

ARCHAEOZOOLOGY OF THE NEAR EAST VI

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archaeozoology of southwestern Asia and adjacent areas

edited by

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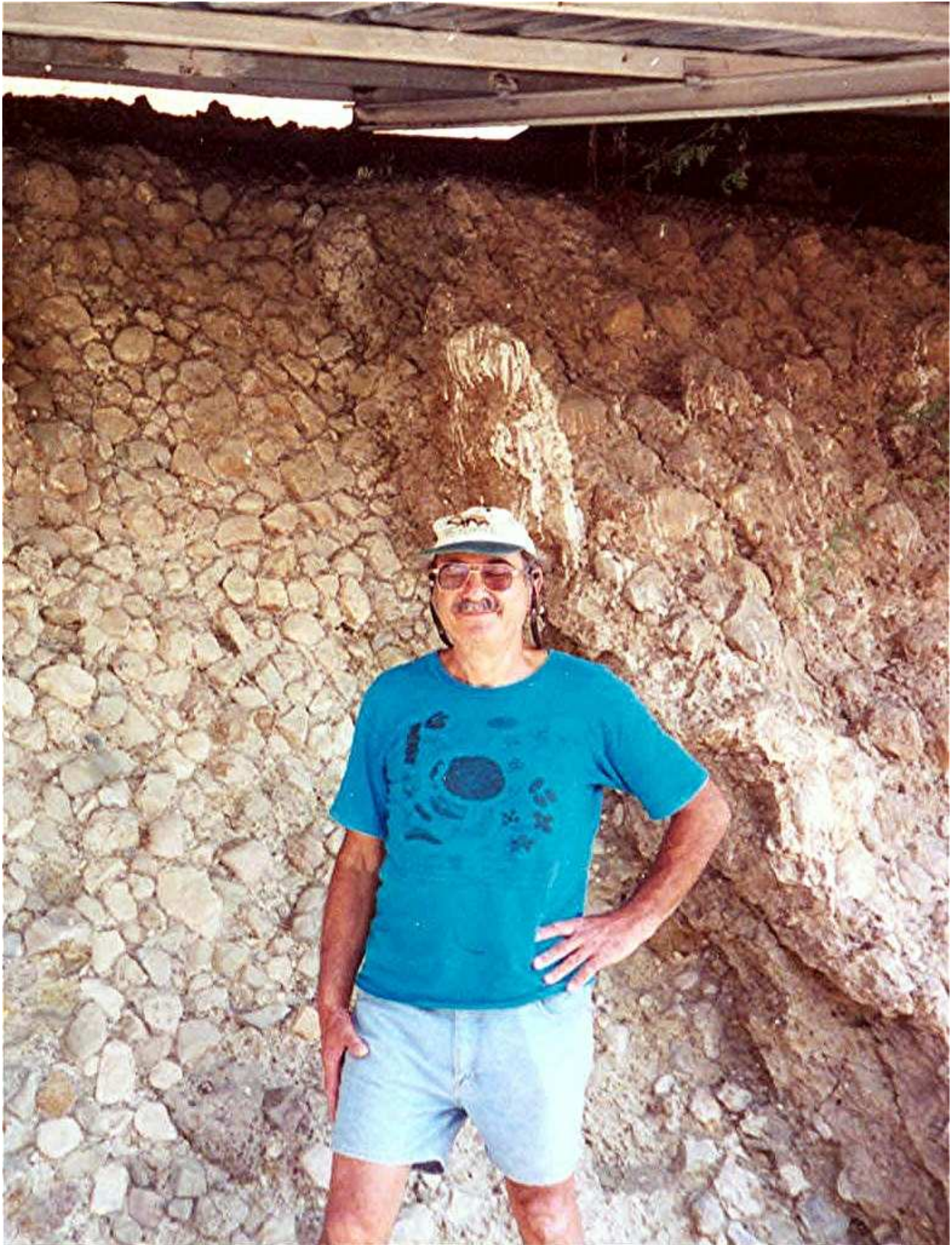
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Prof.Dr. Eitan Tchernov

This volume is dedicated to the memory of Prof. Dr. Eitan Tchernov, in fond memory of his enthusiasm and support to many in the field of archaeozoology.

Preface

The ASWA VI meeting was held at the Institute of Archaeology, University College London, from 30th August-1st September 2002, timetabled to follow on the heels of the ICAZ meeting in Durham, UK. Over 55 participants attended the meeting, travelling from 13 countries, bringing the latest research results from our field. As usual, it was a pleasure to see so many doctoral students presenting their research – a sign for a very healthy future for zooarchaeology in south west Asia. It is still unfortunate, however, that colleagues from some Middle Eastern countries were unable to attend due to financial and political constraints.

Presentations were organized into the following six themes, which highlight the scope of the ASWA membership: Animals in Palaeolithic and Epipalaeolithic Levant; Neolithic Patterns of Animal Use; Animals in Neolithic Anatolia; Animals in the Chalcolithic and Bronze Ages; Iron Age, Nabatean and Roman Patterns of Animal Use; Animals in Ancient Egypt. There was also a poster session, and contributors were invited to submit papers to this volume.

As always with the ASWA forum, the meeting served to welcome new scholars to the group, but was also very much a reunion of old friends and colleagues who have been sharing new information and discussing issues of joint interest for many years now. In this vein, it is a great sadness that ASWA VI was the last international meeting attended by Prof. Eitan Tchernov, an original founder of the group and mentor and inspiration to so many. For many of us, it was the last time we saw Eitan, and experienced his usual incisive comment, unstoppable enthusiasm for the subject, and warm friendship. He will be greatly missed.

ASWA VI was supported by the Institute of Archaeology, UCL, who provided facilities and financial and administrative help. In particular, the organizing team was aided greatly by the administrative assistance of Jo Dullaghan at the Institute. ARC bv (Archaeological Research and Consultancy, Groningen, The Netherlands) once again shouldered the finances of the publication of the proceedings, and we are extremely grateful for their continuing support. Many thanks are also due to the post-graduate student helpers from the Institute of Archaeology who made the meeting run so smoothly: Banu Aydinoğlugil, Jenny Bredenberg, Chiori Kitagawa, Peter Popkin, and Chris Mosseri-Marlio (who also produced the logo reproduced on the frontispiece of this volume).

Many thanks to all the participants for making the meeting such a success!

