THE DEVELOPMENT OF GOAT AND SHEEP HERDING DURING THE LEVANTINE NEOLITHIC

Volume 2

Alexander Michael Richard WASSE

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy at the University of London

January 2000

Institute of Archaeology
University College London

CHAPTER 8: IDENTIFICATION OF 'AIN GHAZAL CAPRINE REMAINS TO SPECIES

8.1: INTRODUCTION:

The identification to species of as large a proportion as possible of the caprine remains from 'Ain Ghazal was undertaken with two key objectives in mind: to generate reliable quantitative, diachronic zooarchaeological data for each species, and to identify the individual morphological characteristics on each POSAC by which an accurate identification to species could be made. To this end the selected caprine remains were subjected to three different analyses (see below and Chapter 2).

In the First Analysis the caprine remains from 'Ain Ghazal were identified to species, where possible, on the basis of traditional methods of comparison with published and unpublished morphological criteria (e.g: Boessneck 1969, Kratochvil 1969, Prummel and Frisch 1986, Helmer and Rocheteau 1994, Wasse n.d.) and modern reference material. The aim was to simply and relatively quickly identify as many POSACs to species as possible. The identifications obtained in this analysis form the basis of the zooarchaeological investigation of the 'Ain Ghazal caprines undertaken in this study. In addition, the potential effect on interpretation of variation in the proportion of each POSAC identifiable to species by this method was examined.

The Second Analysis used metrical techniques (Payne 1969) to identify caprine distal metacarpals to species. The aim was to independently check at least some of the identifications obtained during the First Analysis by an entirely different method before using them as the basis of this zooarchaeological investigation of the 'Ain Ghazal caprines.

The Third Analysis comprised a principal components analysis of the individual morphological characteristics contributing to variation in goat and sheep bone morphology (based on Buitenhuis 1995). The aims of this analysis were threefold: to identify the particular morphological characteristics of each POSAC on which a reliable identification to species could be made, to check the potentially subjective identifications of the First Analysis under controlled, quantitative conditions, and finally to investigate whether this type of principal components analysis has the potential to identify a greater proportion of caprine remains to species than traditional methods.

8.2: FIRST ANALYSIS (COMPARISON WITH PUBLISHED AND UNPUBLISHED MORPHOLOGICAL CRITERIA, AND MODERN REFERENCE MATERIAL):

The sample for this analysis comprised all 4747.5 POSACs (adjusted NISP) from 'Ain Ghazal which were examined during the course of this study. As expected, it proved impossible to identify all specimens to species and a substantial proportion remained in the goat/sheep category. The results of this analysis are listed by phase in Table 8 1.

Phase	n	goat	sheep	gt/sh	% n i.d.	gt:sh
MPPNB	1944.5	1134	7	803.5	58.7	1:0.01
LPPNB	434	138.5	113.5	182	58.1	1:0.8
LPPNB/PPNC	90.5	48	64.5	78	59.1	1:1.3
PPNC	1216.5	220	483.5	513	57.8	1:2.2
Yarmoukian	962	153	321	488	49.3	1:2.1
TOTAL	**4747.5**	**1693.5**	**989.5**	**2064.5**	**56.5**	**1:0.6**

Key: n=adjusted NISP, goat=n identified as goat, sheep=n identified as sheep, gt/sh=n not identified to species, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.1: Results of First Analysis of 'Ain Ghazal Caprine Bone by Phase

8.2.1: Relative Proportion of Goats and Sheep:

The results in Table 8.1 demonstrate that the proportion of sheep in the 'Ain Ghazal caprine sample increased during the period of the site's occupation. There was a marked shift in the goat to sheep ratio from 1:0.01 during the MPPNB, when sheep were virtually absent, to over 1:2 during the PPNC and Yarmoukian periods. Sheep appear to have been first exploited in large numbers at 'Ain Ghazal from the LPPNB onwards.

8.2.2: Proportion of Caprine Remains Identifiable to Species:

The results in Table 8.1 also demonstrate that the proportion of identifiable specimens from each phase is relatively consistent at just under 60%. The slightly lower proportion of identified specimens from the Yarmoukian is almost certainly a reflection of the higher levels of calcretion affecting this material

8.2.3: Proportion of Each POSAC Identifiable to Species:

In Table 8.2 the results of the First Analysis are presented for each POSAC in rank order of percentage identified to species.

POSAC	n	goat	sheep	gt/sh	% i.d.	gt:sh
Distal Metacarpal	278	178.5	94.5	5	98.2	1:0.5
Distal Metatarsal	256	159.5	85	11.5	95.5	1:0.5
Distal Radius	175	89	58	28	84.0	1:0.7
Astragalus	530	236	163	131	75.3	1:0.7
Pelvis	162	68	47	47	71.0	1:0.7
Distal Metapodial	54.5	25.5	13	16	70.6	1:0.5
Calcaneum	336	122	70	144	57.1	1:0.6
Distal Humerus	542	154	140	248	54.2	1:0.9
First Phalanx	719	294	95	330	54.1	1:0.3
Distal Tibia	388	110	85	193	50.3	1.0.8
Distal Scapula	414	84	92	238	42.5	1:1.1
Third Phalanx	464	155	39	270	41.8	1:0.3
Distal Femur	90	7	2	81	10.0	1:0.3
Mandible with teeth	322	11	6	322	5.0	1:0.5
TOTAL	**4747.5**	**1693.5**	**989.5**	**2064.5**	**56.5**	**1:0.6**

Key: n=adjusted NISP, goat=n identified as goat, sheep=n identified as sheep, gt/sh=n not identified to species, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.2: Results of First Analysis of 'Ain Ghazal Caprine Bone by POSAC

The results in Table 8.2 demonstrate that some POSACs are more easily identifiable to species using this method than others. Three categories can be distinguished in the proportions of each POSAC identifiable to species.

1) **>70% identifiable:** distal metacarpal, distal metatarsal, distal radius, astragalus, pelvis and distal metapodial.
2) **40%-60% identifiable:** calcaneum, distal humerus, first phalanx, distal tibia, distal scapula and third phalanx
3) **<10% identifiable:** distal femur and mandible with teeth.

The results in Table 8.2 are broken down by phase in Tables 8.3 to 8.7 to examine whether this pattern is repeated consistently throughout the main phases of occupation at 'Ain Ghazal.

