Backbone of Society: Evidence for Social and Economic Status of the Iron Age Population of Tel Reḥov, Beth Shean Valley, Israel

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Zooarchaeological data from Iron Age urban contexts may reveal information pertaining to ancient economy, society, and culture. In this paper, a large sample of animal bones from the domestic quarters of Iron Age Tel Reḥov in the Beth Shean Valley region of northern Israel is considered. An analysis of livestock herd demography and butchery patterns is used to explore the foodways of the inhabitants of the city. The meat consumption habits of the population included the regular partaking of gourmet portions of sheep and goat meat from young animals, most of which were males—which indicates a strong consumer economy. Wild boar hunting was practiced, and its flesh was occasionally eaten. The consumption of gourmet portions of livestock animals and the practice of wild boar hunting suggest that Iron Age Reḥov was inhabited by a socioeconomic elite.

INTRODUCTION

The analysis of domestic food remains from archaeological sites is a powerful tool for gaining knowledge of ancient foodways. The partaking of food, an essential and universal act, is nearly always enmeshed in a rich fabric of cultural meanings and codes (e.g., Hesse 1990; Simoons 1994; Twiss 2007). It also encapsulates information pertaining to the more mundane aspects of life: from where and whom, and in what manner, food items were obtained, and how they were treated prior to consumption and discard. Both these types of information are cardinal to archaeological investigation of ancient societies. Important contributions have been made toward analyzing ancient historical Levantine bone assemblages, thereby allowing a glimpse into the political, cultural, and ecological circumstances that shaped them (e.g., Davis 1976; Hesse 1986; 1990; 1995; Horwitz 1986–1987; 2001; Wapnish 1993; Hesse and Wapnish 1997; 1998; Zeder 1998; Lev-Tov 1999; 2000; Horwitz and Studer 2005; Raban-Gerstel et al. 2008). Many of these works focused on the utilization of pigs and its ethno-cultural significance. This is understandable and laudable, as this animal bears a heavy load of taboos, rites, and beliefs,

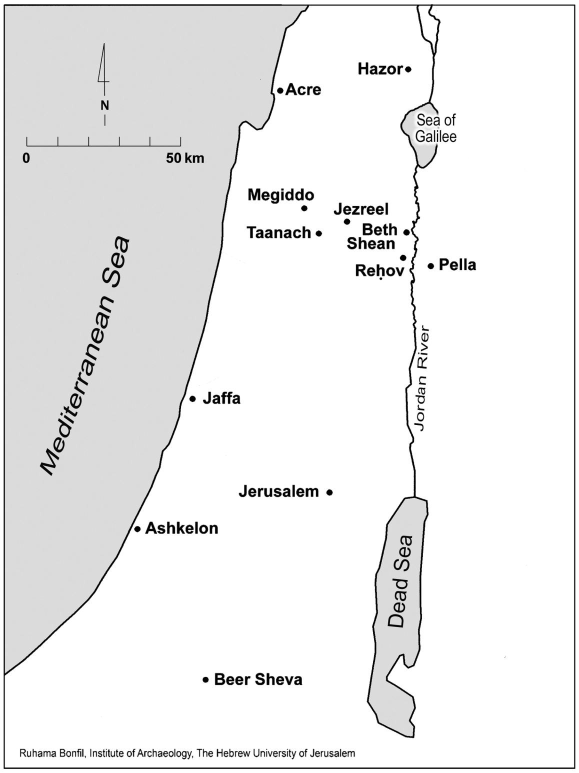

Fig. 1. Location map for Tel Reḥov. Reprinted from Mazar (2005).

which demand explanation (e.g., Simoons 1994: 13–102; Fabre-Vassas 1997). Sheep and goats from Levantine faunal assemblages are no less important for reconstructing the foodways of ancient cultures, although these animals often seem like the uninteresting background of the Levantine economy since the Neolithic. A theoretical framework fashioned by some classical studies (Payne 1973; Redding 1981; Zeder 1991) awaits wide application to suitable Levantine Iron Age data, to infer the specific social, cultural, and economic roles of key sites. Such an application has not often been attempted or carried out in-depth for this period (but see, e.g., Wapnish and Hesse 1988; LaBianca and von den Driesch 1995; Lev-Tov 2000).

Important information on day-to-day life in ancient settlements can be revealed by high-resolution analyses of faunal assemblages from domestic contexts. Such analyses should include detailed zooarchaeological and taphonomic work on large bone assemblages, coupled with full inspection of bone surface modifications. The data sets from which such information may be acquired include the traces of butchery extracted from the bone assemblages, body-part distribution, and demographic profiling of herds, namely, the age and sex distribution of herd animals represented by bones at the site. A combination of these data sets could tell much about the economic status of the inhabitants, since we assume that higher-status, wealthier communities would have consumed better foods which the poorer communities could not afford. When meat is the subject of inquiry, the ability of a community to purchase better and more expensive goods—that is, to indulge in luxurious cuisine—would manifest itself in the ubiquity of gourmet portions of the food animals. By gourmet portions we mean the meatier parts of the upper front and hind limbs and the flesh surrounding the vertebral column, which even today are sold in butchers' shops for relatively high prices. In addition, these portions should originate in young animals, the meat of which is tender. These gourmet portions are superior to the meat derived from the lower limbs, head, and feet, and also to the flesh of older animals, which are usually the females kept to late maturity for breeding purposes in any herd. These latter, subprime portions have lower meat content, and in the case of older animals, are not as tasty.

In this paper we focus on the bones recovered from Tel Reḥov, a large site in the Beth Shean Valley, northern Israel (fig. 1). The assemblage derives from parts of the mound that were identified by the excavators as the domestic quarters of the Iron Age IIA city (Mazar 1999: figs. 6–9; Mazar et al. 2005: 216), excluding a very small quantity of bones (less than 5%) from functionally similar Iron Age IB contexts. The domestic context is suggested by the presence of dense non-monumental buildings, incorporating small storage rooms and domestic appliances, such as loom weights, grinding stones, and ovens. Cultural continuity during the occupation period is suggested by the persistence of specific constructions in the four strata from which the sample was recovered, together with the continuity of the unique architectural style, which consists of mudbrick buildings without stone foundations (Mazar et al. 2005: 216). The pooled bone material from this functionally and temporally homogeneous assemblage produced a large faunal sample. This allowed focus on the analysis of livestock herd maintenance, culling, and butchery practices on the sure ground of a large sample size from functionally uniform, controlled contexts.

Several main lines of inquiry were pursued. Evidence for the consumption of rare meat types, or alternatively, the frequent consumption of gourmet portions of livestock animals, was sought. Since the assemblage was recovered from domestic contexts, and not from an area of special activities which may have involved feasting or ritual slaughter (e.g., a palace or a sacred precinct), such evidence may point to the importance of luxury foods in the diet of the site's population and as an indicator of socioeconomic standing (Ervynck et al. 2003). We assume that the faunal remains from domestic houses reflect mainly a time-averaging of domestic consumption activities and do not contain a major component of refuse from household ritual activities.

It was also hoped that a detailed demographic profiling of caprovine herds would reveal something of the type of herd maintenance strategy employed by the producers of animal goods who supplied livestock animals to the consumers at the site, using existing ethnographic models in the archaeozoological literature (Payne 1973; Redding 1981:365–82). The demographic data—mortality profiles, sex ratios, and sheep/goat ratios of the caprovine sample from the site—should hint at whether herds were kept to produce meat, milk, or wool (Payne 1973). Alternatively, herds could have been maintained to promote general stability of the caprovine population using a generalist herd-security strategy (Redding 1981: 47). For previous empirical work on Near Eastern animal bone assemblages with emphasis on mortality profiles, see the various works by Stein (1986a; 1986b; 1987; 1989; Wattenmaker and Stein 1986).

A demographic analysis supplemented by information on the frequency of pathologically altered bones was applied to the cattle sample in order to detect traces of possible use of these animals for agricultural activities, i.e. traction (Bartosiewicz, Van Neer, and Lentacker 1997: 32–104).