Louise Martin
London 2005



Participants of the 6th ASWA Conference, held at the Institute of Archaeology, University College London.

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ECONOMIC STRATEGIES AND THE ROLE OF CATTLE IN THE SOUTHERN LEVANT IN THE BRONZE AND IRON AGE

Aharon Sasson¹

Abstract

Cattle have been utilized for draught from ancient times to the present day. Cattle frequencies were studied for 70 sites and strata, mainly in Israel. The underlying principle behind the low frequency of cattle (up to 15%) found at many sites was the necessity to maintain a balance between two primary demands: risk minimization and preservation of natural resources (water, pasturage) on one hand and the demand for cattle as draught animals on the other hand. This equilibrium was referred here as the survival subsistence strategy.

Résumé

Les bétail ont utilisé pour l'ébauche des périodes antiques à aujourd'hui. Fréquences ont été étudiées pour 70 emplacements et strates, principalement dedans l'Israel. Le principe fondamental derrière le basse fréquence des bétail (jusqu'à 15%) a trouvé à beaucoup d'emplacements était le nécessité pour maintenir un équilibre entre deux demandes primaires: minimisation de risque et conservation des ressources naturelles (l'eau, pasturage) d'une part et demande des bétail comme animaux de trait d'autre part. Ceci équilibre était référé ici qu'une stratégie de subsistance de survivance .

Keywords: Cattle, Economy, Iron Age, Beer-Sheba, Israel.

Mots clés: Bétail, Économie, Âge du Fer, Beer-Sheba, Israel.

Introduction

Excavations at Tel Beer-Sheba took place in the 1970s. Today, some 30 years later, the major results from this Iron Age II site are about to be published, including the zooarchaeological analysis of stratum II.

Tel Beer-Sheba is located on the northern margins of the Negev desert. The Beer-Sheba region is situated exactly on the isohyets of 200 mm annual rainfall (Fig. 1). This line divides the land of Israel into two major climatic regions - the Mediterranean region to the north and the desert region to the south.

Nine Iron Age strata were excavated at Tel Beer-Sheba. The archaeological data reveal that the site was occupied from the 12th to the 7th century B.C.E. (Aharoni 1973a; Herzog 1993).

In the Iron Age I period the site was a small village but by the time of the Iron Age II strata, Beer-Sheba had developed into an urban settlement (Aharoni 1973b). Stratum II, which was occupied in the 8th century B.C.E., constitutes the last urban phase. Two thirds of this stratum have been excavated and a good picture of an Iron Age II town has emerged. Stratum II reveals Beer-Sheba to have been a planned town extending over 11 dunams, encompassing 75 houses, radial streets, storage houses, a water system and a large city wall (Herzog 1993, Fig. 2). The town of Beer-Sheba was destroyed, at the end of the 8th century B.C.E., probably during Sennacherib's campaign.

About 200 loci have provided more than ten thousand bones for analysis. Forty percent of the assemblage has been identified to skeletal part and species, while 60% could only be identified to the level of group size (Table 1).

Caprinae and cattle comprise over 95% of the assemblage. The ratio of caprinae to cattle was calculated using three different methods: MNI, NISP (Reitz and Wing 1999: 191-202; Grayson 1984: 17-34) and Relative Frequency (see Hesse and Wapnish 1985: 115-116). Table 1 shows that all three methods of calculating species frequencies produce similar results obtained by all three counting methods.

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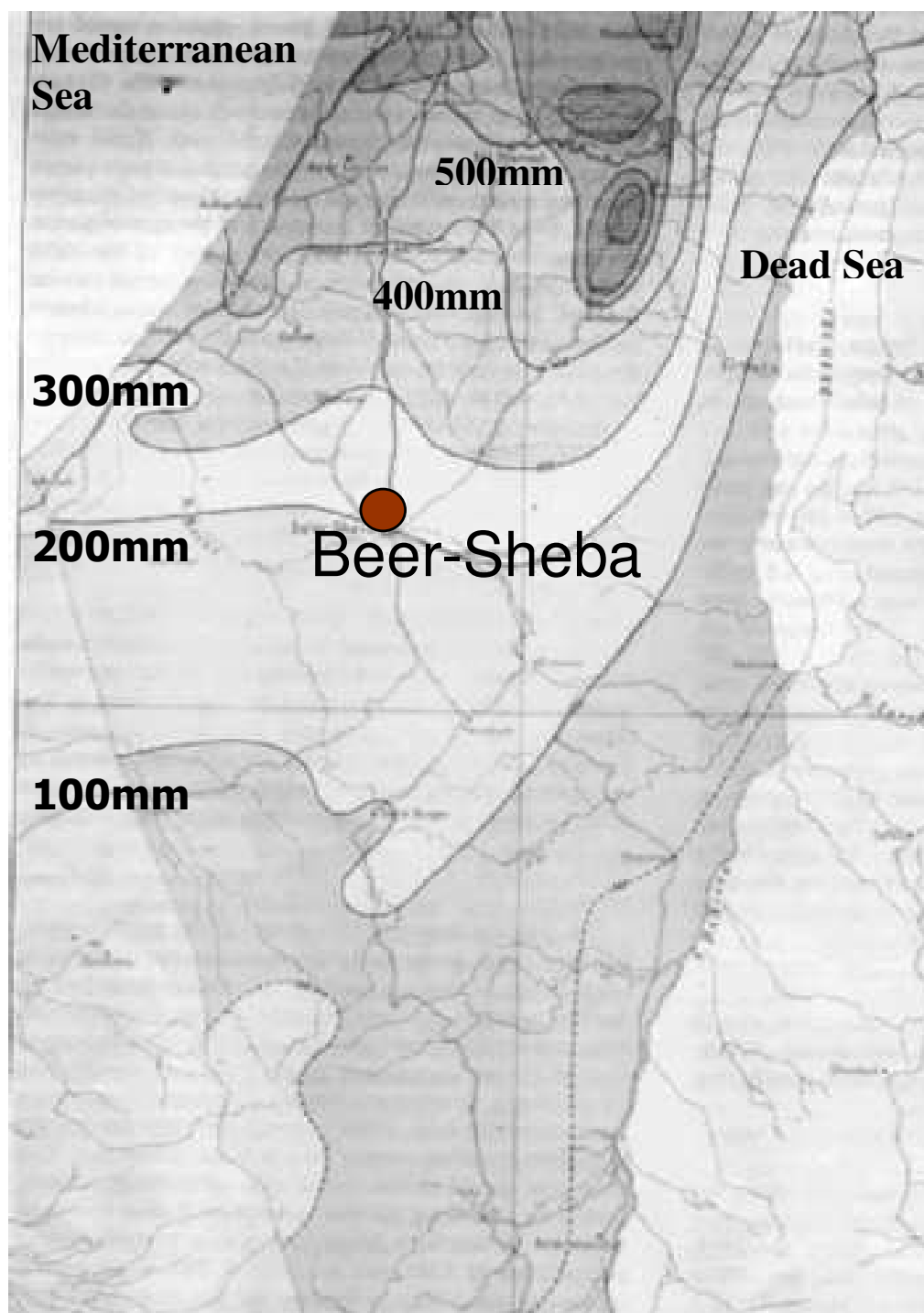