POSAC	MPPNB n	% i.d.	gt;sh
Distal Metacarpal	116	97.4	1:0
Distal Metatarsal	103	93.7	1:0.01
Distal Radius	82	80.5	1:0
Pelvis	13	75.0	1:0
Astragalus	216	74.1	1:0.01
Distal Metapodial	32.5	66.2	1:0
Calcaneum	127	62.2	1:0.03
Distal Tibia	128	57.0	1:0.01
Distal Humerus	166	56.6	1:0.01
First Phalanx	421	53.9	1:0
Distal Scapula	92	43.5	1:0.03
Third Phalanx	315	39.7	1:0
Distal Femur	42	11.9	1:0
Mandible with teeth	52	3.8	1:0
TOTAL	**1944.5**	**58.7**	**1:0.01**

Key: n–adjusted NISP, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.3: Results of First Analysis of MPPNB Caprine Bone by POSAC

POSAC	LPPNB n	% i.d.	gt;sh
Distal Metacarpal	35	98.6	1:0.5
Distal Metatarsal	29	91.4	1:0.4
Astragalus	50	82.0	1:1.2
Distal Metapodial	4	75.0	1:0.2
Distal Radius	18	72.2	1:2.3
Calcaneum	40	57.5	1:0.6
Distal Tibia	44	56.8	1:0.9
Third Phalanx	29	55.2	1:1
Distal Humerus	52	48.1	1:1.3
Pelvis	13	46.2	1:1
First Phalanx	39	43.6	1:0.3
Distal Scapula	54	37.0	1:1.5
Distal Femur	4	25.0	1:0
Mandible with teeth	22	4.3	0:1
TOTAL	**434**	**58.1**	**1:0.8**

Key: n=adjusted NISP, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.4: Results of First Analysis of LPPNB Caprine Bone by POSAC

LPPNB/PPNC			
POSAC	n	% i.d.	gt;sh
Distal Metacarpal	14	100.0	1:1.5
Distal Metatarsal	12	100.0	1:1.4
Pelvis	9	88.9	1:1.7
Astragalus	21	85.7	1:2
Distal Radius	6	83.3	1:1.5
Distal Humerus	24	62.5	1:1.5
First Phalanx	23	60.9	1:0.8
Distal Metapodial	2.5	60.0	1:2
Distal Scapula	11	54.5	1:0.5
Distal Tibia	24	45.8	1:0.8
Distal Calcaneum	11	36.4	0:1
Third Phalanx	12	25.0	1:0.5
Mandible with teeth	15	6.7	0:1
Distal Femur	6	0.0	0:1
TOTAL	**90.5**	**59.1**	**1:1.3**

Key: n=adjusted NISP, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.5: Results of First Analysis of LPPNB/PPNC Caprine Bone by POSAC

PPNC			
POSAC	n	% i.d.	gt;sh
Distal Metacarpal	71	100.0	1:2.2
Distal Metatarsal	63.5	97.6	1:1.9
Distal Radius	47	91.5	1:2.3
Distal Metapodial	9	83.3	1:14
Pelvis	48	72.9	1:1.1
Astragalus	154	69.5	1:2.2
Calcaneum	93	57.0	1:1.5
First Phalanx	130	53.8	1:1.9
Distal Humerus	178	52.8	1:4.2
Distal Tibia	104	51.9	1:3.2
Third Phalanx	80	50.0	1:1.2
Distal Scapula	139	43.9	1:3.4
Distal Femur	25	8.0	1:1
Mandible with teeth	75	5.3	1:0
TOTAL	**1216.5**	**57.8**	**1:2.2**

Key: n=adjusted NISP, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.6: Results of First Analysis of PPNC Caprine Bone by POSAC

	Yarmoukian		
POSAC	n	% i.d.	gt;sh
Distal Metatarsal	48.5	97.9	1:1.6
Distal Metacarpal	42	96.4	1:1.6
Distal Radius	22	90.0	1:4
Astragalus	89	82.0	1:2.8
Distal Metapodial	6.5	76.9	1:9
Pelvis	40	67.5	1:3.5
First Phalanx	106	57.5	1:1.8
Distal Humerus	122	54.1	1:1.5
Calcaneum	65	50.8	1:2.3
Distal Scapula	118	41.5	1:1.6
Distal Tibia	88	36.4	1:4.3
Third Phalanx	28	35.7	1:4
Distal Femur	13	7.7	0:1
Mandible with teeth	174	5.2	1:0.8
TOTAL	**962**	**49.3**	**1:2.1**

Key: n adjusted NISP, % n i.d.=% n identified to species, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.7: Results of First Analysis of Yarmoukian Caprine Bone by POSAC

The results in Tables 8.3 to 8.7 demonstrate firstly that the same POSACs are consistently easier to identify to species, and secondly that the proportion of each POSAC identified to species is similar in each phase. This was expected in light of the consistency in the overall proportion of POSACs identified to species from each phase (see 8.2.2 and Table 8.1).

8.2.4: Effect of the Proportion of Caprine Specimens Not Identified to Species on the Goat to Sheep Ratio:

The results in Tables 8.2 to 8.7 also suggest that a goat to sheep ratio calculated on the basis of less easily identified POSACs is more likely to diverge from that of the sample as a whole than a goat to sheep ratio calculated on the basis of a more easily identified POSAC. This is more clearly demonstrated in Table 8.8 where the mean and standard deviation of the goat to sheep ratios for the six highest ranking POSACs (excluding unassigned distal metapodia) is compared with mean and standard deviation of the goat to sheep ratios for the six lowest ranking POSACs.

POSAC	mean	min	max	std.dev
6 highest ranking	1:0.617	1:0.5	1:0.7	0.098
6 lowest ranking	1:0.550	1:0.3	1:1.1	0.333

Table 8.8: Means, Minima, Maxima and Standard Deviations of Goat to Sheep Ratios of Six Most Identifiable and Six Least Identifiable POSACs (see Table 8.2)

The higher standard deviation of the six lowest ranking POSACs suggests that goat to sheep ratios obtained from caprine samples in which the proportion of specimens unidentified to species is high should be treated with caution. The data in Table 8.8 are presented for each phase in Table 8.9 to examine whether this pattern is repeated consistently throughout the main phases of occupation at 'Ain Ghazal (unassigned distal metapodia excluded throughout).