In addition to answering the question of whether the population of Tel Reḥov was involved in specialized production of secondary animal products (cf. Sherratt 1981; 1983), the demographic profile of the livestock herds may demonstrate whether the animals were culled from locally raised herds or were obtained from herds raised by another component of the economic system of which Tel Reḥov was a part. In other words, it would determine whether the meat economy in Reḥov was a producer economy, in which people consumed the meat of the animals from their own herds, or a consumer economy, in which meat was purchased or otherwise acquired from others who kept herds, i.e., pastoralists (Hesse 1986: 22–26; Stein 1987: 102–3; Zeder 1991: 36–42; Hesse and Wapnish 2002). This can be achieved by high-resolution aging and sexing of the caprovine sample, for we expect culled animals from local herds to display a high proportion of older females, which are no longer necessary as breeding stock. A reduced presence of the mature female component in the sample, made manifest in the dominance of young male animals, should hint that the residents of the site acquired the younger, and therefore better, meat animals from a herd kept elsewhere. Presumably, the majority of mature females, which provide lower-quality meat, were consumed by those hypothetical herd-keepers too poor to afford the regular consumption of young animals, which were marketed for high prices.

The integration of the mortality profile data and the skeleton element abundance profiles for caprovines indicates the economic status of those who lived in Tel Reḥov during Iron Age II. It is expected that a wealthy consumer population would enjoy mainly meat-bearing elements from market-age males. Conversely, less well-off groups would consume greater quantities of less desirable body parts—the heads, necks, and feet, which bear less meat. The less affluent groups would probably also limit themselves to meat from older females, which are past their breeding peak and command lower market prices. Although each of the data sets mentioned above may be prone to misinterpretation due to various analytical biases, it is believed that the combination of demographic and body-part data could lend significant strength to the social status model presented above.

The study of the exceptionally large and well-dated bone assemblage from the domestic quarters of the important Iron Age city at Tel Reḥov may reveal the social makeup and standing of its population. It was also expected that the study would reveal something about the place the city of Reḥov may have held in the local regional economy, and give evidence about the backbone of this Iron Age society: self-sufficiency in acquiring animal products, or trade with pastoralists for animal goods.

THE SITE AND ITS SETTING

Tel Reḥov (Arabic: Tell es-Ṣarem) (fig. 1) is the largest mound in the Beth-Shean Valley, located about 6 km west of the River Jordan, 3 km east of the Gilboa ridge, and 5 km south of Tel Beth-Shean. The mound extends over 10.2 ha, its summit is at an elevation of 116 m below sea level, and it rises 20 m

TABLE 1. Stratigraphy and Chronology in Tel Reḥov

General Stratum	*Local stratigraphy in each of the excavation areas*								*Period*[a]	*Date*[b]
I	A-1	B-1						J-1–2	Early Islamic	8–11th centuries C.E.
II	A-2	B-2			—	—	—	J-3	Iron Age IIB/C	After 732
III	A-3a A-3b	B-3						J-3–4	Iron Age IIB	Until 732
IV	A-4	B-4[C]	C-1a	D-1a	E-1a	F-1	G-1	J-5	Iron Age IIA	Until ca. 830–840
V		B-5a	C-1b	D-1b	E-1b	G-2	G-2	J-6–7		
		B-5b								From ca. 980
VI		B-6	C-2	D-2	E-2	F-3–4	G-3	J-8		
VII		B-7	C-3	D-3					Iron Age IB	Until 990–980
				D-4						
				D-5						ca. 1130 (?)
				D-6					Iron Age IA	12th century
				D-7						
				D-8					Late Bronze IIA–B	14th –13th centuries
				D-9a						
				D-9b						
				D-10					Late Bronze I–IIA	15th–14th centuries
				D-11					MB/LBI	16th century

[a] Terminology following Stern (1993: 1529).
[b] Dates following Stern (1993: 1529); Iron Age IIA dates following the Modified Conventional Chronology (Mazar et al. 2005: 212–50). B.C.E. dates in all cells except the upper one.
[c] Needs further clarification in the future. It is possible that 5a should be correlated with general Stratum IV.

above the surrounding plain. The site is located close to a main north–south road passing through the Jordan Valley and close to an east–west road connecting the coastal valley through the Valley of Jezreel with Transjordan near Pella. The area around the tel is rich in alluvial soil and well suited for agriculture. The Gilboa ridge possibly provided winter pasture on uncultivable terrain. Such proximity to winter pasturage far from cultivated fields, which are liable to destruction by foraging herds, is a necessary feature for the traditional Near Eastern economy involved in both agriculture and transhumant pastoralism. There was a perennial spring just off the site, dry today, which supplied water to the site, as well as other springs at a reasonable distance from the site. The combination of ample fertile land and springs located near important roads provided ideal environmental conditions for the development of a major city.

Tel Reḥov was excavated for eight seasons from 1997 to 2007. The excavation was directed by A. Mazar, on behalf of the Institute of Archaeology of the Hebrew University of Jerusalem, and was funded by a generous grant from Mr. John Camp (Mazar 1999; 2003b; 2008; Mazar et al. 2005; www.rehov.org). Eight excavation areas yielded rich material remains and complex stratigraphy from the Late Bronze Age to the end of Iron Age IIB (eighth century B.C.E.; table 1). The site was already a fortified city during the Early Bronze Age, and Reḥov was a city-state during the Late Bronze Age, by far surpassing in size Beth-Shean, which served as the center of Egyptian administration (Mazar 2003a). Several episodes of rebuilding can be attributed to destruction caused by earthquakes and human activity. However, there is no evidence for violent destruction at the site in the transition from the Late Bronze to the Iron Age, and the painted pottery tradition of the Late Bronze Age continues throughout Iron Age I. Reḥov continued to be one of the largest cities in the Land of Israel throughout the 14th–9th centuries B.C.E., in

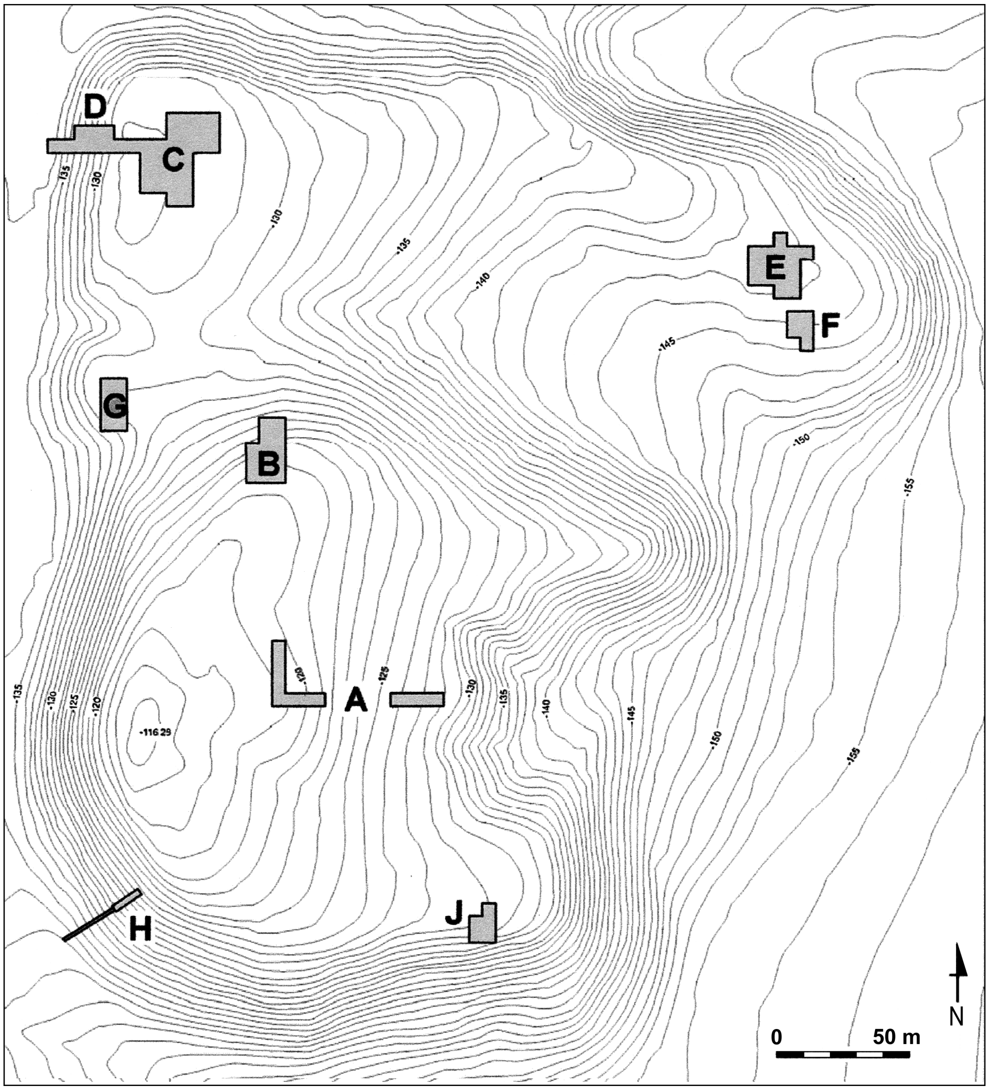

Fig. 2. Excavation areas at Tel Reḥov (drawn by G. Rosenberg).

