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V

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Preface

When I participated in the IVth International Conference of ASWA, held in the summer of 1998 in Paris, I was gratified to learn that the Scientific committee had unanimously agreed to hold the next meeting in Jordan. Thus, on 2 April 2000, the Vth International Conference of the Archaeozoology of Southwest Asia and Adjacent Areas was held for the first time within the region at Yarmouk University in Irbid, Jordan after being held on the past four occasions in Europe.

The themes of this conference were divided into five areas including:

- Paleo-environment and biogeography
- Domestication and animal management
- Ancient subsistence economies
- Man/animal interactions in the past
- Ongoing research projects in the field and related areas

I wish to thank all those who helped make this conference such a success. In particular, I would like to express my appreciation to the Director of the Institute of Archaeology and anthropology at Yarmouk University Special thanks are due to his excellency, the President of Yarmouk University, Professor Khasawneh, who gave his full support and encouragement to the convening of this conference at Yarmouk University and to all those who contributed the working papers which made the conference possible.

I also wish to thank members of the organizing committee who worked very hard for many months in preparing the venue for this conference.

Abdel Halim Al-Shiyab
Yarmouk University
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Note from the editors:
The editors wish to thank Dr. László Bartosiewicz for his excellent assistance in preparing and checking the contributions to this volume.

Participants at the 5th ASWA Conference, held at theYarmouk University in Irbid, Jordan, 2000

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NOTHING TO DO WITH INDIGENOUS DOMESTICATION? CATTLE FROM LATE PPNB BASTA

Cornelia Becker[1]

Abstract

The wild or domestic nature of cattle from Late PPNB sites in the Southern Levant is still a matter of debate, caused, not least, by the low number of Bos remains available from this area to date. About 1400 cattle bones have been excavated at the Late PPNB site of Basta in Jordan. From their number and surprisingly incoherent character, they offer a possibility to clarify this problem. An attempt is made to argue whether the cattle bones exclusively derive from wild or also from domesticated animals. Aspects such as bone size, culling profile, hunting techniques, environmental considerations, spatial and contextual patterns, bone processing as well as the role of cattle in local ritual activities are explored.

Résumé

Le statut sauvage ou domestique du bœuf des sites du PPNB final au sud du Levant est encore un sujet de débat qui n'est pas du à la carence des restes du genre Bos dans la région. Environ 1400 restes de bœuf ont été découvert sur le site de Basta en Jordanie daté du PPNB final. De par leur nombre et leur caractère étonnant ils offrent des éléments qui amplifient le problème du statut de l'animal. Une tentative est faite ici pour discuter le fait que les restes de bœuf proviennent exclusivement de l'espèce sauvage ou également des animaux domestiqués. Différents aspects tels que la taille des os, les profils d'abattage, les techniques de chasse, les conditions environnementales, les schémas spatiaux et contextuels, la découpe des os ainsi que le rôle du bœuf dans les activités rituelles locales sont explorés.

Key Words: Basta/Jordan, Late PPNB, Cattle remains, Domestic or wild, Multi-component approach.

Mots Clés: Basta/Jordanie, PPNB final, Restes de bœuf, Sauvage ou domestique, Approche multivariée.

Introduction

The site of Basta is located on the southeastern edge of the Southern Levant (Fig. 1) in the semi-arid fringes of the western Arabian Plateau in Jordan. It was inhabited during the second half of the 7th millennium BC, a period characterised as Late Pre-Pottery Neolithic B (Late PPNB). Basta became renowned not only for its enormous size of 10-14 ha, but also for its sophisticated architecture and huge number of archaeological finds (Nissen *et al*. 1987, 1988; Gebel 1996, 1998, forthcoming; Gebel and Muheisen 1997; Gebel *et al*. 1988). From extended research and laboratory analyses, major insight into the life of the former inhabitants has been achieved, although a series of questions were raised, many of which can be only partly answered to date. One principal question, for example, touches upon the reasons why the settlement was abandoned at the end of the PPNB (see also Rollefson and Köhler-Rollefson 1989; Nissen 1993; Becker 1998; Gebel 1998).

With about 100,000 bone remains, Basta provided one of the largest faunal samples ever unearthed from a Late PPNB context in this region. The material has repeatedly been the focus of specific analyses (Becker 1987, 1991, manuscript 1993, 1998, 2000a, 2000b). This paper endeavours to discuss a crucial osteological problem in the Basta material: the identification of cattle remains with respect to their wild and/or domestic nature. On first consideration, the cattle bones were treated as though they had come from wild specimens with an option left open for refined results (see Becker 1991, 66f.).

An actualised, albeit rather general view, has already been published (Becker 2000b, 70ff.). The basic data, however, will be provided in full in the following sections.

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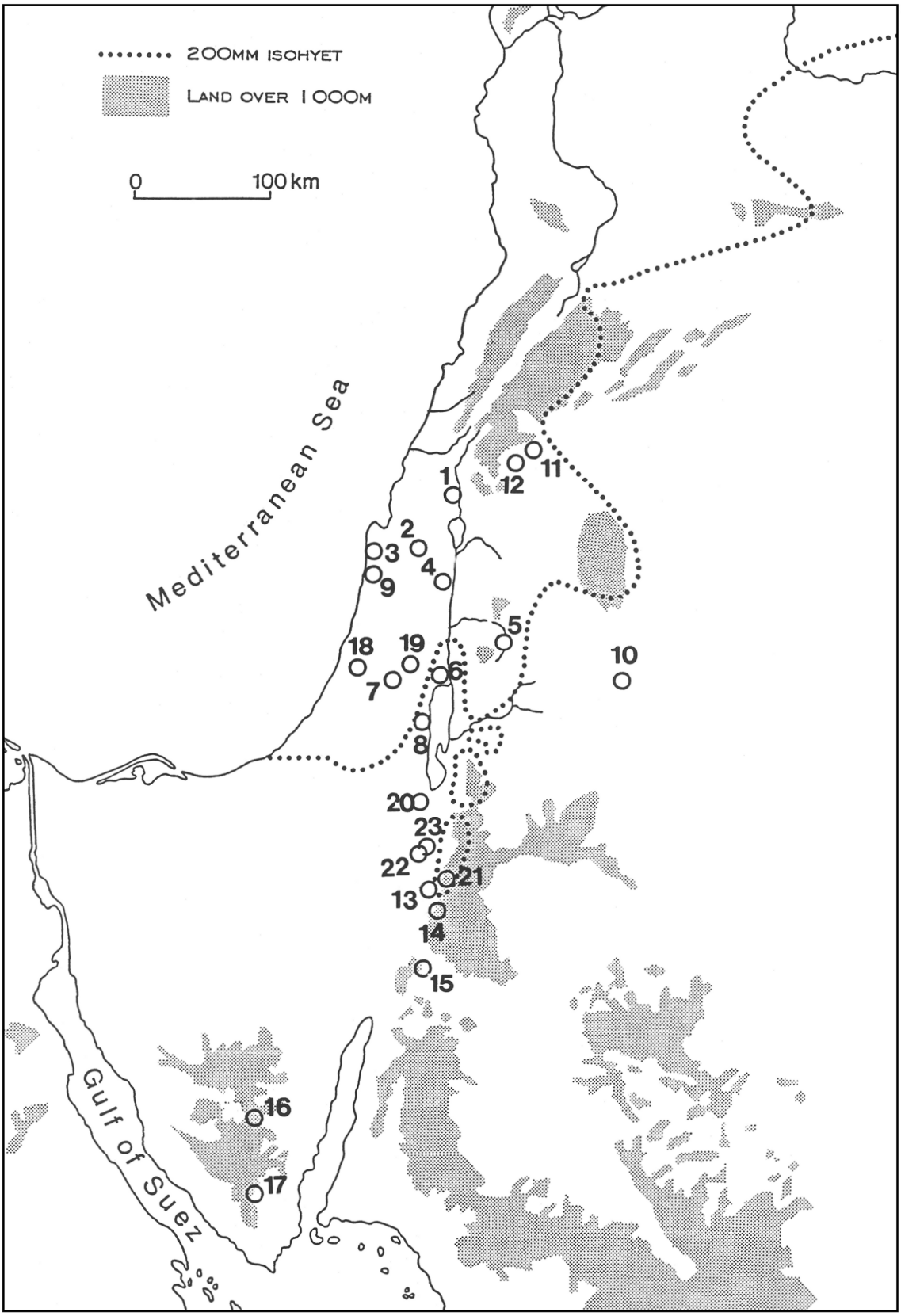


Fig. 1 Map of sites with *Bos* remains from PPNA to PPNC levels. **1** Beisamun, **2** Yiftahel, **3** Nahal Oren, **4** Munhatta, **5** 'Ain Ghazal, **6** Jericho, **7** Abu Gosh, **8** El Khiam, **9** Atlit Yam, **10** Azraq, **11** Ghoraifé, **12** Aswad, **13** Beidha, **14** Basta, **15** Wadi Judayid, **16** Wadi Tbeik, **17** Ujrat el-Mehed, **18** Hatoula, **19** Gilgal, **20** Nahal Hemar, **21** Ba'ja, **22** Ghwair, **23** Wadi Fidan Site A, C (for references see tab. 1).

Table 1. Sites in the Southern Levant with *Bos* remains in PPNA, PPNB and PPNC sequences (numbers see fig. 1).

