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Faunal Remains from Late Chalcolithic–Bronze Age Dwelling and Burial Caves at Shoham (North), Lod Valley

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Introduction

Four Chalcolithic burial caves (Caves 1–4) were excavated at Shoham (North) in the Lod Valley. They form part of a system of cemeteries that probably stretched from Ben Shemen in the south to Mazor (El'ad) in the north (van den Brink and Gophna 2005). The cave chronology is: Cave I—Late EB I, Intermediate Bronze Age (IBA); Cave 2—Chalcolithic, EB I; Cave 3—Chalcolithic/EB I; Cave 4—Chalcolithic, Chalcolithic/EB I, IBA. Aside from their mortuary function during the Late Chalcolithic, the caves were used for domestic purposes in the Early Chalcolithic (Caves 2 and 4) and possibly as refuse dumps during EB I (Caves 1 and 2) (van den Brink and Gophna 2005).

In addition to ceramic vessels, chipped and groundstone artifacts and human remains, 1052 identifiable animal bones were recovered from the caves (Tables 1–4).* Of these, 712 bones were derived from Chalcolithic deposits (Caves 2, 4), 179 from late EB I deposits (Caves 1, 2) and nine bones from Intermediate Bronze Age deposits (Caves 1, 4). An additional 152 bones were derived from mixed Chalcolithic/EB I sediments (Caves 2, 4). The animal bones are described below according to period and cave of origin.

Methodology

For each species, the total number of identifiable bones (N) was calculated and converted into a percentage. Distinction between sheep and goats follows the criteria given by Prummel and Frisch (1986) and remains that could not be distinguished were placed in a combined 'sheep/goat' category. In the absence of measurable long bones, the distinction between donkeys and horses follows dental criteria given by Davis (1980a). The domestic status of the pig remains was assessed following metrical criteria given by Payne and Bull (1988). Measurements of bones and teeth follow those given in von den Driesch (1976).

Age was assessed using the state of epiphyseal fusion (fused or unfused) and the dental eruption stage (Silver 1969). For sheep/goat, dental attrition stages also follow Payne 1973. Bodyparts were grouped into five categories following Horwitz and Tchernov (1989): cranial, trunk, forelimb, hindlimb and feet.

The Finds

Chalcolithic Period (Stratum I)

Cave 2.— Only 13 identifiable bones were recovered from the Chalcolithic level in Cave 2, from L129 (Table 1). The bones all derive from the Chalcolithic burials on the bedrock of the cave, and represent undisturbed material. Species identified are sheep/goat, gazelle, cattle, pig, donkey and dog. The gazelle bones are from an immature animal, as are all the pig bones. The sheep/goat, dog and cattle bones belong to adult animals.

Cave 4.— The majority of the bones recovered from the caves at Shoham (North) are derived from the Chalcolithic level in Cave 4 (N = 699; Table 2). The remains are derived from topsoil, fills and pits.

* Editorial Note: The animal bones recovered from the Shoham (North) excavations (van den Brink and Gophna 2005) were submitted by the excavators on two separate occasions for analysis. As the results of the studies differ greatly, it was decided to present here the reports of both scholars (see Sade, this volume).

Table 1. Fauna from Cave 2

	Chalcolithic	*Late EB I*		*Mixed Chalcolithic/ EB I*	
Species	*N*	*N*	*%*	*N*	*%*
Sheep/goat	1	60	38.0	6	14
Cattle	2	3	2.0	2	4
Pig	3	27	17.0	5	11
Donkey	1	10	6.0	15	34
Dog	5	40	25.5	10	23
Gazelle	1	5	3.0	6	14
Fallow deer	-	4	2.5	-	-
Red fox	-	3	1.0	-	-
Badger	-	2	1.0	-	-
Rodent	-	1	1.0	-	-
Partridge	-	1	1.0	-	-
Amphibian	-	2	1.0	-	-
Total	*13*	*158*	*100*	*44*	*100*

Table 2. Fauna from Cave 4

	Chalcolithic		*Mixed Chalcolithic/EB I*		*Intermediate Bronze*
Species	*N*	*%*	*N*	*%*	*N*
Sheep/goat	253	36.00	12	16.0	-
Cattle	79	11.00	2	2.5	-
Pig	59	8.50	6	8.0	6
Donkey	226	32.30	19	25.0	-
Large equid	3	0.50			
Dog	63	9.00	17	23.0	-
Gazelle	7	1.50	12	16.0	-
Fallow deer	4	0.50	-	-	-
Red fox	2	0.25	3	4.5	-
Striped hyena	2	0.25	2	2.5	-
Porcupine	-	-	2	2.5	-
Unidentified bird	1	0.20	-	-	-
Total	*699*	*100*	*75*	*100*	*6*

Domestic animal species predominate with sheep/goat the most common. Of these, only goat remains were positively identified and included a burnt scapula. Only a few sheep/goat postcranial remains could be used to study mortality profiles (N = 26). The results show that only 15% of the bones belong to immature animals (unfused epiphyses) with the vast majority (85%) representing adult animals. This is corroborated by the dental attrition data, which indicate a predominance of animals in the 4–6 year age group (Payne 1973: Stage G) and even one animal aged 8–10 years.