spite of the great geopolitical changes that took place during this time. The main period excavated in most of the areas was Iron Age IIA. Several phases from this period were detected, and they are divided into three main general strata (VI–IV), dated by ^{14}C dates and pottery studies to the tenth–ninth centuries B.C.E. During this period, the Canaanite painted pottery tradition of the Late Bronze–Iron continuum was replaced by red-slipped and burnished ware, in tandem with changes observed in the other major sites in the region. Unlike other sites, Tel Reḥov exhibits a unique architectural style of mudbrick buildings without stone foundations. The Iron Age IIA strata yielded a wealth of architectural remains and artifacts, including huge pottery assemblages, many cult vessels, seals, etc. The industrial apiaries found in Area C in the northwestern part of the mound are unique (Mazar and Cohen-Panitz 2007; Mazar et al. 2008). In the ninth century B.C.E., Reḥov must have been a major city in the state of Northern Israel, and as such it suffered from severe destruction during the second half of that century, probably by Hazael, King of Damascus. Following this event, the city shrank to half its original size, yet continued to survive until the Assyrian conquest in 732 B.C.E.

This study concentrates on the faunal sample collected during the 2003–2005 excavation seasons in Areas B, C, D, and J of the mound (fig. 2). It utilizes data pertaining to the specific research questions mentioned above—namely, demographic and specific taphonomic data on livestock herd animals. Full treatment of other aspects of the faunal assemblage, such as avifaunal remains, body-part representation profiles of rare taxa, and the state of preservation of the bone assemblage is available elsewhere (Tamar et al. in press). The faunal assemblages from previous excavation seasons were analyzed by M. Sadeh and M. Craig.

METHODS

The faunal assemblage was recovered from loci belonging to Strata VII–IV, dated to Iron Age IB through IIA (table 1). The vast majority of the sample (96%) is from the Iron Age IIA period.

Bones were collected by hand and were washed in water to remove adhering sediments. The recovery of the bones by hand, without sieving, may have introduced a bias in favor of larger taxa in the assemblage. However, we suspect the bias not to have been severe, as numerous bones of fish and birds were recovered, indicating a thorough collection of bones by the excavators. Bone-recording procedures are described in detail elsewhere (Raban-Gerstel et al. 2008). In brief, long bone epiphyses fragments, glenoid fossae of the scapula, the acetabulum, the atlas and axis vertebrae, horns, mandibular teeth, phalanges, and rib articulations were recorded and assigned percentage of completeness in relation to a whole element. Bone identification was carried out using the comparative collections of the Laboratory of Archaeozoology at the University of Haifa, and the Laboratory of Palaeontology and Zooarchaeology at the Hebrew University of Jerusalem. The minimum number of elements (MNE) was calculated by summing the percentages of completeness for each element. The highest MNE count for each taxon, after being standardized to accommodate the frequency of appearance of the element in a complete skeleton, served as the minimum number of individuals (MNI) count for the respective taxon. The number of identified specimens (NISP), which is the raw bone count, was used to determine relative taxonomic abundance. A variety of other parameters were also recorded. These include the state of epiphyseal fusion (Silver 1969: 285–86), cheek teeth wear stage (Payne 1987), and bone surface modifications, such as carnivore gnawing (Marean and Spencer 1991; Blumenchine, Marean, and Capaldo 1996), and burning and butchery marks (Binford 1981: 136–42). Size measurements of fused specimens were taken following the protocol of von den Driesch (1976). Sheep (*Ovis aries*) and goat (*Capra hircus*) bones were distinguished whenever possible using the morphological criteria established by Boessneck (1969). The domestication status of the pig (*Sus scrofa*) was tested using the log-size index method (Uerpmann 1978; Meadow 1984), which enables the comparison of size measurements from various elements from the archaeological sample to a known standard, based on the premise that domestication is evidenced by a reduction in body size (Davis 1981). In the present study, an Anatolian wild boar female (Hongo and Meadow 1998: table 5) was selected as a standard, and the authors' assumption is that if the size measurements from Tel Reḥov specimens are consistently lower than those of a wild boar female, the archaeological specimens would probably represent a domesticated population.

The construction of survival curves, which show the percentage of the archaeological herd that survived each consecutive age class, was based on epiphyseal fusion and cheek teeth wear data. Articulations of bones fuse to the main part of the element at different known ages (Silver 1969: 285–86): the proportion of fused to unfused elements can therefore be used to estimate the proportion of animals of a certain taxon slaughtered at a specific age. Teeth abrade as an animal ages, producing a pattern of wear known empirically to characterize different age classes (Payne 1987). This knowledge can be used to construct the frequency of animals slaughtered in each age class. Teeth wear data are taken to be more reliable, due to the unknown variability in fusion ages between different breeds and geographic locales. Tooth wear is also more reliable where density-mediated attrition is suspected to have taken place. Bones of juveniles are more porous and fragile than those of adults and, under such conditions, would suffer a greater rate of destruction. This may skew the age distribution in favor of adults, the more durable bones of which would be more abundant.

An inseparable part of demographic analysis is the determination of sex ratios in the archaeological herd. This provides a useful means of discriminating between different herd management strategies frequently employed by traditional herd-keepers (e.g., Redding 1981: 234–310). These are strategies meant to optimize the production of milk, meat, or wool, or herd security. The last strategy means ensuring the survival of an adequate herd population in the

TABLE 2. The Mammalian Taxa at Tel Reḥov, the Preferred Habitats of the Wild Species, and Frequencies of Occurrence

Latin Name	*Common Name*	*Habitat*	*NISP*	*%NISP*	*MNI*
Capra/Ovis	Goat/sheep	—	3,376	59%	57
Bos taurus	Cattle	—	1,048	18%	12
Ovis aries	Sheep	—	573	10%	15
Capra hircus	Goat	—	400	7%	8
Sus scrofa	Wild boar	Bushland & dry open country	138	2%	1
Canis sp.	Canines	—	67	1%	1
Equus asinus	Donkey	—	42	1%	1
Dama mesopotamica	Mesopotamian fallow deer	Bushland and woodland	26	—	2
Gazella gazella	Mountain gazelle	Open landscape and bushland	16	—	2
Lepus capensis	Cape hare	—	11	—	
Felis sylvestris	Cat	—	7	—	
Erinaceus sp.	Hedgehog	Bushland & dry open country	3	—	1
Vulpes vulpes	Red fox	Bushland & dry open country	2	—	1
Cervis elaphus	Red deer	Bushland & dry open country	1	—	1
Camelus dromedarius	Camel		1	—	1
Total mammals			5,711		105

event of sudden crashes that might otherwise decimate this important source of livelihood, e.g., drought, disease, and predation. Determination of sex ratios for caprovine herds was made by two methods: first, using a small sample of complete caprovine horn cores; and second, using a procedure known as support vector machine (SVM), belonging to the general family of linear classifiers (Cristianini and Shawe-Taylor 2000). This procedure enables the assignment of measurements of archaeological specimens to one of several classes (in our case, male or female), based on a set of measurements of classified bones. For a set of N dimensional variables, the program constructs an N-1 dimension hyper-plane which segregates in an optimal way the two known groups of the training set. This plane, which is in our case is a simple line, enables the assignment of unclassified data to one of the groups. Use of kernels can be made to better separate the data of the training set; however, this elaboration was not needed in this study, as the raw measurements were easily distinguished by the algorithm. Recent male and female caprovine measurements of the breadth of the trochlea of the distal humerus (BT) and its height (HTC) (Davis 1987: 11) were used as a training set in this study. The ratio between these measurements of the humerus has some notable advantages: distal humeri are generally abundant in archaeological bone assemblages, and their species are easily identified. These elements are also liable to show marked sexual dimorphism due to their support of the greater mass of the forequarters in ungulate males. Although distal metacarpals are slightly more sexually dimorphic than the distal humeri (Davis 1996), the number of metacarpal measurements available for us to use as a training set was smaller than that of distal humeri, and therefore the latter element was chosen for this analysis. MATHEMATICA™ 5.2 was used to conduct SVM analyses. Statistical tests mentioned in the text were carried out using STATISTICA™ 6.0. These tests include χ^2 analyses and Kruskal-Wallis median tests to determine how similar the taxonomic compositions are between strata (Sokal and Rohlf 1995: 425–27).