Fig. 1. Tel Beer-Sheba location and map of mean annual rainfall 1931-1960 in Israel (from Atlas of Israel 1970a).

Table 1. Ratio of Caprinae to Cattle in Stratum II, as obtained from three different methods of calculation.

Species	RF		NISP		MNI	
	#	%	#	%	#	%
Caprine	60.2	85	3512	86	66	85
Cattle	10.9	15	568	14	12	15
Caprine + Medium mammal			9466	91.5		
Cattle + Large mammal			886	8.5		

The relative frequency of cattle and early economic strategies

At first glance, these results are not surprising. A frequency of 15% cattle is common at many ancient sites (Buitenhuis 1990) as well as at pre-modern villages in Israel (Sasson 1998; Sasson in press). However, as already noted, Beer-Sheba is located on an aridity isohyet (Fig. 1). Cattle breeding in this region would have represented a complicated and precarious investment for the people living there since cattle require extensive grazing and plentiful water resources (Dahl and Hjort 1976: 239-243; Clutton-Brock 1987: 68; Halstead 1995: 12; Russell 1988: 57-59; Stol 1995: 195).

A review of ethnographic literature on the Bedouin living near Beer-Sheba and in the Negev desert regions in the twentieth century revealed the three most common livestock species bred by Bedouin to be sheep, goats and camels (Ashkenazi 1957; Marx 1967: 20; Ben David 1982: 122-124; Abu Rabia 1994: 107-110, table 2). Aref el Aref, governor of the Beer-Sheba district in the 1930s, noted that the Bedouin tribes possessed 80,000 head of caprinae and 15,000 camels (El-Aref 1944: 190). Cattle are not mentioned in his descriptions (Table 2)

Table 2. Livestock holdings among the Negev Bedouin (Israel) in the twentieth century.

Year / Decade	Caprine	Camel	Mule	Cattle	Reference
1930's	80,000	15,000		-	El-Aref 1944
1954	7,000	1,300	2300	-	Ashkenazi 1957
Early 1960's	70,000	10,000		-	Marx 1967
End 1970's	+	+		-	Ben David 1982
Middle 1980's	+	+		-	Abu Rabia 1994

What then is the reason for the abundance of cattle bones found on Bronze and Iron Age sites in the Negev versus their absence among the Bedouin in pre-modern times? This question will be answered by positing the existence of an economic strategy termed here “the survival subsistence strategy”. In this approach, the subsistence strategy of an ordinary household in Bronze and Iron Age times was first and foremost that of survivorship. This strategy contrasts with that of the market economy which could be described as a specialized economy aiming at surplus production in order to expand flock size or territory and to gain wealth or political power. The goals of survivorship, on the other hand, were to maintain flock and territorial size at an optimal level in order to satisfy family requirements but not beyond that point (Ingold 1980: 134-140). Redding describes this approach as follows:

‘...one of the strongest selective pressures operating on human behavior is, and has been, for minimizing fluctuations in the resource base, or maximizing subsistence security’ (Redding 1993: 80).

Halstead and O'Shea (1989: 6) note that:

‘...cultural mechanisms for coping with scarcity play central role in the maintenance and transformation of human societies...’

Survivorship was a long-term strategy. Decisions regarding the relative frequency of species to be bred as well as flock composition or size were not taken based on current conditions but with respect to the harsh years. These decisions are critical for herd survival and consequently to the household survival (see also Sasson forthcoming). Binford (2001: 175) notes in his inspiring book:

‘...the amount of food that is available during the least productive period of the year will limit the level of sustainable population within an area...’

If the survival strategy is acknowledged as a significant factor in species composition, the relative abundance of cattle bones on ancient sites and their absence among the Bedouin in modern times can be explained. We should assume that the principal exploitation of cattle in most Bronze and Iron Age sites was as draught animals rather than for meat or milk consumption. In other words, if cattle had not been essential for ploughing and cereal production their remains would have been found in those sites in considerable lower frequencies (for different approach see Grigson 1995). Avitsur that studied ancient traditional crafts in Israel, contends that the main role for cows was to ‘produce’ new generations of bulls and oxen for labor.

Cows were also utilized to work as replacement for bulls, with meat and milk production merely of secondary importance (Avitsur 1965: 27 see also Clutton-Brock 1987: 62). Stol that examined Old Babylonian texts, comments that cattle were not appreciated for their meat or milk but rather for their draught power (Stol 1995: 184).

Hence, the absence of cattle among the Negev Bedouin in modern and pre-modern times is interpreted in light of the survival subsistence strategy. Cattle were displaced by camels (Avitsur

1976: 19) that is better adapted to transport and labor in arid zones than cattle (Dahl and Hjort 1976: 241-244; Clutton-Brock 1987: 124-125; El-Aref 1944: 175-180).

Data and methods

The relative frequency of cattle bones at 70 sites and strata (mainly in Israel) was examined in order to reevaluate the role of cattle in ancient times in light of the survival subsistence strategy. Most of the sites date to the Bronze and Iron ages and others to the Persian, Roman and Islamic periods. The frequency of cattle was calculated in percentages by dividing the NISP values for cattle bones by the total NISP values of caprinae and cattle bones. A cattle mortality profile was constructed as well from those sites that provided relevant data. A site in which the majority of cattle died as mature beasts is marked with an “A” (Tables 7, 8, 9).

