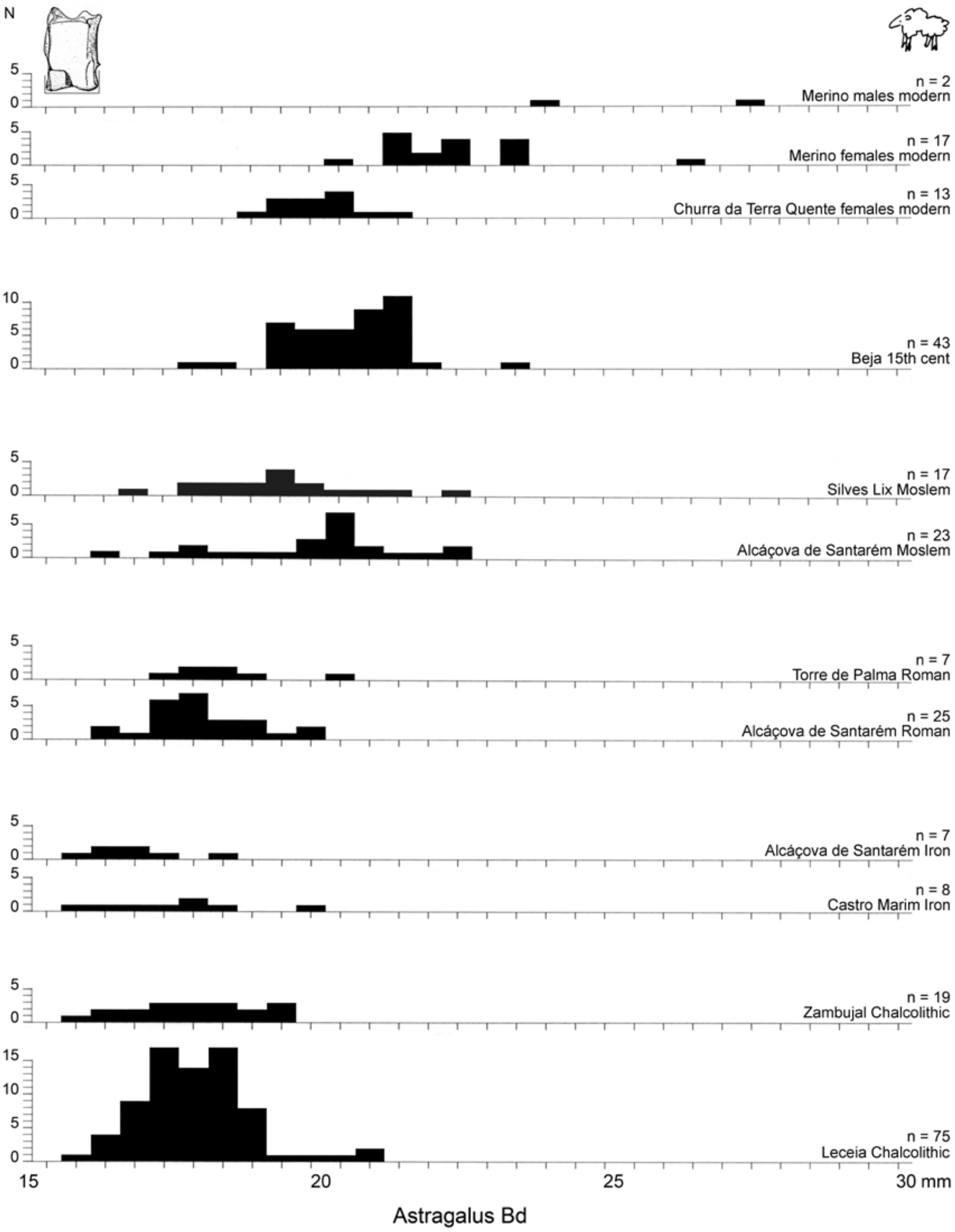

Fig. 21 The increase of sheep size in southern Portugal since the Chalcolithic — a comparison with the Silves sheep. These are stacked histograms of measurements of sheep astragalus distal width (Bd), from bottom to top as follows: Chalcolithic, Iron Age, Roman, Moslem, 15th century AD Beja and modern Churra da Terra Quente ewes, Merino ewes and two Merino males. Note the increase in size between Roman and Moslem periods.

Since higher meat yield in sheep is correlated with larger bones (Hammond, 1960, p. 131), it is logical to link the increased size of Moslem period sheep with their improved meat yield. This leads us to query how this may have happened. Did the Moslems improve the local sheep or did they import new stock from, say, the Maghreb or the Middle East? Evidence from the Cairo Genizeh indicates quite clearly that the Mediterranean world of the 11th and 12th centuries was a kind of medieval common market with the Islamic world forming a free trade area (Goitein, 1967). This communications network, shared by Christians, Jews and Moslems, expressed the notion (Glick, 1979, p. 27) that there was "blessing in movement" as the Arab proverb states "fi'l-haraka baraka". Moreover, Klein (1920, pp. 4-6) suggested that it was the Beni Merin Berbers who introduced the Merinos from northern Morocco during the Almohad expansion into southern Iberia. Not only was the Mediterranean important, but the Atlantic maritime trade between Spain, Portugal and the Maghreb at this time is also well documented (Picard, 1997). Klein also noted that many of the pastoral terms used to this day in Spain are of Arabic origin. There are indeed several likely etymologies of the word *merino* and possible origins of this most important breed of sheep (see for example Laguna Sanz, 1986; Sánchez Belda & Sánchez Trujillano, 1986) although Riu (1986) suggests that the Merinos resulted from cross-breeding of coarse-woolled ewes with north-African fine-woolled rams in the mid 14th century. Even today Merinos tend to be reared in the southern part of Spain and Portugal and they are genetically rather distinct from other breeds kept in central and northern Spain (Arranz & al., 1998). A genetic (mitochondrial DNA) study of seven modern breeds of Portuguese sheep (Pereira & al., 2006) reveals the presence of maternal lineages until now only found in the Middle East and Asia. A broad north-south pattern indicates a trend with southern Portuguese sheep clearly distinct from most other breeds. This is interpreted in terms of an influx of new genetic diversity, via a maritime route, although it is impossible at the moment to know when this happened. Clearly further studies, both osteological and genetic, of sheep remains dating back over the last two or three millennia in Portugal are needed, but it is tempting to imagine that at least some live sheep accompanied the oranges and lemons into the Iberian Peninsula.

Butchery

Table 15 provides a breakdown of chop and cut marks for each part of the skeleton. With their relatively large numbers, it is interesting to compare the butchery pattern of the caprines with that of the cattle. Unfortunately there are too few bones of the other taxa to enable any thorough discussion of this, though some remarks are in order.

A very large proportion of the cattle and caprine (27% and 44% respectively) horn cores had chop marks at their bases. Given the ease with which it is possible to distinguish between horn cores of sheep and goats it was possible to determine that 40% of the sheep horn cores and 50% of the goat were chopped in this way, and given this very small difference it is probably safe to state that these animals horns were treated in a similar manner. It seems most probable that these chops delivered to the base of the horn are evidence for horn working. Horn was the first 'plastic', an important commodity for making containers, combs, knife-handles and even windows of lanterns (Ryder, 1984). Thus these caprine and cattle horn cores are probably the waste from a horner's workshop.

A comparison of the figures for caprines and cattle indicates that in general the cattle bones had suffered a greater degree of butchery be it from the butcher's chopper or his knife. This is easily explained in terms of body size and what a household might have preferred to buy and/or consume in a given period. In other words the cattle carcasses were presumably butchered into a greater number of units while the sheep and goat were probably left as entire joints for household consumption. In general the cattle bones show a greater tendency for chopping than cutting while the caprines although showing more chopping than cutting, have relative greater proportion of cutting — probably due to the smaller size of sheep and goat it would make sense to use a knife rather than a chopper.

It is also worth noting that few caprine metapodials had been chopped (3-4%) while a much larger proportion of the cattle metapodials (40-50%) were chopped. Perhaps this disparity also reflects the tendency to chop away the feet of cattle but leave the feet on the carcass in the case of the caprines.

Table15. Silves-*lixeira*; bones with chop marks (CH) and cut marks (CT).

Bone	*Bos*		*O*		*S*		*CEE*		*ORC*		*LE*		*EQ*		*FEC*		*CAF*		*G*	
	CH	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*	*CH*	*CT*
Horn Core	8/8	1/1	120/272	1/272																
Scapula	8/24	2/24	13/128	11/128	0/1	1/1	0/1	0/1	0/17	0/17	0/3	0/3	0/2	0/2	–	–	0/3	0/3		
Humerus	6/18	1/18	8/170	9/170	0/1	1/1	0/1	0/1	0/36	1/36	0/4	0/4	?1/2	0/2	0/12	0/12	0/2	0/2	0/31	1/31
Radius	3/26	0/26	1/56	0/56	–	–	–	–			–	–	–	–	–	–	0/1	0/1		
Metacarpal	13/25	7/25	2/63	1/63	–	–	1/1	0/1					0/3	1/3	–	–	0/2	1/2		
Pelvis	5/16	1/16	9/76	4/76	–	–	0/1	0/1	2/84	2/84	0/9	0/9	0/4	0/4	0/6	0/6	0/3	0/3		
Femur	0/10	1/10	3/45	1/45	–	–	0/1	0/1	0/43	0/43	0/2	1/2	0/1	0/1	0/1	0/1	0/1	0/1	0/54	8/54
Tibia	15/41	3/41	13/167	1/167	–	–	1/2	0/2	0/5	1/5	0/2	0/2	1/4	0/4	0/7	0/7	0/2	1/2	0/33	13/33
Calcaneum	4/37	1/37	1/119	0/119	–	–	0/2	0/2	–	–	–	–	0/2	0/2	–	–	0/1	1/1		
Astragalus	7/34	3/34	0/47	1/47	–	–	3/8	0/8	–	–	–	–	0/1	0/1	–	–	–	–		
Metatarsal	13/36	3/36	3/70	0/70	–	–	–	–					1/4	0/4	0/1	0/1	–	–	0/14	0/14
Phalanx I	9/92	2/92	1/219	0/219	–	–	–	–					0/10	0/10	–	–	–	–		
Phalanx III	0/41	0/41	0/5	0/5	–	–	–	–					0/2	0/2	–	–	–	–		
Metapodial	2/5	0/5	0/6	0/6	–	–	0/1	0/1					0/4	1/4			0/1	0/1		

Recorded halves are rounded up. For each bone of each species the numerator represents the number with chop or cut marks and the denominator the total count for that particular bone (juveniles and adults combined).
*Note that two caprine (one sheep and one goat) horn cores were sawn. Key: Bos – cattle, O – sheep and goat, S – pig or wild boar, CEE – red deer, ORC – rabbit, LE – hare, EQ – horse or donkey, FEC – cat, CAF – dog, G – probable chicken.

Much of the butchery (see Fig. 22) appears rather crude. Thus many of the distal ends of the cattle metapodials had chop marks above their articulation with the phalanges.

Figure 23 shows an equid tibia with clear signs of chopping across the distal part of the shaft. Other equid bones showing signs of butchery include a cut mark on a metacarpal and a metapodial, and a chopped metatarsal. A humerus may also have a chop mark but it is unclear, and as mentioned earlier, an equid metapodial is burnt. Thus four or five out of a total of 39 recorded equid bones show signs of butchery. In the Moslem period at Alcáçova de Santarém, 17 of 69 equid bones had cut and/or chop marks while equid remains from earlier levels there show no evidence for such marks. Horsemeat is generally not eaten in much of the Old World today (and in the recent past), and Rosenberger (1999) writes that in the early Arab world, although horsemeat was not taboo, no one ate it. Mule and donkey meat was despised, and only in times of absolute need would anyone eat it. The Prophet Mohammed never ate horseflesh, though he did not declare it unlawful. This has led to some doubt about the legality of hippophagy in Islam. Abu Hanifah (AD 699-767), who founded the Hanifite School of Islamic jurisprudence, declared it unlawful and most Moslems in the Near East avoid horseflesh (Simoons, 1994, p. 179). Despite these religious condemnations,

Fig. 22 Distal cattle metacarpal with crude chops marks across the shaft just above the condyles. This is just one example (O7 15 1019; crate 3) that illustrates the manner in which many ungulate long bones were crudely butchered in Silves. Perhaps the butcher was trying to remove the phalanges and missed – evidence of untrained workmanship or is this a case of "do-it-yourself" butchery at home?

Fig. 23 Distal tibia of an equid, probably a horse, with chop marks across the lower part of its shaft (P6 14 1020; crate 3). Are these marks evidence for hippophagy and if so who ate the horse meat?

Fig. 24 A dog calcaneum that has several clear cut marks across the lower part of the plantar edge (M7 6 1036; crate 7). Is this evidence for the consumption of dog flesh or merely the skinning of the animal? Both possibilities are strange given the low esteem with which the dog is held among Moslems.

horse meat was sold in butchers' shops and eaten by a minority of town dwellers in the Moslem world (Benkheira, 1999). Does the presence of butchered (and burnt) equid bone in both Silves and the Moslem level of Santarém signify consumption of horseflesh by the inhabitants of these sites? One possibility is that horseflesh was fed to dogs, an activity that almost certainly required butchery of the equid carcass. Given the general dislike of the dog in the Moslem world, this explanation seems unlikely and these marks on the equid bones are an enigma. Moreno García & al. (2006) describe animal bone anvils and perforated bone objects from Moslem Silves. Some of these were made from equid bones (including radius, metacarpal, tibia and metatarsal) so it is possible that these "butchery" marks on the equid bones were made in the course of preparing bone implements.

Perhaps the strangest example of butchery at Silves (Fig. 24) is a dog calcaneum with knife cut marks across its planter edge. It is difficult to believe, given the general low opinion of the dog held by Moslems, that this animal was butchered and consumed! Of course it may simply be evidence that this dog had been skinned, but again it is difficult to imagine that dog skins were supplied to the local tanners. One other rather remote possibility is that it evidences dog sacrifice – part of a magical ritual as is not unknown in the high Atlas of Morocco (see Benkheira, 1999).

Pathology, trauma and aberrant conditions (Fig. 25)

It is usual that some domestic animal bones show signs of pathology and/or arthroses. In this respect the animal bones from Silves are no exception and several show such signs. For example a distal goat metacarpal is deformed and has what may have been a drainage canal, presumably to allow the exit of pus resulting from severe infection. A caprine mandible shows probable *pre-mortem* loss of the fourth premolar, first and second molars and some widening of the bone in this region.

Fig. 25 Four caprine bones showing signs of trauma and/or disease. a) a caprine (probably goat) metatarsal (QM7 ESC.8A) with a severely deformed condyle. b) a caprine metatarsal (O7 17A 1017 crate 6) with deposition of extra bone around the shaft and some exostoses around the distal articulation c) a caprine radius (M or N7 10 1030 crate 6) with an inaccurately healed break of the shaft. Note the somewhat distorted shaft. Healing may have been accompanied by infection as there are drainage (?for pus) canals within the accreted bone around the site of breakage. Note the cut mark and the clean chop delivered across the distal end of the shaft. d) the central part of an adult caprine mandible (M7 8A 1034 crate 4) with P_2, P_3 and M_3 only. The P_4, M_1 and M_2 had probably been lost (or destroyed) long before the animal was slaughtered as the distance between P_3 and M_3 is short and the mandible ramus locally widened and curved upwards. This example resembles one shown in Franklin, 1950 (see his Plate 22, Fig. 2 lower right photo). Franklin links this irregularity with drought feeding on cereal rations of the young recently weaned animal.

A sheep calcaneum and a metatarsal also show signs of infection. Bony excrescences some three quarters down the shaft of a caprine tibia may reflect some kind of trauma or cancerous growth. A broken caprine radius had re-healed but at a slight angle. It is difficult to know precisely how to interpret these severe signs of arthropathy, infection and disease. One could argue that they reflect poor care on the part of their human owners. But equally one could argue that these problems were not inflicted directly by their owners but that the survival of animals with such apparently severe disabilities shows that some care was taken to keep these poor animals alive.