Phase	POSAC	mean	min	max	std.dev
MPPNB	6 highest ranking	1:0.008	1:0	1:0.03	0.0116
MPPNB	6 lowest ranking	1:0.007	1:0	1:0.03	0.0121
LPPNB	6 highest ranking	1:0.983	1:0.4	1:2.3	0.708
LPPNB	6 lowest ranking	1:0.683	1:0	1:1.5	0.668
LPPNB/PPNC	6 highest ranking	1:1.600	1:1.4	1:2	0.219
LPPNB/PPNC	6 lowest ranking	1:0.300	1:0	1:0.8	0.346
PPNC	6 highest ranking	1:1.867	1:1.1	1:2.3	0.476
PPNC	6 lowest ranking	1:2.167	1:0	1:4.2	1.656
Yarmoukian	6 highest ranking	1:2.550	1:1.6	1:4	1.043
Yarmoukian	6 lowest ranking	1:2.167	1:0	1:4.3	1.721

Table 8.9: Means, Minima, Maxima and Standard Deviations of Goat to Sheep Ratios of Six Most Identifiable and Six Least Identifiable POSACs by Phase (see Tables 8.3 to 8.7)

In four out of the five phases in Table 8.9 the goat to sheep ratio of the lowest ranking skeletal elements has a higher standard deviation than the goat to sheep ratio of the highest ranking skeletal elements. This suggests the problems associated with obtaining representative goat to sheep ratios from caprine samples with a high proportion of specimens which are not identified to species are, if not universal, at least a regularly recurring phenomenon. In addition, the results in Table 8.9 draw attention to the fact that this problem is more pronounced in samples which contain large numbers of both species, such the PPNC and Yarmoukian, than in samples which are dominated by one species or the other, such as the MPPNB.

8.2.5: Effect of Variation in the Proportion of Each POSACs Identified to Species on Construction of Age Profiles:

The methods used in the First Analysis to separate samples of caprine bone clearly and consistently result in the identification of varying proportions of each POSAC, as demonstrated above. This poses a significant problem with regard to the construction of separate age profiles for goats and sheep.

In small samples, such the LPPNB and LPPNB/PPNC, the number of less easily identified POSACs assigned to one species or the other is tiny, owing to the high number of bones remaining in the unidentified goat/sheep category. Unfortunately epiphyseal fusion data from a number of these POSACs, including the distal humerus, first phalanx, distal tibia and distal femur, are commonly used to generate age profiles. It is therefore clear that if this method is used to separate small samples of goat and sheep bone, it will be extremely difficult to construct detailed age profiles for each species which draw on data from less easily identifiable POSACs. Even if samples are large, the fact that the goat to sheep ratio of these elements may not be representative of the sample as a whole (see 8.2.4) means that any age profiles thus generated should be treated with extreme caution.

8.3: SECOND ANALYSIS (METRICAL SEPARATION OF DISTAL METACARPALS):

The sample for this analysis (Payne 1969) comprised the entire sample of 'Ain Ghazal caprine distal metacarpals on which w.cond and w.troch measurements could be taken. It was possible to obtain these measurements on a total of 217 individual metacarpal condyles (see Table 8.10). These included both medial and lateral, and fused and unfused specimens. As each metacarpal has two condyles this was equivalent to an adjusted NISP count of 108.5, or 39.0% of the total sample of 278 (adjusted NISP) caprine distal metacarpals examined during the course of this study (see Table 8.2). The measured condyles were inevitably amongst the best preserved and as a result all but one had been identified to species during the First Analysis. In Figures 8.1 to 8.6 the measured metacarpal condyles are categorised on the graphs according to their identification as goat, sheep or goat/sheep in the previous analysis.

8.3.1: Independent Check of Caprine POSAC Identifications Obtained in the First Analysis:

The w.cond and w.troch measurements of the entire sample of caprine metacarpal condyles from 'Ain Ghazal measured during the course of this study are plotted in Figure 8.1.

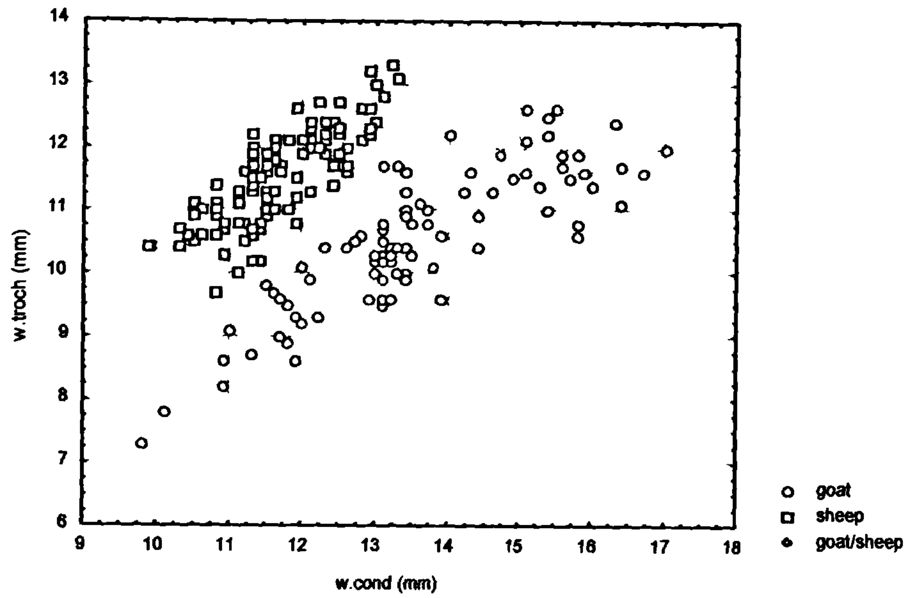


Figure 8.1: Metrical Separation of All 'Ain Ghazal Caprine Metacarpal Condyles

In Figure 8.1 it is clear that the specimens identified as goat or sheep in the First Analysis fall into two clear clusters with no intermediate specimens, confirming the initial identification in each instance. This suggests that Payne's (1969) metrical separation of goat and sheep metacarpals can correctly identify the great majority of distal metacarpal condyles on which w.cond and w.troch measurements can be taken. In addition, it is clear from Figure 8.1 that the single previously unidentified metacarpal condyle should be identified as sheep.

Although the distal metacarpal was one of the easiest POSACs to identify to species in the First Analysis (see 8.2.3), these results suggest that the traditional use of published/unpublished morphological criteria and modern reference material to identify caprine remains to species can produce accurate identifications of a large proportion of specimens. Therefore, as a result of the Second Analysis confidence in the identifications of other POSACs obtained in the First Analysis is increased.

8.3.2: Independent Check of Goat to Sheep Ratios Obtained in the First Analysis:

As it was possible to identify each measured metacarpal condyle to species it was also possible to calculate exact goat to sheep ratios for this POSAC during each phase of occupation. The data in Figure 8.1 are therefore broken down by phase in Figures 8.2 to

8.7 to independently check the goat to sheep ratios for each phase obtained in the First Analysis.

