Faunal Remains

Bethan Charles

INTRODUCTION

A total of 3,895 fragments (32,160 g) of bone were hand-collected during excavations in Trenches 1, 2, 4, 5, 7, 9, 10, 11, 12, 13, 15, 18, and 19 in rescue excavations at Zeugma in 2000. An additional 1,658 fragments (557 g) of bone were recovered from environmental samples sieved through meshes of >10, 10–4, and 4–2 mm.

METHODOLOGY

Identification of the main animal bone assemblage from the site was done through the use of published guides[1] and use of the reference collection at the British Institute of Archaeology in Ankara.[2] The small mammal and bird remains were identified by the author in Turkey and by Sheila Hamilton-Dyer in the UK, both with the aid of comparative specimens. All fish bones were identified by Sheila Hamilton-Dyer using her modern comparative collection, with additional reference to the collection of the Museum for Middle Africa, Tervuren, Belgium. All fragments were identified to species and element where reasonable.

The calculation of the species recovered from the site was done through the use of the total fragment method. All fragments of bone were counted, including elements from the vertebral centrum, ribs, and long bone shafts. In addition, the minimum number of individuals (MNI) was calculated for the main domestic species for the main periods of occupation, following the calculations suggested by Chaplin.[3] MNI was calculated using the most commonly identified fragments of bone identified from each species, according to each phase.

The separation of sheep and goat bones was done using standard criteria.[4] Positive identification of sheep and goat was possible, but most fragments could only be identified as sheep/goat, and it is likely that there may be some overlap in the identification of the individual species.

The aging of the animals was based on tooth eruption and epiphyseal fusion. Silver's tables[5] alone were used to give the timing of epiphyseal closure for cattle, sheep, pigs, and horses. Sheep tooth eruption and wear was measured using a combination of Payne's and Grant's tables.[6] Cattle tooth eruption and wear was measured using Halstead's and Grant's tables.[7] Pig tooth eruption and wear was measured using Higham,[8] Bull and Payne,[9] and Grant,[10] defined by Hambleton.[11] Horse tooth eruption and wear was measured using Levine's tables.[12]

The sex of the animals was ascertained depending on the preservation of indicative fragments of bone. Pathological changes to the bone were identified and described with assistance of published guidelines.[13] The measurements taken were those defined by von den Driesch.[14] Only selected measurements have been included in this report. All aging data and measurements are taken from both the hand-collected and sieved material.

CONDITION

The majority of the bone from the site was chalky with varying degrees of chemical etching. However, evidence of butchery marks and gnaw damage was visible on many elements. Much of the bone indicated that it had been exposed to the elements with evidence of bleaching. As a result the fragility of much of the bone will have contributed to the high number of new breaks recorded on many of the fragments from the site (table 14).

Gnaw marks were identified on 3 percent of the hand-recovered bones from the site (table 14). This included 10 fragments with evidence of rodent gnaw marks, the majority which came from late Roman deposits in Trench 7. Most of the remaining gnawed bone from the site was attributed to scavenging by dogs.

The majority of burnt material from the site, including that from sieved material, came from mid-third-century A.D. deposits. It was mostly recovered from collapsed layers, much of which is likely to be related to the burning of areas of the city during this period. The greater concentration of the material came from destruction layers in Trenches 2, 9, 12, and 18.

RESULTS

A total of 1,810 fragments of animal bone were identified to species or genus (table 15). The majority of the material from the site came from Trenches 2, 7, and 15 (table 1). However, there were no clear concentrations of bone at the site indicative of areas of deliberate dumping. The majority of the material came from make-up layers, rubble backfill, and collapse and destruction layers, much of which belonged to the period of Roman occupation before the middle of the third century A.D. The remaining material was recovered from four pit fills. This included context 7180, which included a small quantity of rodent bones, passerine (song bird) bones, some unidentified fish fragments along with part of a cattle scapula and a domestic fowl radius. The

remaining pit fills 2184, 18098, and 18114 contained mostly small quantities of unidentified fragments of bone.

The calculation of the minimum number of individuals (tables 2 and 15) for the main domestic species indicates that the number of pigs in relation to cattle was higher than is indicated from the total number of fragments (tables 2, 15, and 16). It is probable that this is a result of the bias in the recovery of some of the elements belonging to the smaller animals. It is also the case that pig bones tend not to be as robust as those of cattle and sheep, which may have contributed to the greater destruction and fragmentation of the bones.

Trench	Percent
2	16
4	2
5	1
7	23
9	3
10	0
11	3
12	4
13	0
15	37
10	10
19	1

Table 1. Relative proportion of hand-collected bone by trench.

Period	Cattle	Sheep/ Goat	Goat	Pig
Hellenistic	1	1	1	1
Early Roman	4*	32*	2	4
Mid-Roman	4	15*	5	9*
Late Roman	5*	12*	1	4*
Early Islamic	2*	4	1	2*

*Table 2. Minimum number of individuals from hand-collected material, according to period and species. *These values were calculated using mandibles; all others were calculated using metapodials.*

Few of the main domestic species from the site were recovered from the environmental samples. However, the majority of the small mammal, bird, fish, and amphibian bones (table 17) were recovered from these samples. This highlights the importance of sampling on archaeological sites.