RESULTS

Taxonomic Representation

The mammal bone assemblage discussed in this study comprises 5,711 identified bones (table 2). Most of these bones (NISP = 4,349; 76%) belong to caprovines. From the 973 caprovine bones identified to genus, 573 (10%) represent sheep (*Ovis aries*), and 400 (7%) represent goats. Based on the morphology of 15 complete goat horn cores, the goats are all domestic (*Capra hircus*). Cattle (*Bos taurus*) is the

TABLE 3. Bone Counts for the Main Ungulate Taxa in Tel Reḥov

	Capra hircus		*Ovis aries*		*Capra/Ovis*		*Bos taurus*		*Sus scrofa*	
	NISP	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*
Head										
Occipital condyle	2	2			49	49	7	7		
Petrosum					35	32	9	8		
Horn/Antler					43	21	16	8		
Mandibular condyle					161	81	31	18	1	1
Mandibular teeth	9	9	21	21	395	132	108	13	8	3
Maxilar teeth					316	115	78	23	8	3
Body										
Rib					281	184	83	52	30	20
Atlas			1	1	56	29	3	2	2	2
Axis					42	18	5	2		
Thoracic spine					318	300	31	28	18	17
Forelimb										
Scapula glenoid fossa	19	17	48	43	43	29	12	7	7	6
Humerus complete										
Humerus proximal			6	6	44	24	12	6		
Humerus distal	31	28	72	67	55	29	29	13	4	3
Humerus shaft (foetus)					10	8				
Radius complete			2	2	2	2				
Radius proximal	32	31	25	25	58	31	18	11	1	1
Radius distal	19	17	22	22	8	4	12	10	1	1
Radius shaft (foetus)					3	3				
Ulna	5	3			94	63	22	13	8	8
Metacarpus complete	6	6	5	5	9	8	2	2		
Metacarpus proximal	1	1	2	2	131	95	22	13		
Metacarpus distal	7	7	21	21	20	16	4	4		
Metacarpal shaft (foetus)										
Metacarpal II										
Metacarpal III									1	1
Metacarpal IV									1	1
Hindlimb										
Pelvic acetabulum					296	120	55	20	9	9
Femur complete					1	1				
Femur proximal	4	4	15	13	55	28	18	10		
Femur distal			1	1	88	63	25	13		
Femur shaft (foetus)					3	3				
Tibia complete					2	2				
Tibia proximal	2	2	19	19	26	17	13	8		
Tibia distal			1	1	100	90	28	16	5	5
Tibia shaft (foetus)					3	3				
Fibula									1	1
Astragalus	79	79	109	107	93	73	33	26	6	6
Calcaneus	25	23	39	35	47	22	35	21	1	1
Central 4th tarsal					39	36	28	26		
Metatarsus complete	2	2	4	4	11	10	2	2		
Metatarsus proximal	1	1			121	75	17	9		
Metatarsus distal	5	5	3	3	9	6	7	7		

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TABLE 3. *continued*

	Capra hircus		*Ovis aries*		*Capra/Ovis*		*Bos taurus*		*Sus scrofa*	
	NISP	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*	*NISP*	*MNE*
Metatarsus shaft (foetus)					2	2				
Metatarsus III										
Metatarsus IV									1	1
Metatarsus V										
Toes										
Phalanx 1	46	43	119	105	116	82	114	83	4	3
Phalanx 2	64	63	19	19	51	41	86	80	7	6
Phalanx 3	37	35	11	11	23	17	48	43	4	4
Metapod complete									7	7
Metapod proximal					8	2	4	2		
Metapod shaft (foetus)					7	7				
Metapod distal	4	4	8	8	101	57	31	16	3	3
NISP	400		573		3,375		1,048		138	
% NISP	7.01%		10.05%		59.17%		18.37%		2.42%	
MNI	40		54		66		13		5	

second most abundant taxon at Reḥv, their remains (NISP = 1,048) making up to 18% of the total bone assemblage. Wild boar (*Sus scrofa*) are uncommon and appear infrequently (NISP = 138; 2%). Bone counts for the common ungulate taxa (sheep, goats, cattle, and pigs) are provided in table 3.

Other mammalian species are represented by negligible numbers of specimens (< 1% of the overall NISP, table 2). These include the remains of canids, probably domestic dogs (*Canis* sp., NISP = 64), asses (*Equus asinus,* NISP = 42), Mesopotamian fallow deer (*Dama mesopotamica*, NISP = 26), a single red deer (*Cervus elaphus*) metacarpus, and a camelid (*Camelus dromederius*) radius (Area D1, Iron Age IIA). The camel specimen was not found in a primary context, but the terminus post quem for its deposition was Iron Age IIA, after which habitation of the lower city ceased. Other carnivores represented in the assemblage include the remains of cats (*Felis sylvestris*, NISP = 7) and red foxes (*Vulpes vulpes*, NISP = 2). Additional small-game taxa include Cape hares (*Lepus capensis*, NISP = 11) and hedgehogs (*Erinaceus europeus*, NISP = 3). An interesting find was an imprint of a dog's foot preserved in a mudbrick.

Body dimensions of the pigs from Tel Reḥov are on the average larger than those of an Anatolian wild boar female (Hongo and Meadow 1998; see table 4). This result, combined with the paucity of suid remains (see, for example, the relatively high frequency of pigs recovered from the Bronze Age domestic area of nearby Tell el-Hayyat; Falconer 1995: 407), seems to identify these animals as wild boar rather than domestic pigs. Boar remains were evenly distributed among the excavation units.

Changes in the frequency of caprovines, cattle, and boar representation across the different strata (IV–VII) have been examined in order to trace diachronic changes in taxonomic abundance which may indicate changes in subsistence behavior. A correspondence analysis indicates that most of the differences between strata can be explained by changes in the abundance of boar, which gradually declines from 4.9% in Iron Age IB Stratum VII to 1.5% in Iron Age IIA Stratum IV (fig. 3; Marom and Raban-Gerstel in press). The difference between the representation of boar in Stratum VII and Stratum IV is statistically significant ($\chi^2 = 4.88$, P = 0.03). Changes in the frequency of the caprovines and cattle are insignificant between the layers (Kruskal-Wallis median test: $\chi^2 = 4.00$, P = 0.26), thus lending support to our decision to lump the assemblages from different strata together. Diachronic changes that may have occurred in the frequency of other taxa cannot be demonstrated, due to the sporadic nature of their occurrence.