The only butchered bone found in the assemblage is a sheep/goat scapula severed at a right angle to the axis of the bone from the neck down. As illustrated in Fig. 1, sheep/goat are primarily represented by trunk and

foot elements followed by cranial parts. The limb bones are represented in low frequencies indicative of an assemblage dominated by elements that are poor in meat.

The next most commonly represented species was donkey (Table 2). On the basis of the few measurable postcranial bones (Table 3) and the dental enamel pattern, the vast majority of the remains were identified as domestic donkey (*Equus asinus*). Isolated postcranial remains of a larger equid (Tables 4, 5) may represent horse (*Equus caballus*) or wild ass (*Equus africanus*). The latter remains were found in a baulk just below the topsoil together with a modern *Levantina* shell, such that they may represent a more recent intrusion. It is important to note that none of the equid teeth recovered from Cave 4 exhibited the typical characteristics of horses as described by Davis (1980a).

Both adult and immature equids are represented at Shoham. At least one animal is less than 15 months old and two are just less than 30 months old on the basis of tooth eruption. The most common bone elements of donkeys are cranial elements, especially teeth (67%). All other bodyparts are poorly represented.

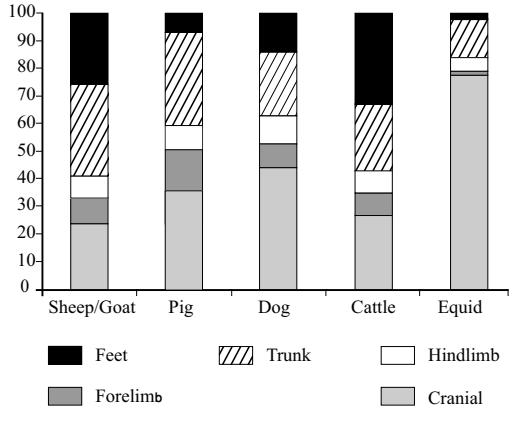

Fig. 1. Bodypart breakdown for species in the Chalcolithic sample from Cave 4 (Data from Table 2). *Cranial*: antler, horn, skull, maxilla, mandible and loose teeth; *Forelimb*: scapula, humerus, radius, ulna, carpals, metacarpal; *Hindlimb*: pelvis, femur, tibia, fibula, patella, calcaneum, astragalus, tarsals, metatarsal; *Trunk*: atlas, axis, cervical, thoracic, lumbar and caudal vertebrae, ribs; *Feet*: 1st, 2nd and 3rd phalanges.

Cattle, pig and dog remains are represented in similarly low frequencies (11%, 8.5% and 9% respectively). The majority of the dog remains are those of adult animals, primarily represented by cranial bones (Fig. 1). As shown in Table 5, the Shoham dogs are all of similar size and slightly smaller than a modern Pariah dog collection from the Suez area. It is important to note that all the dog remains from Cave 4 are derived from topsoil deposits or those close to topsoil, which may indicate that they are later additions to the Chalcolithic deposits. Furthermore, all the jaws are scored by carnivore tooth marks, which lend further support to the suggestion that they were introduced into the cave by another carnivore such as a hyena, or represent refuse that was gnawed by a carnivore.

Most of the cattle remains are those of adult animals, but at least one is an immature animal less than 3½ years old. Foot elements are the most common parts represented (Fig. 1).

The pig bones and teeth are predominantly those of immature animals and few could be measured to determine their domestic status. Results from those bones and teeth that could be measured (Table 6) are comparable in size to domestic animals from the EB I site of Azor, but smaller, especially in breadth parameters, than modern wild boars from the north of Israel. Furthermore, the fact that the Shoham sample contains a high proportion of immature pigs supports their identification as domestic animals, as this is considered a characteristic feature of culling rather than hunting. In the pig sample, cranial elements predominate, followed by trunk elements, with few foot and limb bones represented (Fig. 1).

Several species of wild fauna are represented in this layer by only a few bones, indicating that hunted animals were not commonly exploited. Species found are: mountain gazelle (*Gazella gazella*), fallow deer (*Dama mesopotamica*), red fox (*Vulpes vulpes*), striped hyena (*Hyaena hyaena*) and an unidentified species of bird (Aves). The presence of fallow deer testifies to the relative antiquity of this assemblage as this

Table 3. Equid Individual Bone Measurements (Measurements in mm after von den Driesch 1976)

