'Atiqot 79, 2014

Faunal Remains from the Early Bronze Age Site of Qiryat Ata—Area N

Nuha Agha

This report describes the faunal remains from rescue excavations undertaken at Qiryat Ata—Area N, which are associated with two periods: EB IB (Phase 4, General Site Stratum II) and EB II (Phases 1–3, General Site Stratum I; see Golani, this volume).[1]

Methods

The faunal assemblage in this study includes only material originating in well-stratified loci from the two periods. Due to the small sample size, the remains from Phases 1–3 (EB II) were analyzed as a single assemblage. Except for isolated examples (see below), no use was made of finds from topsoil, disturbed or unclear contexts.

A thick calcite matrix covered most of the bones, rendering identification and surface examination very difficult. The bones were therefore subjected to a cleaning procedure that included immersion in acetic acid (10%) for 1–2 hours, treatment with potassium hydroxide (KOH) solution, washing in water and drying. Most of the carbonate concretions were dissolved and no damage was caused to the bone surfaces. Samples of the faunal remains from each phase were kept in their original, uncleaned condition, to enable future studies such as DNA extraction and isotope analysis.

Bones that were broken, either in antiquity or during excavation, and whose parts were discovered in close proximity to each other, were refitted so as to minimize possible distortion of the results by counting the same element twice. In some cases, this also helped to identify the bone. This method may also prove useful for future spatial analysis.

The bones were identified to anatomical element and attributed to taxon as close as possible to the species level. When possible, identification was made by comparison with bones of modern animals stored in the comparative osteological collection of the National Natural History Collections of the Hebrew University of Jerusalem. Most of the remains that are not indicative of any particular species (diaphysis, vertebrae, ribs, cranial fragments, etc.) were attributed to size classes (Brain 1981), as were severely damaged fragments, especially of joints, which could not be identified to taxon level. In order to maximize the information from these elements, three size classes were defined: large-sized mammals (such as cattle), medium-sized mammals (such as sheep/goat, gazelle, pig) and small-sized mammals (such as small carnivores). Unless otherwise indicated, all counts refer to NISP (Number of Identified Specimens; Table 1).

Each bone was considered to be made of several parts, several of which could be represented in a single fragment. Therefore, for each bone fragment, a series of completeness values were calculated, based on those parts of the bone that survived. This method was deemed preferable to recording the surviving percentage of the whole bone to avoid a quantitative skew of the assemblage (Klein and Cruz-Uribe 1984). Long bones were divided into five main sections: proximal articulation, proximal shaft, middle shaft, distal shaft and distal articulation. The description of other bones was based on Dobney and Rielly (1988); for some fragments (e.g., the 'neck' of a scapula), an even more accurate anatomical

position was recorded. Whenever possible, the body side—left or right—was also recorded.

All measurable bones and all teeth were measured in order to distinguish between sheep and goats, to determine the domestication status of the animal, and to differentiate between the sexes. All measurements were taken according to von den Driesch (1976) using a manual caliper with an accuracy of 0.1 mm (see Appendix 1). Several morphological and metrical methods were employed to distinguish the bones of goats from those of sheep (Boessneck 1969; Payne 1985; Zeder and Lapham 2010; Zeder and Pilaar 2010).

Mortality curves are important in reconstructing ancient economy, as they testify to hunting preferences, domestication processes, and herd management strategies, e.g., the exploitation of herds for secondary products such as milk and wool (Payne 1973; Klein and Cruz-Uribe 1984; Munson 2000). The two methods for estimating the age at death of bones from archaeological excavations are based on the fusion of the bones (Silver 1969), and on patterns of eruption and abrasion of teeth. In the latter method, age is determined according to three mandibular teeth that form a single sequence: deciduous tooth dP4, which is the last one to fall, lower permanent pre-molar P4 that replaces dP4, and the lower permanent third molar M3 that erupts when dP4 falls, or slightly later (Reitz and Wing 1999). When dP4 is found, the specimen is defined as 'young', and when P4 or M3 are found, the specimen is defined as 'mature' or 'old', depending on the height of the crown and its shape (Klein and Cruz-Uribe 1984). The patterns of teeth eruption and dental attrition stages used here are those published by Grant (1982) for various domestic animals. Assignment of absolute age to the eruption and wear patterns was based on the work of Haber and Dayan (2004: Tables 2–5).

The distribution of skeletal elements may be indicative of the function of the site, its internal organization, and the cultural preferences of its inhabitants (Speth 1983; Stiner 1991). In this study, skeletal elements were divided into seven groups, following Stiner (1991; 2002): cranial (antler/horn, skull, maxilla, mandible, loose teeth), axis (pelvis, vertebrae, ribs), upper forelimb (scapula, humerus), lower forelimb (radius, ulna, carpals, metacarpal), upper hindlimb (femur), lower hindlimb (tibia, patella, calcaneum, astragalus, tarsals, metatarsal) and feet (phalanges).