Demographic Profiling for Caprovines

Levantine caprovine bone assemblages present the zooarchaeologist interested in demographic profiling

TABLE 4. Log Size Index (LSI) Values for Suid Measurements from Tel Reḥov, Compared with a Standard Specimen*

Measurement (mm)	*Standard*	*Reḥov*	*Std. Dev.*	*N*	*LSI*
Astragalus GL1	47.5	51.02	3.12	3	0.031
Tibia Bd	33.5	31.92	4.06	3	–0.021
Metacarpus 3 Bp	20.7	20.3	N/A	1	–0.008
Metacarpus 4 Bp	19.1	19.8	N/A	1	0.016
Metatarsus 4 Bp	17.5	20.4	N/A	1	0.067
Average					0.017

* Anatolian wild boar female (Hongo and Meadow 1998)

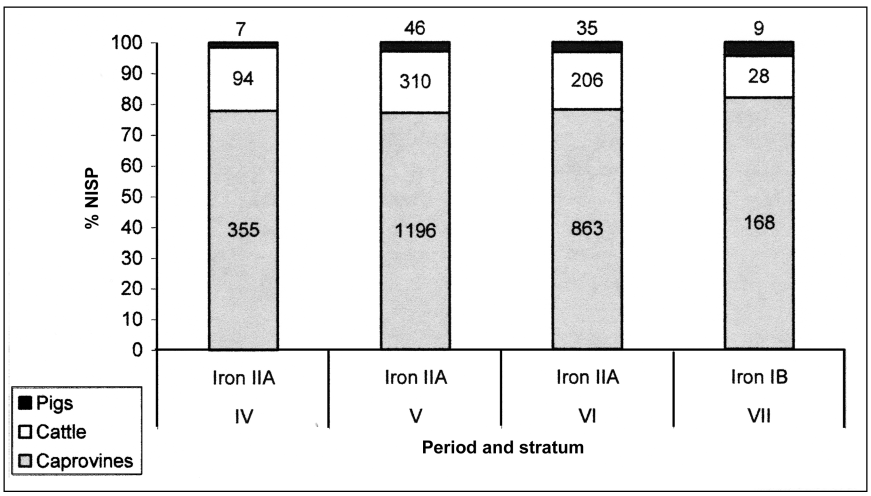

Fig. 3. Frequencies of the different ungulate taxa across strata in Tel Reḥov. Roman numerals on the abscissa denote strata; numbers in bars denote bone counts. The difference in the representation of pigs between Layers VII and IV are statistically significant (χ^2 = 4.88, P = 0.02). The decline in frequency is shown elsewhere to have been gradual, based on a correspondence analysis (Marom and Raban-Gerstel, in press).

with a special difficulty. While in certain parts of northern Europe herds are composed almost exclusively of sheep, and in the mountainous regions of the Near East (the Zagros) goats are dominant, Levantine caprovine herding in ancient times consisted of keeping mixed herds of sheep and goats in various proportions, which correlate roughly with mean annual rainfall and temperature (Payne 1973; Redding 1981: 190–208; Tchernov and Kolska-Horwitz 1990; Grigson 1995: fig. 7). Goats are more resilient to heat and dryness than sheep, but the latter provide a higher calorific yield than the former (Redding 1981: 137–84). In areas in which both sheep and goats can be raised, which include the Mediterranean region of the Levant, it is difficult to distinguish between the bones of these taxa. This is also true in Reḥov, where the specimens of a large number of sheep and goats could not be identified to species. However, the large sample size of caprovine bones in Reḥov allowed the comparison of two key demographic data sets for sheep and goats: changes in the age of slaughter and in sex ratios.

An attempt was made to elucidate caprovine herd composition in terms of sheep-to-goat ratio, sex ratio, and age structure. This data set should be informative as to the herd management strategy and, thus, the economic choices made by the consumers of herd products at Tel Reḥov.

Sheep to Goat Ratio: The sheep to goat ratio in Tel Reḥov is 1.43:1. The relative proportions of the two caprovine taxa are meaningful for the comprehension of herd management strategies (Redding 1981:

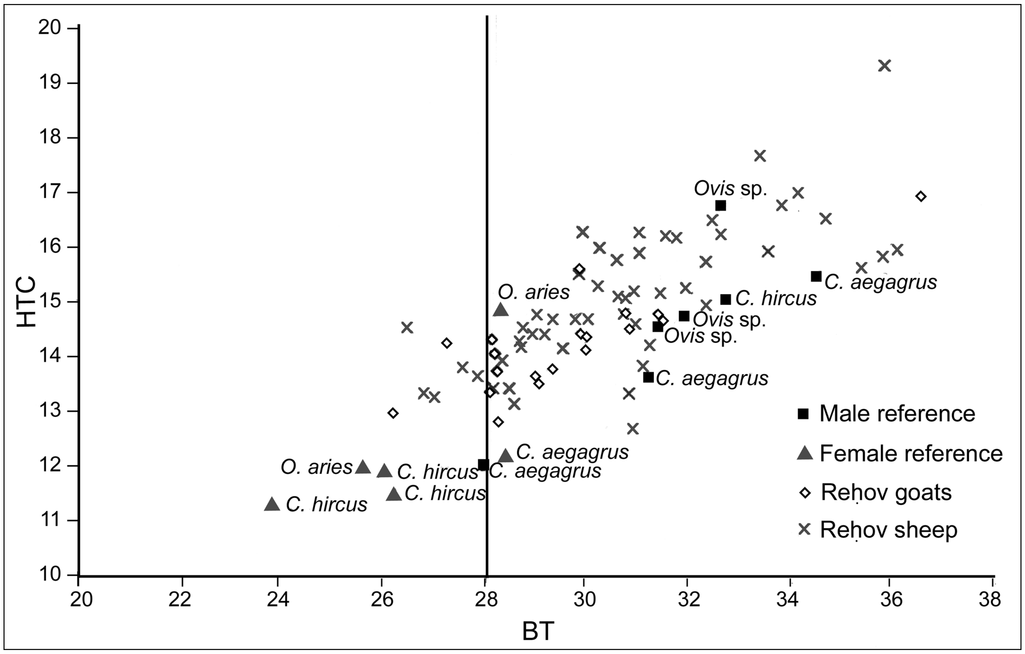

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Fig. 4. Reḥov sheep (N = 52) and goat (N = 19) humerus HTC and BT measurements (in mm), recent male measurements (N = 6), and recent female measurements (N = 6) plotted in relation to the linear classifier calculated based on the recent sample.

234–309). The specific ratio apparent in the Tel Reḥov assemblage is very close to the mean value of 1.37:1 proposed by Redding (1981: 267–68) as an optimal ratio when optimization of herd security is the herders' main management concern in a non-extreme environment. Herd security means holding down fluctuations in herd production caused by changes in environment (e.g., drought, heat) or a calamity that might decimate the herd (e.g., disease). This is attained by keeping a ratio of sheep to goats of 1:1. These two ruminant taxa are somewhat different in their resistance to climatic extremes (goats are better adapted to heat and dryness, and sheep to cold and wet conditions) and to disease (goats are usually more resilient). Facing attritional circumstances that affect the taxa differently, keeping a 1:1 sheep-to-goat ratio will ensure that at least half the herd will have the means to survive. The 1:1 ratio is corrected by Redding in favor of sheep to 1.37:1 to accommodate the faster breeding rate of goats. Therefore, the caprovine herd composition at Tel Reḥov seems to indicate that the animals were utilized to optimize herd security.

Sex Ratio: Measurable distal humeri are abundant in the assemblage (N = 147), and many (N = 71) were easily identified as either sheep or goat. The SVM procedure succeeded in determining a linear classifier that completely segregated male and female humeri from a sample of 11 bones of sexed caprines, which included both wild and domestic sheep and goats. Consequently, measurements of the archaeological sample were classified as male or female based on the classifier for the modern sample. The fact that a perfect classification of males and females was achieved for the reference set, in spite of its taxonomically heterogeneous nature, seems to indicate that the main component of variation in the recent measurements stems from sexual dimorphism, and not genus or species.

Of the 71 distal humeri measurements attributable to either sheep or goats from Reḥov, 44 (62%) were classified as male and 27 (38%) as female (fig. 4). The difference in the relative frequencies of males for sheep (N = 34; 65%) and goats (N = 10; 53%), given the sample size, is non-significant ($\chi^2 = 0.96$, $P = 0.32$).

Horn core morphology differs between males and females, as males often exhibit longer and more robust horns. Only 15 caprovine horn cores were found complete enough for determining sex with confidence, out of which 10 belonged to male individuals (67%) and 5 to females (33%). Since the sample size

TABLE 5. Sex Ratios for Tel Reḥov Caprovines Calculated Using Different Methods

Sexing Method	*Taxon*	*N*	*Male*	*Female*	*% Male*
Humerus measurements (SVM)	Sheep	52	34	18	65
	Goat	19	10	9	53
	Sheep/goat	71	44	27	62
Horn cores	Sheep/goat	15	10	5	67

Note: SVM = support vector machine

is small, and the smaller female horns are less likely to have been preserved in a complete state, this result should be treated with care. However, it still lends strength to the evidence of male dominance in the caprovine herds based on the analysis of humerus measurements.