	Cave 2 (EB I)	Cave 4 (Chalcolithic)																			
Specimen Numbers	#1	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	Donkey*		Horse**	
Distal Humerus																		N	Mean	N	Mean
Bd	67.5																	5	59.1	3	80.5
trochlea length	60.9																				
Distal Metapodial																					
Bd		37.5	33.2	34.3	38.5	38.4	33.5	35.0	34.6	35.3	33.3	33.8	37.0	36.9	35.9	34.1	47.9[$]	5	35.5 mc	3	52.3 mc
																		5	34.9 mt	3	51.6 mt
Proximal Metacarpal																					
Bp	36.1	36.3																5	39.0	3	52.4
Dp	22.1	24.1																5	26.8	-	
Astragalus																					
GH	-	40.6	44.3	42.1	47.3	40.1	44.4											4	45.6	3	63.1
BFd	50.5	31.8	-	40.6	-	31.5	37.7											1	34.9	-	
GB	53.8	35.0	-	37.7	44.0	38.7	46.8											3	47.2	3	64.3
Lmt	36.9	39.6	42.5	41.8	-	-	43.5											5	44.9	-	
Distal Tibia																					
Bd	-	53.8																5	55.6	3	77.7
1st Phalanx	ant	ant	post	post														mixed		ant	post
GL	74.4	72.3	67.7	66.3														5	68.4	3	92.5 89.2
Bd	-	36.0	30.8	21.5														4	34.5	3	47.5 44.4
Bfd	-	34.2	26.9	29.9														5	35.4	3	34.5 33.0
SD	-	26.1	22.4	22.2														5	23.1	-	-

ant = anterior; post = posterior; N = number of specimens; mc = metacarpal; mt = metatarsal
* Measurements from Bronze Age donkeys from Tell Brak (Clutton-Brock 1993)
** Measurements for modern horses from Clutton-Brock and Burleigh (1979: Table 1)
$ This bone is derived from L202, B2043

Table 4. Comparison of Equid Distal Metapodial Measurements (Measurements in mm after von den Driesch 1976)

Site	*Metapodial Bd*				*Metacarpal Bd*				*Metatarsal Bd*			
	N	Mean	Range	SD	N	Mean	Range	SD	N	Mean	Range	SD
Shoham, donkey	15	35.4	33.2-38.5	1.83	-	-			-	-		
Shoham, large equid	1	47.9			-	-			-	-		
Jenin, large equid (1)	-	-			1	47.3			1	47.0		
Ghassul, donkey (2)	1	40.3			-	-			-	-		
Gerar E (2)	-	-			1	41.9			-	-		
Gerar C (2)	-	-			1	47.0			-	-		
Shiqmim, horse (2)	-	-			1	44.1			-	-		
Gerar G, horse (2)	-	-			1	46.5			-	-		
‘Arad, horse (2)	-	-			1	45.0			-	-		
Recent wild ass (3)	-	-			7	41.4	39.1–45.0	2.2	7	41.3	39.0–44.0	2.0
Recent domestic ass (3)	-	-			19	35.4	30.0–39.0	2.4	16	35.0	29.0–38.0	2.6
Recent domestic horses (3)	-	-			5	63.2	59.0–68.0	4.4	5	65.6	61.0–71.0	4.7
Recent Arab horses (4)	-	-			3	52.3	50.3–53.7	1.8	3	51.6	50.3–53.7	1.7
Recent hybrid a (3)	-	-			4	51.8	49.0–55.2	2.8	5	54.0	49.0–59.0	3.7
Recent hybrid b (3)	-	-			2	38.3	36.5–40.0	2.4	2	38.5	36.0–41.0	3.5

SD = standard deviation
(1) Al-Zawahra and Ezzughayyar 1998
(2) Grigson 1993
(3) Eisenmann and Beckouche 1986
hybrid a = female horse X male donkey
hybrid b = male horse X female donkey
(4) Clutton-Brock and Burleigh 1979

Table 5. Dog Mandible Measurements (Measurements in mm after von den Driesch 1976)

	Cave 4								Total Cave 4		Cave 2			Total Cave 2		Pariah Dogs*	
	L151	L151	L151	L151	L151	L150	L145	L202			*L128*	*L128*	*L128*				
Bone side	R	R	R	L	L	R	R	R	N	Mean	*L*	*L*	*L*	*N*	*Mean*	N	Mean
Molar row length	36.3	34.4	-	-	35.1	37.2	34.5	-	5	35.5	-	-	-	-	-	10	36.4
Pre-molar row length	36.8	-	37.6	-	36.3	37.6	35.1	38.1	6	36.9	-	-	-	-	-	10	41.2
Ramus height in front M1	22.9	24.6	21.0	-	25.0	23.2	19.8	-	6	22.7	-	-	-	-	-	10	22.8
Ramus height behind M1	22.8	24.1	22.5	-	25.4	25.9	-	-	5	24.1	-	-	-	-	-	10	23.0
PM4 length	-	10.6	10.8	9.7	10.2	11.5	-	12.0	7	10.6	-	-	9.9	1	9.9	-	-
PM4 breadth	-	5.1	6.0	5.8	5.0	6.0	-	5.8	7	5.4	-	-	4.7	1	4.7	-	-
M1 length	21.9	22.9	21.3	19.7	21.3	22.1	-	22.4	8	21.4	21.6	-	20.0	2	20.8	10	22.8
M1 breadth	8.2	8.5	8.6	8.1	-	8.6	-	8.7	7	8.3	8.5	-	7.8	2	8.1	10	8.4
M2 length	9.1	-	-	-	8.6	-	-	-	2	8.8	-	7.9	-	-	7.9	8	9.3
M2 breadth	5.7	6.3	-	-	6.1	-	-	-	3	6.0	-	6.2	-	-	6.2	8	6.7