The surfaces of bones bear traces of the processes that the bones underwent. Each identified bone was examined with a magnifying glass under direct light (see Blumenschine, Marean and Capaldo 1996) in search of signs that may hint at cultural processes, such as human activity that left cut-marks and burning (Binford 1981), or post-depositional agents such as gnawing by predators or rodents (Binford 1981; Blumenschine, Marean and Capaldo 1996), weathering and root marks, or other natural elements (Behrensmeyer 1978).

RESULTS

The assemblage discussed here consists of remains recovered from 22 loci of clear stratigraphic contexts from EB IB (N = 64) and EB II (N = 66). In general, the faunal remains were in a relatively good state of preservation, and damage by natural elements was minimal. The identified remains were all of mammals (Table 1). The largest group in the assemblage is that of ungulates, represented by cattle (*Bos* sp.), sheep (*Ovis aries*), goat (*Capra hircus*), pig (*Sus* sp.) and mountain gazelle (*Gazella gazella*). The only small mammal identified was a dog (*Canis familiaris*). Complete remains of cattle and pigs were measured (see Appendix 1), and found to be in the range of cattle (*Bos taurus*) and domestic pig (*Sus scrofa*). Previous works dealing with faunal remains from the other excavation areas at the site have revealed a similar picture (Horwitz 2003; 2013; see Maher, this volume: Table 2). However, it is possible that some of the cattle remains from

Area N belonged to aurochs (*Bos primigenius*), as this species was known in the northern Levant until the Iron Age (Tsahar et al. 2009). In addition, a few bones and teeth suspected to be of wild boar have also been documented at Qiryat Ata (Horwitz 2003; 2013; see Maher, this volume).

The EB IB Assemblage (Loci 731, 732, 743)

This assemblage (Table 1; Fig. 1) consists mainly of the remains of sheep/goat, comprising over half the identified remains. The number of goats (9) is nearly equal to that of sheep (10). To these should be added most of the bones in

Table 1. NISP Count and Relative Frequencies of the Species Represented in Area N

	EB IB		EB II		Total	
Taxon/Size Class	NISP	%	NISP	%	NISP	%
Cattle (*Bos taurus*)	2	3.1	21	31.8	23	17.7
Large-sized mammal			8	12.1	8	6.1
Sheep/Goat (*Ovis aries/ Capra hircus*)	19	29.7	11	16.7	30	23.1
Sheep (*Ovis aries*)	10	15.6	5	7.6	15	11.5
Goat (*Capra hircus*)	9	14.1	4	6.1	13	10.0
Pig (*Sus scrofa domesticus*)	5	7.8	4	6.1	9	6.9
Mountain gazelle (*Gazella gazella*)			2	3.0	2	1.5
Medium-sized mammal	18	28.1	10	15.2	28	21.5
Dog (*Canis familiaris*)			1	1.5	1	0.8
Small-sized mammal	1	1.6			1	0.8
Total	*64*	*100.0*	*66*	*100.1*	*130*	*100.0*

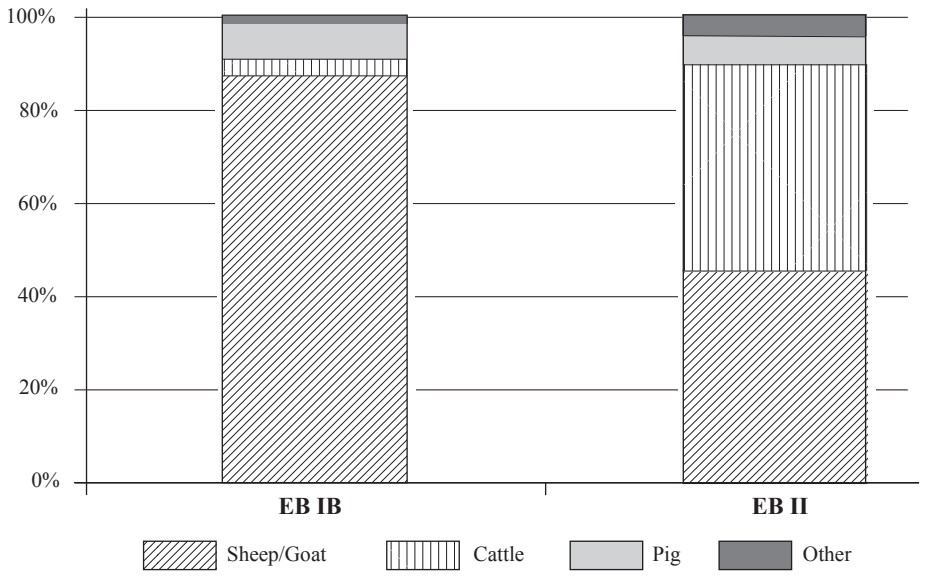

Fig. 1. Distribution of taxa.