Identified Species

Cattle

The most numerous of the large bones identified from the site were the cattle bones (*Bos primigenius* f. *taurus*). Butchery cut marks on many of the bones indicate that the remains recovered from the site are mostly food refuse.

It appears from both the rate of tooth eruption and wear and the fusion rate of the epiphyses that the majority of the cattle meat consumed at Zeugma came from mature and old animals (tables 3 and 18). A few remains from juvenile animals were recovered from contexts 2130, 15095, and 15207. It is possible that calves were slaughtered in greater number but that the remains were not preserved, since bones from immature animals tend to be much more friable and less likely to survive. There is no clear evidence from the material available that the cattle were being kept primarily for their meat, and it is unlikely that beef would have been as widely eaten as pork, lamb, and mutton.

The milk that the cows would have produced may have contributed to the diet of the community, though documentary evidence suggests that sheep and goats would have provided the majority of fresh milk to the inhabitants.[15] It is more likely that cattle would have been valued as draft animals, and the manure used as fertilizer and for fuel. The slaughter of the cattle would have provided not only meat to the inhabitants but also leather, horn, and bone, which could be worked.

A single pelvis was identified as female from context 7000. No other clear indicative elements were identified from the assemblage.

Age	Mid-Roman	Late Roman	Early Islamic
Adult	–	2	–
Old adult	1	–	1
Senile	–	3	–

Table 3. Tooth Wear Stages cattle.

Sheep

Sheep (*Ovis ammon* f. *aries*) bones were the most numerous identified from all phases of activity at the site and sheep would have contributed greatly to the economy of the site.

While the remains identified from the site are considered to be food refuse, it is likely that sheep would have been kept primarily for their secondary products, such as wool, milk, and manure. It is clear from the tooth eruption and wear stages and the rate of epiphyseal fusion of the sheep bones (tables 4 and 19) that many of the animals throughout the main periods of occupation were kept until very old. It is almost certain that the animals would have been kept for milking and the production of wool. A small number of elements from young lambs were identified, mostly from early Roman deposits. It is possible that the smaller, more fragile bones may not have survived as well to enable their recovery during excavation. A single male pelvis from a mid-Roman deposit was the only element complete enough to enable sexing.

Goat

The identification of the goat *(Capra aegagrus* f. *hircus*) from the site was predominantly made from the metapodials, horncores, and phalanges. It is possible that wild goat (*C. aegagrus*) was also eaten during this time. The two species are differentiated by morphological differences in the horn cores and postcranial elements. However, none was identified from the assemblage.

The majority of elements appeared to belong to animals beyond two years of age. Like the sheep, the goats were almost certainly bred for their secondary products. The milk yield of goats would have been higher than that of the sheep, and this is consistent with the general Roman preference for goat milk for drinking and for the production of cheese.[16]

Age	Late Hellenistic	Early Roman	Mid-Roman	Late Roman	Early Islamic
0–2 mos.	–	1	–	–	–
6–12 mos.	–	1	–	–	–
1–2 yrs.	1	–	1	1	–
2–3 yrs.	–	3	3	1	–
3–4 yrs.	–	1	5	1	–
4–6 yrs.	–	–	–	2	1
6–8 yrs.	–	4	2	3	–
8–10 yrs.	–	2	2	–	–

Table 4. Tooth Wear Stages sheep/goat.

Pig

It is clear from the number of pig bones (*Sus scrofa* f. *domestica*) identified from all periods of occupation that pork would have featured heavily in the diet of the inhabitants of the site. Pigs are primarily bred for their meat, blood, and fat. Compared to all of the Near Eastern domesticates, pigs have a higher meat yield, from which higher values of fats and calories are gained.[17] Evidence from both the tooth eruption and wear stages (table 5) and the rate of fusion of the epiphysis (table 20) indicates that few of the pigs from the site lived beyond the age of two to three years of age throughout all periods of occupation. The animals would have reached their optimum weight at this stage and it would have been impractical to keep the animals beyond this age other than for breeding purposes.

Evidence from the canines of the sex ratio of pigs was not conclusive, with only two males identified from the early and late Roman periods and three females and one male from the mid-Roman period. It is likely that the majority of the animals found at the site were bred outside of the city. Although pigs are capable of surviving and breeding in a variety of environments, they are often connected with forested areas. Their ability to survive on extra-urban sources of food would have been particularly important during the autumn and winter, when food became scarce.

It is possible that wild boar may have been eaten at Zeugma, since it was a preferred meat of the Roman gentry.[18] However, none was identified from the assemblage.

Age	Early Roman	Mid-Roman	Early Islamic
2–7 mos.	1	1	–
7–14 mos.	2	1	–
14–21 mos.	–	4	1
21–27 mos.	1	1	–

Table 5. Tooth Wear Stages pig.