* Measurements were taken on Pariah dogs from Suez held in the mammal collections of The Hebrew University of Jerusalem

Table 6. Pig Measurements (Measurements in mm after von den Driesch 1976)

	Cave 2 (late EB I)	Cave 4 (Chalcolithic)			Azor (late EB I)*		Modern Boar**	
Specimen Numbers	#1	#1	#2	#3	N	Mean	N	Mean
Mandible								
decid. M3 length	-	19.4	19.2	18.4	-	-	-	-
decid. M3 breadth	-	9.1	8.5	8.5	-	-	-	-
M1 length	16.9	15.9	-	-	4	15.6	17	15.1
M1 breadth	10.6	10.9	-	-	4	10.4	17	15.6
M2 length	19.3	18.3	19.9	-	3	18.2	14	20.3
M2 breadth	12.5	13.6	13.8	-	3	12.8	14	19.4
M3 length	-	31.1	-	-	5	31.9	5	38.9
M3 breadth	-	14.7	-	-	5	15.3	5	19.5
Maxilla								
M1 length		16.0	15.0					
M1 breadth		14.5	11.4					
M2 length		20.4						
M2 breadth		17.5						
Distal Scapula								
GB		26.6						
neck SD		25.6						
Distal Humerus								
Bd		32.8	44.3					
trochlea length		27.8	32.3					
trochlea height		14.8	16.1					
Proximal Radius								
GL		34.0						
GB		23.1						

* Azor data from van den Brink et al., forthcoming
** Data on modern wild boar taken on specimens from the north of Israel held in the mammal collections of The Hebrew University of Jerusalem

species becomes extinct before the end of the nineteenth century (Yom-Tov and Mendelssohn 1988).

The presence of cranial and postcranial remains of an adult striped hyena in L204 is particularly interesting as many of the bones in this cave exhibit tooth scoring and puncture marks typical of carnivore, especially hyena damage (Binford 1981; Kerbis-Peterhans and Horwitz 1992; Stiner 1994). However, most of the carnivore-damaged bones, as well as the hyena skeletal material, are derived from topsoil layer or fills, suggesting that their activities may have been relatively localized. This is especially clear when the remains recovered from the pits in the bedrock are examined. No carnivore damage was observed on the 25 identified bones from the pits, while the range of species represented was narrower than that in the surrounding fills: sheep/goat, cattle, pig and dog. Noteworthy is the absence of wild carnivores.

The presence of cut-marked and burnt bones in the assemblage from Cave 4 offers clear evidence that at least a component is derived from human activities. It is very possible that the hyenas were attracted to the cave precisely because of the presence of food

debris, suggesting that the carnivore damage may postdate the human activities in the cave. However, this cannot be proven.

Late Early Bronze Age I (Stratum II)
It appears that the Chalcolithic burial caves were reused in late EB I. No architecture was associated with this deposit and the faunal remains were mixed together with the ceramic and lithic material. The excavators have interpreted these remains as representing accumulated domestic refuse (van den Brink and Gophna 2005).

Cave 1.— Twenty-one animal bones were identified from the late EB I deposits in Cave I (Table 7). They are derived from three loci: L142 (close to topsoil), L152b (fill) and L157 (close to topsoil). Species represented are sheep/goat (N = 12), including the remains of at least one goat (*Capra hircus*), cattle (N = 1), pig (N = 6) and donkey (N = 2). At least one sheep/goat is aged 0–2 months (Payne 1973: Stage A) and another 3–4 years (Payne 1973: Stage F). All the pig remains represent immature animals and have unfused epiphyses.

Only one bone, a cattle proximal ulna, is scorched, perhaps by the recent limestone kiln found in this cave. A sheep/goat scapula has been butchered such that the blade was removed about one third below the neck and the spinous process was also cut off. Most bones exhibit gnawing and tooth scoring by carnivores, suggesting that they were either introduced into the cave by carnivores, or represent human food debris scavenged by carnivores.

Table 7. Fauna from Cave 1

	Late EB I	*Intermediate Bronze*
Species	*N*	*N*
Sheep/goat	12	3
Cattle	1	-
Pig	6	-
Donkey	2	-
Total	*21*	*3*

Cave 2.— A relatively large assemblage of 158 identifiable bones was recovered from the late EB I layers (Stratum II) in Cave 2, L128a–c (see Table 1). The bones were found mixed with other domestic debris below a layer of dark topsoil.