Perhaps most interesting is a cattle metatarsal (Fig. 26) with an asymmetric distal end — *i.e.* one condyle, in this case the medial one, is unusually wider than the other; the width of the medial condyle measures 28,6 mm while the lateral one measures 23,9 mm. This wide medial condyle shows up as an outlier, marked with an arrow, on the plot of WCM against WCL measurements of cattle metatarsals in Fig 27. A widening of the medial condyle may be due to overload on the foot joint between the distal metapodials and the proximal phalanx, and in most cases the medial condyle is wider than the lateral one. Bartosiewicz & al. (1997) illustrate several cases of modern draught cattle with these symptoms. However the possibility that soft ground may bring about the same condition needs to be considered. Did this metatarsal belong to an overworked plough ox?

Fig. 26 A cattle metatarsal (left side, K7 9 1013; crate 2). Note the widening of the medial condyle — an arthropathy often considered to result from excess strain in life *i.e.,* an animal used for its power.

Unlike the first and second lower molars which only have two pillars, the third molar tooth of artiodactyls is characterised by having three. The third and smallest one is the hypoconulid. Occasionally for some unknown reason it is missing or reduced. Of the 28 cattle M_3s in the Silves-*lixeira* collection, two have missing hypoconulids and a further one has a reduced hypoconulid (Table 16). Although only a small sample, 3 out of a total of 28 is a fairly high frequency for this aberrant condition. At several other sites in southern Portugal this condition seems to have been present in Iron Age (at Alcáçova de Santarém) and also at the Moslem period level at Alcáçova de Santarém — but not in the Roman period. One speculation is that reduced or missing hypoconulids is an inherited condition somehow related to inbreeding. Were the cattle in Moslem Silves and Iron Age Santarém inbred? Does the absence of this condition in Roman times reflect the greater movement of livestock around the country by Roman cattle herders? Greater movement of cattle by the Romans may be linked to Roman agricultural improvements — a tendency well known in the Roman Empire to the east and north but for which there is little other evidence from Portugal (see "osteometry" above).

Table 16. Cattle lower third molar (M_3) teeth with reduced (in parentheses) or missing hypoconulids — Silves-*lixeira* compared to the Iron Age, Roman and Moslem period levels at several other Portuguese sites.

Site	*Period*	*Number of M_3s with missing (+ reduced) hypoconulids*	*Total Number of Cattle M_3s*
Alcáçova de Santarém	*Moslem*	*3*	*12*
Silves-lixeira	*Almohad Moslem*	*2 (+ 1)*	*28*
Alcáçova de Santarém	*Roman*	*0*	*15*
Castro Marim	*Roman*	*0*	*1*
São Pedro Fronteira	*Roman*	*0*	*5*
Alcáçova de Santarém	*Iron Age*	*5 (+1)*	*19*
Castro Marim	*Iron Age*	*0*	*11*

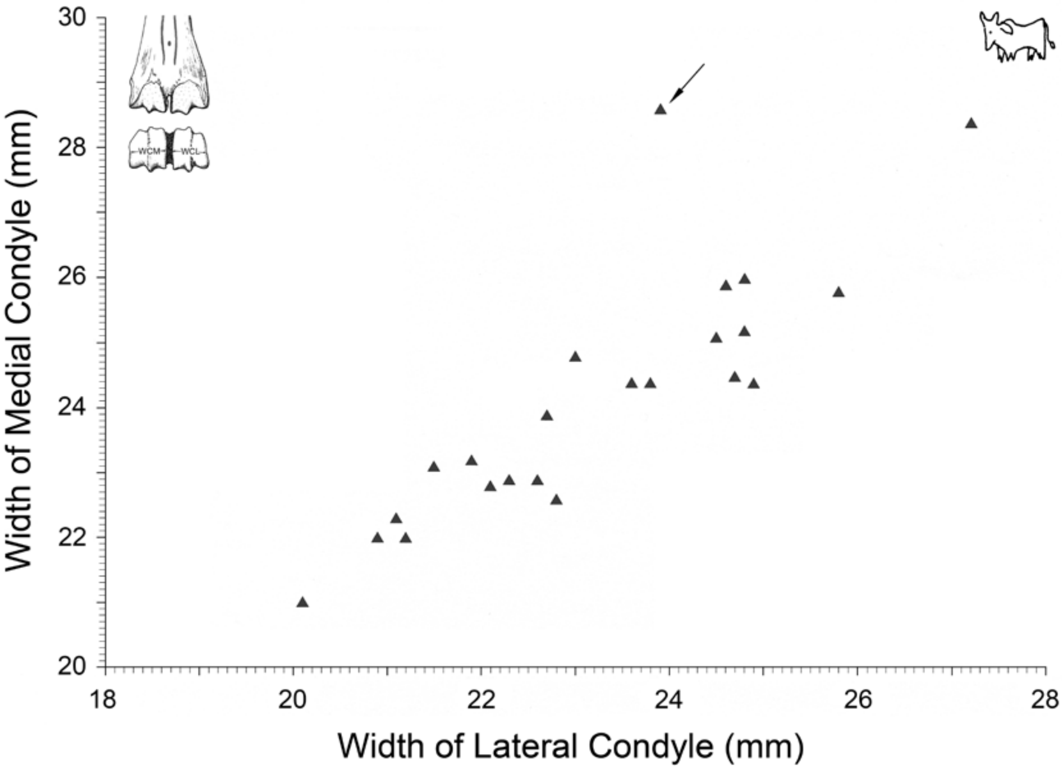

Fig. 27 A plot of the widths of the medial *versus* the lateral condyles (WCM *v* WCL) of cattle metatarsals at Silves-*lixeira*. Note the single specimen (arrowed) illustrated in Fig. 26 in which the medial condyle is considerably wider than the lateral one.

Fish remains, studied by Sonia Gabriel

Introduction

Fish remains, like those of other animals, have an important role in zooarchaeology: they aid in palaeo-environmental reconstruction, and indicate man's economic activities in the past (Casteel, 1976). They may also shed light on fishing methods, the regions of the sea exploited and the season when fishing was undertaken. Archaeological remains of fish can also be used to estimate the weight and size of individual specimens and their age at capture. These kinds of information are obtainable because fish, unlike domesticated animals, are still exploited as wild populations, and although their natural abundance has changed over time, it is probably safe to assume that their biology and morphometry have not changed to any great extent (Wheeler, 1979).

To date, studies of archaeological remains of fish from Portuguese sites are few in number. This is probably due to a) the negligence in recovery and recognizing fish remains in archaeological contexts, b) the inexistence, until recently, of an osteological reference collection, and c) the absence of dedicated ichthyoarchaeologists in Portugal. It is hoped that the data obtained from the Silves-*lixeira* fish remains will contribute towards our understanding of fish and fishing in ancient Portugal.

The size of the sample of fish bones is sufficient to:

a) provide a list of taxa, and
b) their frequencies,
c) calculate the minimum number of fish represented in the sample, and
d) provide a basic estimate of the representation of different parts of the body.

The biology of the taxa found is used to attempt to understand the regions whence the fish came and the fishing techniques used.

Material and methods

The fish remains, like those of mammals and birds (see above), are treated as a single sample. All fish bones were included in the counts. The identified portion includes those remains identified to family, genus or species. The minimum number of individuals (MNI) was calculated using paired elements following White (1953). To avoid distortion in the estimated MNI, intra-species bone size was considered (Bökönyi, 1970; Chaplin, 1971). Vertebrae were also considered when their features and size permitted assignment to species and/or location in the vertebral column. Measurements were taken using digital callipers (Appendix IV), in the manner recommended by Morales & Rosenlund (1979), and Roselló (1989). Body sizes were estimated by comparing the archaeological remains with skeletons in the CIPA reference collection of modern fish. Sizes indicated correspond to total length. The English nomenclature used for bones follows Wheeler & Jones (1989) and English and Portuguese names follow Sanches (1989).

Species identified and their frequencies (see Table 17 for quantitative data and MNI estimates)

Of the 88 fish bones studied, 75 could be identified to family, genus and/or species level. The identified remains comprise a minimum of 27 individuals belonging to 7 families of fin fishes, Muraenidae, Zeidae, Serranidae, Pomatomidae, Sciaenidae, Sparidae, and Mugilidae, and one family of cartilaginous fishes, Triakidae. Sparidae (Sea bream or Porgies) are the most common with 60 bones (NR) representing 80% of the total identified, followed by the Sciaenidae (Croakers) with 7% (NR = 5). The Muraenidae (Morays) and Serranidae (Groupers), each represent 4% (NR = 3), followed by Zeidae (Dories), Pomatomidae (Bluefish), Mugilidae (Mullets) and Triakidae (Houndsharks), each with some 1% (NR = 1) of the total identified.

These are mostly marine fish, native to the Iberian coastal ecosystem (Froese & Pauly, 2008). Some of the identified species: *Sparus aurata*, *Diplodus vulgaris* and *Mugil cephalus*, represent important commercial species in the River Arade (Gonçalves & al., 2006). Both *Argyrosomus regius* and *Mugil cephalus*, provide evidence for an inshore fishery. The Meagre *may* enter the coastal lagoons and estuaries to spawn, and the Flathead grey mullet is usually one of the most common species in estuaries and lagoons (Corbera & al., 1998). The Porgies are typically littoral fish, often occurring in coastal brackish water lagoons and estuaries for feeding and/or schooling, among them the Gilthead seabream (*Sparus aurata*) is frequent in those environments during spring (Froese & Pauly, 2008). *Pomatomus saltatrix* is a species normally found swimming with sharks. It migrates to warmer waters during winter and to cooler waters in summer. In Iberia today it is fished between May and December (Corbera & al., 1998). Though Bluefish are pelagic fishes, most common along surf beaches and rock headlands in clean, high energy waters, adults can also be found attacking shoals of mullet or other fish, in estuaries and brackish water (Froese & Pauly, 2008). The *Galeorhinus galeus*, *Muraena helena*, *Zeus faber*, *Epinephelus costae* and *Dentex gibbosus*, identified in Silves-*lixeira*, point to fishing in the coastal areas adjacent to the estuary of the River Arade. The Moray is a marine reef-associated species, commonly lurking in holes, and writhing through crevices under rocks. Besides being eaten fresh, broiled, boiled and baked, its skin can be used like leather (Froese & Pauly, 2008). It is possible that the identified fishes were caught with nets, and/or traps. Nets must have been used to fish the benthopelagic and pelagic species, and no doubt the larger fish that cannot be caught with other gear. Traps and lines are also likely to have been used for catching Morays and, accidentally or intentionally, other reef-associated species. Trapping is generally used in substrates where others gear are inadequate (Gonçalves & al., 2006).

Table 17. The fish from Silves-*lixeira*; numbers of remains (NR), percentages and estimates of the minimum number of individuals (MNI).

Taxon			*NR*	*%*	*MNI*
Latin name	*English name*	*Portuguese name*			
cf. Galeorhinus galeus	*Liveroil sharks*	*Cação*	1	1,3	1
Muraena helena	*Moray*	*Moreia*	3	4	2
cf. Zeus faber	*Atlantic John Dory*	*Galo-negro*	1	1,3	1
Epinephelus costae	*Golden grouper*	*Mero-amarelo*	3	4	2
Pomatomus saltatrix	*Bluefish*	*Anchova*	1	1,3	1

Sciaenidae indet.	*Croakers*	*Escienídeos*	*3*	*4*	–
Argyrosomus regius	*Meagre*	*Corvina-legítima*	*2*	*2,7*	*2*
Sparidae indet.	*Porgies*	*Esparídeos*	*13*	*17,3*	–
Dentex spp.	*Dentex*	*Capatões e dentões*	*3*	*4*	–
Dentex gibbosus	*Pink dentex*	*Capatão-de-bandeira*	*14*	*18,7*	*3*
Diplodus vulgaris	*Common two–banded seabream*	*Sargo-safia*	*1*	*1,3*	*1*
Pagelus spp.	*Pandoras*	*Besugos, bicas e gorazes*	*2*	*2,7*	–
Pagrus spp.	*Pargo breams*	*Pargos*	*9*	*12*	*4*
Pagrus pagrus	*Common seabream*	*Pargo-legítimo*	*6*	*8*	*5*
Sparus aurata	*Gilthead seabream*	*Dourada*	*12*	*16*	*4*
Mugil cephalus	*Flathead grey mullet*	*Tainha-olhalvo*	*1*	*1,3*	*1*
Total Identified			*75*		*27*
Unidentified			*13*		
Total			*88*		

Body-parts present (Table 18)

Head bones are the most commonly represented parts of the skeleton (NR = 50), followed by vertebrae (NR = 37). One other element present is a single unidentified scale. Most of the head bones, post-temporal, articular, dentary, maxilla, premaxilla and quadrate, belonged to the Sparidae (NR = 40), with higher values for the dentary (NR = 18) and the premaxilla (NR = 15). Usually vertebrae of this family are resistant to *post-mortem* destruction, but some jaw elements, namely the dentary and the premaxilla, appear to be even more resistant (Roselló & Morales 1990). This may explain their abundance, and the absence of loose molariform teeth (commonly preserved in the archaeological record when jaw bones are present), may be due to recovery bias. Other identified dentaries derive from the moray (*Muraena helena*, NR = 3) and the bluefish (*Pomatomus saltatrix,* NR = 1). The opercular bone present in the sample derives from a mullet (*Mugil cephalus*, NR = 1). Vertebrae derive from the finfish families — Zeidae, Serranidae, Sciaenidae, Sparidae, and the cartilaginous fishes Triakidae. Finfish bone survival is unpredictable, since the same skeletal element appears to show different probability of survival when comparing different species (Roselló, 1989). Skull bones tend to be damaged in the archaeological record. However, due to their characteristic morphology and robustness, vertebrae tend to be more common (Wheeler & Jones, 1989). Condrichthyes have a cartilaginous skeleton and lack true bones (Last & Stevens, 1994), however parts of their skeleton (vertebrae in particular), are often strengthened by the deposition of calcium salts. When this deposition is sufficient, these become calcified (Castro, 1983) and usually preserve in the archaeological record. This explains why calcified centra are among the most common cartilaginous fish remains found in the archaeological record.

Table 18. Fish body-parts identified in the Silves-*lixeira*.

	*Cranial/Facial bones (Head)**								*Vertebra*	*Others*
	PTP	***ART***	***DT***	***MX***	***PMX***	***QUA***	***OP***	***Unkn.***	***VRT***	***Scales***
Galeorhinus galeus	–	–	–	–	–	–	–	–	*1*	–
Muraena helena	–	–	*3*	–	–	–	–	–	–	–
Zeus faber	–	–	–	–	–	–	–	–	*1*	–
Epinephelus costae	–	–	–	–	–	–	–	–	*3*	–
Pomatomus saltatrix	–	–	*1*	–	–	–	–	–	–	–
Sciaenidae indet.	–	–	–	–	–	–	–	–	*3*	–
Argyrosomus regius	–	–	–	–	–	–	–	–	*2*	–
Sparidae indet.	*1*	*1*	*1*	*4*	–	–	–	–	*6*	–
Dentex gibbosus	–	–	*3*	*1*	–	*1*	–	–	*9*	–
Dentex spp.	–	–	*1*	–	–	–	–	–	*2*	–
Diplodus vulgaris	–	–	*1*	–	–	–	–	–	–	–
Pagelus spp.	–	–	*1*	–	–	–	–	–	*1*	–
Pagrus pagrus	–	–	–	*1*	*5*	–	–	–	–	–
Pagrus spp.	–	–	*1*	*1*	*6*	–	–	–	*1*	–
Sparus aurata	–	–	*6*	*1*	*4*	–	–	–	*1*	–
Mugil cephalus	–	–	–	–	–	–	*1*	–	–	–
Unidentified	–	*1*						*4*	*7*	*1*
Total NR	*1*	*2*	*18*	*8*	*15*	*1*	*1*	*4*	*37*	*1*

* Total bones (NR) for the head boanes is 50
Abbreviations used for bones: PTP – Post-temporal; ART – Articular; DT – Dentary; MX – Maxilla; PMX – Premaxilla; QUA – Quadrate; OP – Opercular; Unkn. – Unknown; VRT – Vertebra.

