# THE ZOOARCHAEOLOGICAL ASSEMBLAGE FROM THE FRENCH SCHOOL ON YEFET STREET, YAFO (JAFFA)

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#### INTRODUCTION

The salvage excavation at the French School in Yafo yielded a small assemblage of animal bones from the Crusader and late Ottoman periods. The Crusader-period deposits contained few architectural remains with which the faunal material from this period was associated, while the Ottoman-period material was found in waste accumulations in the vicinity of a nineteenth-century well house in Area B (West) and Area B (East) (see Arbel and Talmi, this volume).

This report compares the zooarchaeological remains of the Crusader and Ottoman periods in terms of their taxonomic frequencies and patterns of livestock demography and body-part representation. It also considers the data on assemblage formation and human modification of the bones. The conclusions of this study offer a useful point of reference for future studies on animal use and consumption in historic Yafo, although they should be treated with caution due to our limited understanding of the depositional context of the faunal assemblage.

#### MATERIALS AND METHODS

*Packaging and Cleaning.* The faunal remains from the excavation were recovered by hand. They were washed in tap water and dried in the shade prior to analysis, in order to remove the adhering soil and allow identification.

Bone Identification, Counting and Measurement. The bones were identified using the comparative osteological collection of the Laboratory of Archaeozoology at the University of Haifa. The caprine bones were identified as either sheep (Ovis aries) or goat (Capra hircus) where possible, using the morphological and metrical criteria published by Zeder and Lapham (2010). The donkey (Equus assinus) and horse (E. caballus) teeth were distinguished based on the pattern of the enamel folds on the mandibular molars and pre-

molars (Eisenmann 1986), while some of the post-cranial bones were tentatively identified as belonging to equids based on their size. The suid (*Sus scrofa*) remains were identified as wild boar or domestic pig based on bone measurements (Payne and Bull 1988).

The bone counting followed Davis' (1992) method of recording the most diagnostic skeletal elements or parts thereof (i.e., diagnostic zones): the epiphyses and metaphyses of distal humeri, radii, femora, tibiae and metapodials; the proximal articulations of the first and third phalanges; the ischial acetabular rim of the pelvis; the articulation of scapulae; and the astragalus, calcaneus, isolated cheek teeth and posterior mandibular tooth rows. In accordance with this method, only the fragments preserving more than half of the diagnostic zone in the original element were counted. These fragments comprised the number of identified specimens (NISP) and were used to calculate the taxonomic frequencies. The skeletal element frequencies were calculated by a normalization procedure of dividing the NISP for each element by the number of times that that element occurred in a complete skeleton for each taxon. These calculations constituted the minimal number of animal units (MAU).

All the sufficiently complete bones were measured to the nearest 0.1 mm using Vernier callipers. Most of the measurements were taken following Driesch (1976) and Davis (1992), except for the medial and lateral depths of the caprine distal metapodial trochleae, which were based on Zeder and Lapham (2010).

Age-at-Death and Sex Determination. The state of epiphyseal fusion was recorded for each identified long bone. The degree of wear of isolated caprine teeth and of cattle and pig isolated mandibular teeth and tooth rows was recorded following Grant (1982). Caprine tooth rows were assigned to wear stages following Payne (1973). Sex determination was based on the morphology of the pubic region (Edwards, Marchinton and Smith 1982), as well as on the distribution of measurements of diagnostic skeletal elements in sexually-dimorphic species, especially the breadth of the distal humerus and metacarpus in ungulates.

*Bone Surface Modifications*. All the identified bone fragments were examined for bone surface modifications, mostly with the naked eye, using a strong, oblique light source, or when necessary, using a magnifying glass with a  $\times 10$  magnification. For each butchery mark it was noted whether the mark was caused by a chopper or a knife. The evidence for carnivore gnawing, weathering (Behrensmeyer 1978), burning and root etching was also noted, as was the type of bone fractures, i.e. whether it represented a fresh break that occurred close to the death of the animal as a result of human or scavenger consumption, or a dry break that occurred later on due to physical processes (Villa and Mahieu 1991).