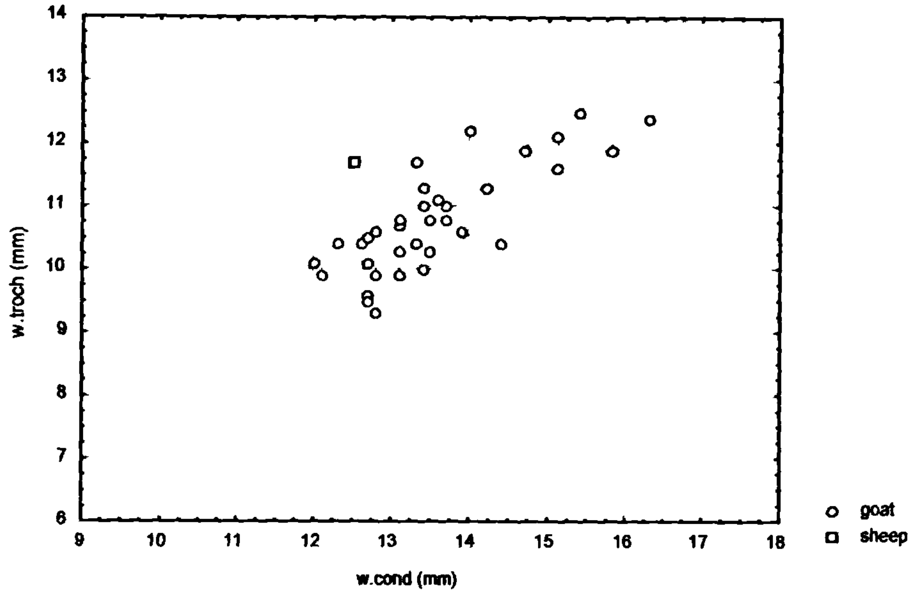


Figure 8.2: Metrical Separation of MPPNB 'Ain Ghazal Caprine Metacarpal Condyles

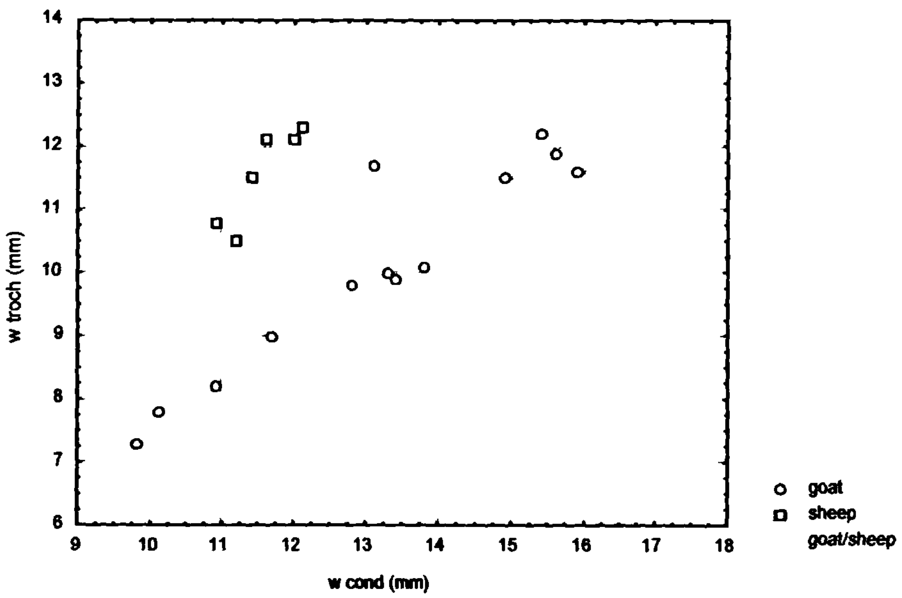


Figure 8.3: Metrical Separation of LPPNB 'Ain Ghazal Caprine Metacarpal Condyles

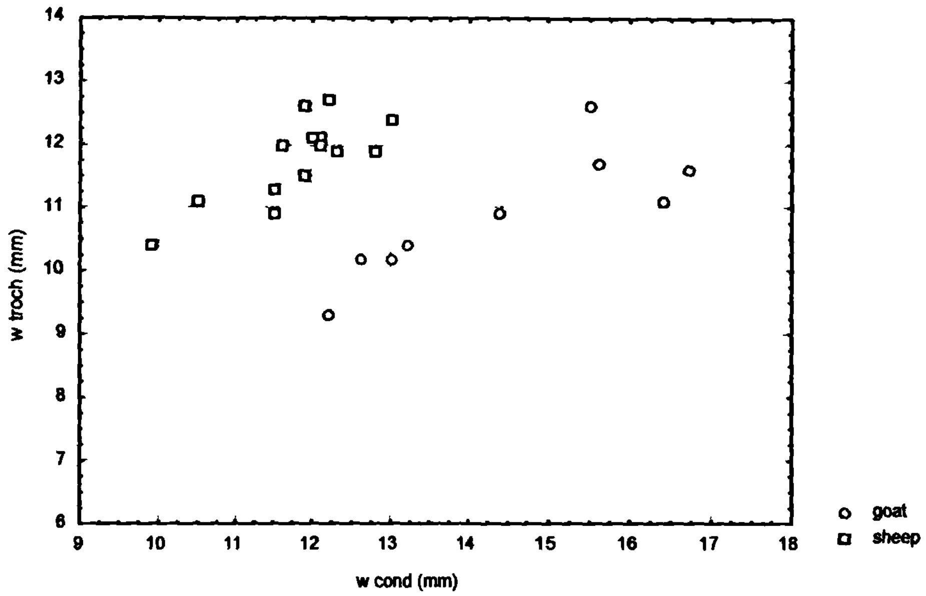


Figure 8.4: Metrical Separation of LPPNB/PPNC 'Ain Ghazal Caprine Metacarpal Condyles