Data from ethnographic sources on the relative frequency of cattle in pre-modern times have also been applied, taken from:

- A detailed animal census carried out in 1943 by the British Mandatory Government of Palestine (Government of Palestine 1943);
- An animal census carried out by LaBianca’s team in the village of Hesban in Jordan in 1970 (LaBianca 1995b).

The figures in both censuses are in numbers of individual animals and do not refer to bones.

Cattle frequency in the Beer-Sheba strata

In the first phase of work, all strata of Tel Beer-Sheba were examined (Table 3). Cattle frequency have not changed significantly during the twelve hundred years of occupation of the site. It is striking that even though the site characterization varied throughout time, from a small village to a fortified town and later to a fortress and a palace (Herzog 1993), the frequency of cattle remained considerably low, ranging between 8 to 16 percent (11% on average).

Table 3. Cattle frequencies within Tel Beer-Sheba strata

Stratum	Date	Type of Settlement	Count	Caprine	Cattle	Total	Cattle in %	
Beer-Sheba IX	Iron Age I	Rural	<i>NISP</i>	303	28	331	8	
			MNI	14	4	18	22	
Beer-Sheba VIII		Rural	<i>NISP</i>	144	21	165	13	
			MNI	16	4	20	20	
Beer-Sheba VII		Rural	<i>NISP</i>	822	88	910	10	
			MNI	27	7	34	21	
Beer-Sheba VI		Rural	<i>NISP</i>	788	147	935	16	
			MNI	28	6	34	18	
Beer-Sheba V		Iron Age II	Urban	<i>NISP</i>	4252	566	4818	12
				MNI	62	7	69	10
Beer-Sheba IV	Urban		<i>NISP</i>	1617	279	1896	15	
			MNI	20	6	26	23	
Beer-Sheba III	Urban		<i>NISP</i>	1287	183	1470	12	
			MNI	21	4	25	16	
Beer-Sheba II	Urban		<i>NISP</i>	3512	568	4080	14	
			MNI	66	12	78	15	
Beer-Sheba H 3	Persian		Fortress	<i>NISP</i>	3976	366	4342	8
				MNI	45	5	50	10
Beer-Sheba H 2	Hellenistic-Roman	Fortress	<i>NISP</i>	1298	131	1429	9	
			MNI	20	3	23	13	
Beer-Sheba H 1	Early Roman	Palace	<i>NISP</i>	1111	95	1206	8	
			MNI	21	4	25	16	
<i>NISP Average</i>							11	
MNI Average							17	

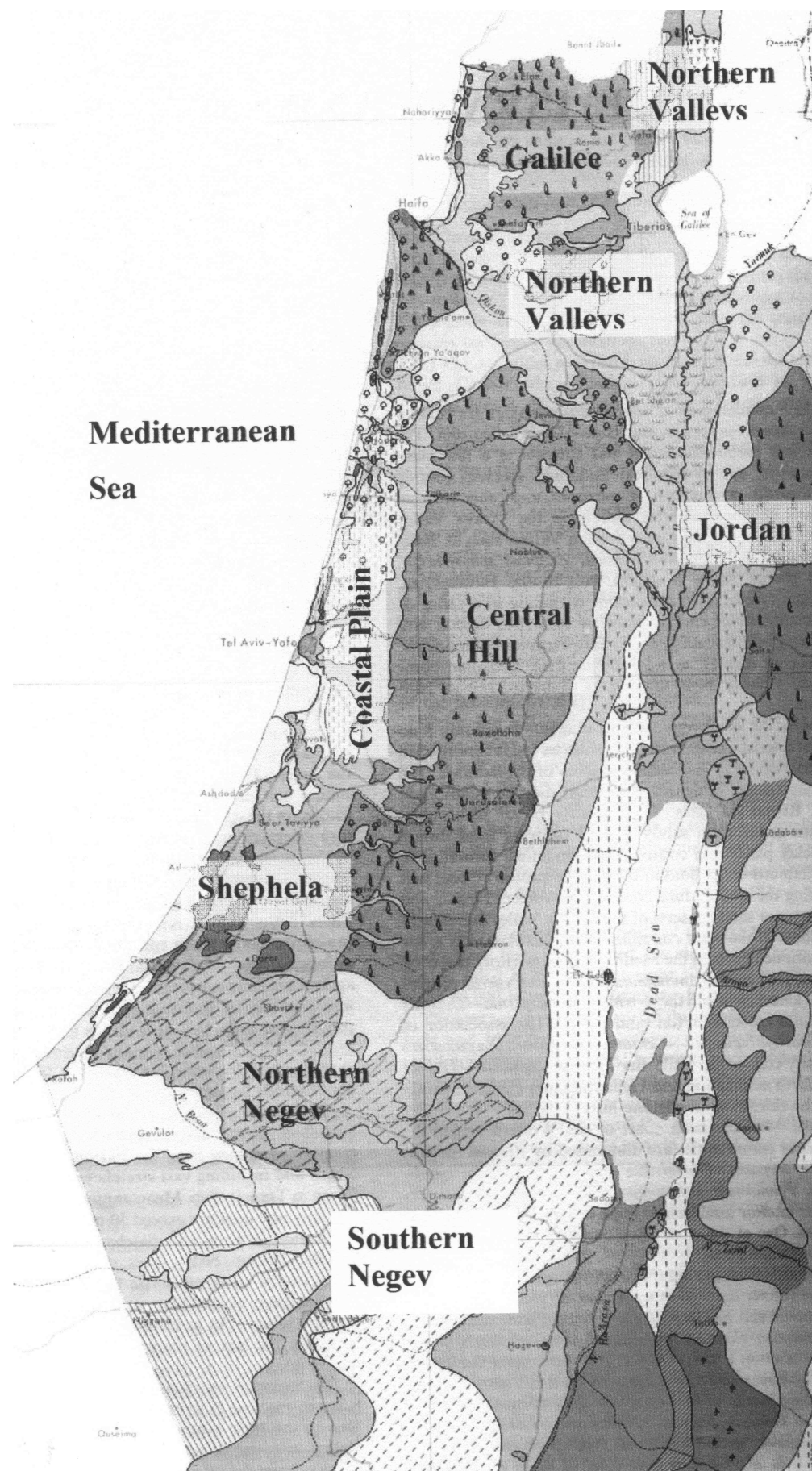


Fig. 2. Geographical regions in Israel (from Atlas of Israel 1970b).