Table 2. Distribution of Skeletal Elements of the Main Species[i]

	Caprines		Cattle		Pig	
Skeletal Element	NISP	%	NISP	%	NISP	%
Early Bronze Age IB						
Cranial	8	14.3			2	40.0
Axis	10	17.9				
Upper forelimb	9	16.1			2	40.0
Lower forelimb	8	14.3	2	100.0	1	20.0
Upper hindlimb	5	8.9				
Lower hindlimb	11	19.6				
Feet	5	8.9				
Total	*56*	*100.0*	*2*	*100.0*	*5*	*100.0*
Early Bronze Age II						
Cranial	11	36.7	7	24.1	1	25.0
Axis	8	26.7	9	31.0		
Upper forelimb	3	10.0	3	10.3	1	25.0
Lower forelimb			2	6.9	1	25.0
Upper hindlimb			4	13.8	1	25.0
Lower hindlimb	5	16.7	2	6.9		
Feet	3	10.0	2	6.9		
Total	*30*	*100.1*	*29*	*99.9*	*4*	*100.0*

[i] Remains of medium- and large-sized mammals were included with those of caprines and cattle, respectively.

the medium-sized-mammal category. Pig is the second most frequent species (c. 8%), while cattle are only represented by only a few bones. The MNI (minimum number of individuals) in the EB IB assemblage comprises two sheep, two goats, one cattle and one pig.

Only the sample of sheep/goat bones allowed examination of the distribution of the skeletal elements (see Table 2), which demonstrates that all portions of the body were present. Thus, the remains included both butchery and consumption waste (Hellwing and Gophna 1984).

Of the 56 bones and one horn, 26 (c. 46%) showed signs of burning. All the burnt bones were of sheep/goat and medium-sized mammals. Sixteen were of white-gray color resulting from direct exposure to fire (Stiner et al. 1995), while the remaining ten were of brown-black color, which may be produced by burning, but could also be the result of post-depositional processes, such as burial below a hearth, or mineral contamination (Shahack-Gross, Bar-Yosef and Weiner 1997).

Cutting marks were observed on eight bones, of which six were of sheep/goat, one of cattle and one of pig (Table 4). One sheep bone showed marks characteristic of skinning, while the others indicate dismemberment. Signs of gnawing caused by predators were identified on two bones. Root marks were discerned on less than a quarter of the long limb bones (6 of 31).

Aging of the sheep/goats was achieved by two methods: dental wear and bone fusion. Three sheep teeth for which age could be estimated originated in the same basket (B7092); therefore, it is reasonable to assume that they belonged to the same animal. Two teeth are mandibular permanent P4 that were worn to a similar degree, characteristic of 37–48 months (Grant 1982: stage g). The mandibular permanent third molar M3 belongs to an animal that could be aged 25–36 months (Grant 1982:

Table 3. Epiphyseal Fusion Data for the Main Species[i]

(a) Cattle						
	EB IB (N = 1)			EB II (N = 8)		
Age Range (months)	F	U	% F	F	U	% F
7–10m						
12–18m				3		100
24–30m				1		100
30–42m				1		100
42–48m		1	0		3	0
48m+						
(b) Sheep/Goat and medium-sized mammals						
	EB IB (N = 22)			EB II (N = 10)		
Age Range (months)	F	U	% F	F	U	% F
Fetus		1	100		1	00
6–10	4	3	57	2	1	67
13–16	2	3	40	3		100
18–24	2	2	50			
30–36		2	0	1		100
36–42	3	1	75		2	0
42+						
(c) Pig						
	EB IB (N = 3)			EB II (N = 4)		
Age Range (months)	F	U	% F	F	U	% F
12	1	2	33	2		100
24				1		100
24–30						
36–42				1		100
42+						

[i] F = fused; U = unfused

stage c). Thus, the individual seems to have been a mature animal aged 37–48 months.

Bone fusion of sheep/goat (Table 3:b) reveals that about half the specimens survived to maturity (approximately 21–24 months). A similar distribution was also found in larger samples of faunal remains from Qiryat Ata (Horwitz 2003:233), and may testify to the exploitation of herds primarily for secondary products (Horwitz 2003:235), and/or the off-site selling of younger animals, perhaps for their meat (Hesse and Wapnish 2001).