## RESULTS

The faunal assemblage consisted of 158 identified bones, of which 110 were retrieved from the Crusader-period layer and 48 from the late Ottoman-period layer (Tables 1, 2). A handful of identified bones from mixed loci were omitted from the analysis.

Species	Cattle		Caprine		Pig	<u>.</u>	Equid		
Element	NISP	MAU	NISP	MAU	NISP	MAU	NISP	MAU	
dp4					2				
P4			1	1	1	1			
M1/2	5	3	1	1	3	2	1	1	
M3	5	3			2	1			
Mandible	5	3	1	1	4	2			
Scapula			1	1	1	1			
Humerus	2	1	2	1	2	1			
Radius							1	1	
Metacarpus	5	3	3	2	1	1	1	1	
Pelvis	1	1					1	1	
Femur	2	1	1	1	2	1	1	1	
Tibia					2	1	2	1	
Astragalus	6	3	1	1	1	1	2	1	
Calcaneus	1	1	3	2	2	1	2	1	
Metatarsus	2	1	3	2	1	1			
Phalanx I	12	2	4	1			2	1	
Phalanx III	7	1							
NISP	53		21		24		13		
%	48		19		21		12		

Table 1. Bone Counts of Common Taxa in Loci of the Crusader Period

Table 2. Bone Counts of Common Taxa in Loci of the Ottoman Period

Species	Cattle		Caprine	;	Pig		Equid		Chicker	1	Camel		
Element	NISP	MAU	NISP	MAU	NISP	MAU	NISP	MAU	NISP	MAU	NISP	MAU	
dp4					1	1							
P4			2	1									
M1/2	3	1	4	1	1	1	1	1					
M3			2	1	1	1							
Mandible			2	1	1	1							
Scapula			1	1									
Humerus	2	1	1	1			3	1	1	1			
Radius													
Ulna									1				
Metacarpus	1	1	1	1	0.5	1							
Pelvis			2	1									
Femur			1	1									
Tibia							1	1	3	2			
Astragalus	1	1	1	1									
Calcaneus	2	1			2	1							
Metatarsus	1	1	1	1									
Phalanx I	2	1	4	1			1	1			1	1	
Phalanx III	1	1											
NISP	13		22		7		6		5		1		
%	23		39		13		11		9		2		

## Assemblage Preservation

The faunal remains appear to represent a complex depositional history, probably originating from mixed secondary and tertiary accumulations. In each of the periods, there were bones with fresh fractures, attesting to human consumption, and those with dry fractures, attesting to post-depositional taphonomic processes such as trampling and crushing. The degree of preservation indicated by the condition of the bone surfaces varied widely, some specimens showing a high degree of weathering and root etching, consistent with a long sub-aerial exposure prior to burial, and others showing well-preserved cortical surfaces, indicating rapid burial. Some carnivore impact on the bones was evidenced by the presence of gnawing marks, characterized by the destruction of their soft, greasy parts such as the distal femur and radius. To some extent, a recovery bias was introduced due to the manual collection of the bones, as indicated by the absence of the small distal caprine and pig phalanges, while the larger cattle phalanges, both the proximal and distal, were present in the assemblage (see Payne 1975).

*The Crusader-Period Material.*— These remains bore fresh and dry bone fractures in similar frequencies of (n = 6 and n=7, respectively). The presence of several root-etched and weathered bones (n = 5) attested to a relatively lengthy period of exposure of some of the bones before burial. Two specimens bore signs of carnivore gnawing, probably caused by dogs.

*The Ottoman-Period Material.*— The small sample from this period included two bones with fresh fractures and two with dry fractures. Two other specimens bore carnivore gnawing marks, and seven specimens were root-etched, indicating a long period of composting near the soil surface.