Cattle frequencies in the Northern Negev

In the second phase, Northern Negev region sites were examined including Tel Beer-Sheba (Table 4, Fig. 2). Zooarchaeological data from ancient Hesban (LaBianca 1990; 1995a) and data from the animal census taken there (LaBianca 1995b) were studied as well. Cattle frequency, as presented in Table 3 ranges from 0% to 17% (except for Tel Masos with cattle frequency of 24%), with an average of 10%. These figures do not vary dramatically regardless of period (Early and Late Bronze Age, Iron Age, Roman and Islamic periods) or type of settlement (rural, fortress or urban). Interestingly, in addition to the animal census, LaBianca's team collected bones in the area of the village. They collected 510 bones of cattle and caprinae of which cattle comprised 6.4% of the total (LaBianca 1995b: 29-31) whereas in the animal census, cattle comprised only 4% (Table 4). Hence, bone collecting created a bias in the proportion of cattle compared to actual data from the animal census (LaBianca 1995b: 22-23).

Table 4. Frequency of cattle at sites in the Northern Negev sites and Hesban (Jordan).

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Reference
Beer-Sheba II	IA II	Northern Negev	Urban	14	Sasson, this publication
Beer-Sheba IX-VI	IA I	Northern Negev	Rural	14	Hellwing 1984
Halif	EB III	Northern Negev	Urban	6	Zeder 1990
Halif	LB	Northern Negev	Urban	16	Zeder 1990
Halif	IA II	Northern Negev	Urban	15	Zeder 1990
Hesban	1970	Jordan	Rural	4	LaBianca 1995b
Hesban II-III	Mamluk	Jordan	Rural	14	LaBianca 1990, 1995a
Hesban XI-XIV	Roman	Jordan	Rural	11	LaBianca 1990, 1995a
Hesban XV-XVII	IA II	Jordan	Rural	9	LaBianca 1990, 1995a
Hesban XVII-XXI	IA I	Jordan	Rural	17	LaBianca 1990, 1995a
Nahal Besor	Islamic	Northern Negev	Rural	0	Nachlieli 1999
Nahal Omer	Islamic	Northern Negev	Rural	0	Nachlieli 1999
Masos	IA I	Northern Negev	Rural	24	Tchernov-Drori 1983
Uza	IA II	Northern Negev	Fortress	7	Sade 1988
Ira	IA II	Northern Negev	Urban	11	Dayan+Horwitz 1999
Arad	EB	Northern Negev	Urban	7	Davis 1978 Davis 1976,
Arad VI-XII	IA II	Northern Negev	Fortress	9	Sade 1988
Qitmit	IA II	Northern Negev	Ritual	7	Horwitz-Raphael 1995
Average				10	

Table 5. Cattle frequency in urban sites.

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Reference
Halif	EB III	Northern Negev	Urban	6	Zeder 1990
Uza	IA II	Northern Negev	Fortress	7	Sade 1988
Arad	EB	Northern Negev	Urban	7	Davis 1976, Lernau 1978
Arad VI-XII	IA II	Northern Negev	Fortress	9	Sade 1988
Yarmouth	EB	Central Hill	Urban	11	Davis 1988
Ira	IA II	Northern Negev	Urban	11	Dayan and Horwitz 1999
Lachish VIII	MB	Shephelah	Urban	12	Drori 1979
Shiloh	MB II-III	Central Hill	Urban	12	Hellwing 1993
Beer-Sheba II	IA II	Northern Negev	Urban	14	Sasson, here
Halif	IA II	Northern Negev	Urban	15	Zeder 1990
City of David	IA II	Central Hill	Urban	15	Horwitz 1996a
Halif	LB	Northern Negev	Urban	16	Zeder 1990
Average				11	
Megiddo	EB I	Northern Valleys	Urban	19	Wapnish-Hesse 2000
Lachish III-IV	IA II	Shephelah	Urban	21	Drori 1979
Dalit	EB II	Shephelah	Urban	24	Horwitz et al 1999
Kabri	IA II	Coastal Plain	Fortress	25	Horwitz 2002
Megiddo	EB III	Northern Valleys	Urban	25	Wapnish-Hesse 2000
Miqne	IA II	Shephelah	Urban	27	Lev-Tov 2000
Miqne	LB	Shephelah	Urban	29	Lev-Tov 2000
City of David	Roman	Central Hill	Urban	29	Horwitz 1996a
Harasim Ivb	IA II	Shephelah	Urban	30	Maher 1999
Lachish VI	LB	Shephelah	Urban	30	Drori 1979
Kinrot	EB	Northern Valleys	Urban ?	32	Hellwing 1988/9
Kinrot	LB	Northern Valleys	Urban ?	32	Hellwing 1988/9
Harasim Ivd	IA II	Shephelah	Urban	34	Maher 1988
Aphek	MB II	Coastal Plain	Urban	40	Hellwing-Gophna 1984
Dan (Tel)	EB II-III	Northern Valleys	Urban	42	Wapnish-Hesse 1991
Kabri	EB	Coastal Plain	Urban ?	44	Horwitz 2002
Gerisa	LB I-II	Coastal Plain	Urban	55	Sade 2001
Miqne	IA I	Shephelah	Urban	56	Lev-Tov 2000
Average				33	

Table 6. Cattle frequencies at rural sites.