Sheep/goat predominate, with remains of both species represented, followed by dog and pig (see Table 1). As with the Chalcolithic sample, the pig remains appear to represent domestic animals (see Table 6). The surprisingly large quantity of dog remains represents at least four individuals (left mandibles), all slightly smaller in size than modern Pariah dogs from this region (see Table 5).

A wide range of wild fauna is also represented in this assemblage, all by only a few bones: mountain gazelle (*Gazella gazella*), fallow deer (*Dama mesopotamica*), chukar partridge (*Alectoris chukar),* badger (probably the common badger *Meles meles*), red fox (*Vulpes vulpes*), an unidentified rodent and an unidentified amphibian, probably the green toad (*Bufo viridis*).

Age determination of sheep/goat remains was based on dental attrition, as too few post-cranial remains were suitable for the compilation of an age profile. Based on Payne's (1973) wear stages, at least two animals were aged 1–2 years (Stage D), one aged 2–3 years (Stage E), one aged 3–4 years and two aged 4–6 years. The majority of the pig bones are those of immature animals with unfused epiphyses. Due to the small size of this sample, no quantifiable age profile could be calculated. The relatively large sample of dog bones contains only adult animals while the other species are all represented by too few bones to facilitate age determination.

Bodypart representation was examined for sheep/goat, pig and dog. Unfortunately, the small size of the cattle and donkey samples did not facilitate study of this feature. Sheep/goat are mainly represented by cranial remains (Fig. 2). Among the pig bones, trunk elements are the most common, followed by cranial remains, while dogs are represented mainly by trunk and cranial parts. Limb bones of sheep/goat and dog

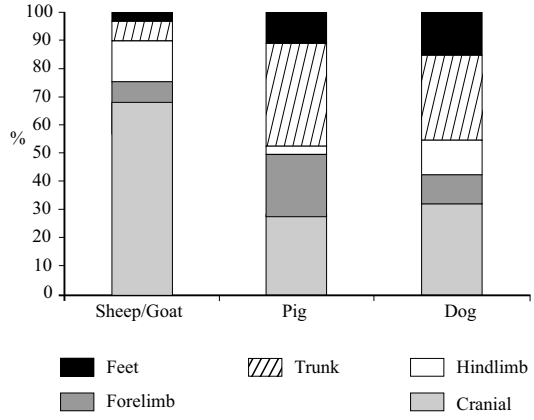

Fig. 2. Bodypart breakdown for species in the EB I sample from Cave 2 (data from Table 1).

are poorly represented, while the pig bones are characterized by a relatively high proportion of forelimbs.

Rodent gnawing is found on a fallow deer phalanx and carnivore puncture marks are present on two bones: a dog pelvis and gazelle phalanx. Many of the bones are missing epiphyses, which is most likely the result of carnivore gnawing.

The wide range of species and age groups, the presence of species like the toad, which probably represent natural mortalities in the cave, the clear presence of rodent and carnivore damage on bones and the low frequency of bone elements rich in meat (upper limbs), all point to this assemblage as representing refuse that was probably discarded in the cave and was subsequently ravaged by carnivores and rodents.

Topsoil: Mixed Chalcolithic/EB I Material (Stratum III)

Cave 2.— The topsoil stratum of Cave 2 (Stratum III) contained mixed Late Chalcolithic/EB I material, which the excavators have suggested was probably brought up from the underlying strata through post-depositional activities of animals (van den Brink and Gophna 2005). The 44 animal bones from L127 belong to this layer. Domesticates predominate in the assemblage: donkey, dog, sheep/goat (including a goat), pig and cattle, with mountain gazelle—the only wild species represented (see Table 1). This faunal spectrum closely resembles that of the underlying late EB I layer, a finding that corroborates the excavators' contention stated above.

Table 8. Fauna from Caves 3, 4

	Mixed Chalcolithic/EB I
Species	*N*
Sheep/goat	3
Cattle	7
Donkey	18
Dog	4
Gazelle	1
Total	33

Caves 3, 4.— Locus 145 contained 33 identified animal bones originating from the mixed Chalcolithic/EB I layer collected from the area of collapse between Caves 3 and 4. Species represented are the same as those found in Cave 4 (Table 8). Consequently, it seems feasible that this sample can be combined with the mixed material from Cave 4 (see Table 2). No unequivocal carnivore damage was noted on these bones.

Cave 4.— An assemblage of 75 identifiable bones was recovered from L151, the topsoil layer in this cave (see Table 2), which contained both Chalcolithic and late EB I ceramics.

Nine species are represented. Domesticates present are: sheep/goat, cattle, pig, donkey and dog. A wide range of wild species is represented: mountain gazelle, red fox, porcupine (*Hystrix indica*) and striped hyena (*Hyaena hyaena*). Carnivore damage is evident on most bones recovered from this layer.