Size

The fish recovered from Silves-*lixeira* range between 30 and over 80 cm.

The *Muraena helena* remains correspond to animals over 80 cm long. The *Epinephelus costae* remains derive from one individual measuring some 73 cm, and another one greater than this. A *Pomatomus saltatrix* dentary corresponds to an animal measuring 86 cm. The *Argyrosomus regius* bones identified in the sample include two different size individuals, one between 60-70 cm, and another approximately 120 cm. The *Dentex gibbosus* remains include two individuals measuring 63 cm and 44 cm, and a third one corresponds to an individual over 63 cm long. The *Pagrus pagrus* remains include five animals; one probably some 54 cm, two smaller and one larger than 54 cm. The *Sparus aurata* identified derive from a fish smaller than 45 cm, and the other three correspond to animals larger than 45 cm. The *Mugil cephalus* corresponds to a fish some 30 cm in length.

Preservation

The fish remains from Silves-*lixeira* are generally well preserved, though some chemical and mechanical processes during burial may have affected their properties (colour, integrity, etc.). Some bones are burned, and others show breakage presumably made during processing for consumption. Though it is not possible to establish a processing pattern, human action is another presumed agent of degradation on bone before burial.

*Silves-*lixeira *and other* Almohad *sites in the southern Iberian Peninsula* (Fig. 1)

Perhaps due to its geographical proximity, the diversity of fish found in the Moslem site of Saltés (Morales & al., 1994) is similar to that of Silves-*lixeira*. As in Saltés, the sample identified in Silves is composed of marine species, and is clearly dominated by the Porgies. Besides these, Triakidae, Sciaenidae, Serranidae and Mugilidae were also identified at Saltés (Morales & al., 1994). However, the presence of the Scombridae: bluefin tuna and mackerel; and the pilchards (Clupeidae) in Saltés are presumed to indicate the existence of an offshore fishery (Morales & al., 1994) which may not have existed in Silves in Almohad times. The absence of pilchards from the Silves fish-bone collection may also reflect the absence of any offshore fishery, although one has to bear in mind that with their small bones, this species may have been lost during excavation.

According to Morales & al. (1994), Saltés, like Mértola and Calatrava, was a production and export centre for fish — mostly pilchards and porgies in the case of Mértola. Historians mention the existence of both a river port and shipyards in Silves, as well as the production and export of figs and wood (Coelho, 1989), indicating the navigability of the River Arade and the existence of commercial relations at the time. Is it possible that Silves formed part of the fish trade described by Morales & al. (1994)?

Conclusions — fish

Despite its small size, the sample of fish bones from Silves-*lixeira* is characterised by its diverse range of taxa (Fig. 28). It indicates the probable existence of an inshore marine fishery. Traps and especially nets as well as line fishing were probably used to catch fish. The fish bones and fragments from Silves-*lixeira* are mostly of considerable size. The most common are the head bones of Porgies, followed by vertebrae, probably because these are dense and robust, and their morphology makes them easy to identify. The absence of smaller elements such as loose molariform teeth, expected given the presence of jaw bones of Sparidae, may reflect recovery bias rather than a pattern resulting from fish processing techniques. We wonder whether this factor may explain the absence or underrepresentation of other smaller species from the Silves fish fauna.

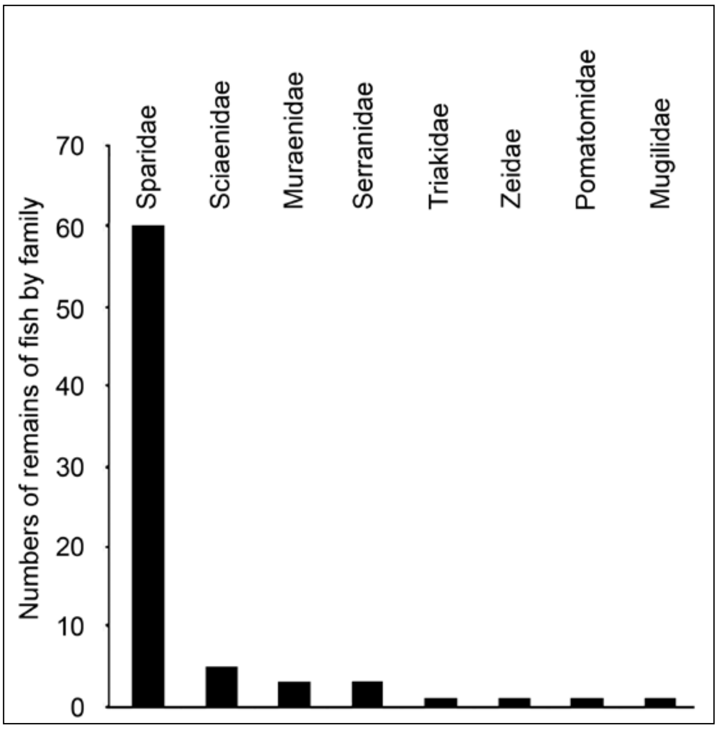

Fig. 28 Fish diversity in the Silves-*lixeira*: numbers of remains by family.

Molluscs (contribution by Maria José Gonçalves with the help of Rita Dias and Pedro Calapez)

For a full report see Gonçalves, Dias and Calapez (in press). Some 4500 individual molluscs (Table 19; the total number of bivalves shells was divided by 2 to provide an estimate of the number of individual molluscs originally present) were recovered from the Silves-*lixeira*. The clear predominance of two species — *Ruditapes decussata*, the carpetshell (a clam), and *Cerastoderma edule*, the common cockle, is quite striking. Both species live in sandy or muddy sandy bottoms and occur at or below mid-tide level. These molluscs are today much appreciated and may well indicate that the Moslem inhabitants of Silves, or at least some of them, did likewise! The scarcity of oyster shells in the *lixeira* is notable, but apparently oysters are well represented in other parts of Moslem Silves.

Table 19. Silves-*lixeira*. Numbers and percentages of mollusc shells. Percentages < 0.5% are left blank (Maria José Gonçalves, Rita Dias and Pedro Calapez unpublished).

Species	*Number*	%
Marine		
Ruditapes decussata	2076	47
Cerastoderma edule	1731	39
Acanthocardia tuberculata	29	1
Glycimeris bimaculata	58	1
Ostrea edulis	134	3
Crassostrea gigas	5	
Mytilus galloprovincialis	28	1
Pecten maximus	26	1
Chamelea gallina	6	
Venus verrucosa	1	
Donisia exoleta	2	
Mesalia brevialis	23	1
Charonia lampas	1	
Cerithium vulgatum	2	
Anomia ephippium	1	
Bolma rugosa	1	
Gibbula magus	1	
Solen marginatus	6	
Hiatella arctica	1	
Haminaea hydatis	1	
Vermetus triqueter	3	
TOTAL	**4136**	
Terrestrial		
Land snails	253	6
GRAND TOTAL	4389	100

Conclusions — general

This study of the animal remains from the Moslem period rubbish pit from Silves shows that the inhabitants of this city in the 12th/13th century were clearly relying for their meat on sheep and goats and to a lesser extent on beef. The chicken and its eggs undoubtedly served as an important source of protein too. Wild animals such as rabbits, hares, red deer, wild boar (or possibly pig), partridge, goose (perhaps domesticated) and other birds, as well as fish (especially the sparids or sea breams) and molluscs (mostly clams and cockles) also contributed to the diet.

Both juvenile and adult sheep and goat are well represented indicating both the exploitation of their meat and secondary products such as milk, wool/hair. In the case of the cattle, most were not slaughtered until old age indicating that this animal was valued more for its secondary products such as milk, power and dung.

Both donkeys and horses were present in Almohad Silves, and no doubt served as pack animals to negotiate the narrow and steep streets of this hill-top town.

The extreme scarcity of pig bones is most striking. This no doubt reflects the influence of the strict Moslem regime of the Muwahhadi Caliphs as well as the Yemeni origin of the people of Silves.

Another interesting aspect concerns the osteometry of the sheep and cattle bones in relation to similar data from other sites in southern Portugal. The great size of the sheep compared to those from preceding times may be linked to the so-called “Arab Green Revolution” of 11th and 12th century Moslem Andalucia. Here then, with the large sheep bones we have evidence for yet another aspect of this Revolution — improvements in the livestock sector.

Unlike the sheep, the cattle show no sign of a size increase — indeed they are even smaller than cattle from earlier times in southern Portugal. Was the bovine sector neglected by the Moslems of Portugal? The Arab disdain for beef is well documented and as we suggest above, this animal was used primarily as a source of power — presumably as a plough animal. More osteometric data from other sites of this period are needed from Portugal to understand whether Silves cattle were exceptionally small, perhaps a local “breed”, or whether a crisis occurred in the bovine sector in the 12th and 13th centuries.

Butchery patterns and the nature of the cut and chop marks indicate substantial processing of the carcasses and the use of horn as a raw material.

Acknowledgements

We are grateful to Cathy Douzil for reading an earlier draft of this report. MJG thanks Rebecca Dean and Pedro Calapez for help identifying the molluscs, Zbigniew Bocheński kindly attempted to identify one of the goose humeri and SG is grateful to Philippe Bèarez for commenting upon an earlier draft of the fish-bone section. We thank José Paulo Ruas for his excellent photographs.

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Appendix I

Measurements in tenths of a millimetre of mammal bones and teeth and bird bones from Silves-*lixeira*, organised by part of skeleton and taxon. Measurements taken are as in Driesch (1976) and Davis (1992, 1996) for artiodactyl metapodials. For equid teeth, see Fig. 2 in Davis, 2002. Approximate measurements are referred to in the "Notes" column.

Columns provide the following information:

"No" personal data-base accession number,
"Site" name of the site,
"Cont" crate number,
"Quad" square,
"Est" stratum
"Cam" level,
"Os" bone,
"Tax" identification to species or species group,
"Fus" state of fusion of epiphysis where relevant. F = fused, UE = epiphysis unfused,

Bones are coded as follows:

AS	astragalus
CA	calcaneum
HU	humerus
FE	femur
MC (MC1 or MC2)	metacarpal (MC1 complete distal end, MC2 single condyle)
MT (MT1 or MT2)	metatarsal (MT1 complete distal end, MT2 single condyle)
MP (MP1 or MP2)	metapodial (MP1 complete distal end, MT2 single condyle)
P1	proximal (first) phalanx
P3	terminal (third) phalanx
TI	tibia
TmT	tarsometatarsal

Mammalian taxa are coded as follows:

B	*Bos* (cattle)
CAF	*Canis familiaris* (dog)
CAH	*Capra* (goat)
CEE	*Cervus elaphus* (red deer)
EQ	Equid
EQA	*Equus asinus* (donkey)
EQC	*Equus caballus* (horse)
FEC	*Felis catus* (cat)
LE	*Lepus* (hare)
MAF	*Martes foina* (marten)
ORC	*Oryctolagus cuniculus* (rabbit)
OVA	*Ovis* (sheep)
S	*Sus* (wild boar/pig)
VUV	*Vulpes vulpes* (fox)

Bird taxa are coded as follows:

AL	*Alectoris* cf *rufa* (partridge)
ANS	*Anser* (goose)
G	*Gallus, Numida or Phasianus* (chicken, guinea fowl or pheasant)

Artiodactyl measurements – Teeth (cattle only).

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Tax*	*M_3-wear stage*	*M_3-length*	*M_3-Wa*	*Notes*
25	Silves-lix	1	L7	6	1020	B	m		140	l.M_3 = c. 33 mm
26	Silves-lix	1	L7	6	1020	B	j	360	150	
63	Silves-lix	2	O6	10A	1030	B	j		144	
67	Silves-lix	2	O7	12	1024	B	j	352	147	
75	Silves-lix	2	K7	19	1020	B	k	345	144	length = approx
101	Silves-lix	2	L7	6	1020	B	k		150	
121	Silves-lix	2	L7	6	1020	B	b	349	138	
123	Silves-lix	2	K7	23	1006	B	g	361	153	
135	Silves-lix	3	N7	11	1031	B	k		149	
179	Silves-lix	3	N7	11	1031	B	f	349		
189	Silves-lix	3	N7	11	1031	B	k	343	149	
202	Silves-lix	3	L7	6	1020	B	f/g	328	147	
215	Silves-lix	3	M7	10	1020	B	h		149	
237	Silves-lix	4	J7	32	1001	B	l	359	156	
288	Silves-lix	4	L7	5	1034	B	k	353	167	
296	Silves-lix	5	L7	10	1032	B	l	353	154	
336	Silves-lix	5	J7	29	1005	B	j		147	
341	Silves-lix	5	M7	15	1024	B	l	346	165	
355	Silves-lix	5	K7	17A	1023	B	l		149	Hypoconulid missing
474	Silves-lix	7	J6	22	1005	B	m	327	149	length = approx
492	Silves-lix	7	M7	23	1003	B	l	342	154	
493	Silves-lix	7	M7/N7	24/23	1001	B	j		141	
531	Silves-lix	7	K7/L7	27/22	1001	B	g	346	146	