Equidae

A small number of equid bones included horse (*Equus ferus* f. *caballus*) and donkey (*E. africanus* f. *asinus*). Evidence of mules was not identified from the assemblage, though it is probable that they were present at Zeugma. Separation of the equid bones was based on tooth patterns and osteometrical data using published guides.[19] The majority of fragments of horse bones recovered from the site consisted of metapodials, phalanges, and loose tooth fragments. No cut or chop marks were clearly identified on any of the bones recovered. It is therefore unlikely that equid meat was eaten at Zeugma. In contrast, at the slightly earlier site of Jebel Khalid further to the east along the Euphrates, equid meat contributed to the diet of the inhabitants to a greater extent than is suggested by the material recovered from Zeugma.[20]

The horses may have been used for riding, possibly as part of the cavalry, as well as for chariot racing and pulling carriages. It is unlikely that they would have been used as draught animals, since cattle were available for this purpose.[21] Donkeys would have been used for light draft work as well as for transportation of goods. Both the horse and donkey would have been selected for breeding mules, although evidence for mules was not discovered.

Dog

A total of 13 fragments of bone belonging to dogs (*Canis lupus* f. *familiaris*) were recovered from hand-collected and sieved material. Three articulating metacarpals and an ulna and radius, possibly relating to the same individual, were recovered from context 15095. A femur and tibia possibly related to the same individual were recovered from context 2035. The remaining elements identified were single fragments from mid- to late Roman levels in Trenches 2, 5, 9, and 10. All of these elements had fused and appeared to belong to mature animals.

A small dog jaw fragment was recovered from context 2238.[22] It was of similar size to a fox but relatively undeveloped in the rear lateral muscle area. The fourth premolar had been lost, and the gap had healed over. Together these features pointed to a small domestic dog of Jack Russell size. The existence of small lapdogs is well attested for the Roman period.[23] The other medium-sized elements attrib-

uted to canids (table 12) are comparable with measurements from dogs found at Sagalassos[24] as well as that of a complete dog burial from an earlier site at Tell Brak in the Khabur basin. This animal has been compared by Clutton-Brock[25] to a Saluki or Persian greyhound, which is thought to have been one of the earliest breeds of hunting dogs. More indirect evidence that dogs were kept at Zeugma is witnessed by bones bearing canid tooth marks from gnawing.

Camel

The excavators found in surface contexts three fragments of camel bone (*Camelus ferus* f. *dromedarius*): the main shaft of a left metatarsal from context 12002 (burnt leveling layer), the premandibular section of the left and right mandible belonging to a male camel from early Roman context 19001, and a tooth from context 15001. Both the mandible and metatarsal had evidence of butchery chop marks. The bones were compared with a specimen of *Camelus dromedarius* held at the British School in Ankara.

The Romans used camels as baggage animals and they have even been found in Western Europe.[26] It is unlikely that the animals were kept within the city, since they required pasturing on a large scale and their unpleasant odor would have been unwelcome near dwellings.[27]

Deer

Three species of wild deer were identified: a single phalanx from a red deer (*Cervus elaphus*) (context 7000), five fragments of fallow deer (*Dama dama*) (Trenches 9, 12, and 15), and a small number of roe deer (*Capreolus capreolus*) (Trenches 7, 11 and 15). It seems that deer did not contribute greatly to the diet of the inhabitants. However, if the animals were hunted, carcasses may have been disposed outside the settlment area. Fallow deer were kept in captivity by the Romans, though there is no indication of this practice at Zeugma.[28]

Summary

The metrical data for cattle, sheep, goats, and pigs show very little change in the stature of animals during separate periods of occupation (tables 7–11), thereby indicating a continuity of farming techniques and breeding methods.

The anatomical representation of the bones shown in table 21 indicates the distribution of elements recovered for each of the main domestic species. It is clear that much of the assemblage consisted of jaw and loose tooth fragments, which tend to be better preserved on most archaeological sites. This was particularly evident in the pig bones recovered.

Small Mammals, Bird, and Fish

These identifications were provided by Sheila Hamilton-Dyer, with the exception of some small mammal bones and the majority of domestic fowl, which were identified by the author.

SMALL MAMMALS

A small number of small mammal bones was identified among the hand-collected bone. The most common identified species was the hare *Lepus* sp. The only two elements from dated deposits include the partial remains of a tibia and femur from an early and a late Roman deposit, respectively, within Trench 7. The two most commonly identified hares at Near Eastern sites are the *Lepus europaeus* and *L. capensis*, a slightly smaller species. From the fragments recovered it was not possible to clearly differentiate between these two species.

A well-preserved complete skull of a lesser mole rat *Spalax* sp. was recovered from a third-century collapse deposit (context 2013). Identification of mole rat species is problematic, and therefore this skull is identified to genus level alone. Mole rats live underground and are found throughout Turkey. They can burrow down to depths of 2–4 m and it is probable, considering the good condition and completeness of the skull, that this may be an intrusive element unrelated to the archaeological context.

A partially preserved skull belonging to the Mustelidae family was recovered from context 2150. The skull may be that of a young least weasel (*Mustela nivalis*)[29] or a marbled polecat (*M. putorius*). However, the identification was not secure.