# Taxonomic Composition

The Crusader-period sample (Table 1) is dominated by cattle (*Bos taurus*, NISP = 53, 48%), followed by lower frequencies of caprines (NISP = 21, 19%), pigs (*Sus scrofa*, NISP = 24, 21%) and equids (*Equus* sp., NISP = 13, 12%). The caprine remains appear to represent both sheep and goats, based on metric analysis of the metapodials (Appendix 1; Fig. 1). The identification of a horse among the equid remains is based on the morphology of a distal metacarpus, while the identification of a donkey is based on a tooth in which the enamel fold morphology could be discerned. The presence of chickens (*Gallus gallus domesticus*) is attested by three leg bones. A single dog tibia is also present.

The dominant taxon among the Ottoman-period remains were caprines (NISP = 22, 46%) rather than cattle (NISP = 13, 27%). The two caprine bones for which the species could be identified belong to sheep (Fig. 1). The suid remains (NISP = 7, 15%) consist of at least one wild individual, represented by a third molar that is unmistakably long in comparison to the same molar in domestic pigs (Fig. 2). The equid remains (NISP = 6, 13%) comprise donkeys (Fig. 3) and probably a horse, evidenced by a large first phalanx. The chickens are



Fig. 1. The sheep to goat ratio based on measurements of the depth of the lateral (A) and medial (B) metapodial trochlea (following Zeder and Lapham 2010); the Crusader-period specimens are from L521–L561, and the Ottoman-period specimen is from L338.



Fig. 2. Lower third molars of a wild boar (1; L341; Length (mm) = 47.4, Width I = 19.3) and a domestic pig (2; L524; Length (mm) = 31.9, Width I = 14.9).



Fig. 3. Assinine mandibular molar from L334 (Ottoman period); note that the buccal enamel fold does not penetrate into the base of the double-knot, which displays a V-shaped morphology (see Eisenmann 1986).

represented by five leg and wing bones: three tibiae, one humerus and one ulna. A single camel (*Camelus dromedaries*) phalanx was found in L306, in association with the remains of an irrigation channel in Area B east.

A statistical comparison of the frequencies of the major taxa, cattle, caprines, pigs and equids (Fig. 4), between the Crusader- and Ottoman-period samples showed a significantly higher frequency of cattle bones in the former sample and of caprine bones in the latter sample (Chi-square = 13.06, P = 0.004, Phi = 0.27); this means that the differences between the two samples are statistically significant. It appears that the bones from the Crusader period represent a higher reliance on beef, while those from the Ottoman period represent a higher reliance on mutton.

#### Age-at-Death and Sex Ratios

The Crusader-period sample comprised a higher percentage of juvenile cattle (19%), caprines (45%) and pigs (83%) than the Ottoman-period sample (10%, 11% and 33%, respectively; Appendix 2; Fig. 5). The relatively high frequency of juvenile cattle in the Crusader period indicates that milking was more important than the production of veal. The greater proportion of adult cattle in the Ottoman period indicates that they were raised mainly to serve as work animals.



Fig. 4. Differences in relative frequencies (%NISP) of the main taxa between the Crusader and Ottoman periods; absolute frequencies in NISP appear above the columns.

Little can be said regarding the caprine age difference between the Crusader- and Ottoman-period samples, due to the presence of only a few bones that could be aged and sexed. One caprine pelvic fragment from the Crusader period and three from the Ottoman period could be identified as those of adult male animals. Possibly, the seemingly younger age of the slaughtered animals in the Crusader period indicates a milk production strategy, while the Ottoman period was characterized by a surplus of adult male sheep that may have been obtained from a breeding stock kept outside the town. It is generally known that in small-scale societies sheep production was carried out in the rural rather than urban context, especially where this involved the keeping of a male breeding stock.