No.	*Site*	*Reference*
1	Beisamun	Davis 1978
2	Yiftahel	Horwitz 1987
3	Nahal Oren	Noy et al. 1973
4	Munhatta	Ducos 1968
5	'Ain Ghazal	Köhler-Rollefson *et al*. 1988; Von den Driesch/Wodtke 1997
6	Jericho	Clutton-Brock 1979
7	Abu Gosh	Ducos 1978
8	El Khiam	Ducos 1968
9	AtlitYam	Galili *et al.* 1993
10	Azraq Basin	Martin 1992
11	Ghoraifé	Ducos 1993
12	Aswad	Ducos 1993
13	Beidha	Hecker 1982
14	Basta	Becker 1998
15	Wadi Judayid	Garrard et al. 1996
16	Wadi Tbeik	Tchernov/Bar-Yosef 1992
17	Ujrat el-Mehed	Dayan et al. 1986
18	Hatoula	Tchernov 1993
19	Gilgal	Tchernov 1993
20	Nahal Hemar	Davis 1988
21	Ba'ja	von den Driesch *et al.* (forthcoming)
22	Ghwair I	Simmons/Najjar 1999
23	Wadi Fidan, Site A, C	Richardson 1997

Cattle from Basta – the basic data

The subsistence strategy practised by the Basta inhabitants during 400-500 years of occupation, was dominated by ovicaprine husbandry, although hunting played a surprisingly important role. From the faunal record (bone weight), it could be concluded that wild mammals provided 46% of the meat diet, the greatest part of which came from cattle. During several campaigns of excavation between 1986 and 1992, 1417 cattle remains with a total weight of 30,121 grams were unearthed. They come from a bulk of 37,280 identified mammal bones (weight: 158,530 grams), sampled from areas A, B and C.

The cattle bones had to be divided into different categories: firstly, we deal with regular refuse from carcass processing and consumption (n = 937) and secondly, with a deposit of two skeletons which have to be interpreted in another fashion (n = 480). Nine artefacts must be added which mirror a specific exploitation of raw material. These artefacts were not counted in the archaeozoological sample, but recorded by the excavators as "small finds".

Cattle as a source of meat

On the basis of the relatively small number of finds, *Bos* remains comprised only a minor part (4%) of the total assemblage. Nevertheless, the importance of cattle in general as a source of meat is clearly indicated: according to bone weight, cattle remains yielded 19% of the total (Fig. 2). Most of the cattle bones were heavily fragmented and badly damaged. Only occasionally, elements from the autopodium and some long bones of young and very young specimens were preserved in total length. They comprise 4.6% of the sample. The long bones, however, were cut into at least three or four sections. Completely preserved joints with fused epiphyses were rarely found.

The presence/absence-analysis of skeletal elements implies that all parts of the skeleton are represented, although compared to a complete animal not in regular frequencies (Table 2; Fig. 3): Ribs, vertebral columns and pelvic girdles are underrepresented, in contrast to an over-representative occurrence of meatless refuse and cranial fragments.

From their appearance and weight, a certain number of the cattle bones can be separated into two size classes: on the one hand, diaphysis fragments of long bones with a very thick compacta, rib fragments of considerable breadth, horn core fragments which represent massive horn cores with large circumferences and other bone finds which clearly were parts of skeletons from heavily built, large animals; on the other hand, one may identify fragments and splinters which obviously come from bones of smaller sized cattle.

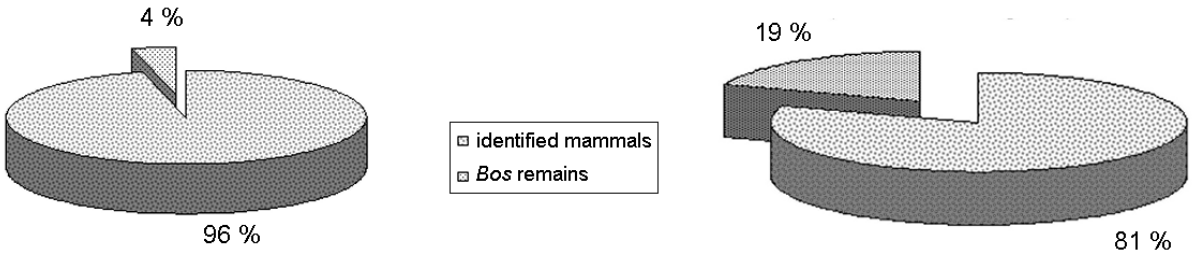


Fig. 2 Basta. Relative frequency of *Bos* remains in comparison to all identified mammal bones (left = NISP, right = weight).

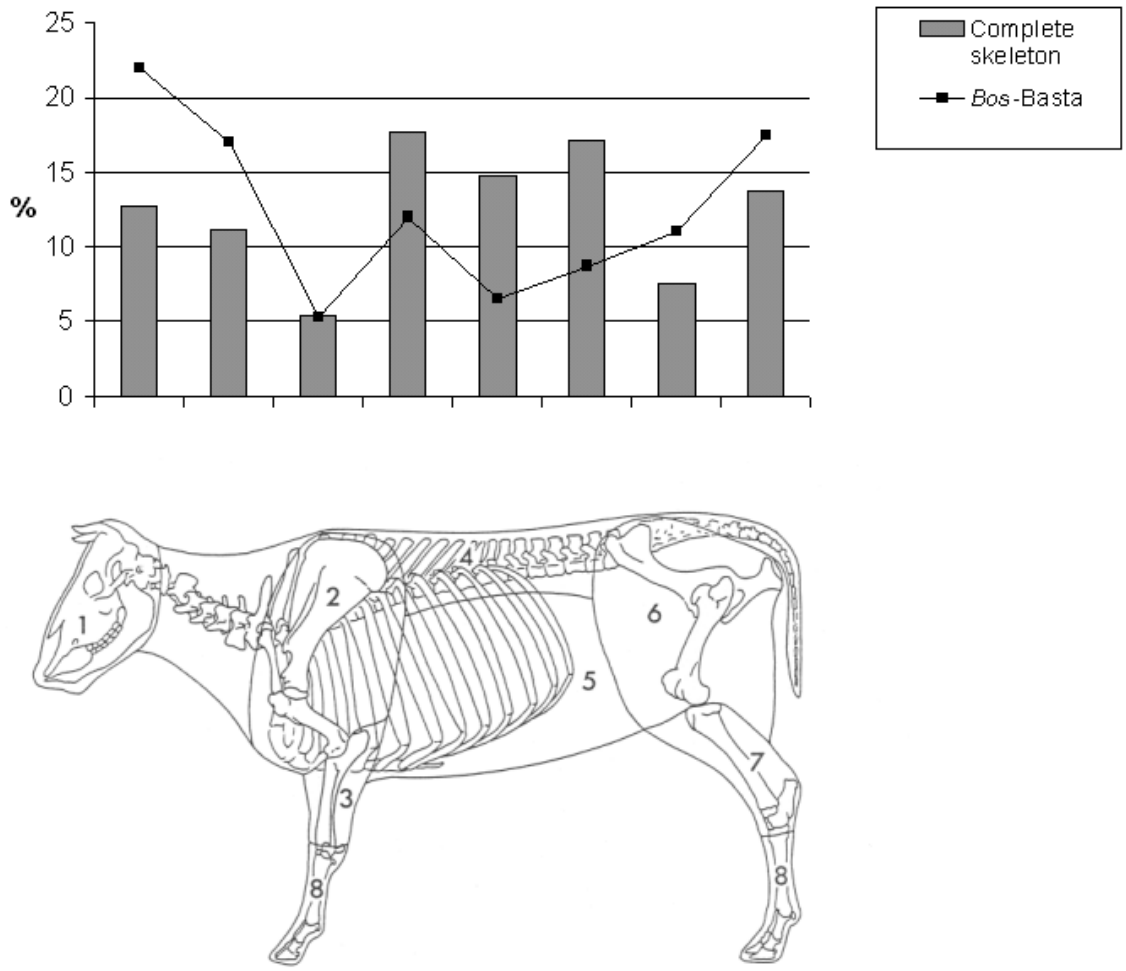


Fig. 3 Basta. *Bos* remains, slaughter and consumption refuse. Comparison of body part frequencies (basis: bone weight).

Table 2. Basta, *Bos*. Bone count.

Skeletal element	*Bone count*	*Skeletal element*	*Bone count*
Processus cornualis	47	Radius	26
Cranium	68	Ulna	13
Maxilla	6	Carpalia	37
Dentes superiores	31	Metacarpus	18
Mandible	23	Pelvis	12
Dentes inferiores	48	Femur	50
Hyoid	7	Patella	6
Atlas	8	Tibia	66
Epistropheus	2	Talus	6
Vertebra thoracales	32	Calcaneus	11
Vertebra lumbales	10	Centrotarsale	7
Vertebra caudales	2	Tarsalia	6
Vertebra indet.	68	Metatarsus	30
Sacrum	1	Metapodium	8
Costae	94	Phalanx 1	54
Sternum	3	Phalanx 2	36
Scapula	55	Phalanx 3	21
Humerus	25		
		Total	937

If we carry out the analysis described above for both size classes separately, the representation of body parts differs considerably (Fig. 4): large specimens are primarily represented by front parts (head and shoulder) and meat bearing sections from the hindlegs, whereas the skeletal-part distribution for small-sized animals actually follows a pattern of more "regular" representation. This result indeed points to a divergent treatment of carcasses of differently sized animals. It can be suggested that from large animals, mainly isolated joints of meat and parts of the skull - in particular horn cores - were brought to the site. The latter could have served as trophies, items of prestige or raw material. Carcasses of smaller sized specimens, however, were carried back to the site in a, more or less, complete state for processing within the boundaries of the settlement. Butchering is also indicated by cut- or scraping marks. In the regular slaughter and consumption refuse, the frequency of cut-marks amounts to 4.1 %. Cut-marks occur in horizontally oriented packages, i.e. at the mid-shaft on long bones, near joints (Fig. 5. a) and in long striations particularly on scapulae and ribs. Chop-marks are encountered less often; they have been evidenced on the diaphyses of a humerus and a radius as well as on a vertebra. About 5% of the *Bos* material was affected by fire, ranging from slightly burnt to heavily calcified. Any regularities in the sense of roasting or grilling could not be recognised.