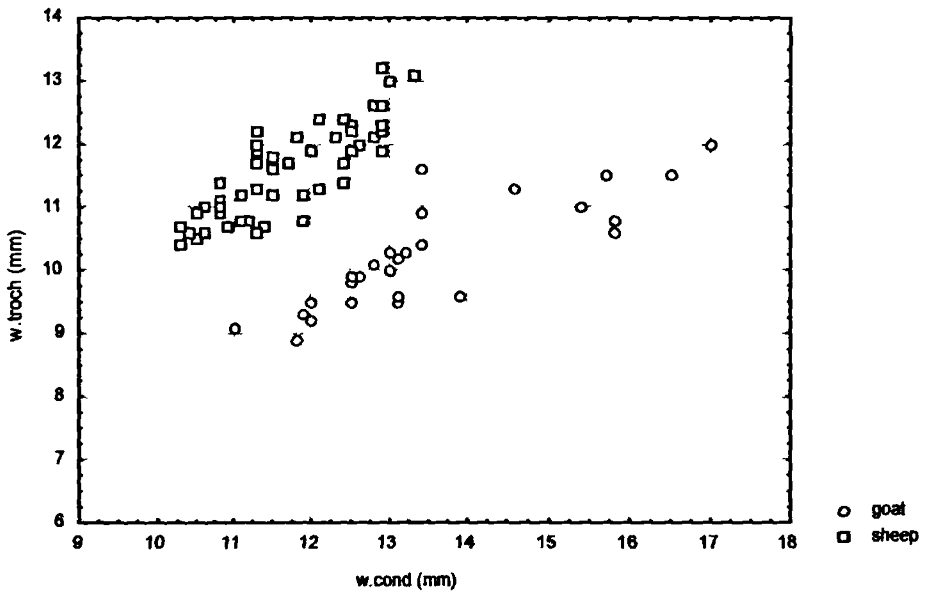


Figure 8.5: Metrical Separation of PPNC 'Ain Ghazal Caprine Metacarpal Condyles

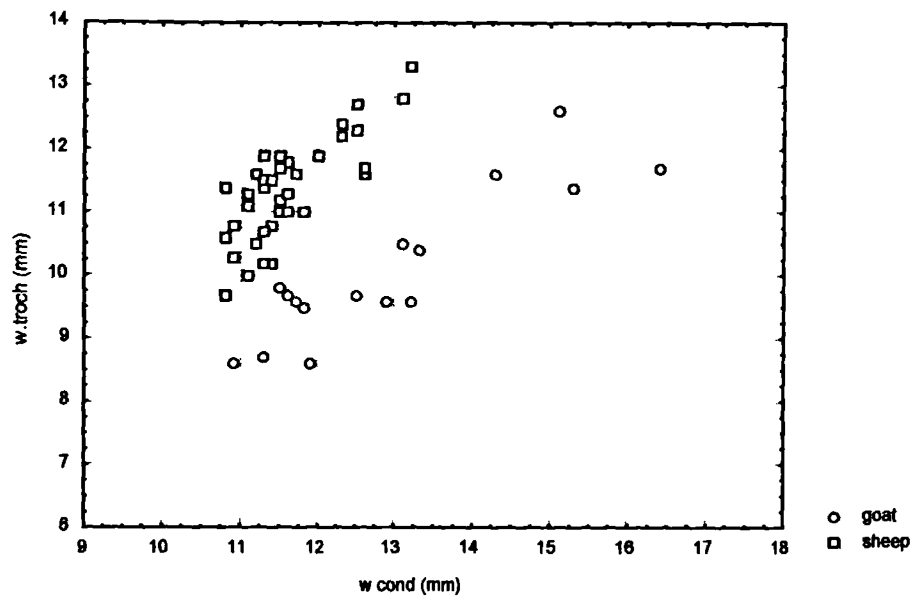


Figure 8.6: Metrical Separation of Yarmoukian 'Ain Ghazal Caprine Metacarpal Condyles

Goat to sheep ratios of metrically separated distal metacarpals for each phase were calculated on the basis of the results in Figures 8.2 to 8.6 and are listed in Table 8.10, where they are compared with the mean goat to sheep ratios of all POSACs obtained in the First Analysis (see Table 8.1).

Phase	n goat	n sheep	n total	2nd Analysis gt:sh	1st Analysis gt:sh
MPPNB	37	1	38	1:0.03	1:0.01
LPPNB	14	7	21	1:0.5	1:0.8
LPPNB/PPNC	10	14	24	1:1.4	1:1.3
PPNC	28	52	80	1:1.9	1:2.2
Yarmoukian	16	38	54	1:2.4	1:2.1
TOTAL	**105**	**112**	**217**	**1:1.1**	**1:0.6**

Key: n=NISP, n goat=n specimens identified as goat in Second Analysis, n sheep=n specimens identified as sheep in Second Analysis, gt:sh=ratio of specimens identified as goat to specimens identified as sheep

Table 8.10: Goat to Sheep Ratios of Metrically Separated 'Ain Ghazal Caprine Metacarpal Condyles (see Figures 8.2 to 8.6), Compared with Mean Goat to Sheep Ratios of all POSACs Obtained in First Analysis (see Table 8.1)

The results in Table 8.10 demonstrate that the goat to sheep ratios for each phase obtained through metrical analysis of metacarpal condyles, in which the entire sample was identified to species, are broadly comparable with the mean goat to sheep ratios of all POSACs for each phase obtained in the First Analysis, despite the fact that in the First

Analysis not all POSACs were identified to species. Confidence is thus increased in the mean goat to sheep ratios for each phase obtained in the First Analysis.

8.4: THIRD ANALYSIS (PRINCIPAL COMPONENTS ANALYSIS):

It was decided to exclude a number of POSACs from this analysis: the pelvis because of the difficulty of distinguishing inter-sexual from inter-species variation, the distal femur because of the paucity of published species-specific morphological characteristics and generally poor state of preservation, and mandibles with teeth because these were identified to species, in the few cases where it was possible, on the basis of dental morphology (Payne 1985b) which is affected by the stage of dental wear.

Unfortunately it was not possible to subject the entire remaining sample of 'Ain Ghazal caprine POSACs owing to the time required to record the requisite data. A sub-sample of 1514, or approximately one third, of the selected POSACs, was therefore drawn from the sample as a whole (see Table 8.11). These were selected on the basis of a subjective assessment of their state of preservation, owing to the need to record as many morphological characteristics as possible on each specimen. It was decided that for a specimen to qualify for inclusion at least two morphological characteristics would have to be recorded. The raw data for this analysis, i.e.: the scores for each specimen, are contained in Appendix A.