The young age-at-death of the pigs in the Crusader period indicates that they were part of a domesticated population kept for the purpose of pork production, as no secondary products could be obtained from these animals. Obtaining the mortality data for the Ottoman-period pig herd is problematic due to the very small number of specimens and the presence of wild boar, which are represented by at least one individual.

With the exception of a single equid foetal humerus from the Ottoman period, all the equid bones are fused, belonging to adult animals. This observation is reinforced by the absence of milk teeth and the worn condition of the permanent dentition.



Fig. 5. The percentage of juveniles calculated as unfused/(fused + unfused) bone elements for each taxon and period. Numbers of fused + unfused elements are given above the columns.

## Skeletal Element Representation

The Crusader-period remains of all four major domestic taxa represent most of the animal body parts, the forelimb, hind limb, head and foot (Fig. 6), indicating that they were retrieved from mixed deposits. This material did not demonstrate the typical pattern of urban sites that often consists of the spatial segregation between the butchery and consumption waste, the former including mainly the feet and sometimes the heads, and the later including the meat-rich body parts such as the limbs. Although the rib and vertebra fragments, which represent the animal trunk, were not included in this study, their presence was observed in all the Crusader-period loci.

In the Ottoman-period assemblage, the cattle are represented mainly by butchery waste, namely, the head and foot elements, while the caprine remains consist mainly of consumption remains. This may indicate that in the part of the town represented in the excavation mutton was consumed, while cattle was slaughtered but not consumed on site.



Fig. 6. The relative frequency of skeletal elements for each of the livestock taxa, indicated by the shading from black to light gray, using the data from Table 1: Equid (1), cattle (2), pig (3) and caprine (4); unshaded parts are either not present or not counted, animal drawings modified from the website of Michel Coutureau and Vianney Forest (www.archéozoo.org), after Barone (1976).

#### **Bone Modification**

Nearly 25% (n = 23) of the identified bones from the Crusader period bore evidence of butchery. The cut marks indicate that both knives (n = 10) and heavy choppers (n = 13) were used in the butchery process, and that their purpose was to disarticulate the carcasses, deflesh the bones and split the long bones longitudinally to obtain the marrow. The heavy butchery using choppers probably accounts for much of the observed fragmentation in the assemblage. The Ottoman-period assemblage also exhibits a high number of butchery marks (n = 9, 18% of the NISP). Remarkably, pigs and horses also appear to have been butchered in nineteenth-century Yafo. The presence of defleshing cut marks on the shaft of a foetal horse humerus (Fig. 7) indicates that the carcass was butchered for human consumption rather than to be fed to dogs (see Albarella and Davis 1996:30).

A noteworthy caprine metatarsus bone from a Crusader-period context (L524) was worked by sawing off the part below the proximal articulation, and perforating it ventraldorsally through the proximal shaft (Fig. 8). This bone also displays a chevron-like pattern of cut marks along its ventral aspect. Parallels of worked metapodial bones with both the perforation and the chevron-like patterning can be noted at contemporary sites in the Iberian Peninsula. In these cases it was suggested that the perforations were used to affix the bone as an axis in a weaving machine, and that the chevron patterning possibly resulted from the secondary use of the item as a bone anvil in a metalworking shop (Davis and Moreno-García 2007:85–91).



Fig. 7. Cut mark on an equid foetal humerus (caudal view) from L336 (Ottoman period), identified by the well-developed large *tuberositas deltoidea* and the trapezoidal section of the proximal diaphysis (Prummel 1987).



Fig. 8. Perforated and incised caprine metatarsus from L524 (Crusader period).

#### **CONCLUSIONS**

The faunal assemblage from the French School excavation revealed that the bones accumulated in different depositional episodes. The bone survivorship and assemblage composition likely reflect in large part the impact of human butchery using heavy choppers, carnivore activity and recovery bias, processes which supposedly affected the Crusader- and Ottoman-period samples in similar ways. The bone samples from both periods consisted mainly of cattle and caprines, with cattle dominating in the Crusader period and caprines, mainly sheep, dominating in the Ottoman period. Some pig, donkey, horse and chicken bones occurred in both periods.