Two different analyses, then, show the Tel Reḥov caprovine assemblages to have been male-dominated (table 5). Two different lines of inquiry—namely, the difference of sizes of the distal humeri and the morphology of horn cores—seem to show the sex ratio to have been roughly 2:1 in favor of males for the entire caprovine sample, although the representation of the different sexes for goats only is more equal (53% males).

Age Structure: Age structure of caprovine herds may often complement the sheep-to-goat ratio in offering some understanding of the herd maintenance strategy employed by herd-keepers. Herds may be managed to maximize meat, milk, or wool production, or to optimize herd security (Payne 1973; Redding 1981: 234–309). A herd managed to maximize wool production will show an age structure in which older individuals dominate, as these are the main producers of wool. A herd managed to optimize milk production will show a peak in mortality rate in the first six months of life, as young males not needed as breeding stock are slaughtered as soon as the milk yield from their lactating dam is secure (but see Redding 1981: 11–53). A herd managed to optimize meat production will show a peak in the mortality around the end of the second year of life, as the males unnecessary for breeding are slaughtered. Keeping the males to a greater age becomes uneconomical, as their growth begins to slow considerably, and the requirements for grazing, browsing, and labor investment make their maintenance inefficient. A herd managed to optimize herd security will show a mortality pattern very close to that of a herd managed to optimize energy yields (i.e., meat and milk production), as yearling males are kept alive until the next age cohort comes to breeding age, to assure the survival of some male breeding stock in case newborn attrition unpredictably rises for some reason.

Mortality curves based on epiphyseal fusion data for sheep and goat humeri and metapodials, which fuse at the end of the first and second years of life, respectively, show negligible differences between the mortality patterns for these two taxa for the first two years of life (fig. 5). Therefore, a mixed caprovine mortality curve which separates the population into their complete life span was constructed, this time based on lower third molar wear pattern (fig. 6). The construction of the mortality curve based on tooth wear was preferred, since the assemblage seems to have suffered from density-mediated attrition (see below). Teeth are less vulnerable than bones to differential destruction of specimens belonging to juvenile animals, and therefore the bias in favor of adults that may appear in epiphyseal fusion-based mortality profiles was countered to a large degree by this method of demographic profiling. The mortality curve was plotted against theoretical mortality curves for optimizing herd security and maximizing energy yields (Redding 1981: 302, 306). Mortality patterns indicating maximizing milk and wool production did not fit the observed data, as it is apparent that the main peak in attrition was around the end of the second, third, and fourth years of life (see above). The mortality curve typical of wool production shows a plateau between 12 and 84 months of life where no animals are culled. It is difficult to discern to which theoretical mortality curve the observed age distribution of Tel Reḥov caprovines fits best: the energy yield optimization, or the herd security optimization curves. Indeed, these theoretical curves are not statistically distinguishable (Kolmogorov-Smirnov, $D = 0.166$, $P > 0.10$).

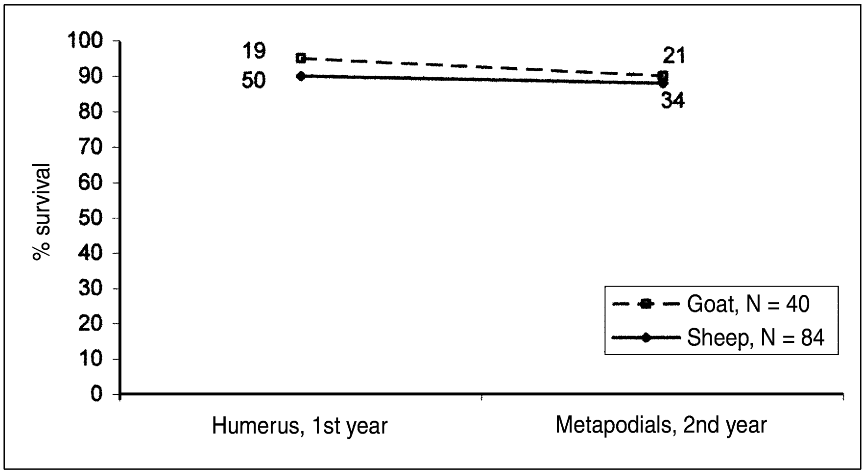

Fig. 5. Separate mortality "curves" for the first and second years of life for sheep and goats, based on distal humeri and metapodials. Numbers near the data points indicate the number of both fused and unfused elements.

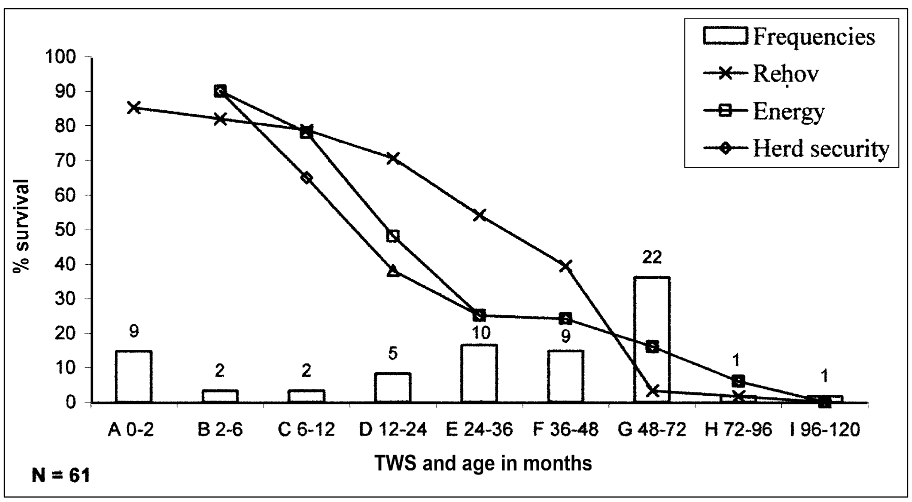

Fig. 6. Caprovine mortality curve based on third molar wear data plotted against the theoretical curves resulting from herd management strategies optimizing energy or herd security (Redding 1981). TWS = tooth wear stage (Payne 1973). Bars show the relative frequency of appearance of each wear stage. Numbers above the bars indicate absolute frequencies.

Mortality for Tel Reḥov caprovine herds, then, seems to have peaked in the second through fourth years of life. This pattern, combined with the dominance of males in the archaeological herd, suggests that most of the mutton supply to Reḥov did not originate in herds kept to optimize wool or milk production, but to a large degree in young males from herds managed to maximize meat yields (cf. Stein's specialized intersite meat exchange curve in Stein 1987: 107), or, should the sheep-to-goat ratio be taken into account, to promote herd security.

Demographic Profiling for Cattle

The demographic profile of the Tel Reḥov cattle herd could be investigated only through the construction of a mortality curve based on epiphyseal fusion data (fig. 7). Sample-size limitation prohibited the

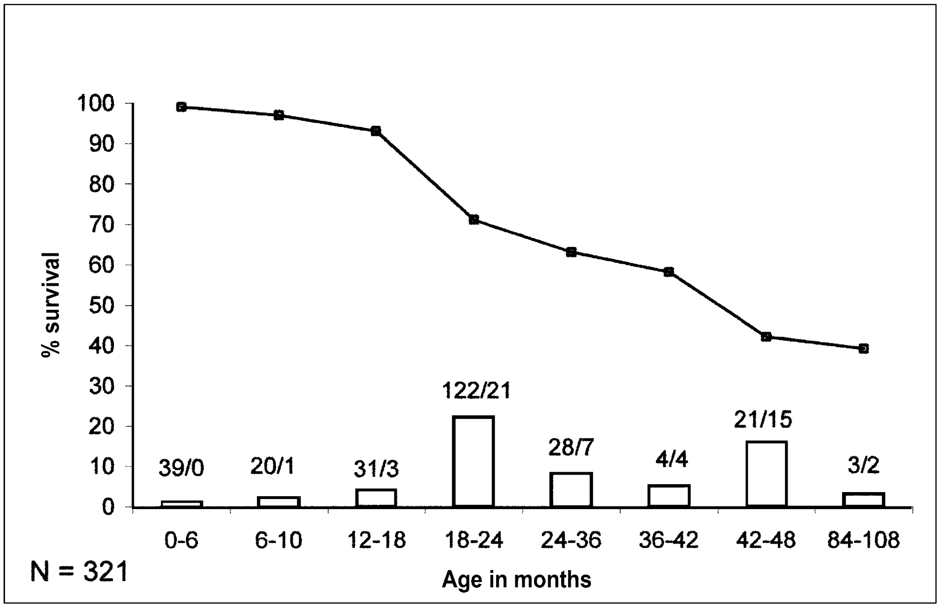

Fig. 7. Cattle mortality curve based on epiphyseal fusion data (Silver 1969). Bars indicate the proportion of fused bones out of the total for each age category. Numbers above the bars indicate the absolute frequencies of fused/unfused bones.