Bones and teeth of small mammals were frequent in the samples. Skeletal elements are generally undiagnostic, although it is often possible to assign them to order. At least one femur could thus be identified as shrew but, as no remains of the diagnostic crania and jaws are present and because 11 shrew species occur in Turkey today,[30] it is not possible to further identify the remains. Other limb bones are of mouse type. Mouse jaws are also present. There are two distinct types; *Mus* and *Apodemus*. The two *Mus* species in Turkey can be separated by crania, but not on the teeth alone.[31] Therefore it was not possible to tell whether these remains represent the commensal house mouse, *M. musculus*, or the Macedonian mouse, *M. macedonicus* (or both). The *Apodemus* jaws are of a relatively large species, probably *A. mystacinus*, the broad-toothed field mouse.

BIRDS

The majority of the bird remains were identified as domestic fowl (*Gallus gallus* f. *domestica*). The chicken bones are all interpreted as food refuse, and many of the elements had butchery marks, including chop marks on two of the femurs and knife marks on an innominate bone. None of the fragments recovered from the rescue excavations appeared to be from very young individuals, and the majority of the bones were fused elements. Chicken long bones tend to fuse at approximately six months of age.[32] The most numerous elements recovered from all phases were the femur, tibio-tarsus, tarso-metatarsal, coracoid, and ulna. The presence and absence of the spur on the tarso-metatarsus was used to sex the domestic fowl. Two males were identi-

fied from contexts 7025 and 7060 and a single female was identified from context 2130. A small number of the bones were measured (table 13) and are comparable with measurements of domestic fowl from Sagalassos.[33]

Many of the less-complete fragments were comparable in size with galliforms and likely to be domestic fowl or possibly a wild species such as francolin. The remaining bird bones recovered from the site were all wild species. The smallest bird remains recovered are small passerines (songbirds). This is a very large group of osteologically similar birds, and no further attempt at identification was made, other than to note some bones of sparrow size and several bones comparable with broad-bills, such as the corn bunting.

One bone (from context 15150) belongs to a small dove, *Streptopelia* sp.: the turtle dove, *S. turtur*, and the palm dove, *S. senegalensis*, are both possible. Other dove bones (from contexts 2039, 2491, 2510, 7003, 7118, and 15286) are larger and comparable with the domestic pigeon or its antecedent the rock dove, *Columba livia*. Phalanges are usually not diagnostic, but the single phalanx from 2198 can be identified as a buzzard-sized raptor. A humerus from context 7004 is damaged but clearly of an owl, probably *Athene* sp. A small duck is also represented, probably teal, *Anas crecca* (context 15007). Like several common ducks, this is a winter visitor to eastern Turkey.

FISH

Identifiable fish remains belong to cyprinids and silurids, and both families are common in the Euphrates basin. Cyprinids are the most widespread and numerous of the freshwater fish of Europe and the Middle East. There are over 100 species and/or subspecies currently reported from Turkey, and many can be distinguished by certain bones only, or by nonosteological characters. Of those remains with diagnostic features, only the genus *Barbus* is present. A dorsal spine identified to *Barbus* has a clear cut mark (context 7060). At least two bones are good matches for *B. esocinus*. One inferior pharyngeal of a large fish from context 5060 did not exactly match any of the specimens in the Tervuren collections. This could, however, be individual variation, but an unknown species is not ruled out.

Several remains are of Siluridae, catfish. At Sagalassos, the catfish remains included *Silurus glanis*, the common European catfish or wels, and *Clarias*, which is not a native European fish.[34] The remains here are of two types, a single cleithrum of a Silurus and several remains of a different type. Careful examination of the *Silurus* cleithrum showed it to match specimens of *S. triostegus* of about 50 cm total length. Some authorities regard this as only a variant of *S. glanis*,[35] but regardless of the taxonomic position, this individual bone matched specimens described as the *triostegus* type, rather than the morphology of *S. glanis*. Other catfish remains included pectoral spines and vertebrae of small catfish belonging to the genus *Glyptothorax*, the exact species of which could not be determined.

Unlike at Sagalassos,[36] no marine species or imported fish are present in these samples. Exploitation of local freshwater fish is common at sites in the Euphrates basin.[37] Apart from the domestic (or probably domestic) mammal and birds, all the fauna are those expected in the local environs.

A few amphibian remains are present; one maxilla can be identified as a toad, *Bufo* sp.

MOLLUSCS

A total of 25 fragments (262 g) of marine and land molluscs were identified by T. P. O'Connor and the author (table 6). The majority of the shell (16 fragments) belonged to the oyster *Ostrea edulis* and came from early Roman deposits from Trench 15 and mid-Roman deposits from Trenches 2, 11, and 15. Four fragments of oyster shell from a collapse layer (context 2039) had been burnt.

Period	*Ostrea edulis*	*Anodonta* sp.	*Helix* sp.	*Glycymeris* sp.
Early Roman	5	0	1	1
Mid-Roman	11	3	0	0
Late Roman	0	4	0	0
Total	16	7	1	1

Table 6. Identified molluscs according to period.