Artiodactyl measurements – Bones.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*Fus*	*GL*	*Bd*	*BT*	*HTC*	*Notes*
1416	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*HU*	*B*	*?*	–	–	*720*	*300*	*BT = approx*
1758	*Silves-lix*	*6*	*M7*	*10*	*1020*	*HU*	*?B*	*F*	–	–	–	*264*	
409	*Silves-lix*	*2*	*M7*	*10/11*	*1009/1020*	*HU*	*B*	*F*	–	–	–	*273*	
1216	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*HU*	*B*	*F*	–	–	–	*287*	
1786	*Silves-lix*	*6*	*M7*	*10/11*	*1020/09*	*HU*	*B*	*F*	–	–	–	*288*	
209	*Silves-lix*	*1*	*L7*	*6*	*1020*	*HU*	*B*	*F*	–	–	–	*292*	
1565	*Silves-lix*	*5*	*N7*	*9*	*1034*	*HU*	*B*	*F*	–	–	–	*305*	
300	*Silves-lix*	*2*	*P6*	*12A*	*1024*	*HU*	*B*	*F*	–	–	–	*317*	
1417	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*HU*	*B*	*F*	–	–	–	*321*	
2178	*Silves-lix*	*7*	*M7*	*23*	*1003*	*HU*	*B*	*F*	–	–	–	*326*	
525	*Silves-lix*	*2*	*L7*	*7*	*1016*	*HU*	*B*	*F*	–	–	*605*	*273*	
1534	*Silves-lix*	*5*	*K7*	*LIMP*	*SUL*	*HU*	*B*	*F*	–	–	*641*	*276*	
2401	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*HU*	*B*	*F*	–	–	*649*	*283*	*Bd = approx*
1518	*Silves-lix*	*5*	*N7*	*7*	*1050*	*HU*	*B*	*F*	–	–	*712*	*317*	
1217	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*HU*	*B*	*F*	–	–	*772*	*333*	
2405	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*HU*	*CAH*	*F*	–	–	–	*134*	
1757	*Silves-lix*	*6*	*M7*	*10*	*1020*	*HU*	*CAH*	*F*	–	–	–	*144*	
114	*Silves-lix*	*1*	*M7*	*18*	*1020*	*HU*	*CAH*	*F*	–	–	–	*144*	
1418	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*HU*	*CAH*	*F*	–	–	–	*149*	
370	*Silves-lix*	*2*	*K7*	*4*	*1034*	*HU*	*CAH*	*F*	–	–	*270*	*120*	
1035	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*CAH*	*F*	–	–	*277*	*126*	
2270	*Silves-lix*	*7*	*J6*	*11*	*1028*	*HU*	*CAH*	*F*	–	–	*277*	*129*	
1901	*Silves-lix*	*6*	*L7*	*18*	*1020*	*HU*	*CAH*	*F*	–	–	*279*	*129*	
296	*Silves-lix*	*2*	*P7*	*5*	*1052*	*HU*	*CAH*	*F*	–	–	*280*	*132*	
656	*Silves-lix*	*3*	*M7*	*10*	*1020*	*HU*	*CAH*	*F*	–	–	*284*	*126*	*BT = approx*
1380	*Silves-lix*	*5*	*P6*	*10A*	*1030*	*HU*	*CAH*	*F*	–	–	*285*	*143*	
941	*Silves-lix*	*4*	*L7*	*14*	*1023*	*HU*	*CAH*	*F*	–	–	*286*	*123*	
2271	*Silves-lix*	*7*	*J6*	*11*	*1028*	*HU*	*CAH*	*F*	–	–	*291*	*132*	
1138	*Silves-lix*	*4*	*M7*	*8A*	*1034*	*HU*	*CAH*	*F*	–	–	*293*	*141*	
1827	*Silves-lix*	*6*	*L7*	*6*	*1020*	*HU*	*CAH*	*F*	–	–	*294*	*122*	
2177	*Silves-lix*	*7*	*M7*	*23*	*1003*	*HU*	*CAH*	*F*	–	–	*302*	*140*	
620	*Silves-lix*	*3*	*L7*	*8*	*1009*	*HU*	*CAH*	*F*	–	–	*303*	*132*	
1720	*Silves-lix*	*6*	*M7*	*11*	*1009*	*HU*	*CAH*	*F*	–	–	*304*	*142*	
526	*Silves-lix*	*2*	*L7*	*7*	*1016*	*HU*	*CAH*	*F*	–	–	*307*	*144*	
870	*Silves-lix*	*4*	*O7*	*11*	*1031*	*HU*	*CAH*	*F*	–	–	*308*	*149*	
1223	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*CAH*	*F*	–	–	*313*	*142*	
711	*Silves-lix*	*3*	*N7*	*13*	*1020*	*HU*	*CAH*	*F*	–	–	*316*	*141*	
1590	*Silves-lix*	*5*	*J7*	*30*	*1004*	*HU*	*CAH*	*F*	–	–	*316*	*152*	
1463	*Silves-lix*	*5*	*K7*	*6*	*1043*	*HU*	*CAH*	*F*	–	–	*317*	*133*	
997	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*CAH*	*F*	–	–	*318*	*148*	
1110	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*CAH*	*F*	–	–	*326*	*143*	
412	*Silves-lix*	*2*	*K7*	*9*	*1013*	*HU*	*CAH*	*F*	–	–	*331*	*141*	
423	*Silves-lix*	*2*	*L7*	*6*	*1020*	*HU*	*CAH*	*F*	–	–	*334*	*157*	*BT = approx*

Artiodactyl and Lepus measurements – Bones.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GL	Bd	BT	HTC	Notes
2243	Silves-lix	7	L7	7	1016	HU	CAH	F	–	–	335	143	
1222	Silves-lix	4	L7	5	1034	HU	CAH	FV	–	–	263	123	BT = approx
905	Silves-lix	4	I7/J7	21	1022	HU	CAH?	F	–	–	270	117	
890	Silves-lix	4	I7/J7	20	1024	HU	CAH?	F	–	–	274	127	
533	Silves-lix	2	L7	7	1016	HU	CAH?	F	–	–	293	133	
897	Silves-lix	4	J6	7	1038	HU	CAH?	F	–	–	308	136	BT = approx
1333	Silves-lix	5	P7	11	1024	HU	CAH?	F	–	–	326	146	
1938	Silves-lix	6	O7	6	1033	HU	CAH?	F	–	–	350	168	
322	Silves-lix	2	K7	19	1020	HU	LE	F	–	104	–	56	
1087	Silves-lix	4	M7	4A	1034	HU	LE	F	–	112	–	54	
1897	Silves-lix	6	M7	8	1034	HU	LE	F	863	105	–	57	GLC = 849
1820	Silves-lix	6	M7	10	1020	HU	LE	FV	–	102	–	52	
665	Silves-lix	3	N7	12	1024	HU	OVA	F	–	–	–	160	
999	Silves-lix	4	L7	5	1034	HU	OVA	F	–	–	260	128	
998	Silves-lix	4	L7	5	1034	HU	OVA	F	–	–	269	134	
408	Silves-lix	2	J7	13	1010	HU	OVA	F	–	–	277	142	
1349	Silves-lix	5	M7	18	1020	HU	OVA	F	–	–	281	145	
1566	Silves-lix	5	N7	9	1034	HU	OVA	F	–	–	285	139	
891	Silves-lix	4	I7/J7	20	1024	HU	OVA	F	–	–	285	150	
1941	Silves-lix	6	J7	24	1013	HU	OVA	F	–	–	293	156	BT = approx
636	Silves-lix	3	P7	3	1051	HU	OVA	F	–	–	297	155	
1225	Silves-lix	4	L7	5	1034	HU	OVA	F	–	–	299	144	
2404	Silves-lix	7	K7/L7	27/22	1001	HU	OVA	F	–	–	300	149	
30	Silves-lix	1	O7	8	1032	HU	OVA	F	–	–	306	155	
275	Silves-lix	2	N7	7	1050	HU	OVA	F	–	–	307	151	
271	Silves-lix	2	J7	11	1014	HU	OVA	F	–	–	310	152	BT = approx
2114	Silves-lix	7	J6	19	1014	HU	OVA	F	–	–	312	152	
1086	Silves-lix	4	M7	4A	1034	HU	OVA	F	–	–	316	161	
655	Silves-lix	3	M7	10	1020	HU	OVA	F	–	–	317	164	
1512	Silves-lix	5	P6	15A	1017	HU	OVA	F	–	–	318	160	
1755	Silves-lix	6	M7	10	1020	HU	OVA	F	–	–	325	165	
29	Silves-lix	1	L7	15	1021	HU	OVA	F	–	–	325	168	
1226	Silves-lix	4	L7	5	1034	HU	OVA	F	–	–	329	150	
1896	Silves-lix	6	M7	8	1034	HU	OVA	F	–	–	329	160	
4	Silves-lix	1	O7	17	1017	HU	OVA	F	–	–	332	177	
659	Silves-lix	3	N7	3B	1034	HU	OVA	F	–	–	338	165	
415	Silves-lix	2	N6/N7	16A/17A	1049	HU	OVA	F	–	–	339	171	BT = approx
1419	Silves-lix	5	M7(N)	10	1020	HU	OVA?	F	–	–	–	145	
1227	Silves-lix	4	L7	5	1034	HU	OVA?	F	–	–	269	129	
1756	Silves-lix	6	M7	10	1020	HU	OVA?	F	–	–	296	145	
1967	Silves-lix	6	P7	7	1050	HU	OVA?	F	–	–	317	156	
1739	Silves-lix	6	K7	12	1029	HU	S	F	–	–	327	201	

Artiodactyl measurements – Bones.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GL	Bd	Dd	WCM	DEM	WCL	DEL	SD	Notes
550	Silves-lix	2	L7	6	1020	MC1	B	F	–	–	–	295	224	–	–	–	Bd = 59 - 60 mm
1782	Silves-lix	6	J7	10	1015	MC1	B	F	–	–	310	–	245	269	228	–	
297	Silves-lix	2	P7	5	1052	MC1	B	F	–	470	256	228	197	222	183	–	
791	Silves-lix	3	N7	8	1032	MC1	B	F	–	475	254	225	194	223	184	–	Dd = approx
563	Silves-lix	2	K7	6	1043	MC1	B	F	–	477	270	233	210	223	195	–	
762	Silves-lix	3	N7	11	1031	MC1	B	F	–	502	258	242	193	236	180	–	
2310	Silves-lix	7	O6	5	1036	MC1	B	F	–	524	301	253	225	248	211	–	
606	Silves-lix	3	O7	15	1019	MC1	B	F	–	534	283	251	208	262	196	–	
1228	Silves-lix	4	L7	5	1034	MC1	B	F	–	539	277	261	203	254	188	–	
585	Silves-lix	3	N6	14	1031	MC1	B	F	–	566	283	274	223	270	210	–	
1008	Silves-lix	4	L7	5	1034	MC1	B	F	–	587	308	283	236	274	221	–	
157	Silves-lix	1	N7	17	1017	MC1	B	F	–	590	–	277	217	–	–	–	Bd & DEM = approx
1754	Silves-lix	6	M7	10	1020	MC1	B	F	–	595	295	278	218	285	238	–	Dd & WCM = approx
1434	Silves-lix	5	K7	10	1006	MC1	B	F	–	614	318	299	242	288	223	–	
1558	Silves-lix	5	N7	13	1020	MC1	B	F	–	741	334	363	276	346	257	–	
1415	Silves-lix	5	M7(N)	10	1020	MC1	B	F	1667	–	–	–	–	–	–	280	GL = v. approx
903	Silves-lix	4	L7	5	1034	MC1	B	F	1706	497	274	240	200	236	188	260	
1007	Silves-lix	4	L7	5	1034	MC1	B	F	1785	561	313	271	238	265	217	310	SD = approx
549	Silves-lix	2	L7	6	1020	MC1	B	F	1824	583	305	286	231	276	219	315	Dd & SD = approx
1229	Silves-lix	4	L7	5	1034	MC1	CAH	F	–	249	155	118	82	113	80	–	
336	Silves-lix	2	N7	6	1033	MC1	CAH	F	–	249	155	119	87	114	84	–	
2366	Silves-lix	7	P6	5	1036	MC1	CAH	F	–	251	154	118	87	116	84	–	
407	Silves-lix	2	J7	13	1010	MC1	CAH	F	–	251	154	118	91	112	85	–	
622	Silves-lix	3	L7	8	1009	MC1	CAH	F	–	251	159	121	91	117	93	–	
1230	Silves-lix	4	L7	5	1034	MC1	CAH	F	–	253	154	119	82	115	81	–	
575	Silves-lix	2	M7	7	1035	MC1	CAH	F	–	254	158	125	83	121	80	–	
1385	Silves-lix	5	M7	12	1033	MC1	CAH	F	–	255	161	120	91	115	88	–	
624	Silves-lix	3	L7	8	1009	MC1	CAH	F	–	266	160	124	95	124	98	–	drain cloaca – infectn.?
623	Silves-lix	3	L7	8	1009	MC1	CAH	F	–	273	166	132	95	127	93	–	
266	Silves-lix	2	O7	12	1024	MC1	CAH	F	1021	239	151	112	83	111	83	125	
1973	Silves-lix	6	P7	7	1050	MC1	CAH	F	1039	239	147	115	84	109	–	141	Bd = approx
1750	Silves-lix	6	M7	10	1020	MC1	OVA	EU	–	258	171	115	103	125	113	–	
307	Silves-lix	2	O7	12	1024	MC1	OVA	F	–	229	142	108	94	107	102	–	
1139	Silves-lix	4	M7	8A	1034	MC1	OVA	F	–	232	151	112	102	107	94	–	
1156	Silves-lix	4	L7	19	1009	MC1	OVA	F	–	234	–	108	99	114	107	–	
162	Silves-lix	1	P7	3	1051	MC1	OVA	F	–	241	152	110	101	115	107	–	Dd = approx
1401	Silves-lix	5	M7	22	1004	MC1	OVA	F	–	246	153	119	109	118	108	–	
820	Silves-lix	3	L7	6	1020	MC1	OVA	F	–	246	168	115	104	120	108	–	
1885	Silves-lix	6	M7	8	1034	MC1	OVA	F	–	254	158	120	102	125	106	–	
265	Silves-lix	2	O7	12	1024	MC1	OVA	F	–	269	173	128	114	129	109	–	Dd = approx
1983	Silves-lix	6	K7	10	1006	MC1	OVA	F	1263	256	160	125	111	119	104	–	
414	Silves-lix	2	K7	9	1013	MC1	OVA	FV	–	238	157	115	104	113	97	–	
567	Silves-lix	2	M7	9	1031	MC1	OVA	FV	–	252	162	121	106	119	99	–	
280	Silves-lix	2	O6	10A	1030	MC1	OVA?	EU	–	259	177	116	99	128	110	–	
306	Silves-lix	2	O7	12	1024	MC1	OVA?	F	–	272	169	125	107	130	112	–	Dd = approx
1886	Silves-lix	6	M7	8	1034	MC1?	OVA	EU	–	265	163	128	108	125	106	–	

Artiodactyl measurements – Bones.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GL	Bd	Dd	WCM	DEM	WCL	DEL	SD	Notes
548	Silves-lix	2	L7	6	1020	MC2	B	F	1782	–	–	–	–	–	–	–	badly damaged
1703	Silves-lix	6	K7	10	1006	MC2	CAH	F	–	–	–	116	84	–	–	–	
1327	Silves-lix	5	P7	11	1024	MC2	CAH	F	–	–	–	122	93	–	–	–	medial or lateral?
177	Silves-lix	1	K7	18	1015	MC2	CAH	F	–	–	–	127	88	–	–	–	
1467	Silves-lix	5	K7	6	1043	MC2	CAH	F	–	–	–	128	91	–	–	–	
2323	Silves-lix	7	O6	5	1036	MC2	OVA	F	–	–	–	126	116	–	–	–	medial or lateral?
122	Silves-lix	1	M7	19	1019	MC2	OVA	F	1302	–	–	–	–	–	–	154	
536	Silves-lix	2	L7	7	1016	MT1	B	F	–	–	–	233	189	–	–	–	
1923	Silves-lix	6	P6	14	1020	MT1	B	F	–	–	305	–	224	–	204	–	badly broken
1931	Silves-lix	6	J7	23	1014	MT1	B	F	–	435	254	210	192	201	178	–	
953	Silves-lix	4	J7	16B	1006	MT1	B	F	–	447	255	220	–	209	185	–	Dd = approx
942	Silves-lix	4	L7	14	1023	MT1	B	F	–	452	262	220	186	212	179	–	
1231	Silves-lix	4	L7	5	1034	MT1	B	F	–	461	267	223	193	211	183	–	
657	Silves-lix	3	M7	10	1020	MT1	B	F	–	462	265	231	195	215	178	–	
169	Silves-lix	1	J7	29	1005	MT1	B	F	–	470	274	229	199	223	186	–	
1414	Silves-lix	5	M7(N)	10	1020	MT1	B	F	–	473	273	228	206	221	188	–	
1791	Silves-lix	6	K7	6	1043	MT1	B	F	–	475	275	232	212	219	192	–	Dd = approx
2309	Silves-lix	7	O6	5	1036	MT1	B	F	–	477	–	226	192	228	182	–	
2119	Silves-lix	7	J6	7	1038	MT1	B	F	–	483	274	229	211	226	196	–	
431	Silves-lix	2	L7	6	1020	MT1	B	F	–	489	279	239	200	227	187	–	
1715	Silves-lix	6	M7	11	1009	MT1	B	F	–	499	–	244	200	236	187	–	
1218	Silves-lix	4	M7	4A	1034	MT1	B	F	–	504	292	248	219	230	203	–	
1595	Silves-lix	5	J7	30	1004	MT1	B	F	–	505	–	–	–	–	–	–	
2200	Silves-lix	7	M7/N7	24/23	1001	MT1	B	F	–	508	279	244	211	238	195	–	
2364	Silves-lix	7	P6	5	1036	MT1	B	F	–	511	–	245	208	247	197	–	
2416	Silves-lix	7	K7/L7	27/22	1001	MT1	B	F	–	520	274	244	202	249	196	–	
1963	Silves-lix	6	K7	22	1009	MT1	B	F	–	522	287	259	211	246	197	–	
1232	Silves-lix	4	L7	5	1034	MT1	B	F	–	526	300	251	221	245	215	–	
79	Silves-lix	1	N7	22	1004	MT1	B	F	–	532	286	252	214	248	204	–	Dd = approx
2363	Silves-lix	7	P6	5	1036	MT1	B	F	–	536	315	260	240	248	229	–	
535	Silves-lix	2	L7	7	1016	MT1	B	F	–	545	299	258	–	258	210	–	
410	Silves-lix	2	K7	9	1013	MT1	B	F	–	560	290	286	216	239	193	–	assymmetric
2225	Silves-lix	7	L7	4	1035	MT1	B	F	–	588	–	284	–	272	–	–	v. damaged by chop
344	Silves-lix	2	P6	14	1020	MT1	CAH	F	–	214	151	–	–	–	–	–	Dd = approx
1112	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	220	148	–	–	–	–	–	
356	Silves-lix	2	P6	10A	1030	MT1	CAH	F	–	221	145	–	–	–	–	–	
1235	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	226	149	–	–	–	–	–	
1704	Silves-lix	6	K7	10	1006	MT1	CAH	F	–	228	137	–	–	–	–	–	
992	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	228	142	–	–	–	–	–	
993	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	228	148	–	–	–	–	–	
168	Silves-lix	1	J7	29	1005	MT1	CAH	F	–	229	150	–	–	–	–	–	
1996	Silves-lix	7	N7	2	1036	MT1	CAH	F	–	233	142	–	–	–	–	–	Dd = approx
1233	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	233	152	–	–	–	–	–	
1413	Silves-lix	5	M7(N)	10	1020	MT1	CAH	F	–	236	152	–	–	–	–	–	
5	Silves-lix	1	O7	17	1017	MT1	CAH	F	–	236	157	–	–	–	–	–	
1234	Silves-lix	4	L7	5	1034	MT1	CAH	F	–	244	154	–	–	–	–	–	