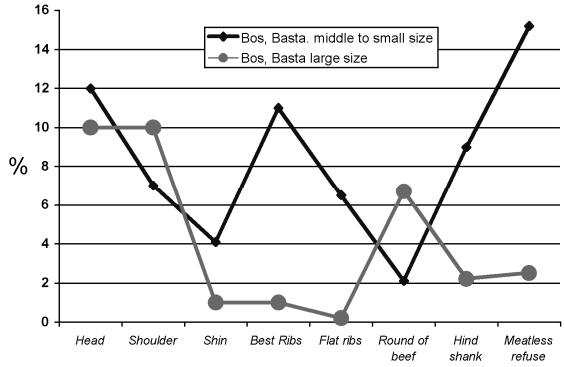


Fig. 4 Basta. *Bos* remains, slaughter and consumption refuse. Body part frequencies among tentatively separated finds from large-sized and middle- to small-sized specimens (basis: bone weight; characterisation of body parts in accordance with numbers in fig. 3).

Spatial distribution

The dumping of refuse from the carcass processing of cattle, prior to the preparation and consumption of cattle meat, follows those patterns which have already been documented for the Basta mammal remains in general (Becker 2000a: 205). Particular places used for slaughtering, food processing, cooking, bone manu-

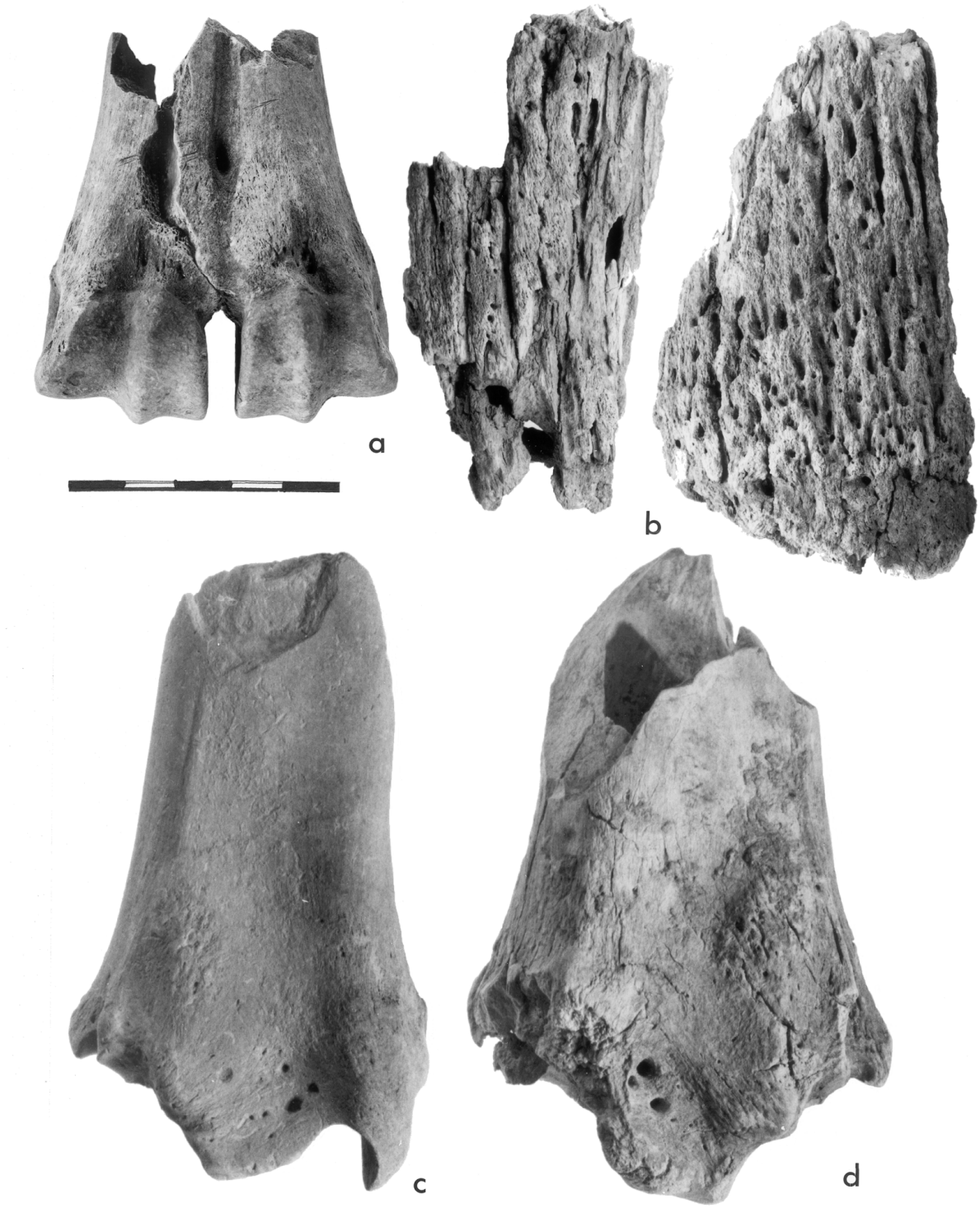


Fig. 5 Basta. *Bos*, metacarpus with cut-marks (a), horn core fragments (b), distal tibiae (c, d). scale in cm (photos: D. Wolf).

facturing or the like could not be pin pointed except in one unit in area B (unit 65). Here, remains of three cattle were recovered: firstly an articulated right hindfoot, a horn core fragment, parts of a mandible and a distal humerus with cut-marks, all coming from a large-sized adult specimen; secondly, the completely preserved left and right hindfeet representing leftovers of a fairly small adult cattle; thirdly, the left and right forefoot plus a section of the tail from a calf. In total, we find an over-representation of meatless parts, which hints at the function of this place as a refuse heap as far as cattle are concerned.

Estimation of size

The low frequency of 88 measurable bones is a result of the high degree of fragmentation. I would like to emphasise that, as such, the measurements in Table 3 do not reflect the potential of the whole assemblage, because many finds, although significant in their dimensions, were not measurable due to their poor preservation (cf. Fig. 5. d). At least half of the bones come from aurochsen, as indicated by their generally enormous size. That applies, for example to rib fragments measuring more than 40 mm in breadth as well as to fragments of horn cores (cf. Fig. 5. b) some of which allow a reconstruction of their former dimension. In one case, this estimate approaches a largest diameter of about 108 mm, a smallest diameter of about 82 - 85 mm and a basal circumference of 320 mm, measurements which, in fact, point to wild specimens (cf. Vila 1998: 115).

The direct comparison of measurements between the Basta remains and those from other PPNB sites suffers from the low number of data available per element. Despite this, the incoherent character of the Basta material can be amplified, i.e. by a comparison with Göbekli Tepe, a PPNA – Middle PPNB site located near Urfa/eastern Turkey (Von den Driesch and Peters 1999: 30). From the dating, the Göbekli material clearly derives from wild cattle. There the aurochsen tali vary in their greatest lateral length from 75-90 mm (n = 21). With 70.9-89.2 mm GLl (n = 6), the Basta variability touches the upper end of the Göbekli Tepe variability and, at the same time, falls considerably below the lowest Göbekli data. A comparable picture emerges from the greatest length on posterior second phalanges: Göbekli Tepe 45.5 - 53.0 mm (n = 12) vs. Basta 43.1 - 49.3 mm (n = 6). Such comparisons could be repeated with data from other sites, too. They all produce the same result: the Basta cattle remains display a large variability in size which ranges from fairly large to middle- and small-sized

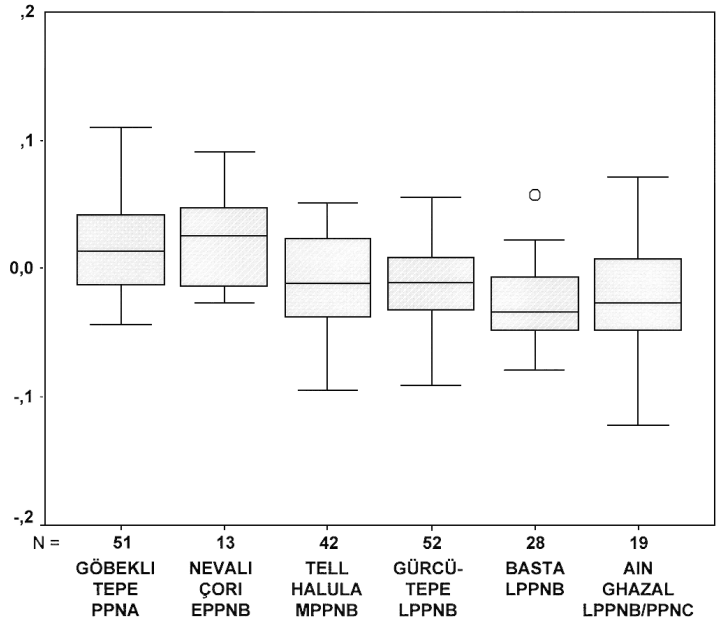


Fig. 6. *Bos* remains from Levantine/Syrian sites. Comparison of LSI variability (reference animal: female *Bos primigenius* from Ullerslev, after Degerbøl 1970; data from J. Peters/München).

animals. The latter often surpass the lower limit for wild cattle as well as any expectations of sexual dimorphism in aurochsen, so it needs to be investigated whether or not domesticated animals are integrated within this sample.

The lack of sufficient metrical data for particular elements prevents a completely satisfactory answer as to the wild and/or domestic nature of the Basta animals. A statistically more relevant evaluation of size can be produced by the combined measurement information from different skeletal elements while using one of the size index techniques, in this case the log-size index LSI (Meadow 1999). The problem arises as to which reference animal should be chosen. Using *Bos primigenius* from Denmark to provide the standard for animals of a distant and bioclimatically different region may create an inappropriate impression (cf. Grigson 1989: 90), if we consider an ecogeographically-caused variation of size in Southern Levantine cattle, as will be discussed later on. However, this reference animal is most often used and it is the best we have to hand.