Pig teeth for which age could be estimated included two deciduous teeth (dP4) of young animals less than 6 months old: one showing wear indicative of stage a, the other, of stage d (Grant 1982). The small sample of pig bones included two unfused bones of very young animals (Table 3:c). Despite the small sample, this may indicate that pigs were slaughtered when still young, in accordance with their being kept only for their fat-rich meat. Due to their short breeding cycle, the slaughter of young pigs does not endanger the security of the herd, in contrast to caprines and cattle (Grigson 2007:98).

No cattle teeth, and only one unfused cattle bone, were found in the EB IB phase (Table 3:a).

The EB II Assemblage (Loci 702, 706, 712, 717, 720, 724, 726, 727, 729, 735–737, 740, 742, 744, 746, 752, 757, 759)

Sheep/goat, together with the medium-sized mammals, comprise the most frequent species in this assemblage (c. 45%; Table 1; Fig. 1). The number of goats (4) is nearly equal to that of sheep (5). Cattle (c. 32%), to which the large-sized mammal category (c. 12%) should be added, is second in frequency. Pig comprises 6% of the assemblage, while mountain gazelle and dog are represented by only a few bones. The MNI in the EB II assemblage is one specimen for each of the species represented.

The distribution of skeletal elements of cattle is balanced, with all body parts present (Table 2). Sheep/goat, however, are represented mainly by cranial and axis bones, with very few limb bones; the lower forelimbs and upper hindlimbs are entirely absent. Such a pattern is characteristic of butchering waste (Hellwing and Gophna 1984). The distribution of sheep/goat skeletal elements in EB II contrasts with that of EB II cattle and EB IB sheep/goat, although this may be a result of the small size of the assemblages (see Horwitz 2013:65).

Only two bones, one of a sheep and the other of a medium-sized mammal, showed evidence of burning, both of a black-brown color that is not necessarily indicative of direct exposure to fire.

Of the 46 bones and horns whose surface was not covered with calcite matrix, 11 showed cutting marks (Table 4): four of cattle and one of a large-sized mammal, two of sheep/goat and a single bone of a pig bore dismemberment marks; one bone of a large-sized mammal and one of sheep/goat bore signs of filleting; and traces of skinning were discerned on one goat horn.

Gnawing marks of predators were observed on two bones, and a third bone revealed signs of gnawing by rodents. Root marks were visible on 10 of 18 of the long limb bones, perhaps due to the relative proximity of the EB II stratum to the surface.

sheep/goat teeth that enabled age determination included a mandible of a sheep 37–48 months old (P4 = Grant stage g, M3 = Grant stage e), an M3 molar of a mature sheep/goat over four years old (Grant stage g), and a pre-molar of a mature goat over four years old (P4 = Grant stage l). Despite the small sample, the results seem to correspond with those reported by Horwitz (2003:232) for other excavation areas at the site, where a high frequency of sheep/goats survived to adulthood, both in EB IB and EB II.

The bone samples (Table 3) were too small for any reliable calculation of age distribution. Nevertheless, of the eight cattle bones for which age could be estimated, the three unfused bones were all of animals that were slaughtered at about 3.5 years of age, which indicates that these animals had survived to maturity. This may indicate that they were exploited for secondary products such as milk and/or as beasts of burden, rather than for their meat.

Unstratified Remains

Of the remains that were found on the surface of the site and in insecure or disturbed contexts, two bones of Persian fallow deer should be mentioned: a calcaneus and a 1st phalanx. Remains of Persian fallow deer have been reported previously from Qiryat Ata (Horwitz 2003:231). Also of note is the right horn of a male gazelle found in L718, a mixed context, bearing signs of abrasion and polish on its proximal end; it could have functioned as a handle. On the horn itself, at a certain distance from the abrasion and polish, were gnawing marks caused by a porcupine (Rabinovich and Horwitz 1994).

DISCUSSION

The excavations at the Bronze Age site of Qiryat Ata yielded a series of faunal assemblages from the EB IB and EB II phases. However, except for the large assemblage from Areas A–G (NISP = 892), each assemblage was relatively

Table 4. Location of Butchery Marks on Bones

No.	Taxon	Element	Location[i]	Function
Early Bronze Age IB				
1	Cattle	Ulna	Margin of medial semilunar notch (RCp-4)	Dismemberment
2	Sheep	Astrgalus	Margins of anterior face (TA-1)	
3	Goat	Humerus	Distal shaft (Hd-2)	
4		Radius	Proximal articulation (RCp-5)	
5	Sheep/goat	Humerus	Distal shaft (Hd-2)	
6	Medium-sized mammal	Rib	Shaft (RS-3)	
7	Pig	Mandible	Below dP3-dP4 (M-3)	
8	Sheep	Skull, horncore	Base of horncore (S-4)	Skinning
Early Bronze Age II				
1	Cattle	Femur	Femur head (Fp-3)	Dismemberment
2		Vertebra lumbar	Spine	
3		Radius	Proximal articulation (RCp-5)	
4		Skull	Maxilla above third molar (S-6)	
5	Large-sized mammal	Rib	Shaft (RS-2)	
6		Femur	Proximal shaft (Fp-6)	Filleting
7	Sheep/goat	Tibia	Proximal shaft (Tp-4)	
8		Scapula	Neck (S-2)	Dismemberment
9	Sheep	Humerus	Distal articulation (Hd-4)	
10	Goat	Skull, horcore	Base of horncore (S-4)	Skinning
11	Pig	Scapula	Neck (S-2)	Dismemberment