Intermediate Bronze Age

Cave 1.— Three sheep/goat bones (MNI = 1) dating to this period are derived from L152a (see Table 7) and were found in association with a human burial. The inventory of the remains

comprises the left jaw of an adult sheep/goat aged 3–4 years (Payne 1973: Stage F) on the basis of dental attrition, and the lower right PM4 and M1 of a sheep/goat that may represent the other side of the jaw of the same animal.

Cave 4.— Six pig bones were recovered from a deposit containing Intermediate Bronze Age cultural remains in L156 (see Table 2): a metapodial and five rib fragments.

DISCUSSION

Chalcolithic versus Early Bronze Age

The only sizable bone samples from Shoham (North) were obtained from the Early Bronze Age material in Cave 2 and the Chalcolithic material in Cave 4. Therefore, these two samples will serve as the focus of the discussion.

Examination of the species lists (Tables 1, 2; Fig. 3) indicates that a similar range of species is represented in the two samples. In both assemblages domestic animals are by far the most common, especially sheep and goats. Based both on their size (see Table 6) and age profiles, pigs in both periods appear to represent domestic animals. As illustrated in Table 5, the Shoham dogs are of slightly smaller size than modern Pariah dogs from this region, and no marked metric differences are evident between the animals from the Chalcolithic sample and those from the Early Bronze Age assemblage.

Although only donkeys have been identified in the Early Bronze Age sample, the Chalcolithic assemblage contains two size classes of equid. The means and ranges of the Shoham donkeys and the larger-sized equid are markedly different (see Table 3), and when tested statistically using a t-test, which compares a single specimen with a larger sample (Simpson, Roe and Lewontin 1960:183), the difference was highly significant ($P < 0.001$). Similar large equids have been reported from other Chalcolithic and Early Bronze Age sites in the southern Levant together with small-sized specimens identified as domestic donkeys. As shown in Table 4, the large-sized distal metapodial from Shoham falls within the upper size range for these large-

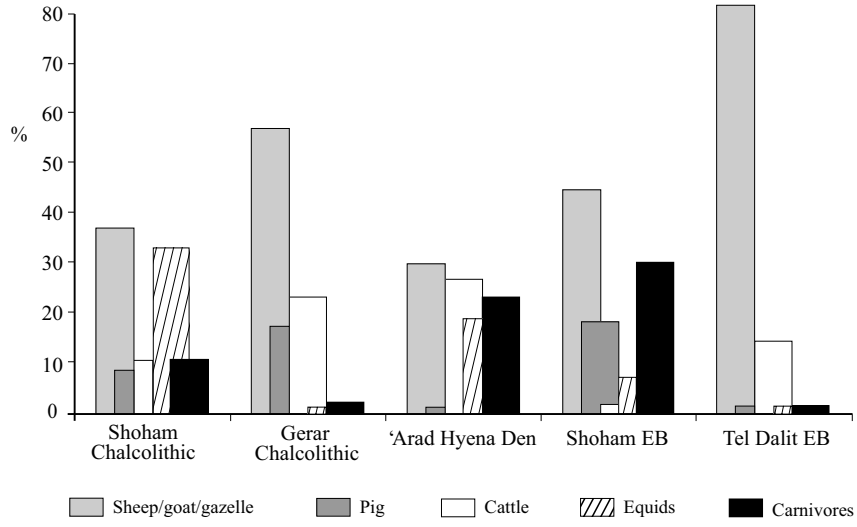

Fig. 3. Comparison of species frequencies from Shoham, the 'Arad hyena den (Kerbis-Peterhans and Horwitz 1992) and the domestic settlements of Early Bronze Age Tel Dalit (Horwitz, Tchernov and Hellwing 1996) and Chalcolithic Gerar (Grigson 1995).

sized specimens, which have been identified by Davis (1980a) and Grigson (1993) as horses. It is interesting that these large-sized Levantine specimens are smaller than modern horses, but fall close to values for modern Arab horses (see Tables 3, 4), as well as a horse metatarsus from the Chalcolithic/Bronze Age levels at the site of Hayaz Hüyük in southern Turkey, which has a distal breadth of 55.8 (Buitenhuis 1991). Using the same statistical method, other large-sized equids from Gerar, Shiqmim and 'Arad were tested against the Shoham donkeys. They differed significantly to three standard deviations from the donkey sample with the exception of the specimen from Gerar E which differed to only two standard deviations. Statistically, these large-sized Levantine equids fall well outside the range of the Shoham donkeys, and as such probably represent another species.

It has been suggested by Grigson (1993) that some of these large-sized Chalcolithic equids may represent more recent intrusions. However, in the absence of ^{14}C dates for any of these bones, their increasing number and presence at a wide range of sites suggest that they represent a genuine Chalcolithic/Early Bronze Age phenomenon. If they represent horses, then Grigson (1993) is correct in claiming the presence of small-sized horses surprisingly early in the southern Levant, i.e., in the fourth millennium BCE. An alternative interpretation is that they represent mules, which would account for their intermediate size between true donkeys and horses. If so, then it attests to the presence of horses in the Chalcolithic and Early Bronze Age in this region, albeit indirectly. However, as indicated by the data in Table 4, they do not resemble either of the two equid hybrids for which data is available.