Two hundred and five data are integrated in Figure 6, which compares LSI ratios from Basta, 'Ain Ghazal and four northern Levantine/Anatolian sites[2]. The data are arranged in chronological order from the PPNA (left) to the PPNC (right). In comparison to the reference animal, one may easily recognise that some aurochsen indeed are evidenced within the Basta finds. Of particular note is the fact that the mean value of the Basta data falls significantly below the zero-line of the standard animal. It is the lowest one for all sites integrated in the graph. Additionally, in comparison with those LSI ratios calculated for Gürcütepe and 'Ain Ghazal, sites where domesticated cattle are actually known to have been raised, one could in fact presume a domesticated status for some of the cattle remains from Basta as well. As a first result, we may assume a mixture of wild and domestic cattle in the Basta material. But more arguments must be collected to support this assumption.

In 1981, Richard Meadow published data for another reference animal, the South Asian *Bos indicus*, a large male domestic zebu[3] from the collection of the Museum of Comparative Zoology, Harvard University. He used this reference animal to argue for the local domestication process in Mehrgarh/ Pakistan (Meadow 1984). In my opinion, a comparison with this reference animal may also illustrate the situation in Basta. Figure 7 shows that an accumulation of LSI ratios for the Basta values right and left of the zero-line of the reference animal is displayed. Again, we have a broad variety of log-size indices demonstrating that some large dimensioned bones from aurochsen and a lot of middle- and small-sized cattle bones characterise this bone assemblage. The latter actually could derive from domestic animals. As a tendency, the results from the first analysis are corroborated

Unfortunately, a serious obstacle to finally solving this question still remains: it is impossible to determine where to draw the line between aurochsen and the supposed domesticated cattle; hence, the ratio of wild versus domestic specimens cannot be given a more precise label. Additionally, the search for telling clues has to take into consideration factors other than metrical analyses.

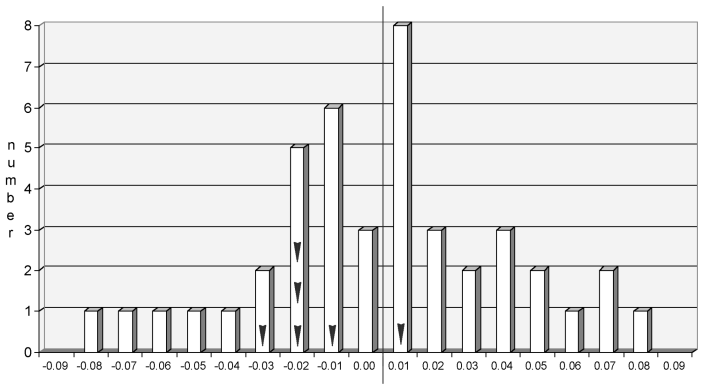


Fig. 7 Basta, *Bos*. LSI variability (n = 43); reference animal: *Bos indicus*; after Meadow 1981; vertical line = zeroline of reference animal; arrows = indices of cow deposit.

[2] This graph is based on data which were provided and calculated most kindly by Joris Peters/Munich, for which I wish to thank him greatly.

[3] Chosen to define a point toward the upper end of the size-range expected for domesticated cattle from South Asia.

Table 3. Basta, *Bos*. Measurements (in mm; after von den Driesch 1976; D= diameter/depth)
( ) bone damaged; < > epiphysis not fused; * cattle deposit (w= weiblich, female)

Maxilla:	L-M3	36.5		Mandible:	L-M3	35.4	
	B-M3	25.0			B-M3	12.0	
Scapula	GLP	85.1	87.5	74.2	(87.5)	78.5	
	LG	70.5	71.8	66.1	(76.5)	65.8	
	BG	59.7	64.3	(53.5)	67.3	53.4	
	KLC	-	(74.2)	63.0	-	-	
Humerus	Bd	97.3	-				
	BT	90.0	-				
	greatest height of trochlea	53.1	-				
	smallest height of trochlea	41.7	-				
	KD	-	45.1				
Radius	Bp	-	-	86.5	-		
	BFp	-	-	79.4	-		
	DFp	45.5	45.2	42.5	52.5		
	KD	-	47.3	-	-		
Ulna	BPc	47.0					
Metacarpus	Tp = Dp	48.6					
Metacarpus	Bd=BFd	69.3	65.8	69.2	-		
	D lateral	25.1	28.7	-	24.3		
	Td = D condylus	34.1	34.8	-	33.7		
Pelvis	LA	73.9* w	69.7 w	66.4 w			
Femur	D Caput	<58.4>					
Tibia	Bd	69.2	81.2	74.8	67.1*	(72.3)	-
	TD = largest Dd	54.0	56.3	55.1	51.5*	-	50.2
	KD	-	-	-	-	52.4	-
Tibia	Bp	109.5					
	Dp	96.2					
		p(+)					
Metatarsus	Bp	58.8	62.7	65.2	-	49.3	
	Dp	57.3	61.2	62.8	50.2	-	
					ad?	Ad?	
Metatarsus	Bd = BFd	62.4	61.0	-	-	<67.8>	
	Dl	24.0	28.0	27.7	28.2	<26.4>	
	DC	33.4	34.1	39.1	36.8	<38.1>	
						epiphysis	
Talus	GLl	74.8	71.0	74.2	70.9*	72.7	(68.4)
	GLm	69.7	65.5	67.5	64.1*	66.6	61.8
	Bd	52.1	46.7	46.4	47.0*	45.5	46.8
	Td = Dl	41.1	39.9	40.9	39.3*	39.5	37.7
						ad?	ad?
Talus	GLl	89.2	75.0				
	GLm	79.2	70.4				
	Bd	59.4	47.2				
	Td = Dl	49.9	41.4				
Calcaneus	GL	137.5*	-	-			
	GB	47.1*	-	50.2			
	GD	57.3*	-	57.2			
	D caput	40.5*	48.5	-			
	B caput	36.9*	40.7	-			
Phalanx 1	Lpe	59.9	75.5	(60.1)	-	-	72.1
	Lme	-	74.8	(59.0)	-	-	-
	Bp	36.4	45.7	33.7	33.0	35.4	34.8
	Bd	-	40.2	31.3	-	-	(35.0)
		ant.	ant.	ant.	ant.	ant.	post.

Table 3. continued

Phalanx 1	Lpe	-	72.7	-	70.8	-	-
	Lme	-	72.0	-	68.8	-	-
	Bp	-	36.1	-	36.1	33.8	32.6
	Bd	30.8 post.	33.0 post.	30.8 post.	30.7 post.	- ant./post?	- ant./post?
Phalanx 1	Bp	34.1 Ant./post.?	36.2 ant./post.?	31.7 ant./post.?			
Phalanx 1	Bd	33.4 ant./post.?	29.6 ant./post.?	29.9 ant./post.?	31.2 ant./post.?		
Phalanx 2	GL	44.2*	42.4*	44.7	48.5	45.0	40.0
	Bp	31.2*	32.6*	36.9	37.7	36.5	31.3
	Bd	- ant.	28.2* ant.	33.3 ant.	29.4 ant.	32.3 ant.	26.0 ant.
Phalanx 2	GL	48.6	43.8	43.3	43.1*	48.1	49.3
	Bp	36.6	34.2	33.6	30.6*	35.1	34.4
	Bd	31.3 post.	27.8 post.	28.1 post.	25.2* post.	30.6 post.	30.1 post.
Phalanx	DLS	(91.7)	-	-	73.6	59.1	-
	Ld	(65.3)	-	-	58.4	50.8	-
	HP	53.0	54.5	47.1*	37.8	-	56.9
	LF	47.3	42.4	34.7*	30.2	-	42.8
	BF	33.2	31.6	25.6*	23.6	-	32.5

Ageing

In terms of statistic reliability the number of ageable elements (n = 243) is in a way doubtful, even more so because no coherent results could be achieved on mandibles and postcranial elements (cf. Tables 4, 5). Only nine maxilla bones were preserved to an extent that they could be used for age determination. The majority (77.8%) belongs to adult specimens. However, the mandibles of younger cattle are much more frequently encountered: Six out of 13 mandibles were from juveniles, two from subadults and only five (38.5%) from adult cattle (adult meaning beyond 3.5 years of age). The results on the long bones are comparably diverse, i.e. high percentages of bones with fused epiphyses in metapodia (64% and 77%) and, in contrast, low ratios in femora and tibiae (30%). The latter closely match the results in mandibles. As a result, one gets the impression of a generally high ratio of young cattle in the Basta material (Fig. 8).

Determination of sex

There are only a few bones which allow the determination of sex: three horn core fragments which due to their appearance could well come from large, male adults (presumably aurochsen) and five pelvis fragments from female specimens. From the impression given by size variability, however, it seems as if female cattle are in the majority (cf. Fig. 7). Nonetheless, as long as the affiliation to wild and/or domestic cattle has not been decided, we can not commit ourselves in any way at all.

Pathologies

Three cases of pathological changes could be evidenced. They all concern exostosis near joints, especially on a vertebra (thoracalis), on a shoulderblade and on the proximal joint of a first anterior phalanx (spat).

Table 4. Basta, *Bos*. Maxillae, mandibles and single teeth. Results of ageing.