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Reference
Avnon	MB I	Southern Negev	Rural	0	Hakker-Orion 1999
Eilot	Islamic	Southern Negev	Rural	0	Horwitz 1998
anah'Nahal La	Islamic	Southern Negev	Rural	0	Nachlieli 1999
Nahal Mitnan	Islamic	Southern Negev	Rural	0	Horwitz 1995
Ein Ziq	MB I	Southern Negev	Rural	0	Hakker-Orion 1999
Nahal Besor	Islamic	Northern Negev	Rural	0	Nachlieli 1999
Nahal Omer	Islamic	Northern Negev	Rural	0	Nachlieli 1999
Be'er Resisim	MB I	Southern Negev	Rural	1	Hakker-Orion 1999
Hesban	1970	Jordan	Rural	4	LaBianca 1995b
Shiloh	LB	Central Hill	Rural	9	Hellwing 1993
Hesban XV-XVII	IA II	Jordan	Rural	9	LaBianca 1990+1995a
City of David	IA I	Central Hill	Rural	10	Horwitz 1996a
Hebron (District)	1943	Central Hill	Rural	11	Gov. Of Palestine 1943
Hesban XI-XIV	Roman	Jordan	Rural	11	LaBianca 1990+1995a
Hesban II-III	Mamluk	Jordan	Rural	14	LaBianca 1990+1995a
Qasile	IA I	Coastal Plain	Rural	14	Davis 1985
Beer-Sheba IX-VI	IA I	Northern Negev	Rural	14	Hellwing 1984
Qiri	IA II	Northern Valleys	Rural	15	Davis 1987b
Ai - Raddana	IA I	Central Hill	Rural	17	Hesse 1999
Hesban XVIII-XXI	IA I	Jordan	Rural	17	LaBianca 1990+1995a
Average				7	
Shiloh	IA I	Central Hill	Rural	23	Hellwing 1993
Yaqush	EB I	Northern Valleys	Rural	23	Hesse-Wapnish 2001
Masos	IA I	Northern Negev	Rural	24	Tchernov-Drori 1983
Yaqush	EB II	Northern Valleys	Rural	24	Hesse-Wapnish 2001
Gaza (District)	1943	Coastal Plain	Rural	26	Gov. Of Palestine 1943
Sefad (District)	1943	Galilee	Rural	27	Gov. Of Palestine 1943
Michal	IA	Coastal Plain	Rural	34	Hellwing-Feig 1989
Yaqush	EB III	Northern Valleys	Rural	34	Hesse-Wapnish 2001
Michal	Persian	Coastal Plain	Rural	39	Hellwing-Feig 1989
Izbet Zarta	IA	Coastal Plain	Rural	39	Hellwing 1986
Lod (District)	1943	Coastal Plain	Rural	42	Gov. Of Palestine 1943
Gerisa	IA I	Coastal Plain	Rural	45	Sade 2001
Michal	LB	Plain Coastal	Rural	47	Hellwing-Feig 1989
Dan (Tel)	IA II	Northern Valleys	Rural	54	Wapnish-Hesse 1991
Average				34	

Table 7. Cattle frequencies at the Southern Negev.

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Reference	Adult Cattle
Avnon	MB I	Southern Negev	Rural	0	Hakker-Orion 1999	X
Eilot	Islamic	Southern Negev	Rural	0	Horwitz 1998	X
Nahal L'anah	Islamic	Southern Negev	Rural	0	Nachlieli 1999	X
Nahal Mitnan	Islamic	Southern Negev	Rural	0	Horwitz 1995	X
Ein Ziq	MB I	Southern Negev	Rural	0	Hakker-Orion 1995	X
Timna	LB	Southern Negev	Ritual	0	Lernau 1988	X
Be'er Resisim	MB I	Southern Negev	Ritual	1	Hakker-Orion 1999	X
Average				0		

Cattle frequencies at urban and rural sites

In the third phase of research, cattle frequencies by settlement type were examined (Tables 5, 6). It was assumed that the number of cattle at urban sites, governed by the ruling classes (Herzog 1997: 13; Hopkins 1996: 128; LaBianca 1999: 21), would be significantly higher in view of the political power wielded through control over water resources and pasture lands. However, the data in Table 4 contradict this assumption. The average frequency of cattle at 12 sites (out of the 30 that were studied) is 11%. No homogeneous pattern can thus, be identified among the urban sites. The second group of sites (lower section of Tables 5 and 6) will be discussed below.

No homogeneous pattern can be identified among rural sites either (Table 6). These sites represent various periods (Bronze Age, Iron Age, Persian, Roman and Islamic periods) and regions (southern and northern Negev, Central Hills, Coastal Plain, and Northern Valley). The sites in Table 6 cluster into three groups: those with low cattle frequencies (0%-1%, see lower section of Table 6); those with cattle bone frequencies of 7% on average; and sites with high cattle frequencies of 34% on average (see upper section of Table 6).

Regional patterning and the subsistence survival strategy

In the final phase of this analysis, all of the sites were grouped into three tables based on their geographical location (Fig. 2). An evident pattern emerges from these tables. In the southern Negev (Table 7) cattle are almost absent (average 0%), in the northern Negev and Central Hill region (Table 8) the average cattle frequency is 12%; and in the lowland regions (Table 9) cattle proportions are clearly high at 33% on average. Cattle frequencies at all sites were tested statistically against three variants: settlement type (urban or rural), geographical location and the combination of both. The statistical test (two way ANOVA) was carried out on material from Arcsin, \sqrt{p} = where "p" is the cattle proportion at the site (in order to achieve a normal division). No difference was found between cattle proportions and settlement type ($p = .694$). Likewise, no interaction was found between cattle proportions, settlement type and geographical location ($p = .523$). In contrast, a highly significant difference was found between cattle proportions and geographical location ($p < .001$).

This pattern can be interpreted in light of the posited subsistence survival strategy. Cattle breeding was a complicated and precarious task as a result of their demand for extensive pasturage and plentiful water resources. Consequently, we find a low proportion of cattle in many of the sites. The subsistence survival strategy was fundamental to the lives of the ancient inhabitants and therefore did not change regardless of period or type of settlement, even at urban settlements.

Cattle bones have nonetheless been found at most of these sites although it stands in contrast with the survival strategy. The reason is that cattle were essential for ploughing and grain cultivation. Thus, cattle were bred at those sites but in low frequencies.

Cattle frequencies was also tested against carrying capacity in various regions. Seligman et al (1959: 15-27) examined the carrying capacity in most regions in Israel and note that a basic animal unit (one mature cow weighing 450 kg.) requires forage equal to 135 kg of barley. This means that one cow requires 135 feed units per month. Those authors surveyed and quantified the vegetation composition in 13 regions in Israel, using similar ecological variables, and calculated the amount of feed units provided by each region. Carrying capacity can be described therefore as the amount of feed units per dunam. For example: the average carrying capacity for all regions is 31 feed units per dunam. The highest carrying capacity (54 feed units) was found in the Upper Jordan valley (described here as Northern Valleys; see Fig. 2, Table 9), while the region with the lowest carrying capacity (7 feed units) is the Northern Negev (Fig. 2, Table 8). The correlation between carrying capacity values and cattle frequencies (Tables 8, 9; Fig. 2) was statistically tested. A strong and positive correlation was found between the two groups of values ($r = .74$, $p < .05$).