Artiodactyl measurements – Bones.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GL	Bd	Dd	WCM	DEM	WCL	DEL	SD	Notes
2176	Silves-lix	7	M7	23	1003	MT1	CAH	F	–	252	157	–	–	–	–	–	
534	Silves-lix	2	L7	7	1016	MT1	CAH	F	1167	233	154	–	–	–	–	–	
621	Silves-lix	3	L7	8	1009	MT1	CAH	FV	–	212	–	–	–	–	–	–	
335	Silves-lix	2	N7	6	1033	MT1	OVA	F	–	226	157	–	–	–	–	–	
889	Silves-lix	4	I7/J7	20	1024	MT1	OVA	F	–	228	160	–	–	–	–	–	
1788	Silves-lix	6	M7	13	1032	MT1	OVA	F	–	229	154	–	–	–	–	–	
1891	Silves-lix	6	M7	8	1034	MT1	OVA	F	–	231	157	–	–	–	–	–	
1889	Silves-lix	6	M7	8	1034	MT1	OVA	F	–	236	149	–	–	–	–	–	
2199	Silves-lix	7	M7/N7	24/23	1001	MT1	OVA	F	–	238	158	–	–	–	–	–	
1140	Silves-lix	4	M7	8A	1034	MT1	OVA	F	–	239	163	–	–	–	–	–	
1751	Silves-lix	6	M7	10	1020	MT1	OVA	F	–	241	170	–	–	–	–	–	
819	Silves-lix	3	L7	6	1020	MT1	OVA	F	–	242	161	–	–	–	–	–	
594	Silves-lix	3	J6	20	1010	MT1	OVA	F	–	245	165	–	–	–	–	–	
1982	Silves-lix	6	K7	10	1006	MT1	OVA	F	–	245	174	–	–	–	–	–	
1522	Silves-lix	5	N7	7	1050	MT1	OVA	F	–	246	169	–	–	–	–	–	
650	Silves-lix	3	N7	16	1018	MT1	OVA	F	–	246	170	–	–	–	–	–	
810	Silves-lix	3	L7	17	1016	MT1	OVA	F	–	248	168	–	–	–	–	–	Dd = approx
912	Silves-lix	4	I7/J7	21	1022	MT1	OVA	F	–	251	161	–	–	–	–	–	
1521	Silves-lix	5	N7	7	1050	MT1	OVA	F	–	251	176	–	–	–	–	–	
902	Silves-lix	4	L7	5	1034	MT1	OVA	F	–	254	169	–	–	–	–	–	
1412	Silves-lix	5	M7(N)	10	1020	MT1	OVA	F	–	257	175	–	–	–	–	–	
1466	Silves-lix	5	K7	6	1043	MT1	OVA	F	–	268	178	–	–	–	–	–	
156	Silves-lix	1	N7	17	1017	MT1	OVA	F	–	271	182	–	–	–	–	–	
1141	Silves-lix	4	M7	8A	1034	MT1	OVA	F	–	277	189	–	–	–	–	–	
64	Silves-lix	1	L7	6	1020	MT1	OVA	F	1398	–	166	–	–	–	–	113	
932	Silves-lix	4	K7	6	1043	MT1	OVA	FV	–	258	179	–	–	–	–	–	
1890	Silves-lix	6	M7	8	1034	MT1	OVA	FV	–	267	169	–	–	–	–	–	
2365	Silves-lix	7	P6	5	1036	MT1	OVA?	F	–	233	155	–	–	–	–	–	Dd = approx
1487	Silves-lix	5	P7	8	1030	MT1	OVA?	F	–	235	150	–	–	–	–	–	
538	Silves-lix	2	L7	7	1016	MT1?	CAH	EU	–	245	154	–	–	–	–	–	

Artiodactyl and Lepus measurements – Bones.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*Fus*	*Bd*
1984	*Silves-lix*	*6*	*M7*	*10*	*1030*	*TI*	*B*	*F*	*476*
2146	*Silves-lix*	*7*	*P7/O7*	*18/20*	*1004*	*TI*	*B*	*F*	*496*
725	*Silves-lix*	*3*	*N7*	*13*	*1020*	*TI*	*B*	*F*	*497*
1753	*Silves-lix*	*6*	*M7*	*10*	*1020*	*TI*	*B*	*F*	*499*
779	*Silves-lix*	*3*	*N7*	*10*	*1030*	*TI*	*B*	*F*	*500*
728	*Silves-lix*	*3*	*N7*	*13*	*1020*	*TI*	*B*	*F*	*502*
672	*Silves-lix*	*3*	*L7*	*16*	*1019*	*TI*	*B*	*F*	*503*
170	*Silves-lix*	*1*	*J7*	*29*	*1005*	*TI*	*B*	*F*	*512*
171	*Silves-lix*	*1*	*J7*	*29*	*1005*	*TI*	*B*	*F*	*513*
654	*Silves-lix*	*3*	*M7*	*10*	*1020*	*TI*	*B*	*F*	*528*
2265	*Silves-lix*	*7*	*J6*	*11*	*1028*	*TI*	*B*	*F*	*528*
1000	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*B*	*F*	*529*
62	*Silves-lix*	*1*	*L7*	*6*	*1020*	*TI*	*B*	*F*	*548*
247	*Silves-lix*	*1*	*K7*	*22*	*1009*	*TI*	*B*	*F*	*556*
1158	*Silves-lix*	*4*	*O7*	*21*	*1001*	*TI*	*B*	*F*	*563*
1555	*Silves-lix*	*5*	*M7*	*15*	*1024*	*TI*	*B*	*F*	*567*
1658	*Silves-lix*	*6*	*J7*	*7*	*1028*	*TI*	*B*	*F*	*569*
727	*Silves-lix*	*3*	*N7*	*13*	*1020*	*TI*	*B*	*F*	*570*
1677	*Silves-lix*	*6*	*L7*	*6*	*1020*	*TI*	*B*	*F*	*571*
103	*Silves-lix*	*1*	*J7*	*19*	*1025*	*TI*	*B*	*F*	*585*
766	*Silves-lix*	*3*	*N6*	*16A*	*1049*	*TI*	*B*	*F*	*589*
1340	*Silves-lix*	*5*	*K7*	*8*	*1024*	*TI*	*B*	*F*	*596*
1300	*Silves-lix*	*4*	*l7*	*5*	*1034*	*TI*	*B*	*F*	*598*
28	*Silves-lix*	*1*	*L7*	*15*	*1021*	*TI*	*B*	*F*	*607*
724	*Silves-lix*	*3*	*N7*	*13*	*1020*	*TI*	*B*	*F*	*611*
726	*Silves-lix*	*3*	*N7*	*13*	*1020*	*TI*	*B*	*F*	*616*
1752	*Silves-lix*	*6*	*M7*	*10*	*1020*	*TI*	*B*	*F*	*620*
822	*Silves-lix*	*3*	*L7*	*6*	*1020*	*TI*	*B*	*F*	*625*
561	*Silves-lix*	*2*	*K7*	*6*	*1043*	*TI*	*CEE*	*F*	*477*
821	*Silves-lix*	*3*	*L7*	*6*	*1020*	*TI*	*CEE*	*F*	*502*
1937	*Silves-lix*	*6*	*O7*	*6*	*1033*	*TI*	*LE*	*F*	*132*
2331	*Silves-lix*	*7*	*P6*	*5*	*1036*	*TI*	*LE*	*F*	*148*

Artiodactyl measurements – Bones.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GL	Notes
2203	Silves-lix	7	M7/N7	24/23	1001	CA	B	F	1061	
1478	Silves-lix	5	L7	8A	–	CA	B	F	1157	definite Bos
15	Silves-lix	1	P6/P7	16	1049	CA	B	F	1163	
2418	Silves-lix	7	K7/L7	27/22	1001	CA	B	F	1165	GL = approx
1115	Silves-lix	4	L7	5	1034	CA	B	F	1175	
1965	Silves-lix	6	P7	7	1050	CA	B	F	1195	
524	Silves-lix	2	L7	7	1016	CA	B	F	1198	
1323	Silves-lix	5	N7	17A	1049	CA	B	F	1245	
301	Silves-lix	2	O7	12	1024	CA	B	F	1252	GL = approx
1038	Silves-lix	4	L7	5	1034	CA	B	F	1303	GL = approx
976	Silves-lix	4	O7	10	1030	CA	CAH	F	509	
277	Silves-lix	2	O6	10A	1030	CA	CAH	F	532	
1773	Silves-lix	6	N6	10A	1031	CA	CAH	F	545	
1406	Silves-lix	5	M7(N)	10	1020	CA	CAH	F	547	
888	Silves-lix	4	I7/J7	20	1024	CA	CAH	F	547	
1208	Silves-lix	4	J7	25	1009	CA	CAH	F	552	
1117	Silves-lix	4	L7	5	1034	CA	CAH	F	555	
1407	Silves-lix	5	M7(N)	10	1020	CA	CAH	F	557	
764	Silves-lix	3	N7	11	1031	CA	CAH	F	562	
1436	Silves-lix	5	N7	LIMP	–	CA	CAH	F	582	
1360	Silves-lix	5	K7	20	1014	CA	CAH?	F	533	
599	Silves-lix	3	N7	11	1031	CA	CAH?	F	551	
765	Silves-lix	3	N7	11	1031	CA	CAH?	F	575	
1775	Silves-lix	6	N6	10A	1031	CA	CAH?	F	606	
1443	Silves-lix	5	N7	LIMP	–	CA	CEE	F	1159	
2230	Silves-lix	7	L7	4	1035	CA	OVA	F	530	
523	Silves-lix	2	L7	7	1016	CA	OVA	F	540	
1573	Silves-lix	5	P7	5	1052	CA	OVA	F	551	
2056	Silves-lix	7	K7	26	1003	CA	OVA	F	560	
1540	Silves-lix	5	K7	LIMP	SUL	CA	OVA	F	566	
1329	Silves-lix	5	P7	11	1024	CA	OVA	F	569	
1774	Silves-lix	6	N6	10A	1031	CA	OVA	F	569	
2277	Silves-lix	7	M7	6	1036	CA	OVA	F	575	
1857	Silves-lix	6	M7	8	1034	CA	OVA	F	586	
1435	Silves-lix	5	N7	LIMP	–	CA	OVA	F	598	
1583	Silves-lix	5	K7	16	1024	CA	OVA	F	611	
1399	Silves-lix	5	M7	22	1004	CA	OVA	F	616	pathol: ?infection hole
977	Silves-lix	4	O7	10	1030	CA	OVA	F	622	
1694	Silves-lix	6	P6	14	1020	CA	OVA	F	628	
179	Silves-lix	1	K7	18	1015	CA	OVA	F	631	
925	Silves-lix	4	K7	6	1043	CA	OVA	F	633	
995	Silves-lix	4	L7	5	1034	CA	OVA	F	634	
1328	Silves-lix	5	P7	11	1024	CA	OVA	F	639	
1663	Silves-lix	6	K7	6A	1046	CA	OVA	F	639	