[i] Cut-marks codes after Binford 1981.

small (Table 5). The remains, which included mainly livestock—sheep, goats, cattle and pigs—and a few wild animals, revealed that the transition from an early EB IB village to an EB II urban settlement, as revealed in the animal economy, was gradual. Its clearest manifestation is a decline in the frequency of pigs. In the late EB IB and EB II, more than half the caprines were kept alive into adulthood, presumably for their secondary products. Cattle were also kept to maturity to serve as a source of milk and/or labor. Pigs were raised for their meat and culled when very young (Horwitz 2003:235–236).

The main aim of the analysis of the present faunal assemblage from Area N was to test if these conclusions hold true for this excavation area as well, and to examine aspects of spatial variability in the composition of the faunal assemblages. The analysis of the remains was limited by the small size of the samples (Total NISP = 130), which probably reflects hand collection in the field (see Horwitz 2013:61, 64, 66). This collection method is biased to larger, complete elements, and, as a result, small bones such as those of small species, birds, fish and reptiles are virtually absent from the sample, despite the proximity of the site

Table 5. Relative Frequencies of Taxa According to Excavation Areas in Qiryat Ata (aurochs and boar were counted as Bos sp. and *Sus scrofa*, respectively)

(a) Early Bronze Age IB (General Strata III–II)					
Area / Species	N (NISP = 64)	A–G[i] (NISP=372)	L[ii] (NISP=147)	O[iii] (NISP=50)	
Bos sp.	3.1	33.9	25.2	38.0	
Dama mesopotamica		1.6			
Ovis aries/ Capra hircus	29.7	28.0	56.5	14.0	
Ovis aries	15.6	1.1			
Capra hircus	14.1	1.3			
Sus scrofa	7.8	27.2	14.3	46.0	
Gazella gazelle		2.2			
Medium-sized mammal	28.1				
Canis familiaris		0.3	3.4		
Small-sized mammal	1.6				
Other		4.3	0.7	2.0	
Total	*100.0*	*99.9*	*99.9*	*100.0*	
(b) Early Bronze Age II (General Stratum I)					
Area / Species	N (NISP=66)	A–G (NISP=520)	L (NISP=72)	O (NISP=68)	S[iv] (NISP=180)
Bos sp.	31.8	33.1	44.4	70.5	43.5
Dama mesopotamica		1.0			0.9
Large-sized mammal	12.1				
Ovis aries/ Capra hircus	16.7	36.9	54.2	7.3	39.8
Ovis aries	7.6	1.0			0.9
Capra hircus	6.1	1.7			6.5
Sus scrofa	6.1	20.0	1.4	22.1	5.6
Gazella gazelle	3.0	3.1			
Medium-sized mammal	15.2				
Canis familiaris	1.5	0.4			0.9
Other		2.8			1.9
Total	*100.1*	*100.0*	*100.0*	*99.9*	*100.0*

[i] Horwitz 2003.
[ii] Sadeh 2000.
[iii] Horwitz 2013.
[iv] see Maher, this volume.

to the Mediterranean coast and Naḥal Qishon. Therefore, no attempt was made to reconstruct the natural environment of the site.

A comparison of the composition of taxa in the EB IB and EB II faunal assemblages of the current excavation reveals that in both assemblages, sheep/goat and cattle comprise c. 90% of the identified remains, while pig, the third most frequent species, constitutes a small but stable portion of the assemblages.

The main difference between the two assemblages lies in the frequency of cattle and

sheep/goat. In the EB IB phase, sheep/goat (together with the medium-sized mammals) comprise no less than 87% of the assemblage, cattle a mere 3%. In the EB II phase, sheep/goat are the most frequent component (c. 45%), while cattle (together with large-sized mammals) are now c. 44%. Not only does the composition of the taxa differ between the two assemblages, it also deviates from those published from other excavation areas at Qiryat Ata (Table 5); this is especially true for the high frequency of sheep/goat and the low frequency of cattle in EB IB in the present excavation. These data may suggest a certain degree of spatial variance in the distribution of faunal remains at the site. However, as the excavation exposed building remains that were interpreted as domestic structures, similar to those exposed in the other excavation areas, it does not seem that the variances in taxa frequencies stem from a different function for Area N. These differences are probably better explained by the small size of some of the samples, for example those of Areas L, O and S. Note that the smaller the sample, the higher the deviation in the results when compared to the frequencies in the large samples from Areas A–G. For example, in the EB IB assemblage of Area N (NISP = 64), cattle comprise only 3%, in EB IB of Area O (NISP = 50), pigs are 46% but caprines only 14%, while in EB II of Area O (NISP = 68), caprines are only 7.3%.