POSAC	n	n goat	n sheep	n goat/sheep
Distal Scapula	153	50	46	57
Distal Humerus	189	50	82	57
Distal Radius	69	28	38	3
Distal Tibia	141	49	48	44
Distal Metacarpal	124	62	61	1
Distal Metatarsal	122	70	50	2
First Phalanx	274	118	68	88
Third Phalanx	107	43	23	41
Astragalus	220	105	90	25
Calcaneum	115	46	43	26
TOTAL	**1514**	**621**	**549**	**349**

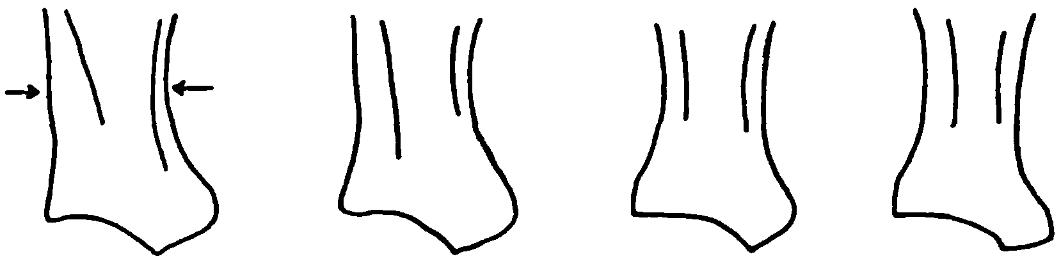
Key: n–NISP, n goat=n specimens identified as goat in First Analysis, nsheep=n specimens identified as sheep in First Analysis, n goat/sheep=n specimens identified as goat/sheep in First Analysis

Table 8.11: The Sample of 'Ain Ghazal Caprine POSACs Subjected to Principal Components Analysis

In the results presented below the selected specimens are categorised according to their previous identification as goat, sheep or goat/sheep in the First Analysis. It should also be noted that in the plots of factor scores for each POSAC presented below (Figures 8.7 to 8.16) the number of plotted points is less than the number of analysed specimens owing to the fact that the same combination of character scores were in some instances recorded on more than one specimen. NISP, rather than adjusted NISP counts, are used throughout.

8.4.1: Principal Components Analysis of Caprine Distal Scapulae:

Schematic drawings of the various distal scapula morphological characteristics are provided in Figure 8.7.



1	2	3	4
Very Thick	Thick	Slender	Very Slender

Characteristic B23: General Form of Neck of Scapula (Boessneck 1969)

1	2	3	4
Very Strong	Strong	Light	Very Light

Characteristic B24/PF5: Curvature of Margo Cervicalis

(Boessneck 1969, Prummel and Frisch 1986)

1	2	3	4
Very Strong	Strong	Light	Very Light

Characteristic B25: Pecten on Collum (Boessneck 1969)

Figure 8.7: Schematic Drawings of Caprine Distal Scapula Morphological Characteristics

1 Elongated Round | 2 Lightly Angular | 3 Rounded with Break | 4 Strongly Angular

Characteristic B26/PF6: Supraglenoid Tubercle (Boessneck 1969, Prummel and Frisch 1986)

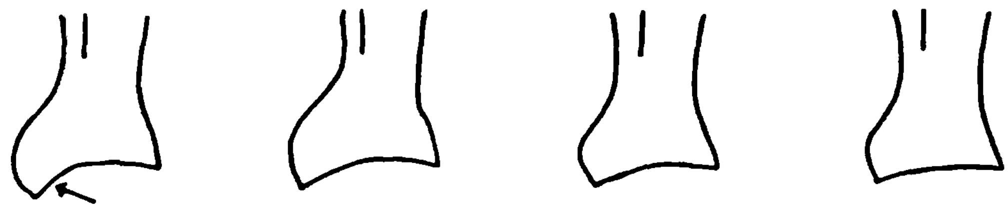
1 Strongly Elliptic | 2 Elliptic | 3 Lightly Elliptic | 4 Round

Characteristic B27/PF8: Shape of Glenoid Cavity (Boessneck 1969, Prummel and Frisch 1986)

1 Short and Clear | 2 Long and Clear | 3 Long and Unclear | 4 Short and Unclear

Characteristic B29: Subscapular Fossa (Boessneck 1969)

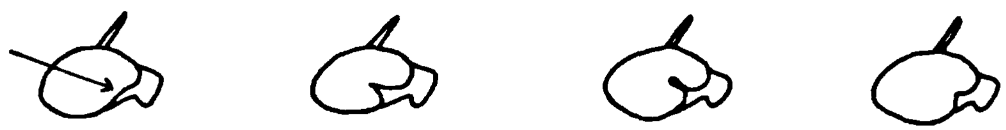
Figure 8.7 (cont): Schematic Drawings of Caprine Distal Scapula Morphological Characteristics



1 2 3 4

Very Strong Strong Light Very Light

Characteristic PF7: Distal Extension of Coracoid Process (Prummel and Frisch 1986)



1 2 3 4

Unclear/Missing Wide and Deep Narrow and Deep Short and Narrow/Fused

Characteristic BU1: Fossa Synovialis in Fovea Articularis (Buitenhuis 1995)

1 2 3 4

Very Strong Strong Slight None

Characteristic HR1: Hollow for Muscle Attachment on Supraglenoid Tubercle (Helmer and Rocheteau 1994)

Figure 8.7 (cont): Schematic Drawings of Caprine Distal Scapula Morphological Characteristics

The score counts and calculated factor loadings for the various distal scapula morphological characteristics are listed in Tables 8.12 and 8.13 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B23	Goat	50	0	4	7	4	35
B23	Sheep	46	0	3	12	3	28
B23	Goat/Sheep	57	0	2	11	15	29
B24/PF5	Goat	50	0	3	15	13	19
B24/PF5	Sheep	46	5	18	3	0	20
B24/PF5	Goat/Sheep	57	0	16	15	5	21
B25	Goat	50	0	3	13	24	10
B25	Sheep	46	4	14	11	1	16
B25	Goat/Sheep	57	0	8	16	25	8
B26/PF6	Goat	50	1	1	20	15	13
B26/PF6	Sheep	46	25	17	0	0	4
B26/PF6	Goat/Sheep	57	1	10	9	2	35
B27/PF8	Goat	50	0	4	22	22	2
B27/PF8	Sheep	46	14	24	6	0	2
B27/PF8	Goat/Sheep	57	2	16	17	5	17
B29	Goat	50	0	3	14	14	19
B29	Sheep	46	11	1	3	2	29
B29	Goat/Sheep	57	11	6	9	14	17
PF7	Goat	50	0	5	25	14	6
PF7	Sheep	46	15	18	11	0	2
PF7	Goat/Sheep	57	4	8	13	2	30
BU1	Goat	50	0	1	12	21	16
BU1	Sheep	46	4	22	3	0	17
BU1	Goat/Sheep	57	8	4	6	1	38
HR1	Goat	50	0	1	13	29	7
HR1	Sheep	46	12	18	11	1	4
HR1	Goat/Sheep	57	2	6	7	10	32

Key: characteristic=see Figure 8.7, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.12: Score Counts for Caprine Distal Scapula Characteristics

characteristic	Factor 1	Factor 2
B23	0.086408	0 8 729
B24_PF5	0.651516	0.057998
B25	0.5333	0.556045
B26_PF6	0 743196	-0.06754
B27_PF8	0 682669	-0.26356
B29	0.471412	0.167147
PF7	0 706736	-0.28125
BU1	0.64138	-0.09029
HR1	0 7 3351	0.002696
Eigenvalue	3.362502	1.191885
Prp.Totl	0.373611	0.132432

Table 8.13: Factor Loadings for Caprine Distal Scapula Characteristics (Highest Factor Loadings in Red)

The relative contribution of each characteristic to the overall morphological variation between distal scapulae of goats and sheep is demonstrated by the factor loadings in

Table 8.13. Factor 1 was affected mainly by B26-PF6, PF7, HR1 and B27-PF8, and Factor 2 by B23. As the eigenvalue of both factors is greater than one, the morphological variation incorporated in each factor can be regarded as significant The five characteristics affecting factors 1 and 2 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal scapulae to species and are presented in rank order of reliability in Table 8.14.