Six fragments of shell identified as *Anodonta* sp. were recovered from mid-Roman deposits found in Trenches 2 and 9 and late Roman deposits in Trench 7. A single shell identified as the large gastropod from the genus *Helix*, possibly *H. pomatia,* was found in context 15095. A small shell belonging to a dog-cockle, *Glycymeris* sp., was also recovered from context 15095. It had a small perforation through the shell and may have been worn as jewelry.

Butchery

Butchery marks were identified on 19 percent of the bones recovered by hand from the excavations, predominantly those of the main domestic species (sheep/goat, cattle, and pig). The majority of the evidence for butchery includes chop marks across the shafts of the long bones along with evidence of splitting of the shaft for marrow extraction. Fewer knife marks were identified on the shaft fragments. However, this may be a result of the surface condition of some of the bone, with lighter cut marks not visible.

Many of the ribs had knife and chop marks and a small number of sheep vertebrae from the Roman phases had evidence of sagittal cleaving, as a result of the carcass having been halved down the medial line. A small number of cattle and sheep mandibles also had evidence of butchery chop marks. None of the skull fragments identified from the excavations had evidence of butchery, and few of the bones had evidence of knife marks on the shafts.

A cattle metatarsal from context 18076 had been carefully sawn across the proximal section of the shaft, leaving part of the proximal articulation. It is possible that it may have been worked-bone refuse.

Pathology

Evidence of abnormal abrasion on the teeth of ovicaprines was observed on three mandibles (contexts 2012, 5048, and 15009). Two of these show evidence of very heavy wear on P4 and M1, forming a severe "V" shape in the tooth row. This type of malformation is known as "Einbiß," and is often the result of malocclusion of the toothrow or lack of an opposing wear surface.[38] A small amount of decay on the lingual side in the form of P3, a dark spot on the enamel close to the occulsal surface, was also observed on one right mandible (context 5048). The wear pattern on a right mandible from context 15009 was not as severe as the others and had the form of a concave semicircular dip from M2 through to P4.

The remains of a sheep mandible (right) from context 11106 contained three molars; P4 was absent. The area for P2 and P3 had completely closed over. The bone was slightly porous but there was no evidence of infection.

Part of a sheep mandible from the diastema to the gap for M3 was recovered from context 7118. Teeth present included P3 and P4. The gap either side of the position for M1 is larger than normal and bulbous in shape. There is also a reduction in the bone, which would have left more of the tooth exposed. Around the position of the roots of M1 and M2 there is a slight dimple, and the area is slightly pitted. It is probable that there was an infection in this area, possibly from the forming of an abscess. It is possible that the tooth was lost prior to the death of the animal.

A cattle distal phalanx (right) from context 15009 displayed some lipping around the edge of the articulating surface and minor deterioration of bone at the distal end.

A single, poorly preserved, complete cattle calcaneus (right) from context 12012 displayed a large amount of bone growth all around the anterior process and *sustentaculum tali*. Immediately above this area, a slightly porous circular plate of bone was attached to the surface. The cause of this additional bone growth is uncertain. The actual articulating surface of the bone did not show any evidence of malformation. Two small knife marks were observed on the dorsal section of the *corpus calcenei.*

A domestic fowl tarso-metatarsus (right) had an elongated bulbous growth on the proximal section along the medial side. The bone was smooth around this area and may have been the result of a prior trauma or infection of the bone.

CONCLUSION

It is clear that domestic species (cattle, sheep/goat, and pig) dominated the meat diet of the inhabitants at Zeugma, with sheep and goats being most important. The diet was also supplemented with a wide variety of other species, such as camel, deer, hare, domestic fowl, wild birds, and fish.

The animals present in the assemblage are typical of those found throughout the Near East and Turkey during the early Roman period. Comparisons can be made with similar dated assemblages from sites in western Turkey such as Sagalassos[39] and Gordion,[40] in addition to slightly earlier deposits from sites along the Euphrates River, such as Jebel Khalid.[41]

It is probable that the majority of meat eaten by the inhabitants was not from animals kept immediately within the city. Cattle were probable kept along the lowlands close to the river, as they require a large quantity of water and are able to drink up to 16 gallons a day.[42] However, their use as draft animals would have kept them closer to more densely settled areas.[43] Pigs were probably also kept close to the settlement, housed within purpose-built sties, since they also require a lot of water and shelter from the sun. It is unlikely that pigs were farmed on a large scale. They were probably attached to small dwellings and fed on refuse and crop spoilage. Poultry was probably also farmed on a smaller scale closer to dwelling areas.

Both sheep and goats would have been well adapted to the dry environment of the area, and would have been herded around the hills and valleys between seasonally available grazing areas, much as they are farmed in the region today. The importance of their secondary products would have been of equal if not greater value than their meat.

It is likely that fish and birds contributed to a far greater degree to the diet of the inhabitants than is indicated from the assemblage recovered. It is probable that much of the evidence has been lost, since the bones are more prone to destruction and loss due to their small size and friability. Fish meat is likely to have been popular, and the proximity of the site to the river and trading routes would have provided ample opportunity to exploit the surrounding resources.

The sample of animal bone recovered from the excavations does not appear to represent clearly defined areas of rubbish disposal that might suggest butchery sites or large-scale kitchen waste. It is probable that much of the refuse material from the city may have been taken elsewhere and dumped in middens outside of the main occupation area or dumped into the river.