Skeletal element	Stage of dentition	Stage of wear	Age estimation	Number of finds	Frequency of adults
Maxilla - P4	erupted	++	adult ?	1	
M3	just erupted	-	subadult	1	
M3	erupted	(+)	early adult	3	7 = 77.8%
M3	erupted	++	adult	2	
M3	erupted	+++	adult-senile	2	
total				9	
Mandibula - PM	in eruption		juvenile	2	
PM	just erupted	-	juvenile	4	
PM	erupted	++	adult	1	
M1	just erupted		subadult	1	5 = 38.5%
M3	just erupted		subadult	1	
M3	erupted	++	adult	3	
M3	erupted	+++	adult-senile	1	
total				13	

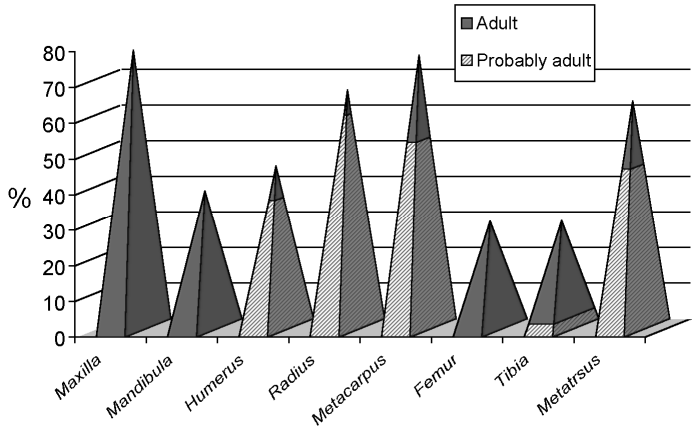


Fig. 8 Basta, *Bos*. Ageing. Relative frequency of elements from adult and probably adult cattle.

Chronological aspects

Unfortunately, we have no clearly defined stratigraphy in Basta, but we may divide the material into finds from substructures, from the floor (room fill) and from rubble-layers. This stratification implies a chronological succession, the oldest finds being those from the substructures, the youngest from the rubble-layers. Large- and small-sized cattle bones occur simultaneously in all levels. Comparing the number of *Bos* remains to other ungulate species, there is a change in frequency from 3% in the deepest sequence to 5.8% in the uppermost one (Fig. 9). Although the ratio as such has doubled, one should ask critically if this relatively modest increase, compared to the amount of sheep and goat, indicates a substantial change in economy in terms of an increased number of domestic cattle, an issue which will be discussed in the following final section.

Cattle deposit in area C

Within a test unit of 2 x 4 m, ca. 3 m below the present surface at the northern fringe of the settlement in a space outside the walls, a well-preserved human skeleton and bones of several ungulates were unearthed (pers. com. Gebel). The human skeleton was covered with stones; the body - presumably that

Table 5. Basta, *Bos*. Analysis of epiphyseal closure on postcranial elements.

\+ epiphysis fused; (+) epiphysis in fusion; - epiphysis not fused; l.p.e. loose, unfused proximal epiphysis; l.d.e loose, unfused distal epiphysis; p proximal; d distal

Skeletal element	**Age/epiphyseal closure**	**Number of finds**	**Total per element**	**Fused/adult n - %**
Scapula	infantile	1		
	juvenile	2	14	11= 78,6%
	adult, tuber +	11		
Humerus	p+d?	1		
	p?d+	4		
	p-d?	2	11	5 = 45.5%
	p?d-	1		
	l.p.e.	1		
	infantile(p-d-)	2		
Radius	p+ (looks adult)	9		
	d+	1		
	d-	1	15	10 = 66.7%
	l.p.e.	1		
	l.d.e.	2		
	foetal (p-d-)	1		
Ulna	p+	5		
	juvenile (p-)	1	7	5 = 71.4%
	infantile	1		
Metacarpus	p+ (looks adult)	9		
	d+	4		
	d-	2	17	13 = 76.5%
	l.d.e.	2		
Pelvis	juvenile	1		
	adult	3	4	3 = 75%
Femur	p+	3		
	d+	6		
	p-	5		
	d-	1	30	9 = 30%
	l.p.e.	9		
	l.d.e.	2		
	infantile (p-d-)	4		
Tibia	p+	3		
	p (+)	1		
	d+	5		
	p-	7		
	d-	1	30	9 = 30%
	l.p.e.	9		
	l.d.e.	2		
	infantile	2		
Metatarsus	p+ (looks adult)	10		
	d+	4		
	d-	4		
	l.d.e.	2	22	14 = 63.6%
	juvenile (p+d-)	1		
	infantile (p+d-)	1		
Talus	adult	8		
	adult?	2	10	8 = 80%
Calcaneus	tuber +	4		
	tuber -	2	6	4 = 66.7%
Phalanx 1	+	24		
	-	4	32	24 = 85.7%
	infantile	4		
Phalanx 2	+	13		
	-	4	22	13 = 59.1%
	neonatal	2		
	infantile	3		
Phalanx 3	infantile	2		
	juvenile	2	10	6 = 60%
	adult	6		

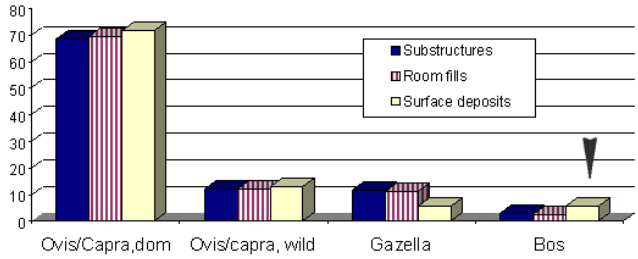


Fig. 9 Basta. Relative frequency of ovicaprines, gazelles and cattle from different accumulation levels (basis: bone count; n = 9,822).

of an adult man[4] - had been sprinkled with red ochre and decorated with a large piece of mother-of-pearl on his right shoulder.At a short distance of less than a metre, the excavators found the skeleton of a bovine plus an unborn calf, both lying in almost natural positions. From the foetus 219 tiny bone remains (bone weight: 312 g) were preserved and from the cow 261 fragments (bone weight: 3.865 g), all deriving from different parts of the skeleton (Fig. 10). All the bones were brittle and only some allowed measuring (data* in Table 3). The identification of the cow is not only based on the presence of the foetus, but could also be determined from the shape of one horn core and the anatomy of the pelvic bones.

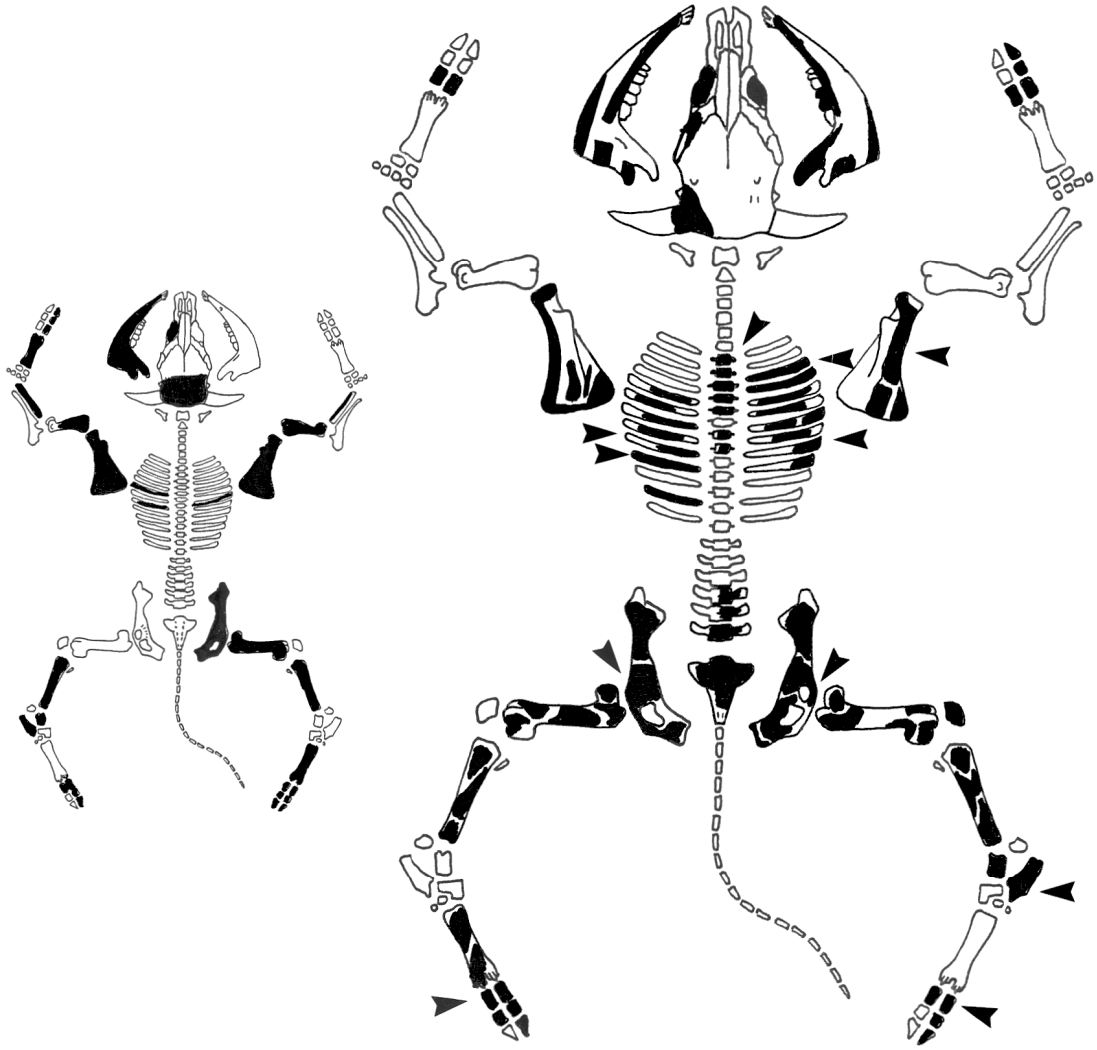
The cow was butchered, but not divided into smaller sections. The bones were defleshed carefully. Several rib and vertebra fragments, the right scapula, the pelvis, the sacrum, a calcaneus and some phalanges exhibited many fine striations, coming from sharp flint knives (see arrows in Fig. 10). Compared to the frequency of cut-marks in the regular bone refuse (4.1%), these bones yield a higher frequency (8.0%) which underlines the particular treatment given to this animal. The bones of the foetus display no cut-marks at all. The defleshing may have been followed by ritual consumption of meat. Afterwards, the cattle bones seem to have been deposited in the pit in a, more or less, anatomically correct arrangement[5]. The assumption that the meat was consumed during a ritual feast is additionally supported by bone remains found in close proximity. They come from eight ovicaprines and a gazelle and yield skeletal elements exclusively from body parts rich in meat: forelimbs, vertebral columns, ribs, the pelvic girdle and femora (Fig. 10, bottom).