Table 6. Incidences of Pathologies Occurring on Caprovine and Cattle Bones in Tel Reḥov

Caprovines	*N*	*Cattle*	*N*
Mandible	3	Phalanges	13
Phalanges	12	Ribs	5
Tarsals	3	Metapodials	4
Femura	2	Tarsals	1
Humerus	1		
Radius	1		
Pelvis	1		
Vertebra (t)	4		
Rib	2		
Metapodials	3		
N	32		23
NISP	4,347		1,048
%	0.74		2.19
χ^2	17.3	P	< 0.001

construction of such a profile based on tooth wear, and also rendered sexing procedures impractical.

Cattle culling seems to have peaked at the end of the second year of life (70% survival rate) and again during the fourth year (40% survival rate). This is rather similar to the caprovine mortality curve. The later culling of cattle may have at least two possible explanations: (1) calves reach optimal weight for slaughter later in life than lambs or kids; and (2) juvenile cattle were used for work, e.g., traction or plowing. Of course, one can imagine a combination of the two scenarios, in which young cattle were used for work until reaching an optimal weight at which they were slaughtered.

Some indication that cattle were involved in agricultural work may be found in the frequency of pathological alteration of cattle bones at Tel Reḥov (table 6). Pathological cattle bones (N = 23) comprise 2.2% of the entire cattle specimen sample (NISP = 1,048). Most of these pathologies (N = 18; 78%) appear in the feet: metapodials and phalanges. This figure is significantly higher (χ^2 = 17.3, P = 0.001) than the pathology rate for caprovine specimen (N = 32; 0.7%). Caprovine pathologies seem to occur more rarely in the feet (N = 18; 56%), although this could be an artifact of the more balanced frequency of representation of caprovine skeletons at the site (see below). This high rate of pathology in cattle feet may indicate stress injuries and alterations to the bone caused by traction or plowing (Bartosiewicz, Van Neer, and

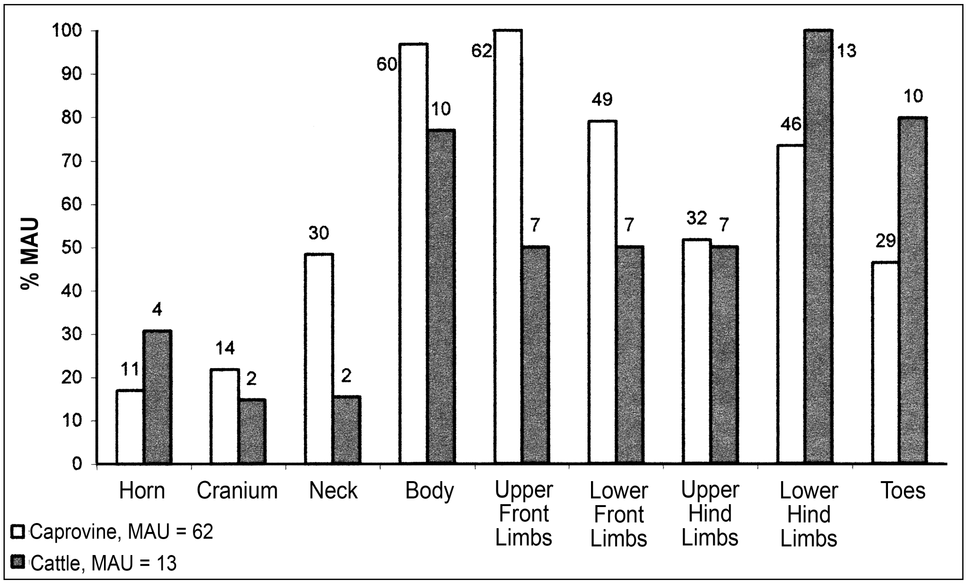

Fig. 8. Representation of the various skeleton portions for cattle and caprovines.

Lentacker 1997: 32–79). A more complete discussion of the pathologies in Tel Reḥov has been published elsewhere (Sapir-Hen et al. 2008).

Butchery

When comparing the body-part representation profile of the entire caprovine assemblage to that of cattle (fig. 8), the general distribution of body portions appears different, as lower hind limbs and toes of cattle are better represented than the rest of the body, and caprovines show a high representation of front limb and trunk parts. The greater representation of feet in cattle may be an artifact of a recovery and/or analytic bias (e.g., Marean and Frey 1997), or a preservation bias caused by differential bone fragmentation of differently sized ungulate taxa (Yeshurun, Marom, and Bar-Oz 2007).

It is important to note that the best-represented caprovine body parts at the site derive from the trunk and the long bones of the limbs. Since the assemblage shows a statistically significant correlation between bone density (Lam, Xingbin, and Pearson 1999) and frequency of representation (Spearman's $R = 0.44$, $P = 0.05$), it is expected that the axis skeleton, which includes the low-density vertebrae and the pelvis, would be underrepresented. This is especially true in comparison with durable elements of the skeleton, i.e., the teeth. The fact that an overrepresentation of trunk elements occurs is taken to underline a strong trend of differential transportation of limb and trunk parts to the domestic quarters of the site.

Upper limb bones and the trunk are the meatier parts of the carcass, as opposed to the feet and the head, which are considered slaughter waste in consumer populations utilizing more nutritious parts of the carcasses only. Such a consumption method may point to the gourmet strategy of meat utilization and is practicable, as the name suggests, for those who can afford to discard the less nutritious parts of the slaughtered animals and buy more expensive cuts of meat.

Butchery marks were found on a relatively high percentage of the caprovine and cattle bones (N = 671; 12%; table 7). These are mainly the traces of carcass dismemberment activities (67% for both cattle and caprovines). Butchery marks resulting from skinning are rare (2% for caprovines and 3% for cattle). Conversely, butchery marks resulting from the filleting of meat from bones are surprisingly numerous on caprovine bones (12%, as compared with 4% for cattle). Figure 9 shows the percentage of butchered specimens out of the total NISP for the different skeleton portions for caprovines and cattle. Intense butchery is evident for both taxa in the upper limbs, as opposed to the lower limbs and toes. The most striking difference between the butchery of cattle and caprovine carcasses is that the mandibles of cattle all

TABLE 7. Frequency of Occurrence of the Various Butchery Marks for Caprovines and Cattle in Tel Reḥov

	Caprovine		*Bos*		*Total*	
	N	%	N	%	N	%
Severing the head	2	0	0	0	2	0
Skinning	9	2	8	3	17	3
Dismemberment	296	67	154	67	450	67
Filleting	51	12	10	4	61	9
Hanging	1	0	0	0	1	0
Other	82	19	58	25	140	21
Total	441	100	230	99	671	100

Source: Cut-mark typology follows Binford (1981).
Note: Percentages are of the total number of butchered specimen.

show butchery marks on the ascending ramus (N = 31; 100% of NISP for this element). It is proposed that this is the result of the dismemberment of the lower jaw in order to remove the tongue. Bones of dogs (N = 3), fallow deer (N = 1), ass (N=1), gazelle (N = 3), pigs (N = 21), and camel (N = 1) exhibit butchery marks resulting from carcass dismemberment, providing evidence for the actual consumption of these taxa.

DISCUSSION

The faunal assemblage from the ninth and tenth centuries in Tel Reḥov reflects an animal economy relying largely on the utilization of sheep, goats and cattle, with occasional consumption of game: boar, deer, and gazelle. Dogs, asses, and camels were also eaten by the inhabitants of the site, based on the observation of butchery marks on specimens of these taxa.