If these large-sized equids are indeed *in situ* Chalcolithic finds (they may be intrusive as indicated by their proximity to topsoil), then, in my opinion, they probably do not represent horses, but rather wild ass (*Equus africanus*), as do the other large-sized Chalcolithic equids. This would mean that despite the domestication of the donkey (approximately the fifth millennium BCE; see Clutton-Brock 1992), the wild ass continued to be exploited in this region, especially in the more open steppe areas. This explanation would most easily account for the presence of two size groups within Chalcolithic/Early Bronze Age equid populations in the Levant, as well as explain the absence of typically caballine (horse-like) features in the dentition of equids from these same sites. The larger size of these Chalcolithic–Early Bronze Age asses, when compared to a modern population of *E. africanus,* may be related to the fact that local wild asses were larger than modern wild specimens of this species. This is illustrated by the large size of two first phalanges identified as *E. africanus* from the Negev Natufian site of Upper Besor 6 (Horwitz and Goring-Morris 2001). These phalanges are larger than those of modern *E. africanus*, but statistically closer to them than to other equid species.

Despite the fact that the Chalcolithic and Early Bronze Age samples from Shoham contain a similar range of species, they differ in relative frequencies. Cattle and donkey frequencies are markedly higher in the Chalcolithic sample than in the Early Bronze Age (cattle 11% to 2%; donkey 33% to 6%) while pig and dog remains are more frequent in the Early Bronze Age sample (pig 17% to 8.5%; dog 25% to 9%). Sheep/goat predominate in both samples and are present in similar frequencies (36% in the Chalcolithic versus 38% in the Early Bronze Age). It is not clear whether these differences are related to the changing function of the caves, from burial caves and localities serving an undefined domestic function in the Chalcolithic period to a refuse dump in the Early Bronze Age, or whether they represent chronological changes in the subsistence base of the people that exploited the caves. A further factor which may account for the differences is hyena activity in the caves. Striped hyenas (*Hyaena hyaena*) commonly use caves as maternity dens into which they introduce remains of their prey (hunted/scavenged), resulting in the creation of large bone assemblages (Binford 1981; Stiner

1994). Such activities have been documented in the southern Levant (Skinner, Davis and Ilani 1980; Kerbis-Peterhans and Horwitz 1992; Kuhn 2002). Thus, the Shoham fauna may represent a palimpsest of different activities, human and carnivore.

Chalcolithic Burial Offerings

The caves were clearly used for human interments. If the Chalcolithic fauna were associated with this activity, one would expect to find some evidence to support this, as burial offerings have been shown to exhibit unique characteristics: selection of a narrow range of species, selection of certain body parts or the presence of whole animals and selection of certain age and sex categories (Horwitz 1987). However, none of these features are evident in the Shoham sample. It has been similarly difficult to prove direct association between fauna and human interments at other Chalcolithic burial caves, such as Naḥal Qana (Horwitz 1996), Sha'ar Efrayim (Smith and Horwitz 1998) and Ben Shemen (Davis 1980b). Consequently, despite the fact that some of these animal bones were recovered in good stratigraphic contexts together with Chalcolithic material, it cannot be concluded with any certainty that they represent burial offerings or remains of funerary repasts.

Comparison with fauna from the Chalcolithic settlement at Gerar (Fig. 3) highlights the differences between consumption debris deriving from a domestic settlement and that found in the Shoham Chalcolithic assemblage. Despite similarities between the two in the spectrum of taxa represented, Shoham has an abundance of carnivore and equid remains and few bones of commonly consumed domesticates—sheep, goat, cattle and pig. This would indicate that the Shoham assemblage represents a mixture of animals that were introduced into the cave through non-anthropogenic activities (such as carnivores) and animal remains discarded by humans. The large number of equid remains may then represent carcasses of animals associated with the domestic function of the cave that were disposed of in the caves, or remains of scavenged animals introduced by hyenas.

Domestic Debris

During the Early Bronze Age the caves were reused as refuse dumps for a nearby settlement. Consequently, it is expected that the fauna should resemble remains recovered from domestic settlements of this period. Although the Shoham assemblage contains a similar range of species to that found in domestic settlements of this period (e.g., Grigson 1987; 1995; Horwitz and Tchernov 1989; Horwitz, Tchernov and Hellwing 1996), it differs markedly in the relative frequencies of the main species represented. With this in mind, the Shoham samples were compared to those from the Early Bronze Age settlement of Tel Dalit that is located in a similar environment (Horwitz, Tchernov and Hellwing 1996).