In both periods represented in Area N, the ratio between sheep and goats was more-or-less equal. In previous studies of faunal remains from Qiryat Ata, different ratios between sheep and goats were observed. In the small sample of sheep and goats from Area S in EB II, goats outnumbered sheep (see Maher, this volume). In Areas A–G, sheep were slightly more common in EB IB, but goats were more frequent in EB II. It should be taken into consideration that the differentiation between sheep and goats is not at all self evident, and different researchers employ somewhat different methods. In addition, the small assemblages surely affected the sheep/goat ratio. The abundance of sheep in the faunal record of the Early Bronze Age in the southern Levant, especially from EB II onward, has been interpreted as indicating their exploitation for wool in the framework of a market economy (Grigson 1995). If so, then the relatively high frequency of goats at Qiryat Ata, in both EB IB and EB II, may testify to an emphasis on the production of both meat and milk products and not of wool from sheep (Horwitz 2003:236). The distribution of caprine ages, in which young specimens are relatively few, may be interpreted in a number of ways; for example, it may be seen as evidence for keeping a large portion of the animals into adulthood, presumably for their secondary products (Horwitz 2003:235). However, it should be noted that a high level of immature mortality is needed to maintain optimal exploitation efficiency of caprine herds (Cribb 1984). Thus, the mortality curves observed may also suggest that the young animals that were culled were not consumed at the site but elsewhere, perhaps traded for their meat. Alternatively, the reduced frequency of immature caprines in the assemblage may be related to transhumance practices, e.g., keeping only a selected portion of the herd near the site (Cribb 1984).

The age of the cattle remains in the EB II phase reveals that most animals reached maturity; hence, their value was in the secondary products they provided, such as milk and/or labor, rather than their meat.

In both periods, hunting of wild animals played only a marginal role in the economy of the site. The wild species included mountain gazelle in EB II, and fallow deer and mountain gazelle in uncertain stratigraphic contexts.

In summary, despite their somewhat exceptional composition, the assemblages from Area N appear to correspond, in general, with the patterns of animal husbandry and animal exploitation seen elsewhere at Qiryat Ata. They also seem to support the findings that the transition from EB IB to EB II at the site had only a minor effect on the composition of the taxa, despite the important economic and social transformation to an urban society at this juncture (Horwitz 2003).

APPENDIX 1. BONE MEASUREMENTS
(after von den Driesch 1976; with the exception of HT = trochlea height of the distal humerus, after Horwitz, Cope and Tchernov 1990)

	Notes[i]	Stratum	Period	Measurements (mm)[ii]				
(a) Cattle								
Humerus				*Bd*	*BT*	*HT*		
	F	I	EB II	80.3	74.3	31.6		
Radius				*Bp*	*BFp*			
	F	I	EB II	76.3	71.1			
Ulna				*BPC*				
	U	II	EB IB	29.17				
Femur				*DC*				
	U	I	EB II	40.3				
	U	I	EB II	48.2				
Metacarpal				*Bp*	*Dd*			
	F	I	EB II	50.00	29.6			
1st phalanx				*GLpe*	*Bp*	*SD*	*Bd*	
	F	I	EB II	57.7	26.4	22.1	25.2	
3rd phalanx				*DLS*	*MBS*	*Ld*	*DLS*	
	F	I	EB II	83.8	30.1	58.5	83.8	
(b) Sheep/Goat								
Cranium				*Min. Horn Base*	*Max. Horn Base*	*M3 L*	*M3 B*	
	Sheep	II	EB IB	30.1	42.9			
	Sheep	I	EB II	35.22	53.45			
	Goat	I	EB II	13.9	21.2			
	Sheep	I	EB II			22.85	7.59	
Scapula				*SLC*	*GLP*	*LG*	*BG*	
	Sheep/ Goat, U	II	EB IB	20.8	24	28.4		
	Goat, F	II	EB IB	22.3	27.6	35.1	20.2	
	Goat, F	II	EB IB	20.8	24	28.4	17.2	
	Sheep/ Goat, F	I	EB II	22.1	26.8	32.1	20.8	
Humerus				*Bd*	*BT*	*HT*		
	Goat, F	II	EB IB	31.43		16.12		
	Sheep, F	II	EB IB	27.3	25.6	14.4		