The cattle and caprine remains from the Crusader period represent the slaughter of young animals that may reflect more intensive milk production, or a preference for the production of veal and lamb/kid meat. In the Ottoman period, most of the animals were slaughtered as mature adults. The adult cattle of both sexes was probably employed for work, while the adult caprines, mainly male sheep, may have been acquired for consumption from the breeding stock of specialized pastoral producers, since they would not have been usually penned in towns.

Remarkably, in the Ottoman period, when Yafo was largely a Muslim town, there is evidence of pig butchery and the hunting of wild boar. The relative frequency of pig bones in the Ottoman periods is in fact similar to that of the Crusader period. Moreover, the finding of a defleshed foetal equid humerus further suggests that an atypical cuisine for a Muslim community was practiced in the part of the settlement represented in the excavation. Some religious tolerance toward the consumption of both equid and wild boar flesh may be expected among a poverty-stricken Muslim population of that period, but is also characteristic of Maghrebi Islam (Simoons 1994:341). The presence of North African immigrants at the periphery of nineteenth-century Yafo has been documented by Abbasi (2007), raising the intriguing possibility that the excavated area was the part of the town occupied by these immigrants.

This faunal assemblage raises interesting questions regarding the urban economy and group identity of Yafo in the medieval and late Ottoman periods. The present report could not address these issues in greater depth due to the limitations of sample size and the lack of sealed contexts in the excavation. It is to be hoped that this line of questioning will be further pursued in future work.

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Measurements
1. Bone
APPENDIX

DTrMed																												
DTrLt																												
Dd	33.8				30.4	32.4					28.4	34.4	30.1	27.9		25.1												
GLI	62.2			61.7	56.8	60.0	65.4																					
Glpe																	53.6	61.4	52.7	60.6		58.2	50.4	53.7	58.3	56.3	62.4	s (1992)
BFd											52.4	61.8	53.3	51.0		45.7												and Davi
HTC								34.3																				n (1976).
ΒT								72.3	70.5																			v Driescł
Bd	39.6	39.5	38.9		36.6	37.5	39.9				48.4	55.0	48.5	50.7	55.9	41.8	26.0	29.6		31.3		23.1	21.2	26.3	28.9	23.6	29.0	ons follov
Bp																	27.6	32.9	22.5	35.0	31.2	22.7	23.2	27.8	29.3	26.6	30.5	abbreviati
SD																												a; other a
Γ																												trochle
GL																												medial
Basket	7072	7903	7152	7237	7253	6749	7078	7182	6749	6761	7125	7223	6713	7064	7064	6713	7177	7157	7106	7253	7253	7253	5744	7144	7165	7237	6750	pth of the
Locus	524	534	534	554	561	346	519	546	346	346	524	551	346	524	524	346	548	523	524	561	561	561	519	529	534	554	334	Med = de
Age	Fused	Fused	Fused	Fused	Unfused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Unfused	Unfused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	rochlea; DTi
Element	Astragalus	Humerus	Humerus	Humerus	Metacarpus	Metacarpus	Metacarpus	Metapodial	Metatarsus	Metatarsus	Phalanx I	Phalanx 1	Phalanx 1	Phalanx 1	Phalanx I	th of the lateral t												
Taxon	Cattle																											i DTrLt = dept