The crucial question still remains unanswered: was the cow wild or domesticated? Unfortunately, the bones were very fragile, and only some could be measured. It is most instructive to study the position of single bones from the same specimen within the variation of the log-size indices. Considering the measurements in comparison to their arrangement right and left of the zero-line of the reference animal (Fig. 7, arrows), the key problem is repeated here: the measurements in question are grouped in that part of the variation where sizes of both wild and domestic cattle theoretically overlap. Nevertheless, as a tendency this animal could well be a domesticated cow, although this remains questionable.

Iconographic evidence

In area B, at the bottom of a stone borrowing pit of post-Late PPNB date dug into a ruined house with typical Late PPNB architecture, four small figurines were found which are characterised as a hoard deposit (Fig. 11). This post-Late PPNB phase dates, in view of the occurrence of silex points of Yarmoukian character, to the first half of the 6th millennium BC. One of the figurines was a bucranium pendant made out of fired clay (Fig. 11. middle).

[4] The final anthropological analysis is expected.
[5] Unfortunately, no photographic documentation of this situation nor useful drawings were made during excavation.



Remains of small ruminants (goat, sheep, gazelle)

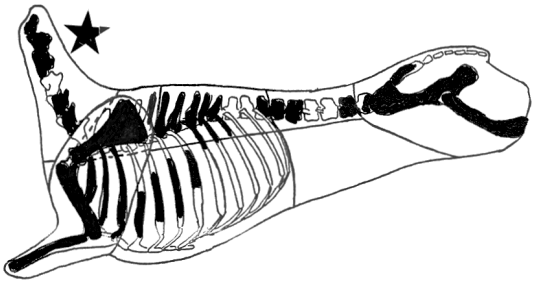


Fig. 10 Basta, Area C. Test unit: 2 x 4m. Schematic representation of body parts from a foetus (left; n = 219, weight: 312 grams) and an adult cattle (right; n = 261, weight: 3.865 grams) as well as from small ruminants (bottom). Arrows = cut-marks, star = chop-marks.

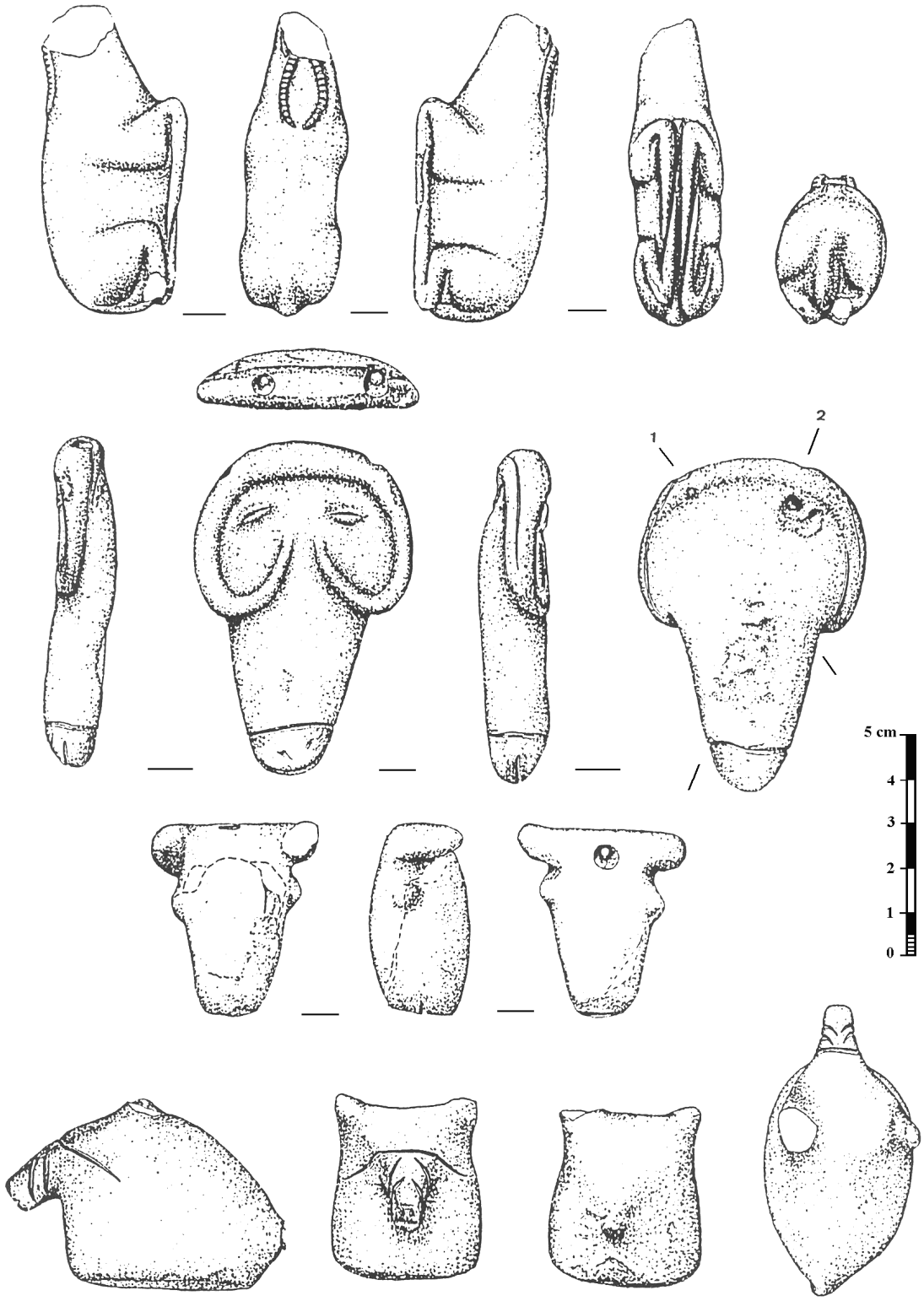


Fig. 11 Basta. Zoomorphic figurines from a hoard deposit. From top to bottom: Gazelle (limestone), ram's head/phallus (limestone), bucranium pendant (fired clay), possible bear (sandstone; from Hermansen 1997, 333).

It measures 52 x 22 mm. The figurine is finger-shaped with only few anatomical characteristics. Intuitively, I would characterise it as a portrait of a domestic animal. One horn core has a reddish pigmentation.

The perforation of the pendant is biconical, pierced from the back and from above (Gebel, pers. com.; Gebel *et al*., unpubl. manuscript).

The other pendant is made of limestone. It represents the head of a ram and – if one turns it 180 degrees – looks like a phallus. Two other figurines have the shape of a gazelle (limestone) and probably a bear (sandstone). Even for modern observers, the gazelle figurine is of particularly high aesthetic quality.

Exploitation of cattle bones as specific raw material

The last aspect I wish to mention briefly is the exploitation of bovine remains as a source of specific utensils. Scapulae and radii were processed and used in a very unique manner which, as far as I know, has never been recorded for a Levantine site of this date. It was most fortunate that in one case the artefacts were found *in-situ* (Fig. 12): Four large shoulder blades (three of bovines and one of an equid: Fig. 12. 6) were arranged like an oval platform under a simple vessel made out of unburned clay and placed upside down. The bones are heavily calcinated in declining intensity from the scapulas' joints to the blades' rim, indicating that the greatest heat was produced at the border of this arrangement. Most probably, the vessel was used as an ember-oven for heating some sort of material. A smoothed and partly calcinated artefact made out of a radius was found nearby (Fig. 12. 3); it served as a shovel to sweep ashes over this construction. This arrangement of the vessel, fire remains and bone utensils was discovered in a courtyard. Another heat-affected scapula and four identically worked radii were found in other parts of the excavation. A more detailed documentation of these artefacts will be presented elsewhere (Becker, in print.).

An attempt to interpret the data

The wealth and diversity of data connected with cattle bones and discussed here, is significant. In summary, these data clearly touch upon different aspects of former life at Late PPNB Basta. They reveal an intriguing number of results, the interpretation of which turns out to be problematic. To begin with the easier part: It is obvious that cattle, the largest artiodactyl in the environment of Basta, attracted a great deal of attention. Hunting focussed on aurochsen, played a major role in the acquiring of meat. From my intimate knowledge of this material, I would estimate that at least half of the bones counted and about two-thirds of the bone weight does derive from wild cattle remains. Aurochsen were butchered in a particular manner, as could be explained from the analysis of the body-part frequency. Transport of trophies and body parts rich in meat seems to have been practised.

The occurrence of wild cattle in the environment of Basta is not surprising, since the plant cover and the structure of the landscape offered suitable conditions at least for smaller herds of aurochsen to survive. This extinct species is said to have been a non-obligatory grazer which fed on grass, herbs and leaves. In the Basta region, such a vegetation was present along the wadis, in sheltered valleys and in the open steppe-forest (Neef 1997). *Bos primigenius* is also evidenced from other sites in the vicinity of Basta, such as Beidha and Ba'ja (Fig. 1 and table 1 with references); hence, we may conclude that the southern regions of the Southern Levant were in fact also part of the former natural range of this species.