Cattle bones are virtually absent in the southern Negev because the arid climate is unfavorable for this species. Probably the absence of cattle at sites of the Islamic period is due to their having been replaced by camels.

It seems likely that at those sites where cattle bone frequencies reaches levels of 15% - cattle were primarily utilized for ploughing. Meat and milk were produced mostly by caprinae. Although the

Table 8. Cattle frequencies in the Central Hill area and the Northern Negev; X= no available data; A= cattle died as mature animals; Y= cattle died as calves.

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Carrying Capacity	Reference	Adult Cattle
Nahal Besor	Islamic	Northern Negev	Rural	0	7	Nachlieli 1999	X
Nahal Omer	Islamic	Northern Negev	Rural	0	7	Nachlieli 1999	X
Qa'aqir (Tomb)	MB I	Central Hill	Burial	1	24	Horwitz 1987	X
Hesban	1970	Jordan	Rural	4	7	LaBianca 1995b	X
Halif	EB III	Northern Negev	Urban	6	7	Zeder 1990	X
Uza	IA II	Northern Negev	Fortress	7	7	Sade 1988	A
Arad	EB	Northern Negev	Urban	7	7	Davis 1976, Lernau 1978	X
Qitmit	IA II	Northern Negev	Sacred	7	7	Horwitz-Raphael 1995	Y
Shiloh	LB	Central Hill	Rural	9	24	Hellwing 1993	A
Sasa (Tomb)	MB II	Galilee	Burial	9	31	Horwitz 1987	X
Hesban XV-XVII	IA II	Jordan	Rural	9	7	LaBianca 1990+1995a	A
Arad VI-XII	IA II	Northern Negev	Fortress	9	7	Sade 1988	A
City of David	IA I	Central Hill	Rural	10	24	Horwitz 1996a	X
Hebron (District)	1943	Central Hill	Rural	11	24	Gov. Of Palestine 1943	X
Yarmouth	EB	Central Hill	Urban	11	24	Davis 1988	X
Hesban XI-XIV	Roman	Jordan	Rural	11	7	LaBianca 1990, 1995a	A
Ira	IA II	Northern Negev	Urban	11	7	Dayan + Horwitz 1999	A
Shiloh	III-MB II	Central Hill	Urban	12	24	Hellwing 1993	A
Hesban II-III	Mamluk	Jordan	Rural	14	7	LaBianca 1990, 1995a	A
Beer-Sheba II	IA II	Northern Negev	Urban	14	7	Sasson, Here	A
Beer-Sheba IX-VI	IA I	Northern Negev	Rural	14	7	Hellwing 1984	A
City of David	IA II	Central Hill	Urban	15	24	Horwitz 1996a	X
Halif	IA II	Northern Negev	Urban	15	7	Zeder 1990	X
Halif	LB	Northern Negev	Urban	16	7	Zeder 1990	X
Ai - Raddana	IA I	Central Hill	Rural	117	24	Hesse 1999	X
Hesban XVIII-XXI	IA I	Jordan	Rural	17	7	LaBianca 1990, 1995a	A
Shiloh	IA I	Central Hill	Rural	23	24	Hellwing 1993	A
Masos	IA I	Northern Negev	Rural	24	7	Tchernov-Drori 1983	A
M. Eibal	IA I	Central Hill	Ritual	25	24	Horwitz 1986/7	A
Zefad (District)	1943	Galilee	Rural	24	31	Gov. Of Palestine 1943	X
City of David	Roman	Central Hill	Urban	29	24	Horwitz 1996a	X
Average				12			

Central Hill region is located in the Mediterranean zone which receives ca. 600mm annual rainfall, cattle frequencies there were relatively low (Table 8). Seligman et al (1959: XI) provide an explanation commenting:

'...The vegetation in the Mediterranean zone varies from open grasslands to close maquis and forest. The various open pasture types, that consist mainly of herbaceous vegetation, cover 38% of the surveyed area and produce 67% of the pasture forage. The maquis and forest types cover 31% of the surveyed area but produce only 19% of the total pasture forage...'

Thus, although the Central Hill region has sufficient water resources for cattle breeding, this task would still have been risky in this region due to the relatively low carrying capacity of the land.

A relatively high cattle frequency is characteristic of the lowland regions (Table 9) where the climate is Mediterranean and the carrying capacity is relatively high. Consequently, cattle breeding in those regions would have been a safe and secure investment. Meat and milk were most likely produced at those sites by both cattle and caprinae, but presumably for the most part by cattle.

Additional indications for cattle as draught animals

Pathologies

An iron plough-share was found in Stratum II (Beit Arieah 1973). Pathologies in cattle bones may be good indications of the how they were used in draught work (Baker, 1980: 114-117). However,

Table 9. Cattle frequencies in lowland areas (Northern Valleys, Coastal Plain, Shephelah). X= no available data; A= cattle died as mature animals; Y= cattle died as calves.