Pig remains are held to represent wild boar, and not domesticated pigs, based on the body-size criterion and the relative rarity of suid remains in the assemblage (< 5%), which were evenly distributed in the site. The presence of wild boar remains in the domestic quarters of the Iron Age city has two implications: first, that pork was considered edible by some of the residents of the site, which may be a basis for future studies of ethnicity in this period; and second, that wild-boar hunting was practiced. Wild-boar hunting was a sport for the elites, as taking down this ferocious, tough, and dangerous animal required a measure of skill, cooperation, and specialized equipment (e.g., Cartmill 1993: 62–75). Dogs were probably needed as well to flush this nocturnal animal from its daytime hiding places in thickets.

The decline in the abundance of pigs from Iron Age IB to Iron Age IIA demands an explanation, although at this stage only tentative guesses may be proposed. One possible reason may be that consistent hunting reduced the wild boar population to a point where encounters would have been rare. A second possible explanation is that the elite practice of boar-hunting declined, maybe due to the influence of spreading Israelite religious/cultural norms.

Caprovine exploitation practices offer a rare glimpse into Iron Age II economy. The sheep and goat bones found at the site appear to have been mainly limb and axis skeleton elements of juvenile males, from herds managed in a way meant to optimize herd security. Body-part representation, marked by infrequent occurrence of low-utility skeleton parts, suggests that butchery was carried out away from the domestic quarters, which enjoyed relatively high-quality meat portions. The high frequency of young males (i.e., those of market age in premodern agro-economies; see Stein 1987: fig. 6) suggests that the older portion of the herd, mainly old females past their breeding optimum, was consumed elsewhere.

It is proposed that while the residents of the domestic quarters of the city subsisted mainly on gourmet portions—high-quality meat from young animals—lower-quality meat from the older females of the herd was generally consumed by a different segment of the economic system. Most probably, these were the herd-keepers who designated the better meat animals for marketing.

The existence of a separate pastoralist component in the agricultural economic system is a common feature in the Near East. Sheep and goats are generally herded away from the fields of an agricultural community during the growth seasons, only approaching the settlement to graze on stubble and gain access to permanent water sources near the settlement in the hottest summer months (Redding 1981: 53–80; Köhler-Rollefson 1992). Therefore, herders and their flocks are usually spatially separated from the main settlement. Some authors propose that this spatial segmentation of agropastoral society dates back to the end of the Pre-Pottery Neolithic (e.g., Köhler-Rollefson 1988; Rollefson and Köhler-Rollefson 1993). It may be suggested that the winter pasture for the herds was in the nearby Gilboa region, which is topographically unsuitable for agriculture.

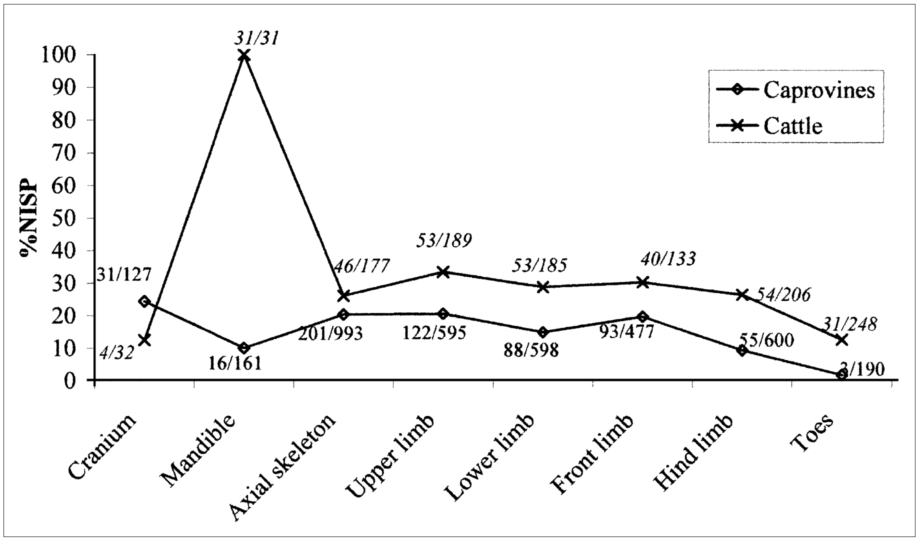

Fig. 9. Absolute and relative frequencies of butchered NISP out of the total NISP for each of the various skeleton portions of caprovines and cattle. Data point labels in italics denote the cattle serie.

The caprovine utilization pattern at Tel Reḥov is indirect evidence of the existence of producers and consumers in Iron Age II society, as well as of the existence of pastoralists who provided herd products to the city's population (see also Wapnish 1993: 434; Hesse and Wapnish 2002). The exact nature and organization of the pastoralists cannot be ascertained, as pastoralism may take many forms (Khazanov 1984: 1–17; Bar-Yosef and Khazanov 1992: 1–10), ranging from "pure" pastoral nomads who subsist solely on their animals, to very limited village-based transhumance, practiced by the same group tending the agricultural production (Khazanov 1984: 1–17). Direct evidence for the existence of pastoralists is known in this period only in the southern desert regions (Shahack-Gross and Finkelstein 2008), in large part due to the difficulty involved in identifying ephemeral pastoralist sites in the archaeological record. It is therefore impossible to determine whether the herds that supplied Rehov were kept by nomads, or (maybe more parsimoniously) by nearby villagers practicing some limited form of seasonal transhumance.

The high-quality meat consumed on the site is evidence of the affluent status of its occupants, who could afford gourmet portions of meat, unlike the proposed pastoral group which subsisted on the "leftovers," either poor-quality meat portions or the flesh of older animals. The circulation of animals in Iron Age economic systems was previously reported for Tell Jemmeh in the Assyrian period, where demographic evidence for the export of meat animals was detected, probably for the benefit of the Assyrian garrison or government (Wapnish 1993: 437–39). Hesse's (1986) paper on the fauna shows Iron Age Tel Miqne-Ekron to have been a consumer site. The profound discussion in Hesse's paper claims that the abundant animals of market age in Iron Age Tel Miqne-Ekron show the site to have been a consumer of animal goods from markets found elsewhere. The example of Tel Miqne-Ekron resembles the pattern observed in Tel Reḥov, although in the latter there is evidence of the marketing of gourmet portions of male animals, as well as evidence from the general mortality profiles. This standardization of the age and the sex of the animals consumed, and also of the portions consumed at the site, leads to the interpretation of the animal economy at Reḥov as a consumer site sensu stricto (Zeder 1991: 36–44), which is a rare phenomenon in Iron Age Israel (cf. Raban-Gerstel et al. 2008: 48).

The cattle, however, seem to have been slaughtered on site, based on the body-part distribution showing a high proportion of slaughter waste parts, i.e., feet. The high frequency of pathological incidences in foot bones seems to indicate utilization in agricultural activities. Thus, it is suggested that cattle was raised on site for use in agricultural chores, i.e., traction, and then consumed on a local basis. Even here, a gourmet strategy of butchery seems to have been practiced, as the preferentially frequent dismemberment of the lower jaw for the removal of the tongue seems to indicate.

The question of the socioeconomic standing of the residents of Tel Reḥov during the Iron Age was tackled using a simple model of gourmet consumption strategy. The premises of the model are straightforward: wealthier people can afford to consume better cuts of meat. The measurement of the quality of meat consumed in the domestic quarters of the site was based on two data sets: the portions of the animals that were brought to the houses, and the age and sex of the animals from which these portions were derived. Meatier portions from younger animals are considered to have been more desirable. These expectations were then tested, using quantitative and taphonomic analyses which supported the hypothesis that such a gourmet strategy was practiced at the site. This strongly suggests that Iron Age Reḥov harbored an elite stratum of society, able to indulge in gourmet portions of prime aged animals for its sustenance. Hunting wild boar, an endeavor requiring a certain savoir faire and equipment, provides another tell-tale marker for a luxurious diet (Ervynck et al. 2003: 429) and a taste for hunting as sport.

The indications of a strong and affluent consumer society in the tenth and ninth centuries B.C.E. Levant are, to the best of our knowledge, unique and expressly underline the value of detailed zooarchaeological inquiry in the study of Iron Age society and economy. Such an inquiry should be based on simple and robust models which generate falsifiable hypotheses which can be tested using multiple lines of evidence. Such models exist, as do the quantitative and taphonomic methods to test them. Wide application of robust methodology and rigorous hypothesis testing, using the quantitative analysis of large zooarchaeological data sets, would surely assist the ongoing research of the Iron Age of the southern Levant.

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