(cont.).
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APPENDIX

DTrMed																17.0	18.7	16.9	19.3			18.4				
DTrLt																11.5	12.5	11.7	13.8			11.6				
Dd				46.0													19.2	17.5				18.1				
GLI																								46.3		
Glpe									38.0		38.0	43.4								38.4			37.0			
BFd			62.3														30.8	28.0				27.9				
HTC													17.5	17.1	16.6											18.4
ΒT													34.0	34.3	33.7											30.4
Bd	29.3	63.4	67.1	62.1	35.3	30.0	25.9		13.6	15.4	13.5	12.6					36.2	26.6		13.1	18.8	26.5	11.3			
Bp	31.6					26.1		15.3	13.8		13.6	13.7								13.7			12.1			
SD						17.0																				
Г																										
GL																		134.8							74.1	
Basket	7227	7253	5744	7182	9609	7182	7182	5746	6095	6731	6729	7212	6067	6764	7078	7212	7070	9609	7253	6724	7072	7060	7212	7253	6760	5746
Locus	553	561	519	546	338	546	546	537	341	344	346	534	332	355	519	534	529	338	561	334	524	521	534	561	347	537
Age	Fused	Unfused	Unfused	Fused	Fused	Unfused	Unfused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Unfused	Fused	Fused	Fused	Unfused	Fused	Fused	Fused	Fused	Fused
Element	Phalanx III	Radius	Radius	Tibia	Femur	Metacarpus	Metacarpus	Phalanx 1	Phalanx 1	Phalanx 1	Phalanx 1	Phalanx I	Humerus	Humerus	Humerus	Metacarpus	Metacarpus	Metacarpus	Metapodial	Phalanx I	Astragalus	Metatarsus	Phalanx I	Astragalus	Calcaneus	Humerus
Taxon	Cattle				Caprine								Sheep								Goat			Pig		

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APPENDIX

	DTrMed																	
	DTrLt																	
	Dd													50.2	40.7			
	GLI																	
	Glpe																	
	BFd			20.8	38.5	38.8				32.5	38.5	46.5			52.2	42.3		
	HTC							36.9										
	BT							85.0	69.0									
cont.).	Bd			23.0						33.8	39.6	56.6	60.9	79.8	51.3	45.4		18.5
DIX 1. (	Bp									39.2	49.3					52.8		
Appen	SD									23.3	28.9					33.2		
	L	47.7	31.9															
	GL			95.7			87.0			71.5	79.8					89.2	72.9	
	Basket	6095	7106	6750	7138	7182	7182	6037	6749	7191	7191	7253	7191	6037	7191	6761	6067	5746
	Locus	341	524	334	535	546	546	306	346	546	546	561	546	306	546	346	332	537
	Age	d	а	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused	Fused		Fused
	Element	M3	M3	Metacarpus	Astragalus	Astragalus	Calcaneus	Humerus	Humerus	Phalanx I	Phalanx I	Radius	Tibia	Tibia	Metacarpus	Phalanx I	Humerus	Tibia
	Taxon	Pig			Equid										Horse		Chicken	Dog

Cattle											
Crusader Pe	riod	Late Ott	oman Period								
Fused	30		9								
Unfused	7		1								
Mandible (M1M3)	g, g, g	M1/2	j								
M3	g	M1/2	g								
Mandible (M2)	g	M1/2	g								
Mandible (M1M3)	k, h, d										
Mandible (M1M3)	k, l, g										
Mandible (M1M3)	g, k, g										
Caprine											
Crusader Pe	riod	Late Ott	oman Period								
Fused	11	Fused	8								
Unfused	9	Unfused	1								
Mandible (P4M2)		Mandible (P3M3)	Е								
		Mandible (P4M2)	P4 unerupted								
		M3	unworn								
	Р	ig									
Crusader Pe	riod	Late Ott	oman Period								
Fused	2	Fused	2								
Unfused	10	Unfused	1								
Mandible (dp2dp4)	e	Mandible (dp4M1)	l, b								
Mandible (P3M3)	f, a	M3	d								
Mandible (M2M3)	e, a										
Mandible (dp3dp4)	a										

APPENDIX 2. Ageing Data for the Main Taxa, Organized Chronologically.<sup>i</sup>

<sup>i</sup> Lowercase letters indicate tooth wear stages, following Grant (1982); uppercase letters indicate wear stages of mandibular teeth, following Payne (1973).

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