[i] F = fused, U = unfused, B = burnt.
[ii] Bp = breadth of proximal end; DC = greatest breadth of the caput femoris; BFp = breadth of facies articularies proximalis; SD = smallest breadth of diaphysis; B (pig metapodial) = breadth in the middle of the diaphsis; Bd = breadth of distal end; Dd = distal depth; BT = greatest breadth of trochlea; SLC = smallest length scapula; GLP = greatest length of glenoid process; GL = greatest length; BG = breadth of glenoid cavity; BPC = greatest breadth across coronoid process; GLl = greatest length of lateral half; GLm = greatest length of medial half; Dl = depth of the lateral half; Dm = depth of the medial half; GLpe = greatest length of peripheral half; DLS = diagonal length of sole; LD = length of dorsal surface; MBS = middle breadth of sole; M3L = length; M3B = breadth.

APPENDIX 1. (cont.)

	Notes	Stratum	Period	Measurements (mm)				
Femur				*Bd*				
	Sheep/ Goat, F	II	EB IB	38.7				
Tibia				*Bd*	*Dd*			
	Sheep, F	II	EB IB	23.9	17.3			
	Goat, F	II	EB IB	23.3	15.9			
Astragalus				*GLI*	*GLm*	*Dl*	*Dm*	*Bd*
	Sheep	II	EB IB	28.2	26.9	14.7	15.4	17.4
	Sheep, B	II	EB IB	29.2	27.8	16.4	17	18.3
1st phalanx				*GLpe*	*Bp*	*SD*	*Bd*	
	Sheep/ Goat, U	II	EB IB			8.77	10.44	
	Goat, F, B	II	EB IB	37.5	11.3	9.2	10.2	
	Sheep, F	I	EB II	40.62	13.47	11.58	13	
	Sheep, F	I	EB II	37.47	13.31	10.82	12.51	
	Goat, F	I	EB II	36.7	12.9	10.6	11.5	
2nd phalanx				*GL*	*Bp*	*SD*	*Bd*	
	Goat, F, B	II	EB IB	21.7	11.3	9.5	9.9	
(c) Pig								
Scapula				*SLC*	*GLP*	*LG*	*BG*	
	U	II	EB IB	14.6		19.4	16.6	
	F	I	EB II	21.8	33.2	27	24.8	
Radius				*Bp*				
	F	II	EB IB	22.12				
Femur				*Bd*				
	F	II	EB IB	54.29				
Metacarpal 3				*GL*	*B*	*Bd*		
	F	I	EB II	61	11.8	15.6		

NOTE

[1] I am grateful to Amir Golani for inviting me to study the faunal remains from his excavation in Area N, and to Guy Bar-Oz and Shelley Sadeh for their careful reading and thoughtful remarks.

REFERENCES

Behrensmeyer A.K. 1978. Taphonomic and Ecological Information from Bone Weathering. *Paleobiology* 4:150–162.

Binford L.R. 1981. *Bones: Ancient Men and Modern Myths*. New York.

Blumenschine R.J., Marean C.W. and Capaldo S.D. 1996. Blind Tests of Inter-Analyst Correspondence and Accuracy in the Identification of Cut Marks, Percussion Marks and Carnivore Tooth Marks on Bone Surfaces. *JAS* 23:493–507.

Boessneck J. 1969. Osteological Differences between Sheep (*Ovis aris Linne*) and Goat (*Capra hircus Linne*). In D. Brothwell and E.S. Higgs eds. *Science in Archaeology: A Survey of Progress and Research* (2nd ed.). London. Pp. 331–358.

Brain C.K. 1981. *The Hunters or the Hunted? An Introduction to African Cave Taphonomy*. Chicago.

Cribb R. 1984. Computer Simulation of Herding Systems as an Interpretive and Heuristic Device in the Study of Kill-Off Strategies. In J. Clutton-Brock and C. Grigson eds. *Animals and Archaeology* 3: *Early Herders and Their Flocks* (BAR Int. S. 202). Oxford. Pp. 161–170.

Dobney K. and Rielly K. 1988. A Method for Recording Archaeological Animal Bones: The Use of Diagnostic Zones. *Circaea* 5:79–96.

Driesch A. von den. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites* (Peabody Museum Bulletin 1). Cambridge, Mass.

Golani A. This volume. Rescue Excavations at the Early Bronze Age Site of Qiryat Ata—Area N.

Grant A. 1982. The Use of Tooth Wear as a Guide to the Age of Domestic Ungulates. In B. Wilson, C. Grigson and S. Payne eds. *Ageing and Sexing Animal Bones from Archaeological Sites* (BAR Int. S. 109). Oxford. Pp. 91–109.

Grigson C. 1995. Plough and Pasture in the Early Economy of the Southern Levant. In T.E. Levy ed. *The Archaeology of Society in the Holy Land*. London. Pp. 245–268.