TABLES

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
ER	Astragalus	GLI	66	66	1
MR	Astragalus	GLI	63–70.1	67.1	3
ER	Metacarpal	Bp	59	59	1
LR	Metacarpal	Bp	49.8–57	53.4	2
MR	Tibia	Bd	61–62.1	61.6	2
EH	Tibia	Bd	64.4	64.4	1

Table 7. Metrical data, cattle.

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
ER	Metacarpal	Bp	23.2–25.2	24.2	2
MR	Metacarpal	Bp	21–24.7	22.8	4
LR	Metacarpal	Bp	25	25	1
MR	Metacarpal	GL	111–116	114	3
MR	Metacarpal	Bd	24.7–27.9	26.6	4
MR	Metatarsal	GLI	114.8–122	118.4	2
MR	Metatarsal	Bd	21.2–24.7	23	2

Table 8. Metrical data, goat.

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
ER	Metacarpal	Bp	23–24.1	23.7	3
MR	Metacarpal	Bp	23–25.2	24.1	2
LR	Metacarpal	Bp	22.3–25.7	24	4
Early Islamic	Metacarpal	Bp	24–24.6	24.3	2
ER	Radius	Bp	27–29.5	28.2	3
MR	Radius	Bp	27–31.2	30	4
ER	Tibia	Bd	22.3–27.8	27	6
MR	Tibia	Bd	24.4–30	26.4	6
LR	Tibia	Bd	23–27.9	21	5
Early Islamic	Tibia	Bd	22.2–26.8	24.5	4

Table 9. Metrical data, sheep/goat.

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
LH	Astragalus	GLI	31	31.0	1
MR	Astragalus	GLI	27.5–32.1	30.3	7
LR	Astragalus	GLI	28–30.1	2901.0	3
ER	Humerus	Bd	30–31.8	30.6	3
MR	Humerus	Bd	28–32.8	31.0	4
LR	Humerus	Bd	30.4	30.4	1
ER	Metacarpal	GL	120.8	120.8	1
MR	Metacarpal	GL	122.1	122.1	1
ER	Metacarpal	Bd	25	25.0	2
MR	Metacarpal	Bd	23.2–25.4	24.3	2
Early Islamic	Metacarpal	Bd	24.4	24.4	1
MR	Metatarsal	GL	131	131.0	1
LR	Metatarsal	GL	141	141.0	1
MR	Metatarsal	Bd	23–25.7	24	4
LR	Metatarsal	Bd	23.7	23.7	1

Table 10. Metrical data, sheep.

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
MR	Astragalus	GLI	31.8	31.8	1
LR	Astragalus	GLI	39.8–47	43.4	2
MR	Astragalus	Bd	19	19	1
LR	Astragalus	Bd	23.5–26	24.8	2

Table 11. Metrical data, pig.

Context	Element	GL	Bp	SD	Bd	SDO	DPA
2035	Femur				30		
5075	Femur		38.1				
9192	Humerus				35.8		
15095	Ulna					19	23
15095	Radius	181	16.5	10.9			

Table 12. Metrical data, dog.

Period	Element	Measurement	Range (mm)	Mean (mm)	No.
ER	Femur	Bp	13–14	13.5	2
MR	Femur	Bp	11.5–12.9	12.1	4
LR	Femur	Bp	15	15	2
MR	Femur	GL	62.1–65.5	63.8	2

Table 13. Metrical data, domestic fowl.

Period	Butchered	Burnt	Gnawed	New breaks	Total fragments
Hellenistic	5	1	0	14	43
% of total fragments	12	2	0	33	
Early Roman	236	8	21	390	919
% of total fragments	26	1	2	42	
Mid-Roman	182	100	24	627	1,336
% of total fragments	14	7	2	47	
Late Roman	188	22	36	515	1,110
% of total fragments	17	2	3	46	
Early Islamic	44	1	9	112	196
% of total fragments	22	1	5	57	
Total	**746**	**145**	**102**	**1,883**	**3,927**
% of total fragments	19	4	3	48	

Table 14. Numbers and condition of hand-retrieved bone fragments.

Species	Hellenistic	Early Roman	Mid-Roman	Late Roman	Islamic	Undated	Total
Cattle	4	63	64	96	19	21	267
Sheep	2	17	70	33	6	7	135
Sheep/goat	8	290	260	239	48	50	895
Goat	1	9	15	1	1	4	31
Pig	3	48	187	82	15	31	366
Equus	–	1	2	1	–	–	4
Horse	1	6	7	4	4	1	23
Donkey	–	4	1	2	–	2	9
Camel	–	1	–	1	–	1	3
Red deer	–	–	–	–	1	–	1
Fallow deer	–	–	6	3	–	–	9
Roe deer	–	2	2	–	–	–	4
Dog	–	5	4	1	–	1	11
Hare	–	1	1	–	–	1	3
Mole rat	–	–	1	–	–	–	1
Mustelidae	–	–	–	1	–	–	1
Bird	2	10	20	5	0	5	42
Fish	0	1	1	1	0	2	5
Small	0	0	2	0	0	0	2
Medium	18	362	560	455	61	139	1,595
Large	4	100	113	176	39	56	488
Total	**43**	**920**	**1,316**	**1,101**	**194**	**321**	**3,895**

Table 15. Total number of hand-collected bones according to species and period. Small = lagomorph/rodent size; Medium = sheep/pig size; Large = cattle/horse size.