Artiodactyl measurements – Bones.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*GL*	*Bd*	*Dd*	*Notes*
944	*Silves-lix*	*4*	*L7*	*14*	*1023*	*AS*	*B*	*–*	*444*	*–*	
419	*Silves-lix*	*2*	*N6/N7*	*16A/17A*	*1049*	*AS*	*B*	*589*	*–*	*–*	*GL = approx*
471	*Silves-lix*	*2*	*N7*	*12*	*1024*	*AS*	*B*	*601*	*386*	*323*	
139	*Silves-lix*	*1*	*O7*	*7*	*1050*	*AS*	*B*	*616*	*–*	*–*	
1759	*Silves-lix*	*6*	*M7*	*10*	*1020*	*AS*	*B*	*587*	*365*	*323*	
1760	*Silves-lix*	*6*	*M7*	*10*	*1020*	*AS*	*B*	*596*	*363*	*314*	
1106	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*AS*	*B*	*–*	*344*	*–*	
1001	*Silves-lix*	*4*	*L7*	*5*	*1034*	*AS*	*B*	*576*	*396*	*318*	
1798	*Silves-lix*	*6*	*O7*	*13*	*1020*	*AS*	*B*	*650*	*394*	*353*	
641	*Silves-lix*	*3*	*J7*	*7*	*1028*	*AS*	*B*	*619*	*390*	*342*	*Dd = approx*
1883	*Silves-lix*	*6*	*M7*	*8*	*1034*	*AS*	*B*	*577*	*–*	*320*	
1884	*Silves-lix*	*6*	*M7*	*8*	*1034*	*AS*	*B*	*601*	*382*	*330*	
1377	*Silves-lix*	*5*	*P7*	*11*	*1024*	*AS*	*B*	*619*	*382*	*333*	
1964	*Silves-lix*	*6*	*P7*	*7*	*1050*	*AS*	*B*	*597*	*373*	*327*	
1411	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*AS*	*B*	*595*	*397*	*340*	
2204	*Silves-lix*	*7*	*M7/N7*	*24/23*	*1001*	*AS*	*B*	*482*	*322*	*264*	
823	*Silves-lix*	*3*	*L7*	*6*	*1020*	*AS*	*B*	*555*	*368*	*314*	
2278	*Silves-lix*	*7*	*M7*	*6*	*1036*	*AS*	*B*	*591*	*388*	*321*	
1935	*Silves-lix*	*6*	*O7*	*6*	*1033*	*AS*	*B*	*566*	*–*	*307*	
256	*Silves-lix*	*1*	*L7*	*17*	*1016*	*AS*	*B*	*–*	*388*	*–*	
943	*Silves-lix*	*4*	*L7*	*14*	*1023*	*AS*	*B*	*616*	*383*	*331*	
2128	*Silves-lix*	*7*	*P7/O7*	*18/20*	*1004*	*AS*	*B*	*609*	*353*	*333*	
2127	*Silves-lix*	*7*	*P7/O7*	*18/20*	*1004*	*AS*	*B*	*612*	*387*	*345*	
913	*Silves-lix*	*4*	*I7/J7*	*21*	*1022*	*AS*	*B*	*558*	*348*	*315*	
933	*Silves-lix*	*4*	*K7*	*6*	*1043*	*AS*	*B*	*–*	*–*	*352*	*= approx*
934	*Silves-lix*	*4*	*K7*	*6*	*1043*	*AS*	*B*	*612*	*403*	*347*	
325	*Silves-lix*	*2*	*K7*	*19*	*1020*	*AS*	*B*	*552*	*346*	*299*	
568	*Silves-lix*	*2*	*M7*	*9*	*1031*	*AS*	*CAH*	*281*	*180*	*139*	
754	*Silves-lix*	*3*	*M7*	*8*	*1034*	*AS*	*CAH*	*294*	*188*	*152*	
1221	*Silves-lix*	*4*	*L7*	*5*	*1034*	*AS*	*CAH*	*302*	*197*	*165*	
792	*Silves-lix*	*3*	*L7*	*17*	*1016*	*AS*	*CAH*	*300*	*199*	*153*	
869	*Silves-lix*	*4*	*O7*	*11*	*1031*	*AS*	*CAH*	*289*	*184*	*149*	
2057	*Silves-lix*	*7*	*K7*	*26*	*1003*	*AS*	*CAH*	*291*	*189*	*158*	
2358	*Silves-lix*	*7*	*P6*	*5*	*1036*	*AS*	*CAH*	*–*	*192*	*–*	
292	*Silves-lix*	*2*	*P7*	*5*	*1052*	*AS*	*CAH*	*255*	*170*	*131*	
2116	*Silves-lix*	*7*	*J6*	*19*	*1014*	*AS*	*CAH*	*294*	*195*	*148*	
1437	*Silves-lix*	*5*	*N7*	*LIMP*		*AS*	*CAH*	*258*	*174*	*136*	
2100	*Silves-lix*	*7*	*P6*	*5*	*1036*	*AS*	*CAH*	*283*	*188*	*152*	
760	*Silves-lix*	*3*	*N7*	*11*	*1031*	*AS*	*CAH*	*–*	*181*	*148*	
1826	*Silves-lix*	*6*	*L7*	*6*	*1020*	*AS*	*CAH*	*278*	*177*	*140*	
1762	*Silves-lix*	*6*	*M7*	*10*	*1020*	*AS*	*CAH*	*283*	*182*	*147*	
1761	*Silves-lix*	*6*	*M7*	*10*	*1020*	*AS*	*CAH*	*290*	*182*	*143*	
1698	*Silves-lix*	*6*	*K7*	*5*	*1044*	*AS*	*CAH*	*301*	*186*	*160*	
1499	*Silves-lix*	*5*	*M7*	*7*	*1035*	*AS*	*CAH*	*297*	*186*	*149*	
850	*Silves-lix*	*3*	*M7*	*10*	*1020*	*AS*	*CAH?*	*–*	*198*	*–*	
627	*Silves-lix*	*3*	*M7*	*14*	*1030*	*AS*	*CEE*	*–*	*322*	*282*	

Artiodactyl measurements – Bones.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*GL*	*Bd*	*Dd*	*Notes*
593	Silves-lix	3	J6	20	1010	AS	CEE	–	326	283	
2426	Silves-lix	7	K7/L7	27/22	1001	AS	CEE	529	333	287	
2222	Silves-lix	7	J6	18	1015	AS	CEE	480	304	266	
825	Silves-lix	3	L7	6	1020	AS	CEE	566	337	305	
824	Silves-lix	3	L7	6	1020	AS	CEE	–	348	–	
2425	Silves-lix	7	K7/L7	27/22	1001	AS	CEE	–	302	–	
245	Silves-lix	1	JF	27	1008	AS	CEE?	533	–	–	Bd=33–34mm
628	Silves-lix	3	M7	14	1030	AS	OVA	305	193	168	
1108	Silves-lix	4	M7	4A	1034	AS	OVA	325	206	178	
369	Silves-lix	2	K7	4	1034	AS	OVA	304	193	167	
818	Silves-lix	3	L7	6	1020	AS	OVA	282	192	155	
978	Silves-lix	4	O7	10	1030	AS	OVA	277	182	153	
1002	Silves-lix	4	L7	5	1034	AS	OVA	360	220	198	Bd = approx
1003	Silves-lix	4	L7	5	1034	AS	OVA	321	212	178	
1004	Silves-lix	4	L7	5	1034	AS	OVA	–	198	–	
1107	Silves-lix	4	M7	4A	1034	AS	OVA	321	203	182	Bd = approx
1142	Silves-lix	4	M7	8A	1034	AS	OVA	275	169	155	
1384	Silves-lix	5	M7	12	1033	AS	OVA	294	188	158	
2058	Silves-lix	7	K7	26	1003	AS	OVA	291	188	163	
2059	Silves-lix	7	K7	26	1003	AS	OVA	329	196	181	
2126	Silves-lix	7	J6	7	1038	AS	OVA	284	176	156	
2269	Silves-lix	7	J6	11	1028	AS	OVA	–	178	–	
2312	Silves-lix	7	O6	5	1036	AS	OVA	299	190	168	
1113	Silves-lix	4	L7	5	1034	AS	OVA?	285	184	154	all msmnts approx

Equid measurements.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*fus*	*GL*	*Bd*	*Dd*	*Bp*	*Dp*	*LmT*	*GH*	*GB*	*SD*	*Notes*
558	*Silves-lix*	*2*	*K7*	*23*	*1006*	*AS*	*EQ*	–	–	*495*	–	–	–	*605*	*595*	*609*	–	
543	*Silves-lix*	*2*	*L7*	*7*	*1016*	*MC*	*EQ*	*F*	–	*380*	*277*	–	–	–	–	–	–	
2434	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*MC*	*EQ?A*	*F*	*1829*	*347*	*258*	–	–	–	–	–	*246*	
828	*Silves-lix*	*3*	*L7*	*6*	*1020*	*MC*	*EQ?A*	*F*	*1898*	*391*	*286*	–	–	–	–	–	*266*	*?articulates with 829*
1975	*Silves-lix*	*6*	*N6*	*15*	*1020*	*MP*	*EQ*	*F*	–	*498*	*383*	–	–	–	–	–	–	
817	*Silves-lix*	*3*	*M7*	*21*	*1009*	*MP*	*EQ*	*F*	–	*526*	*409*	–	–	–	–	–	–	*probable horse*
2415	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*MP*	*EQ?C*	*F*	–	*512*	*408*	–	–	–	–	–	–	
539	*Silves-lix*	*2*	*L7*	*7*	*1016*	*MT*	*EQ?A*	*F*	*2290*	*341*	*286*	–	–	–	–	–	*236*	*probable ass*
2151	*Silves-lix*	*7*	*P7/O7*	*18/20*	*1004*	*MT*	*EQ?C*	*F*	*2649*	*431*	*350*	–	–	–	–	–	*274*	
559	*Silves-lix*	*2*	*K7*	*23*	*1006*	*MT*	*EQ?C*	*F*	*2716*	–	*380*	–	–	–	–	–	*306*	*probable horse*
1295	*Silves-lix*	*4*	*l7*	*5*	*1034*	*MT*	*EQA*	*F*	–	*292*	*234*	–	–	–	–	–	–	
2413	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*P1*	*EQ*	*F*	*769*	*354*	*212*	–	–	–	–	–	*250*	
782	*Silves-lix*	*3*	*N7*	*10*	*1030*	*P1*	*EQ*	*F*	*699*	*326*	*194*	–	–	–	–	–	*244*	*probable ass*
117	*Silves-lix*	*1*	*M7*	*18*	*1020*	*P1*	*EQ*	*F*	*720*	*342*	*197*	*423*	*305*	–	–	–	*245*	
829	*Silves-lix*	*3*	*L7*	*6*	*1020*	*P1*	*EQ?A*	*F*	*743*	*356*	*204*	*404*	*300*	–	–	–	*246*	
1023	*Silves-lix*	*4*	*L7*	*5*	*1034*	*P1*	*EQ?C*	*F*	*843*	*418*	*242*	*544*	*382*	–	–	–	*330*	
1157	*Silves-lix*	*4*	*L7*	*19*	*1009*	*P1*	*EQ?C*	*F*	*866*	*411*	*244*	*550*	*376*	–	–	–	*318*	
1433	*Silves-lix*	*5*	*K7*	*10*	*1006*	*P1*	*EQ?C*	*F*	*837*	*426*	*242*	*559*	*375*	–	–	–	*324*	
1549	*Silves-lix*	*5*	*K7*	*24*	*1005*	*P1*	*EQ?C*	*F*	*850*	*412*	*243*	*540*	*375*	–	–	–	*313*	
2414	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*P1*	*EQ?C*	*F*	*844*	*408*	*253*	*554*	*374*	–	–	–	*319*	
630	*Silves-lix*	*3*	*P6*	*14*	*1020*	*TI*	*EQ*	*F*	–	*712*	*434*	–	–	–	–	–	–	*Dd = approx*
610	*Silves-lix*	*3*	*L7*	*8*	*1009*	*TI*	*EQ*	*F*	–	*740*	*512*	–	–	–	–	–	–	*Prox epiph = U Dd = approx*
860	*Silves-lix*	*3*	*M7*	*10*	*1020*	*TI*	*EQ*	*F*	–	*604*	–	–	–	–	–	–	–	

Rabbit measurements.

No	Site	Cont	Quad	Est	Cam	Os	Tax	Fus	GLC	Bd	HTC	SLC	Notes
991	Silves-lix	4	L7	5	1034	HU	ORC	F	–	–	35	–	
50	Silves-lix	1	L7	5	1034	HU	ORC	F	–	–	38	–	
58	Silves-lix	1	O7	14	1023	HU	ORC	F	–	72	33	–	prox = U
65	Silves-lix	1	L7	6	1020	HU	ORC	F	–	72	35	–	
2329	Silves-lix	7	P6	5	1036	HU	ORC	F	–	74	35	–	
2085	Silves-lix	7	O6	5	1036	HU	ORC	F	–	74	35	–	
2287	Silves-lix	7	O6	5	1036	HU	ORC	F	–	74	36	–	
929	Silves-lix	4	K7	6	1043	HU	ORC	F	–	74	39	–	
2156	Silves-lix	7	M7	6	1036	HU	ORC	F	–	75	35	–	
893	Silves-lix	4	I7/J7	20	1024	HU	ORC	F	–	75	36	–	
2328	Silves-lix	7	P6	5	1036	HU	ORC	F	–	76	38	–	
2326	Silves-lix	7	P6	5	1036	HU	ORC	F	–	77	37	–	
1611	Silves-lix	5	N7	20	1004	HU	ORC	F	–	77	37	–	
1674	Silves-lix	6	M7	4A	1034	HU	ORC	F	–	77	39	–	
1579	Silves-lix	5	P7	5	1052	HU	ORC	F	–	78	36	–	
1338	Silves-lix	5	O7	19	1049	HU	ORC	F	–	78	36	–	
138	Silves-lix	1	O7	7	1050	HU	ORC	F	–	78	36	–	
111	Silves-lix	1	J7	19	1025	HU	ORC	F	–	78	38	–	prox = U
1747	Silves-lix	6	P7	12	1023	HU	ORC	F	–	78	39	–	
1243	Silves-lix	4	L7	5	1034	HU	ORC	F	–	78	40	–	
1324	Silves-lix	5	L7	10	1032	HU	ORC	F	–	78	40	–	
1308	Silves-lix	4	l7	5	1034	HU	ORC	F	–	78	41	–	
380	Silves-lix	2	K7	4	1034	HU	ORC	F	–	79	38	–	
990	Silves-lix	4	L7	5	1034	HU	ORC	F	–	79	38	–	
2327	Silves-lix	7	P6	5	1036	HU	ORC	F	–	80	35	–	
2014	Silves-lix	7	J6	11	1028	HU	ORC	F	–	82	37	–	
31	Silves-lix	1	O7	8	1032	HU	ORC	F	–	86	38	–	
989	Silves-lix	4	L7	5	1034	HU	ORC	F	521	75	39	–	
1699	Silves-lix	6	O7	4	1035	HU	ORC	F	526	79	39	–	
236	Silves-lix	1	P7	12	1023	HU	ORC	F	528	75	38	–	
2232	Silves-lix	7	L7	4	1035	HU	ORC	F	533	74	36	–	
1995	Silves-lix	7	N7	2	1036	HU	ORC	F	547	75	37	–	
381	Silves-lix	2	K7	4	1034	HU	ORC	F	553	81	36	–	
2275	Silves-lix	7	M7	6	1036	HU	ORC	F	568	77	38	–	
2194	Silves-lix	7	M7/N7	24/23	1001	HU	ORC	F	570	–	35	–	
1898	Silves-lix	6	M7	8	1034	HU	ORC	FV	–	71	36	–	

Rabbit measurements.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*Fus*	*GLC*	*Bd*	*HTC*	*SLC*	*Notes*
1845	*Silves-lix*	*6*	*M7*	*8*	*1034*	*SC*	*ORC*	*F*	–	–	–	*38*	
1091	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*SC*	*ORC*	*F*	–	–	–	*39*	
1093	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*SC*	*ORC*	*F*	–	–	–	*39*	
1028	*Silves-lix*	*4*	*L7*	*5*	*1034*	*SC*	*ORC*	*F*	–	–	–	*40*	
1843	*Silves-lix*	*6*	*M7*	*8*	*1034*	*SC*	*ORC*	*F*	–	–	–	*40*	
378	*Silves-lix*	*2*	*K7*	*4*	*1034*	*SC*	*ORC*	*F*	–	–	–	*42*	
2330	*Silves-lix*	*7*	*P6*	*5*	*1036*	*SC*	*ORC*	*F*	–	–	–	*42*	
572	*Silves-lix*	*2*	*M7*	*7*	*1035*	*SC*	*ORC*	*F*	–	–	–	*42*	
1844	*Silves-lix*	*6*	*M7*	*8*	*1034*	*SC*	*ORC*	*F*	–	–	–	*43*	
1842	*Silves-lix*	*6*	*M7*	*8*	*1034*	*SC*	*ORC*	*F*	–	–	–	*43*	
379	*Silves-lix*	*2*	*K7*	*4*	*1034*	*SC*	*ORC*	*F*	–	–	–	*43*	
2272	*Silves-lix*	*7*	*M7*	*6*	*1036*	*SC*	*ORC*	*F*	–	–	–	*43*	
1092	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*SC*	*ORC*	*F*	–	–	–	*44*	
2273	*Silves-lix*	*7*	*M7*	*6*	*1036*	*SC*	*ORC*	*F*	–	–	–	*44*	
2284	*Silves-lix*	*7*	*O6*	*5*	*1036*	*SC*	*ORC*	*F*	–	–	–	*44*	
1932	*Silves-lix*	*6*	*O7*	*6*	*1033*	*SC*	*ORC*	*F*	–	–	–	*46*	*?modern*
1144	*Silves-lix*	*4*	*L7*	*5*	*1034*	*SC*	*ORC*	*F*	–	–	–	*47*	
1283	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*ORC*	*F*	–	*99*	–	–	
783	*Silves-lix*	*3*	*N7*	*10*	*1030*	*TI*	*ORC*	*F*	–	*99*	–	–	
2089	*Silves-lix*	*7*	*P6*	*5*	*1036*	*TI*	*ORC*	*F*	–	*99*	–	–	
1410	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*TI*	*ORC*	*F*	–	*109*	–	–	

Carnivore teeth.