Grigson C. 2007. Culture, Ecology, and Pigs from the 5th to the 3rd Millennium BC around the Fertile Crescent. In U. Albarella, K. Dobney, A. Ervynck and P. Rowley-Conwy eds. *Pigs and Humans: 10,000 Years of Interaction*. Oxford. Pp. 83–108.

Haber A. and Dayan T. 2004. Analyzing the Process of Domestication: Hagoshrim as a Case Study. *JAS* 31:1587–1601.

Hellwing S. and Gophna R. 1984. The Animal Remains from the Early and Middle Bronze Ages at Tel Aphek and Tel Dalit: A Comparative Study. *Tel Aviv* 11:48–59.

Hesse B. and Wapnish P. 2001. Commodities and Cuisine: Animals in the Early Bronze Age of Northern Palestine. In S.R. Wolff ed. *Studies in the Archaeology of Israel and Neighboring Lands in Memory of Douglas L. Esse* (SAOC 59/ASOR Books 5). Chicago–Atlanta. Pp. 251–282.

Horwitz L.K. 2003. Early Bronze Age Animal Exploitation at Qiryat Ata. In A. Golani ed. *Salvage Excavations at the Early Bronze Age Site of Qiryat Ata* (IAA Reports 18). Jerusalem. Pp. 225–241.

Horwitz L.K. 2013. Early Bronze Age Fauna from Qiryat Ata—Area O. *'Atiqot* 75:61–70.

Horwitz L.K., Cope C. and Tchernov E. 1990. Sexing the Bones of Mountain-Gazelle (*Gazella gazella*) from Prehistoric Sites in the Southern Levant. *Paléorient* 16(2):1–12.

Klein R.G. and Cruz-Uribe K. 1984. *The Analysis of Animal Bones from Archaeological Sites*. Chicago–London.

Maher E.D. This volume. Animal-Based Economy and Local Ecology: The Early Bronze Age II Fauna from Qiryat Ata—Area S.

Munson P.J. 2000. Age-Correlated Differential Destruction of Bones and Its Effect on Archaeological Mortality Profiles of Domestic Sheep and Goats. *JAS* 27:391–407.

Payne S. 1973. Kill-Off Patterns in Sheep and Goats: The Mandibles from Aşvan Kale. *Anatolian Studies* 23:281–303.

Payne S. 1985. Morphological Distinctions between the Mandibular Teeth of Young Sheep, *Ovis*, and Goats, *Capra*. *JAS* 12:139–147.

Rabinovich R. and Horwitz L.K. 1994. An Experimental Approach to the Study of Porcupine Damage to Bones: A Gnawing Issue. In M. Patou-Mathis ed. *Outillage peu élaboré en os et bois de Cervidés* IV: *Taphonomie/Bone Modification* (Artefacts 9). Treignes. Pp. 97–118.

Reitz E.J. and Wing E.S. 1999. *Zooarchaeology*. Cambridge.

Sadeh M. 2000. Animal Bones from Qiryat 'Ata, Area L. *Tel Aviv* 27:57–60.

Shahack-Gross R., Bar-Yosef O. and Weiner S. 1997. Black-Coloured Bones in Hayonim Cave, Israel: Differentiating between Burning and Oxide Staining. *JAS* 24:439–446.

Silver I.A. 1969. The Ageing of Domesticated Animals. In D.R. Brothwell and E.S. Higgs eds. *Science in Archaeology: A Survey of Progress and Research* (2nd ed.). London. Pp. 283–302.

Speth J.D. 1983. *Bison Kills and Bone Counts: Decision Making by Ancient Hunters*. Chicago.

Stiner M.C. 1991. Food Procurement and Transport by Human and Non-Human Predators. *JAS* 18: 455–482.

Stiner M.C. 2002. On *in situ* Attrition and Vertebrate Body Part Profiles. *JAS* 29:979–991.

Stiner M.C., Kuhn S.L., Weiner S. and Bar-Yosef O. 1995. Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone. *JAS* 22:223–237.

Tsahar E., Izhaki I., Lev-Yadun S. and Bar-Oz G. 2009. Distribution and Extinction of Ungulates during the Holocene of the Southern Levant. *PLoS ONE* 4(4):e5316. doi:10.1371/journal.pone.0005316 (accessed June 25, 2014).

Zeder M.A. and Lapham H.A. 2010. Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, *Ovis*, and Goats, *Capra*. *JAS* 37: 2887–2905.

Zeder M.A. and Pilaar S.E. 2010. Assessing the Reliability of Criteria Used to Identify Mandibles and Mandibular Teeth in Sheep, *Ovis*, and Goats, *Capra*. *JAS* 37:225–242.