Rank	Characteristic	Description
1	B26-PF6	Shape of supraglenoid tubercle
2	PF7	Distal extension of coracoid process
3	HR1	Hollow for muscle attachment on supraglenoid tubercle
4	B27-PF8	Shape of glenoid cavity
5	B23	General form of neck of scapula

Table 8.14: Most Reliable Caprine Distal Scapula Characteristics in Rank Order

The factor loadings of each analysed distal scapula are plotted in Figure 8.8.

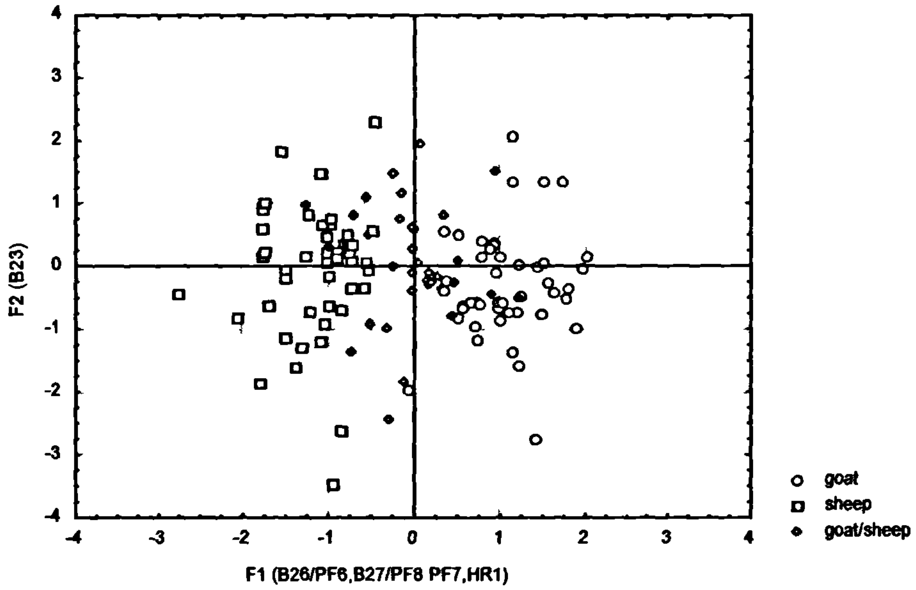


Figure 8.8: Factor Scores of Each Analysed Caprine Distal Scapula

In Figure 8.8 the factor loadings of distal scapulae identified to species in the First Analysis fall into two separate clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. 17 of these previously unidentified specimens, marked solid in Figure 8.8, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 40 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

8.4.2: Principal Components Analysis of Caprine Distal Humeri:

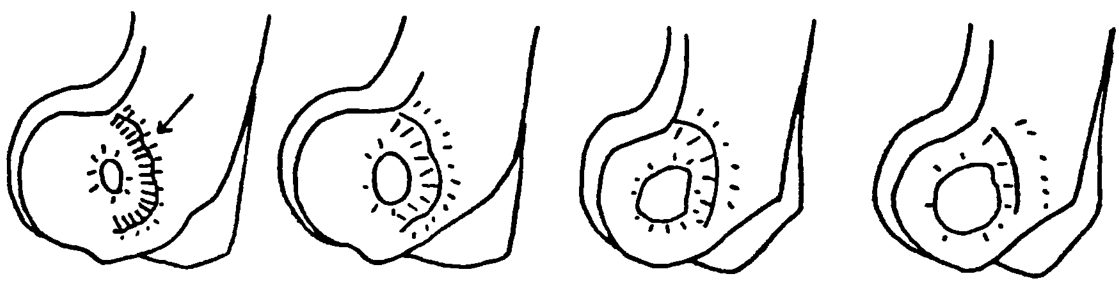
Schematic drawings of the various distal humerus morphological characteristics are provided in Figure 8.9.

1	2	3	4
Highly Tapered	Tapered	Almost Parallel	Parallel

Characteristic B33: Form of Trochlea Humeri (Boessneck 1969)

1	2	3	4
Much Thickening	Some Thickening	Minimal Thickening	No Thickening

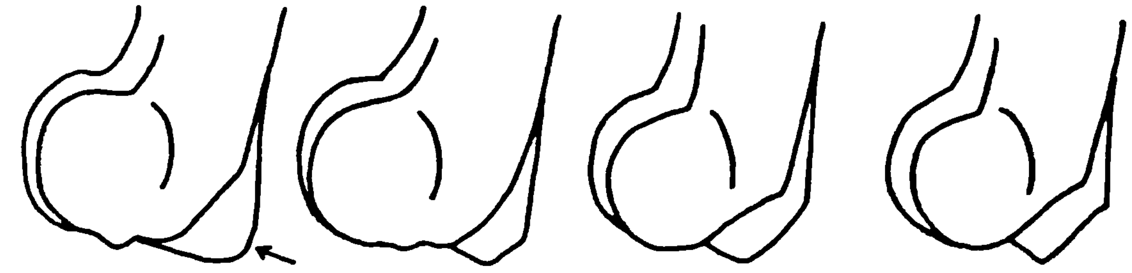
Characteristic B34: Granular Thickening at Lateral Border of Trochlea Surface (Boessneck 1969)