We do not know the extent to which these hunting parties were connected with rituals and particular prestigious activities beyond the pure dietary contribution. However, evidence for the generally high value given to cattle (whether wild or domestic) in this PPNB community as well as activities that differ from mundane butchering and meat consumption are witnessed.

One line of argumentation is based upon the deposit of a pregnant cow, which from its particular treatment, arrangement and context provides clear evidence for a ritual feast.

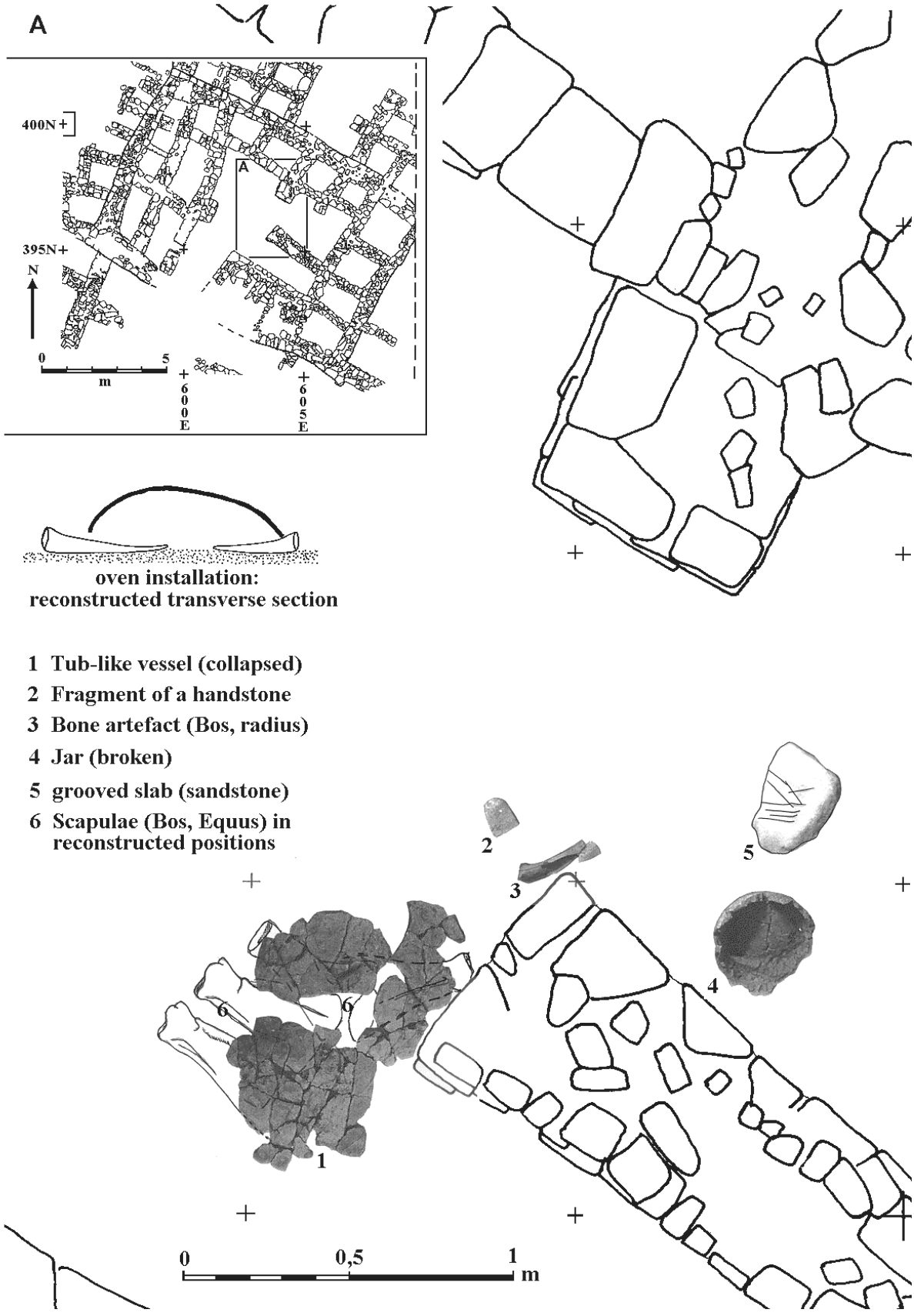


Fig. 12 Basta, area B. Complex of rooms with open space. *In situ* evidence with fireplace and associated artefacts (drawing: H.G.K. Gebel, C. Becker).

This hypothesis is strongly supported by the association of this animal with additional portions of meat, indicated from particular body parts of small ungulates. The strongest argument in favour of a cultic or ritual context is the location of the deposit in an extra-mural space near a human burial.

The burial and the deposit probably may be interpreted as a ritual entity. However, as long as we do not know definitely whether the sacrified animal was wild or domestic, interpretation in greater depth must be postponed. Common sense decrees that killing a pregnant domestic cow, a safe source for many ancestors, would have been counter-productive. Was the sacrifice intented to display an outstanding honour to the buried person? Yet, from another point of view, special regard could also be demonstrated through the sacrifice of a wild specimen which had been trapped. In any case, the true background of this arrangement will never be known, although features like this one are not at all unique in Near Eastern prehistory. Sacrificing selected animals in a pit, trench or other constructions is often evidenced, e.g. in the PPNB tell-site of El Kowm (Vila 1991) or in graves from Mehrgarh (Lechevallier *et al.* 1982: 100). One may add the evidence from "offrandes alimentaires" (cattle, sheep, goat, gazelle) from Late Bronze Age burials in Halawa/Syria (Boessneck and Kokabi 1981, 90f.). The symbolic and/or cultic "value" of cattle/aurochsen in general is witnessed quite regularly in Neolithic and pre-Neolithic contexts, both in Europe and in the Near and Middle East (among many others Hodder 1990; Bru 1992; Vila 1993; Cauvin 1994; Schmidt 1997/8; Russell 1998; Rosenberg 1999: 26 and fig. 10; Hauptmann 1999; Özdoğan 1999: 47 and fig. 24; Chapman 2000: 217; Coqueugniot 2000: 69; Stordeur 2000).

The iconographic representation of cattle in Basta also points to the special role of these animals within the sphere of rituals, as witnessed by the small bucranium pendant. Similar objects have been reported from other Levantine sites with PPNB and PNA sequences; they were part of a wide-spread iconographic tradition (Hermansen 1997). These finds are interpreted as offerings which can be understood as part of a generalised reciprocal relationship between people and "otherworldly beings" (Hermansen 1977: 339). The occurrence of iconographic representations point to a belief in supernatural beings, towards whom such offerings are directed

The most debatable part of the conclusions concerns the true nature of the Basta cattle remains. The mere fact that a cultural value was given to cattle already hints at their specific status, which may be connected with the domesticated nature of at least some of these animals, whose bones were found in the consumption refuse. Hence, this assumption has to be proven with "hard data".

From the metrical analysis, a mixture of aurochsen and domesticated cattle seems to be indicated, although a clear-cut differentiation was not possible. Nevertheless, the question still remains whether the latter were locally tamed and domesticated or imported and from where?

Before trying to answer these questions, two key issues have to be considered: the range and estimated body size of wild cattle and our present knowledge of cattle domestication in the Southern Levant.

Bos primigenius with its subspecies was widely distributed over most parts of Eurasia, including North Africa and the Middle and Near East (Uerpmann 1987, 71ff.). The southern border of this distribution ran through the Sinai Peninsula, as indicated by bone finds from Wadi Tbeik and Ujrat el-Mehed (fig. 1.16, 17). Among other sites, Basta marks the southeastern boundary of its range; on the Arabian Peninsula, the hot and dry conditions would of course have limited this range (Schmidt-Nielsen 1979, 71ff.). Although as a reaction to favourable or deteriorating environmental conditions, the limits of this distribution could have fluctuated (Ducos and Horwitz 1997; Cauvin *et al*. 1998), the vast extent of the natural range of aurochsen in general is unchallenged. It implies a broad biological adaptability of this species (Uerpmann 1979: 125). According to the generally accepted view, distribution over a large territory influences the variability of body size in a species, an observation which applies not only to cattle but also to other ungulates such as red deer (Bützler 1986: 121). Animals from the south supposedly have a smaller body size and lighter weight than their relatives in northern regions (Bergmann's rule: Illies 1971: 5; Davis 1981; Grigson 1989). Consequently, for *Bos primigenius* which once roamed the Southern Levant and in particular its most southernly part, a comparatively small size can be expected, as D. Helmer (1989: 112) has hypothesized for Palestine. Unfortunately, the amount of metrical data available for this area is far from sufficient to make any precise statements on the size of wild cattle, either for a specific period or concerning developments

over a longer time-span, as the attempt of P. Ducos and L.K. Horwitz (1997) has demonstrated. Although their results look temptingly significant, we must not close our eyes to the fact that for a period of about 7000 years, only 130 measured bones have been considered (Ducos and Horwitz 1997: 236). Particularly for the late PPNB, the lack of data has even greater consequences, for it is this period when domestic cattle appeared on the scene and when their bones might be expected in the refuse of Southern Levantine settlements. The crucial problem is how to differentiate them from aurochsen remains, since a major overlap in size has to be calculated.

Basta is an almost perfect example of this intriguing situation. It has been repeatedly mentioned that two groups of sizes can be recognised within the metrical variability of the Basta material: bones of large size which clearly represent wild cattle, and bones of middle and small size, which either could represent female aurochsen (a less feasible conclusion) or both female aurochsen and domesticated cattle. I would favour the latter explanation. If viewed alone, morphometric criteria are quite often difficult to use (Vigne *et al*. 2000a: 201). Fortunately, the sample from Basta offers more than metrically based information, which under such conditions needs to be noted here.