No	Site	Cont	Quad	Est	Cam	Tax	Complement	P_1–P_4 l	P_2–P_4 l	P_3–M_1 l	M_1–M_3 l	depth behind M_1	dP_4 l	P_3 l	P_3 w	P_4 l	P_4 w	M_1 l	M_1 w	Notes
86	Silves-lix	2	K7	4	1034	CAF	C–M_3	–	376	–	373	–	–	–	–	–	–	231	92	P_2–M_3 length = 739
283	Silves-lix	4	J7	25	1009	CAF	M_1	–	–	–	–	–	–	–	–	–	–	226	90	
234	Silves-lix	4	J7	25	1009	CAF	P_1–P_4	439	389	–	–	–	–	–	–	–	–	–	–	
56	Silves-lix	1	K7	22	1009	CAF	P_4–M_1	–	–	–	–	–	–	–	–	120	64	226	90	
416	Silves-lix	6	L7	6	1020	FEC	C–M_1	–	–	182	–	–	–	50	24	65	28	71	33	
326	Silves-lix	5	N7	6	1033	FEC	C–M_1	–	–	189	–	103	–	57	25	59	30	–	–	
319	Silves-lix	5	J7	22	1015	FEC	C–M_1	–	–	177	–	91	–	50	24	64	28	66	33	
199	Silves-lix	3	L7	17	1016	FEC	C–P_4	–	–	207	–	–	–	–	–	–	–	–	–	
418	Silves-lix	6	M7	8	1034	FEC	DP_3–DP_4	–	–	–	–	–	60	–	–	–	–	–	–	
417	Silves-lix	6	M7	8	1034	FEC	M_1	–	–	180	–	88	–	–	–	–	–	–	31	
496	Silves-lix	7	J6	18	1015	FEC	P_3–M_1	–	–	191	–	93	–	52	24	68	29	72	32	
265	Silves-lix	4	M7	8A	1034	FEC	P_3–M_1	–	–	184	–	–	–	49	26	65	31	–	34	
98	Silves-lix	2	J7	13	1010	FEC	P_3–M_1	–	–	197	–	–	–	–	–	70	28	75	34	
83	Silves-lix	2	K7	8	1024	FEC	P_3–M_1	–	–	196	–	–	–	54	27	69	31	74	35	

Carnivore bones.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*Fus*	*GL*	*Bd*	*HTC*	*Notes*
2281	*Silves-lix*	*7*	*M7*	*6*	*1036*	*CA*	*CAF*	*F*	*516*	–	–	
660	*Silves-lix*	*3*	*J7*	*26*	*1037*	*HU*	*CAF*	*F*	–	–	*136*	
1614	*Silves-lix*	*5*	*O7*	*14*	*1023*	*HU*	*FEC*	*F*	–	*157*	*57*	
635	*Silves-lix*	*3*	*P6*	*14*	*1020*	*HU*	*FEC*	*F*	–	*164*	*57*	
770	*Silves-lix*	*3*	*O7*	*10*	*1030*	*HU*	*FEC*	*F*	–	*169*	*58*	
986	*Silves-lix*	*4*	*O7*	*17*	*1017*	*HU*	*FEC*	*F*	*896*	*163*	*55*	*GLC = 882*
176	*Silves-lix*	*1*	*K7*	*5*	*1044*	*HU*	*FEC*	*F*	–	*194*	*65*	*Felis cf catus*
1408	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*HU*	*FEC*	*F*	–	*176*	*53*	
1899	*Silves-lix*	*6*	*M7*	*8*	*1034*	*HU*	*FEC*	*F*	–	*152*	*50*	
1900	*Silves-lix*	*6*	*M7*	*8*	*1034*	*HU*	*FEC*	*F*	–	*150*	*51*	
2025	*Silves-lix*	*7*	*O6*	*14*	*1020*	*HU*	*FEC*	*F*	–	*156*	*56*	*from same animal as 2026?*
2026	*Silves-lix*	*7*	*O6*	*14*	*1020*	*HU*	*FEC*	*F*	–	*157*	*54*	*prox = U*
2216	*Silves-lix*	*7*	*J6*	*18*	*1015*	*HU*	*FEC*	*F*	–	*164*	*49*	
2362	*Silves-lix*	*7*	*P6*	*5*	*1036*	*MCII*	*CAF*	*F*	*582*	*80*	–	
1572	*Silves-lix*	*5*	*N7*	*7*	*1035*	*MCIII*	*CAF*	*F*	*565*	–	–	
1892	*Silves-lix*	*6*	*M7*	*8*	*1034*	*MTIII*	*CAF*	*F*	*790*	*83*	–	
569	*Silves-lix*	*2*	*O6*	*14*	*1020*	*RA*	*VUV*	*F*	–	*162*	–	*BFd = 149*
1950	*Silves-lix*	*6*	*K7*	*8*	*1024*	*TI*	*CAF*	*F*	*2252*	*241*	–	
1740	*Silves-lix*	*6*	*J7*	*13*	*1010*	*TI*	*FEC*	*F*	–	*153*	–	
882	*Silves-lix*	*4*	*I7/J7*	*20*	*1024*	*TI*	*FEC*	*F*	*1009*	–	–	
421	*Silves-lix*	*2*	*N6/N7*	*16A/17A*	*1049*	*TI*	*FEC*	*F*	*1036*	–	–	
305	*Silves-lix*	*2*	*O7*	*12*	*1024*	*TI*	*MAF*	*F*	–	*99*	–	*cf Martes foina*

Bird measurements.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*GL*	*GLC*	*Bd*	*Dd*	*SD*	*Notes*
1381	*Silves-lix*	*5*	*M7*	*12*	*1033*	*FE*	*AL*	–	–	*96*	–	–	*Alectoris cf rufa*
2319	*Silves-lix*	*7*	*N6*	*5a*	*1034*	*FE*	*AL*	–	*528*	–	–	–	*Alectoris sp GLC = approx*
2098	*Silves-lix*	*7*	*P6*	*5*	*1036*	*FE*	*AL*	–	*544*	*98*	–	–	*Alectoris cf rufa*
768	*Silves-lix*	*3*	*O7*	*10*	*1030*	*FE*	*G*	–	–	*133*	–	–	
1239	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	–	*135*	–	–	
2357	*Silves-lix*	*7*	*P6*	*5*	*1036*	*FE*	*G*	–	–	*135*	–	–	
2233	*Silves-lix*	*7*	*L7*	*4*	*1035*	*FE*	*G*	–	–	*139*	–	–	
255	*Silves-lix*	*1*	*L7*	*17*	*1016*	*FE*	*G*	–	–	*139*	*119*	–	
826	*Silves-lix*	*3*	*L7*	*6*	*1020*	*FE*	*G*	–	–	*140*	–	–	
1644	*Silves-lix*	*6*	*L7*	*8*	*1009*	*FE*	*G*	–	–	*140*	–	–	
1048	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	–	*141*	–	–	
1409	*Silves-lix*	*5*	*M7(N)*	*10*	*1020*	*FE*	*G*	–	–	*141*	–	–	
1783	*Silves-lix*	*6*	*J7*	*10*	*1015*	*FE*	*G*	–	–	*141*	–	–	
2268	*Silves-lix*	*7*	*J6*	*11*	*1028*	*FE*	*G*	–	–	*142*	–	–	
2240	*Silves-lix*	*7*	*N6*	*5a1*	*1034*	*FE*	*G*	–	–	*143*	–	–	
2356	*Silves-lix*	*7*	*P6*	*5*	*1036*	*FE*	*G*	–	–	*143*	–	–	
1665	*Silves-lix*	*6*	*K7*	*6A*	*1046*	*FE*	*G*	–	–	*147*	–	–	
470	*Silves-lix*	*2*	*N7*	*12*	*1024*	*FE*	*G*	–	–	*155*	–	–	
886	*Silves-lix*	*4*	*I7/J7*	*20*	*1024*	*FE*	*G*	–	–	*158*	–	–	*Bd = approx*
1489	*Silves-lix*	*5*	*J7*	*29*	*1005*	*FE*	*G*	–	–	*158*	–	–	
77	*Silves-lix*	*1*	*N7*	*3*	*1035*	*FE*	*G*	–	–	*159*	*129*	–	
2432	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*FE*	*G*	–	–	*160*	–	–	
1513	*Silves-lix*	*5*	*P6*	*15A*	*1017*	*FE*	*G*	–	–	*160*	–	–	
373	*Silves-lix*	*2*	*K7*	*4*	*1034*	*FE*	*G*	–	–	*161*	–	–	
1015	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	–	*167*	–	–	
293	*Silves-lix*	*2*	*P7*	*5*	*1052*	*FE*	*G*	–	–	*169*	*146*	–	
398	*Silves-lix*	*2*	*L7*	*19*	*1009*	*FE*	*G*	–	*648*	*138*	–	*60*	*medullary bone*
1241	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	*666*	*138*	–	*59*	*no prox foramen*
1306	*Silves-lix*	*4*	*l7*	*5*	*1034*	*FE*	*G*	–	*676*	*133*	–	*61*	*no prox foramen*
2282	*Silves-lix*	*7*	*O6*	*5*	*1036*	*FE*	*G*	–	*678*	*143*	–	–	
1871	*Silves-lix*	*6*	*M7*	*8*	*1034*	*FE*	*G*	–	*686*	*129*	–	*62*	
1014	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	*694*	*139*	–	*62*	*no prox foramen*
1525	*Silves-lix*	*5*	*N7*	*7*	*1050*	*FE*	*G*	–	*704*	*149*	–	*65*	
1869	*Silves-lix*	*6*	*M7*	*8*	*1034*	*FE*	*G*	–	*708*	*151*	–	*64*	
1240	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	*710*	*140*	–	*68*	*no prox foramen*
1242	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	*713*	*155*	–	*68*	*no prox foramen*
1872	*Silves-lix*	*6*	*M7*	*8*	*1034*	*FE*	*G*	–	*745*	*142*	–	*59*	
2215	*Silves-lix*	*7*	*J6*	*18*	*1015*	*FE*	*G*	–	*757*	*162*	–		
334	*Silves-lix*	*2*	*N7*	*6*	*1033*	*FE*	*G*	–	*764*	*145*	*134*	*66*	*no prox foramen*
1870	*Silves-lix*	*6*	*M7*	*8*	*1034*	*FE*	*G*	–	*776*	*154*	–	*68*	
1742	*Silves-lix*	*6*	*J7*	*13*	*1010*	*FE*	*G*	–	*785*	*157*	–	–	*GLC = approx no prox. foramen*
600	*Silves-lix*	*3*	*N7*	*11*	*1031*	*FE*	*G*	–	*804*	*172*	–	–	*Bd = approx no prox. foramen*
2433	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*FE*	*G*	–	*805*	*168*	–	*78*	*GLC = approx*
1873	*Silves-lix*	*6*	*M7*	*8*	*1034*	*FE*	*G*	–	*819*	*172*	–	*76*	
1013	*Silves-lix*	*4*	*L7*	*5*	*1034*	*FE*	*G*	–	*931*	*202*	–	*98*	*no prox. foramen*
2318	*Silves-lix*	*7*	*N6*	*5a*	*1034*	*HU*	*AL*	–	–	*100*	–	–	*Alectoris sp*

Bird measurements.

No	*Site*	*Cont*	*Quad*	*Est*	*Cam*	*Os*	*Tax*	*GL*	*GLC*	*Bd*	*Dd*	*SD*	*Notes*
375	*Silves-lix*	*2*	*K7*	*4*	*1034*	*HU*	*AL*	–	–	*101*	–	–	*Alectoris sp*
827	*Silves-lix*	*3*	*L7*	*6*	*1020*	*HU*	*AL*	–	–	*104*	–	–	*Alectoris cf rufa*
1111	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*AL*	*482*	–	*100*	–	*43*	*Alectoris sp*
987	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*ANS*	–	–	*237*	–	–	*Anser sp*
2101	*Silves-lix*	*7*	*K7*	*26*	*1003*	*HU*	*ANS*	–	–	*246*	–	–	*Anser sp*
2360	*Silves-lix*	*7*	*P6*	*5*	*1036*	*HU*	*G*	–	–	*124*	–	–	
2359	*Silves-lix*	*7*	*P6*	*5*	*1036*	*HU*	*G*	–	–	*126*	–	–	
272	*Silves-lix*	*2*	*J7*	*11*	*1014*	*HU*	*G*	–	–	*130*	–	–	
2099	*Silves-lix*	*7*	*P6*	*5*	*1036*	*HU*	*G*	–	–	*132*	–	–	
530	*Silves-lix*	*2*	*L7*	*7*	*1016*	*HU*	*G*	–	–	*134*	–	–	
2423	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*HU*	*G*	–	–	*134*	–	–	
695	*Silves-lix*	*3*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*137*	–	–	
155	*Silves-lix*	*1*	*N7*	*17*	*1017*	*HU*	*G*	–	–	*139*	–	–	
1236	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*139*	–	–	
1488	*Silves-lix*	*5*	*J7*	*29*	*1005*	*HU*	*G*	–	–	*143*	–	–	
2422	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*HU*	*G*	–	–	*145*	–	–	
653	*Silves-lix*	*3*	*M7*	*10*	*1020*	*HU*	*G*	–	–	*146*	–	–	
1403	*Silves-lix*	*5*	*N6*	*16A*	*1049*	*HU*	*G*	–	–	*150*	–	–	
1011	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*154*	–	–	
1012	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*156*	–	–	
696	*Silves-lix*	*3*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*159*	–	–	
2367	*Silves-lix*	*7*	*L7*	*8*	*1009*	*HU*	*G*	–	–	*162*	–	–	
51	*Silves-lix*	*1*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*166*	–	–	
752	*Silves-lix*	*3*	*M7*	*8*	*1034*	*HU*	*G*	–	–	*172*	–	–	*? with medullary bone*
1010	*Silves-lix*	*4*	*L7*	*5*	*1034*	*HU*	*G*	–	–	*177*	–	–	
345	*Silves-lix*	*2*	*P6*	*14*	*1020*	*HU*	*G*	*605*	–	*129*	–	*51*	
1564	*Silves-lix*	*5*	*N7*	*9*	*1034*	*HU*	*G*	*632*	–	*129*	–	–	
1307	*Silves-lix*	*4*	*l7*	*5*	*1034*	*HU*	*G*	*634*	–	*130*	–	*58*	
413	*Silves-lix*	*2*	*K7*	*9*	*1013*	*HU*	*G*	*643*	–		–	–	
1088	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*HU*	*G*	*726*	–	*149*	–	*64*	
145	*Silves-lix*	*1*	*P7*	*7*	*1050*	*TI*	*AL*	–	–	*74*	*80*	–	*Alectoris sp*
1027	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*AL*	–	–	*77*	*78*	–	*Alectoris sp*
1471	*Silves-lix*	*5*	*K7*	*6*	*1043*	*TI*	*AL*	–	–	*78*	*79*	–	*Alectoris sp*
529	*Silves-lix*	*2*	*L7*	*7*	*1016*	*TI*	*AL*	–	–	*81*	*77*	–	*Alectoris cf rufa*
1026	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*AL*	–	–	*84*	*82*	–	*Alectoris sp*
32	*Silves-lix*	*1*	*O7*	*8*	*1032*	*TI*	*G*	–	–	*100*	*102*	–	
2013	*Silves-lix*	*7*	*P7*	*3*	*1051*	*TI*	*G*	–	–	*101*	*105*	–	
1017	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*G*	–	–	*102*	*105*	–	
1882	*Silves-lix*	*6*	*M7*	*8*	*1034*	*TI*	*G*	–	–	*103*	*104*	–	
393	*Silves-lix*	*2*	*N6*	*5a*	*1034*	*TI*	*G*	–	–	*104*	–	–	
2228	*Silves-lix*	*7*	*L7*	*4*	*1035*	*TI*	*G*	–	–	*104*	–	–	
2332	*Silves-lix*	*7*	*P6*	*5*	*1036*	*TI*	*G*	–	–	*105*	*99*	–	
16	*Silves-lix*	*1*	*P6/P7*	*16*	*1049*	*TI*	*G*	–	–	*106*	*112*	–	
2430	*Silves-lix*	*7*	*K7/L7*	*27/22*	*1001*	*TI*	*G*	–	–	*110*	*111*	–	
1103	*Silves-lix*	*4*	*M7*	*4A*	*1034*	*TI*	*G*	–	–	*112*	*112*	–	
1019	*Silves-lix*	*4*	*L7*	*5*	*1034*	*TI*	*G*	–	–	*112*	*113*	–	

Bird measurements.