Species	Early Roman	Mid-Roman	Late Roman	Undated	Total
Sheep/goat	0	22	7	6	35
Goat	0	2	0	1	3
Pig	0	15	6	5	26
Deer	0	0	0	1	1
Dog	0	1	1	0	2
Bird	1	41	13	5	60
Small mammal	0	20	21	4	45
Fish	0	11	20	23	54
Amphibian	0	3	0	0	3
Small	0	155	17	77	249
Medium	0	654	304	184	1,142
Large	0	3	14	21	38
Total	**1**	**927**	**403**	**327**	**1,658**

Table 16. Total number of sieved bones according to species and period. Small = lagomorph/rodent size; Medium = sheep/pig size; Large = cattle/horse size.

Species/genus	Hellenistic	Early Roman	Mid-Roman	Late Roman	Undated	Total
Hare	–	1	1	–	1	3
Mole rat	–	–	1	–	–	1
Mustelidae	–	–	–	1	–	1
Shrew	–	–	–	2	–	2
Mus	–	–	4	3	–	7
Apodemus	–	–	1	–	–	1
Mouse size	–	–	8	11	3	22
Rodent	–	–	7	5	1	13
Domestic fowl	2	5	28	9	–	44
Galliform	–	2	7	1	3	13
Columba	–	2	3	1	–	6
Passerine	–	–	7	2	–	9
Buzzard	–	–	–	–	1	1
Owl	–	–	–	1	–	1
Duck	–	–	1	–	–	1
Unidentified bird	–	2	15	4	6	27
Toad	–	–	–	–	1	1
Amphibian	–	–	–	–	2	2
Cyprinid	–	1	9	6	–	16
Catfish	–	–	4	1	2	7
Fish	–	–	21	15	–	36
Total	**2**	**13**	**117**	**62**	**20**	**214**

Table 17. Small mammal, bird, amphibian, and fish bones from hand-collected and sieved material.

Age	Element	Early Roman F	Early Roman UF	Mid–Roman F	Mid–Roman UF	Late Roman F	Late Roman UF	Early Islamic F	Early Islamic UF
10 mos.	Scapula D	1	–	–	–	1	–	–	–
18 mos.	Humerus D	–	–	–	–	2	–	–	–
	Radius P	–	–	–	–	–	–	–	–
2–2.5 yrs.	Metacarpal D	1	1	–	–	1	–	–	–
	Tibia D	–	1	3	1	–	–	–	–
	Metatarsal D	1	–	–	–	1	–	–	–
3.5 yrs.	Calcaneum P	–	2	1	–	1	–	–	–
	Femur P	–	1	1	–	–	–	–	–
3.5–4 yrs.	Humerus P	–	–	–	–	1	–	–	–
	Radius D	–	–	–	–	1	–	1	–
	Ulna P	–	–	–	–	–	–	–	–
	Femur D	2	1	–	–	–	–	–	–
	Tibia P	–	–	–	–	–	1	–	–

Table 18. Epiphyseal fusion of cattle bones according to element and phase. D = distal; P = proximal; F = fused; UF = unfused.

Age	Element	Early Roman F	Early Roman UF	Mid-Roman F	Mid-Roman UF	Late Roman F	Late Roman UF	Early Islamic F	Early Islamic UF
10 mos.	Humerus D	5	2	6	1	8	1	1	–
	Radius P	6	1	4	–	3	–	–	–
	Scapula D	4	–	3	–	4	–	1	–
1.5–16 mos.	Tibia D	8	–	11	2	5	–	4	–
	Metacarpal D	3	–	3	3	1	1	–	–
	Metatarsal D	–	1	9	–	2	2	–	–
2.5–3 yrs.	Calcaneum P	–	3	4	–	3	1	1	–
	Radius D	3	–	4	2	1	–	–	–
	Femur P	1	2	3	5	1	3	–	1
	Ulna P	–	–	–	2	1	–	–	1
3–3.5 yrs.	Humerus P	–	2	3	–	–	–	–	–
	Femur D	–	1	3	1	–	–	1	–
	Tibia P	3	–	–	–	1	1	–	–

Table 19. Epiphyseal fusion of sheep/goat bones according to element and phase. D = distal; P = proximal; F = fused; UF = unfused.