As illustrated in Fig. 3, it is clear that at both Shoham and Tel Dalit, medium-sized ungulate remains (sheep/goat/gazelle) are the most common species, although at Tel Dalit they are present in higher frequencies than at Shoham. Moreover, the Shoham samples contain significantly higher frequencies of equids and carnivores, especially dogs. The frequencies of pig and cattle remains found in both these assemblages vary markedly, and may be related to the local geographical conditions existing at each site rather than to site function.

It may be concluded then, that in terms of species frequencies the Shoham Early Bronze Age assemblage is characterized by different features to those found in the contemporaneous settlement. The broad spectrum of species represented (many of which inhabit caves), the high frequency of skeletal elements that are less valued for consumption, i.e., poor in meat (crania, feet), the wide range of ages represented, especially for sheep/goat, plus evidence for carnivore and rodent activity, suggest that this assemblage represents butchery debris and unwanted carcasses discarded in the caves.

Carnivore Activities

It is important to note that many of the bones from both the Chalcolithic and Early Bronze Age assemblages at Shoham exhibit characteristic carnivore damage in the form of tooth scoring on the bone surface, puncture marks and uneven edge damage. Furthermore, as indicated by the paucity of material that could be measured, few of the long bones are complete (Binford's 'bone cylinders'), especially of the larger species (cattle and equids). Considered together with the presence of hyena skeletal remains in the Chalcolithic deposits of Cave 4, it is possible that a portion of the Shoham faunal assemblage may have been introduced into the site by carnivores rather than by humans. An alternate option is that hyenas ravaged the bone assemblage after it had been discarded in the caves as has been suggested for the site of Naḥal Qana (Horwitz 1996).

When species frequencies at Shoham are compared to those from the 'Arad striped hyena den, and material from Early Bronze Age and Chalcolithic settlements in the region (Fig. 3), it is evident that the Shoham sample most closely resembles the 'Arad den. Furthermore, if part of the Shoham fauna is derived from carnivore activities then this may also account for the mixing of material from different periods in the caves as attested to in the flint assemblage (Marder 2005). It would also mean that the division of the faunal assemblage into Chalcolithic and Early Bronze Age samples is spurious, and that they should be treated as a single unit. This is corroborated by the fact that the two samples share a common spectrum of species, though differ in their relative proportions. It may then be conjectured that the observed differences in the relative frequencies of species in the different periods is related to differences in sample size or composition of the animal bone concentrations found in the two caves, rather than to chronological or functional differences between the samples.

An alternative explanation, similarly plausible, is that if the Shoham assemblage represents butchery debris or animal carcasses discarded by people, it would more closely resemble a scavenged bone assemblage. Such a bone sample would be characterized by high frequencies of rarely consumed species (e.g., carnivores, equids) and cranial and foot remains that are poor in meat. In contrast, assemblages derived from domestic sites are expected to contain higher frequencies of commonly consumed species (sheep, goat, cattle, pig) and higher proportions of meat-rich skeletal elements (upper limbs, trunk). Similarly, age profiles will differ between the two assemblage types, with scavenged assemblages often having higher frequencies of very young and very old animals (Binford 1991; Stiner 1994).

The faunal assemblages recovered from the burial caves of Sha'ar Efrayim (Smith and Horwitz 1998) and Naḥal Qana (Horwitz 1996), both of which yielded Chalcolithic interments in association with large animal-bone assemblages, were compared to the Shoham assemblage. In both cases, the bone samples were interpreted as being partly the result of carnivore activity. At least in the case of Naḥal Qana, it was possible to show that the carnivore activity postdated that of the Chalcolithic human interments due to a puncture mark on one of the human bones (Horwitz 1996). At both these sites, as at Shoham, a mixture of domestic and wild species was recovered. The wild fauna included species that naturally inhabit caves: small carnivores, rodents, reptiles and amphibians, and as such represent accidental intrusions. Although feral dogs are also known to utilize caves, they appear to have served as a common food source (scavenged) for striped hyenas that utilized the 'Arad den, and as such may be considered as a characteristic feature of striped hyena dens in this region.

The status of the sheep, goat, cattle, donkey and pig remains in these cave sites is more problematic as these species may have served as food items or burial offerings introduced by people, subsequently ravaged by carnivores attracted to the caves by the presence of food debris. As such, they may represent food items of human rather than carnivore origin.

Indications for human activities are found on bones from these caves in the form of cut marks and burning. However, they offer no resolution as to who initially introduced the bones into the cave as they may have been scavenged by hyenas from a nearby settlement. Indeed, in the ‘Arad hyena den where there is no evidence for human occupation, past or present, several burnt bones were also found (Kerbis-Peterhans and Horwitz 1992).

The data presented here suggest that although the Shoham bone collection resembles that recovered from the ‘Arad hyena den in many features, several different explanations may account for this pattern. Unfortunately, it is not possible to determine with any precision the extent of human versus carnivore activities at this site, but it is clear that both agents contributed to the creation and modification of the Shoham faunal assemblage.

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