No	Site	Cont	Quad	Est	Cam	Os	Tax	GL	GLC	Bd	Dd	SD	Notes
528	Silves-lix	2	L7	7	1016	TI	G	–	–	116	114	–	
1018	Silves-lix	4	L7	5	1034	TI	G	–	–	116	116	–	
1016	Silves-lix	4	L7	5	1034	TI	G	–	–	119	123	–	
1557	Silves-lix	5	N7	13	1020	TI	G	–	–	123	126	–	
1238	Silves-lix	4	L7	5	1034	TI	G	–	–	124	135	–	
23	Silves-lix	1	N7	14	1023	TI	G	–	–	125	–	–	
161	Silves-lix	1	P7	3	1051	TI	G	–	–	125	123	–	
1207	Silves-lix	4	L7	5	1034	TI	G	–	–	132	129	–	
1797	Silves-lix	6	O7	13	1020	TI	G	–	–	136	141	–	Dd = approx
374	Silves-lix	2	K7	4	1034	TI	G	–	–	144	132	–	Bd without bump = 133
1025	Silves-lix	4	L7	5	1034	TI	G	–	1014	112	109	55	
1311	Silves-lix	4	l7	5	1034	TI	G	–	1156	124	122	64	
1024	Silves-lix	4	L7	5	1034	TI	G	–	1269	122	126	68	
1496	Silves-lix	5	N7	11A	1031	TI	G	1122	–	112	117	58	with medullary bone
1312	Silves-lix	4	l7	5	1034	TI	G	1127	–	116	123	60	
985	Silves-lix	4	O7	17	1017	TI	G	1200	1156	126	122	62	
946	Silves-lix	4	L7	14	1023	TI	G	1275	1226	129	123	69	
658	Silves-lix	3	N7	3B	1034	TmT	AL	431	–	86	–	39	Alectoris sp
1560	Silves-lix	5	N7	9	1034	TmT	AL	456	–	93	–	39	Alectoris sp
2096	Silves-lix	7	P6	5	1036	TmT	G	–	–	137	–	–	with spur
1049	Silves-lix	4	L7	5	1034	TmT	G	–	–	138	–	–	no posterior keel, sex?
1020	Silves-lix	4	L7	5	1034	TmT	G	–	–	142	–	–	no spur no posterior keel
856	Silves-lix	3	M7	10	1020	TmT	G	–	–	143	–	–	has spur scar
1765	Silves-lix	6	M7	10	1020	TmT	G	811	–	127	–	65	no post keel, tarsal = FV = JUV
1550	Silves-lix	5	K7	24	1005	TmT	G	834	–	139	–	69	with spur
2244	Silves-lix	7	L7	7	1016	TmT	G	837	–	142	–	70	no medull. Bone, spur reduced
1022	Silves-lix	4	L7	5	1034	TmT	G	911	–	167	–	81	with spur no post keel

Appendix II

Measurements in tenths of a millimetre of fore (F) and hind (H) proximal phalanges of several species of equids housed in various institutions. The specimens of the Otranto ass, *Equus hydruntinus,* in Rome and Florence, are from the Grotta Romenelli in Apulia. The measurements are those illustrated in Driesch (1976). Note that for most skeletons one fore and one hind phalanx were measured.

Genus and species	*Age*	*Museum*	*Cat. N.º*	*F/H*	*GL*	*Bp*	*Dp*	*SD*	*Bd*	*Dd*
Equus asinus	*Modern*	*Ingiliz Arkeoloji Enst, Ankara*	*2*	*F*	*629*	*306*	*222*	*178*	*274*	*155*
Equus asinus	*Modern*	*Ingiliz Arkeoloji Enst, Ankara*	*2*	*H*	*580*	*315*	*223*	*176*	*255*	*155*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1875 28*	*F*	*772*	*423*	*293*	*259*	*367*	*212*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1875 28*	*H*	*737*	*460*	*303*	*284*	*360*	*206*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1893 634*	*F*	*821*	*414*	*331*	*256*	*364*	*210*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1893 634*	*H*	*774*	*433*	*326*	*252*	*349*	*202*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1933 397*	*F*	*703*	*382*	*279*	*232*	*342*	*189*
Equus asinus	*Modern*	*Musée d'Histoire nat., Paris*	*1933 397*	*H*	*662*	*393*	*277*	*224*	*317*	*179*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1904.6.12.1*	*F*	*829*	*427*	*331*	*271*	*373*	*217*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1904.6.12.1*	*H*	*775*	*436*	*331*	*270*	*344*	*206*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1951.6.12.1*	*F*	*678*	*370*	*264*	*231*	*322*	*190*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1951.6.12.1*	*H*	*632*	*371*	*266*	*223*	*311*	*181*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1951.8.28.14*	*F*	*631*	*354*	*253*	*217*	*311*	*176*
Equus asinus	*Modern*	*Nat. Hist. Mus., London*	*1951.8.28.14*	*H*	*590*	*366*	*258*	*209*	*290*	*173*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1929 35*	*H*	*730*	*511*	*365*	*322*	*395*	*221*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1929 37*	*F*	*763*	*499*	*326*	*304*	*395*	*219*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1929 37*	*H*	*716*	*503*	*350*	*299*	*373*	*218*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1932 46*	*F*	*766*	*513*	*328*	*316*	*404*	*223*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1932 46*	*H*	*708*	*499*	*349*	*300*	*387*	*214*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1935 486*	*F*	*750*	*492*	*341*	*314*	*415*	*224*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1935 486*	*H*	*718*	*502*	*355*	*307*	*389*	*221*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1941 322*	*F*	*741*	*496*	*329*	*311*	*392*	*226*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1941 322*	*H*	*709*	*496*	*353*	*309*	*375*	*218*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1962 228*	*F*	*805*	*500*	*356*	*330*	*436*	*242*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1962 228*	*H*	*766*	*508*	*374*	*323*	*421*	*234*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1973 109*	*F*	*745*	*494*	*317*	*330*	*399*	*227*
Equus caballus	*Modern*	*Musée d'Histoire nat., Paris*	*1973 109*	*H*	*715*	*478*	*332*	*310*	*376*	*223*
Equus caballus	*Modern*	*Nat. Hist. Mus., London*	*1907.5.15.1*	*F*	*790*	*500*	*338*	*320*	*388*	*228*
Equus caballus	*Modern*	*Nat. Hist. Mus., London*	*1907.5.15.1*	*H*	*741*	*505*	*355*	*306*	*381*	*223*
Equus caballus	*Modern*	*Nat. Hist. Mus., London*	*1945.6.11.1*	*F*	*813*	*526*	*347*	*322*	*429*	*239*

Genus and species	*Age*	*Museum*	*Cat. N.º*	*F/H*	*GL*	*Bp*	*Dp*	*SD*	*Bd*	*Dd*
Equus caballus	Modern	Nat. Hist. Mus., London	1945.6.11.1	H	758	530	379	316	401	244
Equus caballus	Modern	Nat. Hist. Mus., London	1960.2.1.4	F	759	469	318	307	388	230
Equus caballus	Modern	Nat. Hist. Mus., London	1960.2.1.4	H	732	478	341	307	375	226
Equus caballus	Modern	Nat. Hist. Mus., London	1961.5.10.2	F	825	519	349	320	416	240
Equus caballus	Modern	Nat. Hist. Mus., London	1961.5.10.2	H	791	523	369	319	398	237
Equus caballus	Modern	Nat. Hist. Mus., London	1963.1.25.1	F	830	501	364	331	416	248
Equus caballus	Modern	Nat. Hist. Mus., London	1963.1.25.1	H	790	507	389	323	402	243
Equus caballus (Garrano)	Modern	CIPA Ref. Coll. female	238	F	866	559	336	308	418	239
Equus caballus (Garrano)	Modern	CIPA Ref. Coll. female	238	H	835	562	365	308	403	246
Equus caballus (Garrano)	Modern	CIPA Ref. Coll. female	265	F	836	536	356	324	431	237
Equus caballus (Garrano)	Modern	CIPA Ref. Coll. female	265	H	821	543	375	322	413	239
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1901 9	F	736	398	298	235	334	187
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1880 1103	F	795	453	316	269	372	203
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1880 1103	H	739	454	324	251	355	200
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1893 509	F	765	410	306	234	355	195
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1893 509	H	715	408	313	232	333	198
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1901 9	H	671	414	292	234	315	191
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1902 487	F	769	414	296	244	353	203
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1902 487	H	702	427	304	240	328	197
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1905 259	F	712	394	292	239	355	195
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1905 259	H	682	408	313	230	328	194
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1909 208	F	760	410	298	240	349	190
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1909 208	H	730	423	313	237	324	195
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1912 332	F	724	408	289	241	350	188
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1912 332	H	695	421	304	242	330	196
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1928 2	F	710	412	289	243	348	186
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1928 2	H	686	428	303	240	320	180
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1963 363	F	864	464	339	247	364	223
Equus hemionus	Modern	Musée d'Histoire nat., Paris	1963 363	H	776	478	345	252	352	217
Equus hemionus	Modern	Musée d'Histoire nat., Paris	A548	F	811	414	310	233	364	196
Equus hemionus	Modern	Musée d'Histoire nat., Paris	A548	H	755	426	324	233	349	202
Equus hemionus	Modern	Nat. Hist. Mus., London	1957.7.18.1	F	755	437	305	250	357	202
Equus hemionus	Modern	Nat. Hist. Mus., London	1957.7.18.1	H	701	439	314	236	337	192
Equus hemionus	Modern	Nat. Hist. Mus., London	976e	F	860	419	334	261	363	227
Equus hemionus	Modern	Nat. Hist. Mus., London	976e	H	800	419	337	252	337	219
Equus hydruntinus	Upper Pal.	Ist. di Paleontol. Umana, Rome	–	F	797	377	307	245	345	211

Genus and species	*Age*	*Museum*	*Cat. N.º*	*F/H*	*GL*	*Bp*	*Dp*	*SD*	*Bd*	*Dd*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*809*	*375*	*300*	*241*	*320*	*199*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*817*	*397*	*303*	*244*	*355*	*204*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*825*	*391*	*306*	*247*	*344*	*200*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*827*	*386*	*302*	*248*	*351*	*204*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*835*	*401*	*309*	*250*	*357*	*206*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*845*	*400*	*322*	*246*	*352*	*204*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*853*	*398*	*314*	*256*	*352*	*212*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*862*	*410*	*318*	*263*	*358*	*212*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*F*	*863*	*409*	*320*	*271*	*380*	*212*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*769*	*404*	*322*	*257*	*329*	*205*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*772*	*386*	*315*	*236*	*314*	*197*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*780*	*430*	*326*	*261*	*348*	*211*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*792*	*411*	*318*	*240*	*330*	*200*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*796*	*388*	*302*	*234*	*321*	*197*
Equus hydruntinus	*Upper Pal.*	*Ist. di Paleontol. Umana, Rome*	–	*H*	*855*	*402*	*310*	*276*	*380*	*209*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*F*	*812*	*386*	*305*	*242*	*346*	*202*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*F*	*852*	*377*	*297*	*254*	*358*	*205*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*F*	*866*	*396*	*289*	*243*	*353*	*205*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*F*	*868*	*411*	*328*	*273*	*369*	*209*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*H*	*726*	*382*	*293*	*233*	*303*	*185*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*H*	*758*	*403*	*306*	*243*	*317*	*193*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*H*	*774*	*407*	*309*	*251*	*340*	*202*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*H*	*775*	*382*	*314*	*228*	*312*	*190*
Equus hydruntinus	*Upper Pal.*	*Palaeont. Colln. Univ. Florence*	–	*H*	*804*	*423*	*316*	*251*	*332*	*201*

Appendix III

Measurements of fish bones in tenths of a millimetre. Bones are coded as follows: DT = Dentary; MX = Maxilla; PMX = Premaxilla; QUA = Quadrate; V (number) = Vertebra (vertebral order). Measurement abbreviations follow Roselló (1989), except for Vertebrae, where D = Dorsoventral diameter; C = Craniocaudal diameter. BL = Vertebral Body length.

Archaeological context	*Taxon*	*Bone*	*D*	*C*	*BL*	^{C}*Ac*	*BAa*	*CAa*	^{A}*H*	^{A}*HA*	^{A}*Hc*	^{B}*L*	^{A}*LC*	^{A}*LI*	^{A}*LF*
Quadrado M7. Camada 1034 Estrato 8	*Argyrosomus regius*	V_4	*225*	*302*	*280*	–	–	–	–	–	–	–	–	–	–
Quadrado M7. Camada 1034 Estrato 8	*Argyrosomus regius*	V_5	*138*	*161*	*124*	–	–	–	–	–	–	–	–	–	–
Quadrado M7. Camada 1034	*Dentex gibbosus*	*MX*	–	–	–	–	–	–	–	–	*134*	–	–	–	–
Quadrado M7. Camada 1034	*Dentex gibbosus*	*QUA*	–	–	–	–	*127*	*18*	–	–	–	–	–	–	–
Quadrado O6. Estrato5	*Dentex gibbosus*	V_2	*174*	*163*	*149*	–	–	–	–	–	–	–	–	–	–
Quadrado M7. Camada 1034	*Dentex gibbosus*	$V_{2/3}$	*153*	*147*	*107*	–	–	–	–	–	–	–	–	–	–
Quadrado M7. Camada 1034	*Dentex gibbosus*	V_3	–	–	*172*	–	–	–	–	–	–	–	–	–	–
Quadrado M7. Camada 1034	*Dentex gibbosus*	$V_{10/11}$	*76*	*75*	*99*	–	–	–	–	–	–	–	–	–	–
Quadrado I6/I7. Crivo	*Dentex gibbosus*	V_{12}	*215*	*210*	*227*	–	–	–	–	–	–	–	–	–	–
Quadrado I6/I7. Crivo	*Dentex gibbosus*	$V_{16/17}$	*197*	*187*	*241*	–	–	–	–	–	–	–	–	–	–
Quadrado L7. Estrato 5	*Dentex gibbosus*	$V_{16/17}$	*118*	*128*	*143*	–	–	–	–	–	–	–	–	–	–
Quadrado L7. Camada 1034. Estrato 5	*Epinephelus costae*	$V_{20/21}$	*132*	–	*283*	–	–	–	–	–	–	–	–	–	–
Quadrado L7. Camada 1009. Estrato 19	*Pagrus pagrus*	*MX*	–	–	–	*186*	–	–	*192*	–	*224*	*551*	–	–	–
Quadrado L7. Camada 1020. Estrato 6	*Pagrus pagrus*	*PMX*	–	–	–	–	–	–	–	–	–	–	–	–	*319*
Quadrado P7. Camada 1052	*Pagrus pagrus*	*PMX*	–	–	–	–	–	–	–	–	–	*351*	–	–	*330*
Quadrado N7. Camada 1034	*Sparus aurata*	*DT*	–	–	–	–	–	–	*294*	*186*	–	*454*	*269*	*285*	–
Quadrado M7. Camada 1034. Limpeza	*Sparus aurata*	*MX*	–	–	–	–	–	–	–	–	*100*	–	–	–	–
Quadrado M7. Camada 1034. Estrato 8	*Sparus aurata*	*PMX*	–	–	–	–	–	–	–	–	–	–	–	–	*296*
Quadrado L7. Camada 1034. Estrato 5	*Sparus aurata*	V_{14}	–	–	*117*	–	–	–	–	–	–	–	–	–	–