From the culling profile of the Basta material there is little doubt that a relatively high frequency of young animals is manifested. At first sight, we could be happy with this result, in accordance with the conventional interpretation: hunting is indicated by a high frequency of adults, whereas many young specimens are indicative of domestication. In addition, for Middle PPNB sequences in the Southern Levant, a phase without any indication of domestic influences on cattle at all, age profiles definitely indicate a predominance of adult animals (Horwitz 2000: 69). Yet, results from other faunal samples also predating any domestication processes contradict such a view. In these cases, higher frequencies of young cattle are found as well (Peters *et al.* 2000). This has also been emphasised by J.-D. Vigne and D. Helmer (1999: 132). The authors express their doubts as to the usefulness of conventional deductive interpretation rather waiting for ongoing genetic research, (see for example Bailey *et al.* 1996; MacHugh *et al.* 1998) – a view I share entirely.

Is the ratio of male versus female specimens more expressive? In the Basta material it appears that female cattle predominate. This result seems to be an additional argument in favour of the occurrence of domestic animals. Unfortunately, the sex ratio alone is not significant for the wild or domestic status of a population. On the contrary, a number of divergent results has come from cattle material dating to periods preceding domestication. For example, at PPNA Göbekli Tepe and Early PPNB Nevali Çori, bulls seem to have dominated (< 60%), in contrast to sites such as Mureybit III (PPNA) with equal proportions of both sexes or PPNA Jerf el Ahmar and Early PPNB Dja'de, where females dominate (Peters *et al*. 2000: 40 and footnote 106). Since it may be relevant for the culling profile, it is concluded that specific sex ratios could also point to selective hunting and/or particular hunting techniques (Grigson 1989, 78ff.).

But what do we know exactly about Late PPNB hunting techniques? It would seem practical wisdom that a hunter would follow different practises while trying to minimise the risks to himself. Hunting in groups of people with bow and arrow is quite seldom indicated (cf. Akkermans and Cavallo 1999: 10; Cavallo *et al*. 2000, 5ff.). If we consider the large size of (male) aurochsen and their probable aggressiveness when they felt cornered by an approaching enemy, would not everyone prefer a less direct system of capture than confrontation in the open steppe? Why not trap cattle in large pits or try to capture calves? If we envisage pit-traps, then the occurrence of animals of all ages should be expected and trapping cows with their calves increases in probability, because of their close relationship. In other words, the relative accessibility of different ages and sexes as well as particular hunting procedures may dictate the result. In addition, it should be born in mind that the behavioural and biological patterns of this extinct animal are mostly unknown. All we know is deduced from research on modern cattle breeds and from a small herd of re-bred aurochsen, kept in an enclosure near Düsseldorf in Germany (Perrey 1999).

Notwithstanding all the objections listed above, the culling profile as well as the sex ratio seem to suggest, however vaguely, that the metrically founded argument in favour of the existence both of aurochsen and domestic animals, might be a possibility. Earlier formulated results on cattle frequencies which did not take a certain number of domesticates into consideration (Becker 2000a, 200f.), should be reconsidered. Here, we must stress that in terms of reliability, a precise ratio of wild vs.

domestic cattle for the Basta assemblage cannot be stated definitely. I reckon, however, that approximately half of the material does come from domesticated animals.

If we accept this interpretation so far, the second problematic issue still remains: is this an incipient domestication of cattle or an import of already domesticated animals. To date, we have no clear evidence for any local domestication of cattle in this region. From an ecogeographical standpoint, this idea seems less likely. The abundance, distribution and structure of natural resources, in this case the occurrence of herds of wild cattle, are the dominant factors which affect the behaviour of men. One may ask critically whether in this rather marginal and highly structured landscape with quite low precipitation levels (cf. Becker 2000a, 198ff.) the transformation from wild to domestic cattle could be successful. Such an undertaking would require sustained breeding of larger tamed populations and the reliability of food resources to ensure the survival of such herds and buffer failures. The provision of fodder could have been a largely limiting factor. The hot and dry summer months represent an especially critical ecological threshold, if we consider the competitive role of sheep and goat in the Basta area.

The favourite habitat of aurochsen was undoubtedly the riverine, wet marshy region along the Middle Euphrates and the alluvial plains in the Damascene Basin. Here, a pool of wild animals large enough for the long process of domestication did exist, as has been demonstrated in the many sites with clear evidence for early cattle domestication (Peters *et al*. 2000; Vigne *et al.* 2000b). It can be postulated that in these northern regions domestication started in the Middle PPNB and was fully developed by the Late PPNB. The northern regions of the Southern Levant (or the "Central" Levant, however) were integrated within this process. Incipient domestication of cattle is postulated for example at ʻAin Ghazal (Von den Driesch and Wottke 1997, fig. 15, 16), Jericho (Clutton-Brock 1979), Beisamun (Davis 1978) and Abu Gosh (Helmer 1989). For the southernmost part of this area, the scenario appears more obscure due to the scarcity of data. The environmental conditions and the population density of wild cattle in the southern part of the Southern Levant could hardly have been comparably favourable and thus, indigenous domestication has little credibility. In addition, in the Basta assemblage we have no development of large to small animals, which one would expect with a local domestication process, but rather a simultaneous occurrence of both sizes from the oldest sequences onwards. Although from the oldest to the younger strata the frequency of cattle remains doubles, the relative amount of cattle bones in comparison to the overwhelming number of ovicaprines, never reaches a significant amount. A more striking example in this respect was demonstrated among other places at Tell Halula (Helmer 1994: 47). There, a dramatic increase of cattle remains from the Middle to the Late PPNB was observed. In combination with metrical data this not only clearly supports the idea that domestic cattle were kept in considerable numbers, but also that a local domestication took place there (cf. also Tchernov 1993: 207).

To conclude, I think it is more likely that the Basta cattle were imported into the greater Petra area, an idea already expressed by J.-D. Vigne (2000, tab. 1 and p.156). That may also account for the domesticated cattle evidenced at Ba'ja, another Late PPNB site in the vicinity of Basta (Von den Driesch *et al*. forthcoming; Von den Driesch 2000: 72). The provenance of such animals is still a matter of debate. We have sites such as ʻAin Ghazal and farther to the north, Tell es Sinn, Bouqras and El Kowm, where indigenous cattle domestication is attested and populations large enough for export from settlements, may have existed. Transport of animals from those regions along the Levantine Corridor, through the semi-arid strip along the Jordanian Rift Valley, is feasible (cf. Tchernov 1993: 212).

The Late PPNB is the pivotal time period when diffusion from the centres of domestication into those areas without sufficiently large stock for local domestication can easily be imagined. Most obviously, the kind of relationship between the Basta community and northern regions during the Late PPNB cannot be simply read off from a faunal assemblage alone, but patterns of cultural connections which are affected by a variety of factors must also be considered (cf. Reinhold and Steinhof 1995, 13ff.). It seems plausible to argue that a site of that size (10 ha) would have had a major effect on surrounding communities and exert a "magnetic pull" on new economic features.

The familiarity of the Basta inhabitants with aurochsen as hunted game and their experience with sheep and goat husbandry could have led to an accumulation of knowledge large enough to help them

adapt relatively quickly to the management of cattle. However, the reliance on domestic cattle as a source of meat can never have been decisively large and cattle-breeding seems to have been practised on a relatively small scale, as estimated from the low number of bones from domestic cattle. This supplementary source of meat did not have a major impact on food procurement activities – people continued to practise ovicaprine husbandry on a large scale and continued their hunting.

Nevertheless, the impression remains that beyond the number of cattle finds in this assemblage, the species as such had an important meaning for the inhabitants. The relationship between man and cattle in Basta may not have been guided by rational economic thinking alone. The most important aspect of cattle management may not have been the procurement of meat *per se* or the sheer quantity of it, but the "arrangement" for visual display or the satisfaction of non-profane demands. The deposit of zoomorphic items and of a pregnant cow as well as the ritual consumption of meat may be seen within the context of such demands. Whoever masterminded the latter performance, was rewarded with prestige, esteem, honour and rank, and the person(s) for whom this was arranged most probably enjoyed a higher social rank, too. Interestingly, in Basta this masterminding ability was evidenced in other aspects of the material culture such as the architecture (Nissen *et al*. 1987, 88f.). From proceedings such as a great feast or display, people could maintain social cohesion or the necessary bonds between households. In this respect, cattle might have played an important role. Not only may a successful hunt for aurochsen have been largely connected with prestige, but also ownership of domestic animals could represent means to define household wealth.

Concluding remarks

It is widely acknowledged that during the Late PPNB special economic developments did take place, a glimpse of which was also reflected in remote regions of the southern part of the Southern Levant, namely at the site of Basta. The study described here focussed on the role of cattle within this scenario. An attempt was made to answer the question of whether during the 7th millennium BC, domestic cattle had found their way into the Petra area. While irrefutable proof is lacking due to the scattered nature of the database, I have argued that this question may be answered positively. However, for a variety of reasons of which ecological considerations are the strongest, incipient domestication of cattle at Basta seems less plausible. I would rather suggest the introduction of already domesticated specimens from northern areas. If we accept these results as an interim solution, the estimated amount of meat from wild game in Basta consequently has to be reduced and previous considerations need to be corrected (cf. Becker 2000a, 200f.), although not dramatically.

The line of argumentation considers a wide range of information primarily from the bone material itself, but also beyond the osteological evidence, following a "sous-système d'une chaîne opératoire", well known in archaeology and also proposed for osteological concerns by J.-D. Vigne (1998). If one understands all available aspects as a network of associated factors and not in isolation, it can reasonably be hypothesised that during the Late PPNB in Basta, a particular association between men and cattle, including both wild and domesticated animals, did exist.

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