Site and Strata	Period	Region	Type of Settlement	Cattle in %	Carrying Capacity	Reference	Adult Cattle
Kabri	IA II	Coastal Plain	Fortress	25	45	Horwitz 2002	A
Gaza (District)	1943	Coastal Plain	Rural	26	45	Gov. of Palestine 1943	X
Michal	IA	Coastal Plain	Rural	34	45	Hellwing-Feig 1989	A
Michal	Persian	Coastal Plain	Rural	39	45	Hellwing-Feig 1989	A
Izbet Zarta	IA	Coastal Plain	Rural	39	45	Hellwing 1986	A
Aphek	MB II	Coastal Plain	Urban	40	45	Hellwing-Gophna 1984	A
Lod (District)	1943	Coastal Plain	Rural	42	45	Gov. of Palestine 1943	X
Kabri	EB	Coastal Plain	Urban ?	44	45	Horwitz 2002	A
Gerisa	IA I	Coastal Plain	Rural	45	45	Sade 2001	A
Michal	LB	Coastal Plain	Rural	47	45	Hellwing-Feig 1989	A
Gerisa	II-LB I	Coastal Plain	Urban	55	45	Sade 2001	A
Qiri	IA II	Northern Valleys	Rural	15	41	Davis 1987b	X
Megiddo	EB I	Northern Valleys	Urban	19	41	Wapnish-Hesse 2000	Y
Yaqush	EB I	Northern Valleys	Rural	23	54	Hesse-Wapnish 2001	X
Yaqush	EB II	Northern Valleys	Rural	24	54	Hesse-Wapnish 2001	X
Dan (Tomb)	MB	Northern Valleys	Rural	25	54	Horwitz 1996b	A
Megiddo	EB III	Northern Valleys	Urban	25	41	Wapnish-Hesse 2000	Y
Kinrot	EB	Northern Valleys	Urban ?	32	54	Hellwing 1988/9	A
Kinrot	LB	Northern Valleys	Urban ?	32	54	Hellwing 1988/9	A
Yaqush	EB III	Northern Valleys	Rural	34	54	Hesse-Wapnish 2001	X
Dan (Tel)	III-EB II	Northern Valleys	Urban	42	54	Wapnish-Hesse 1991	A
Dan (Tel)	IA II	Northern Valleys	Rural	54	54	Wapnish-Hesse 1991	A
Lachish VIII	MB	Shephelah	Urban	12	42	Drori 1979	X
Lachish III-IV	IA II	Shephelah	Urban	21	42	Drori 1979	X
Dalit	EB II	Shephelah	Urban	24	42	Horwitz et al 1999	A
Miqne	IA II	Shephelah	Urban	27	42	Lev-Tov 2000	A
Miqne	LB	Shephelah	Urban	29	42	Lev-Tov 2000	A
Harasim Ivb	IA II	Shephelah	Urban	30	42	Maher 1999	A
Lachish VI	LB	Shephelah	Urban	30	42	Drori 1979	X
Harasim Ivd	IA II	Shephelah	Urban	34	42	Maher 1998	A
Miqne	IA I	Shephelah	Urban	56	42	Lev-Tov 2000	A
Average				33			

although I have searched for pathologies in cattle bones Stratum II, following the work of Bartosiewicz et al (1997) none could be identified. This fact might be explained in light of Avitsur's study on the native ard in traditional cultivation in Israel. According to Avitsur (1965: 56-74), three different types of ard were adapted to varying soil conditions, climate and farming in Israel: the heavy, the medium and the light ard.

For the last type, Avitsur says:

'The light ard or the simple sole ard was meant for the loess and loess and sand soils of the Negev' (Avitsur 1965: IV).

Because this ard was much lighter in weight than any of its counterparts elsewhere in the world, it may explain why no pathologies were found on cattle bones.

Cattle age

Cattle were put to work only when they became mature (Sherratt 1983; Heimpel 1995: 134-135; Stol, 1995: 175-176; Halstead 1995; van Driel 1995; Zeder 1991: 29). A cattle mortality profile can therefore provide good indication of the role of cattle at ancient sites and this was analyzed in Stratum II at Tel Beer-Sheba. Out of 568 cattle bones, fusion lines were still apparent on 200 specimens. These bones were grouped into two age categories: bones that had fused between 7 to 18 months and

bones that fused between 24 to 42 months (Fig. 3). Each group contained about 100 bones. Eighty-eight percent of the bones in the first group and 81% in the second group were found to be fused, indicating that the cattle were slaughtered or died when they were older.

Cattle mortality profiles were also studied at all sites in Tables 6, 7 and 8. Not all the zooarchaeological reports provided mortality profile data. In the 34 (89%) out of 37 sites and strata that did provide such age data, the majority of cattle died as adults. This strongly suggests that the main function of cattle at those settlements was in draught work.

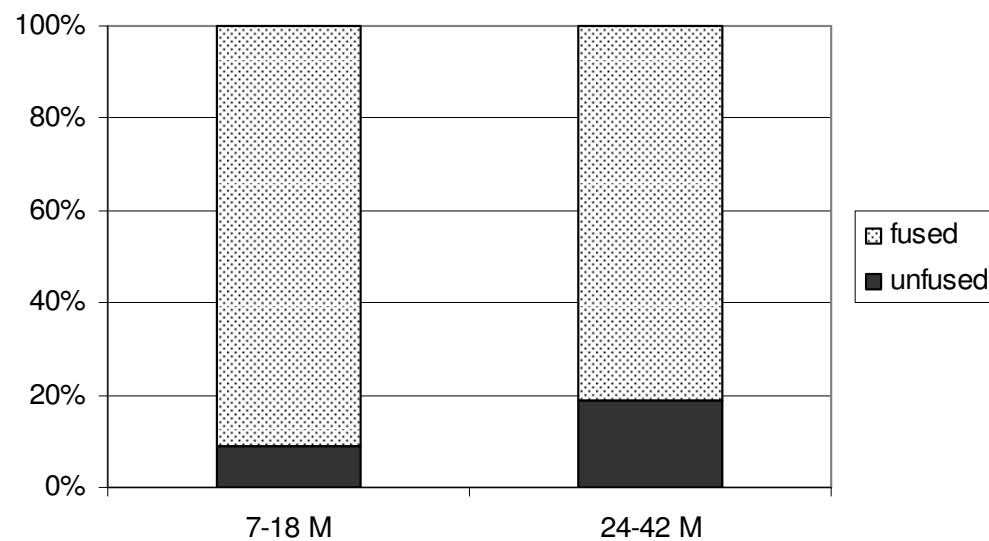


Fig. 3. Cattle mortality profile in Stratum II, Tel Beer-Sheba.

Summary

The relative frequency of cattle bones found in Stratum II, Tel Beer-Sheba was 15%, relatively high due to the low carrying capacity and low precipitation in the northern Negev region. It is also notable in contrast to the complete absence of cattle among the present-day Negev Bedouins. Cattle were vital for ploughing and in cereal cultivation. This is the primary reason their bones are found at most Bronze and Iron Age sites in the Levant.

Cattle frequencies were studied for 70 sites and strata, mainly in Israel, and interpreted in light of what was termed in this paper, the survival subsistence strategy. This strategy was fundamental to the lives of the ancient inhabitants and remained unchanged regardless of period or type of settlement, including urban sites. Cattle breeding was complicated and precarious task due to their demand for extensive pasturage and plentiful water resources. The underlying principle behind the low frequency of cattle (up to 15%) found at many sites was the necessity to maintain a balance between two primary demands: risk minimization and preservation of natural resources (water, pasturage) on one hand and the demand for cattle as draught animals on the other hand. This equilibrium was referred here as the survival subsistence strategy.

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