Age	Element	Early Roman F	Early Roman UF	Mid-Roman F	Mid-Roman UF	Late Roman F	Late Roman UF	Early Islamic F	Early Islamic UF
1 yr.	Scapula D	2	2	1	2	1	–	–	–
	Humerus D	–	–	4	6	1	–	1	1
	Radius P	–	–	1	1	–	1	–	–
2 yrs.	Tibia D	–	1	1	1	–	1	1	–
	Metacarpal D	–	1	–	8	–	–	–	–
2.25 yrs.	Metatarsal D	2	–	–	4	–	2	–	–
3.5 yrs	Humerus P	–	–	–	–	–	–	–	1
	Radius D	–	1	–	7	–	2	–	–
	Femur P	–	–	–	1	2	–	–	–
	Femur D	–	–	–	2	–	–	–	–
	Tibia P	–	–	–	–	–	–	–	–

Table 20. Epiphyseal fusion of pig bones according to element and phase. D = distal; P = proximal; F = fused; UF = unfused.

	Hellenistic			Early Roman			Mid-Roman			Late Roman			Early Islamic			
Bone	**Cattle**	**S/G**	**Pig**	**Cattle**	**S/G**	**Pig**	**Cattle**	**S/G**	**Pig**	**Cattle**	**S/G**	**Pig**	**Cattle**	**S/G**	**Pig**	**Total**
Horncore	–	1	–	–	4	–	–	5	–	1	2	–	1	–	–	14
Skull	–	1	–	3	2	7	–	7	24	–	2	6	–	–	2	54
Maxilla/ pre-maxilla	–	–	–	–	2	6	–	6	10	–	4	4	–	–	1	33
Jaw	–	1	–	4	51	5	3	26	17	10	23	6	2	3	2	153
Loose teeth	–	3	–	11	76	8	9	48	30	11	39	19	3	8	1	266
Atlas	–	–	–	–	2	–	–	1	–	–	–	–	–	–	–	3
Axis	–	–	–	1	–	–	–	2	–	–	–	–	–	–	–	3
Other vertebrae	–	1	–	1	3	–	2	8	–	–	6	1	1	2	–	25
Ribs	–	–	–	17	30	1	15	63	3	22	72	1	1	4	–	229
Scapula	–	2	1	1	7	6	–	4	5	3	4	2	–	2	–	37
Pelvis	–	–	–	–	10	2	1	14	6	2	6	1	1	1	–	44
Humerus	–	–	–	–	19	2	3	19	16	6	15	6	1	4	2	93
Radius	–	–	–	–	19	1	1	11	11	2	10	5	1	3	1	65
Ulna	1	–	–	2	1	2	–	7	4	1	2	3	–	1	1	25
Femur	1	1	–	5	9	2	2	16	12	2	7	7	1	4	–	69
Tibia	1	–	1	1	18	1	4	19	5	1	15	2	–	6	1	75
Astragalus	–	–	–	1	1	–	7	9	2	3	7	2	1	1	–	34
Calcaneum	–	–	–	2	4	–	3	9	8	3	6	–	–	1	1	37
Other carpal/ tarsal	1	–	–	–	–	–	2	2	–	1	1	–	1	–	–	8
Metacarpal	–	1	1	3	29	2	1	22	12	6	20	3	–	7	–	107
Metatarsal	–	–	–	4	20	2	3	24	8	10	17	5	2	3	–	98
Metapodials	–	–	–	–	–	1	1	1	3	2	1	2	1	–	2	14
Phalanges	–	–	–	7	9	–	7	21	11	10	13	6	2	5	1	92
Other	–	–	–	–	–	–	–	1	–	–	1	1	–	–	–	3
Total	**4**	**11**	**3**	**63**	**316**	**48**	**64**	**345**	**187**	**96**	**273**	**82**	**19**	**55**	**15**	**1581**

Table 21. Anatomical representation. S/G = sheep/goat.

NOTES

1. Schmidt 1972; Hillson 1986, 1995; Lister 1996; Cohen and Serjeantson 1996.
2. I thank Hugh Elton for assistance at the British Institute of Archaeology in Ankara.
3. Chaplin 1971.
4. Boessneck 1969; Prummel and Frisch 1986.
5. Silver 1969.
6. Payne 1973; Grant 1982.
7. Halstead 1985; Grant 1982.
8. Higham 1967.
9. Bull and Payne 1982.
10. Grant 1982.
11. Hambleton 1999.
12. Levine 1982.
13. E.g., Baker and Brothwell 1980.
14. Von den Dreisch 1976.
15. White 1970.
16. White 1970.
17. Zeder 1991.
18. Frayn 1996.
19. Armitage and Chapman 1979; Eisenman 1986; Uerpmann and Uerpmann 1994.
20. Steele 2002.
21. White 1970.
22. Identified by Sheila Hamilton-Dyer.
23. Clutton-Brock 1987.
24. De Cupere 2001.
25. Clutton-Brock 2001.
26. Clutton-Brock 1987.
27. Zeuner 1963.
28. Broekhuizen et al. 1992, cited in De Cupere 2001.
29. Levent Atici, pers. comm.
30 Krystufek and Vohralik 2001.
31. Harrison and Bates 1991.
32. West 1985.
33. De Cupere 2001.
34. Van Neer et al. 1997.
35. Coad 1991.
36. De Cupere 2001.
37. Wäsle 1976.
38. Van Neer, pers. comm.
39. De Cupere 2001.
40. Zeder and Arter 1994.
41. Steele 2002.
42. Reynolds 1987.
43. Zeder 1991.

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