1	2	3	4
Very Strong Crest/Pit	Strong Crest/Pit	Some Crest/Pit	Minimal Crest/Pit

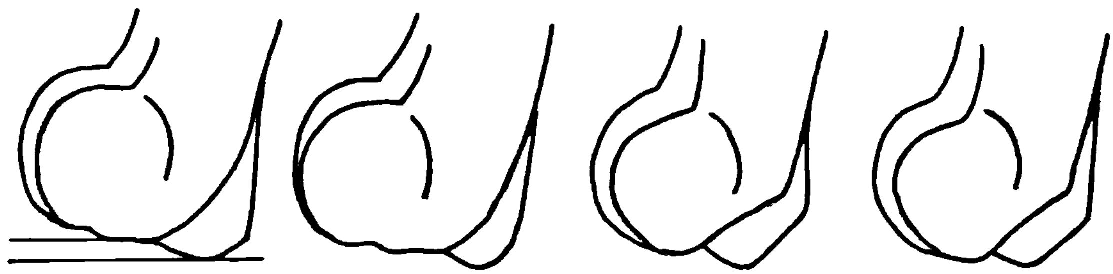
Characteristic B35: Pit of Lateral Epicondyle (Boessneck 1969)

Figure 8.9: Schematic Drawings of Caprine Distal Humerus Morphological Characteristics



1 Not Cut Back | 2 Slightly Cut Back | 3 Cut Back | 4 Heavily Cut Back

Characteristic B36: Form of Distal Part of Medial Epicondyle (Boessneck 1969)



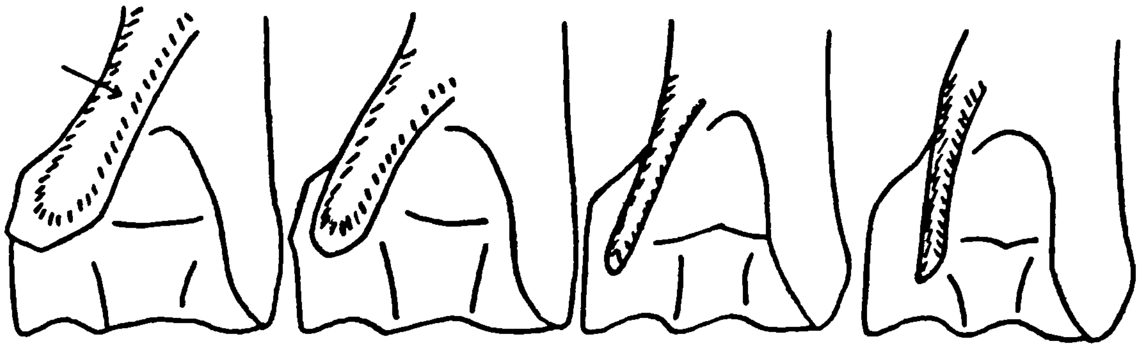
1 Major Drop | 2 Drop | 3 Slight Drop | 4 No Drop

Characteristic U1: Uerpmann's Variation on B36 (Uerpmann pers. comm.)

1 Great Angle | 2 Medium Angle | 3 Slight Angle | 4 Almost Straight

Characteristic PF9: Transition from Shaft to Lateral Epicondyle (Prummel and Frisch 1986)

Figure 8.9 (cont): Schematic Drawings of Caprine Distal Humerus Morphological Characteristics



1 2 3 4

Very Broad Ridge | Broad Ridge | Sharp Ridge | Very Sharp Ridge

Characteristic B15: Transition from Shaft to Lateral Epicondyle (Boessneck 1969)

1 2 3 4

Halfway | Just Over Halfway | Just Below Top | Almost to Top

Characteristic PF10: Articulation at Distal End of Medial Epicondyle (Prummel and Frisch 1986)

1 2 3 4

Short and Very Curved | Short and Curved | Long and Slightly Curved | Long and Parallel

Characteristic AW1: Form of Distal End of Lateral Epicondyle (Wasse n.d.)

Figure 8.9 (cont): Schematic Drawings of Caprine Distal Humerus Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine humeri are presented in Tables 8.15 and 8.16 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B33	Goat	50	6	18	18	1	7
B33	Sheep	82	13	42	21	0	6
B33	Goat/Sheep	57	10	20	16	2	9
B34	Goat	50	0	10	10	14	16
B34	Sheep	82	5	20	25	9	23
B34	Goat/Sheep	57	0	3	5	11	38
B35	Goat	50	0	7	17	18	8
B35	Sheep	82	12	42	17	5	6
B35	Goat/Sheep	57	4	10	15	12	16
B36	Goat	50	0	4	18	19	9
B36	Sheep	82	27	31	6	0	18
B36	Goat/Sheep	57	3	7	9	0	38
U1	Goat	50	3	11	17	10	9
U1	Sheep	82	14	28	20	3	17
U1	Goat/Sheep	57	3	6	7	4	37
PF9	Goat	50	0	3	22	14	11
PF9	Sheep	82	19	42	8	1	12
PF9	Goat/Sheep	57	4	24	3	6	20
B15	Goat	50	0	12	16	9	13
B15	Sheep	82	17	39	12	0	14
B15	Goat/Sheep	57	3	12	20	0	22
PF10	Goat	50	0	1	7	33	9
PF10	Sheep	82	38	25	2	0	17
PF10	Goat/Sheep	57	2	4	10	1	40
AW1	Goat	50	0	2	20	20	8
AW1	Sheep	82	36	27	6	0	13
AW1	Goat/Sheep	57	1	15	7	0	34

Key: characteristic=see Figure 8.9, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.15: Score Counts for Caprine Distal Humerus Characteristics

Characteristic	Factor 1	Factor 2
B33	0.125455	-0 7151
B34	0.321674	-0.56373
B35	0.554699	-0.45107
B36	0 710232	0.295117
U1	0.371667	0.214533
PF9	0 684588	0.230008
B15	0.599436	-0.06976
PF10	0 82 917	0.175986
AW1	0 7 2	-0.04167
Eigenvalue	3.074049	1.256213
Prp.Totl	0.341561	0.139579

Table 8.16: Factor Loadings for Caprine Distal Humerus Characteristics (Highest Factor Loadings in Red)

The relative contribution of each characteristic to the overall morphological variation between distal humeri of goats and sheep is demonstrated by the factor loadings in Table 8.16. Factor 1 was affected mainly by PF10, B36, AW1 and PF9 and Factor 2 by B33. As the eigenvalue of both factors is greater than one, the morphological variation incorporated in each factor can be regarded as significant. The five characteristics affecting factors 1 and 2 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal humeri to species and are presented in rank order of reliability in Table 8.17

Rank	Characteristic	Description
1	PF10	Length of facet on distal medial epicondyle
2	B36	Form of distal medial epicondyle
3	AW1	Form of distal lateral epicondyle
4	PF9	Transition from shaft to lateral epicondyle
5	B33	Form of trochlea humeri

Table 8.17: Most Reliable Distal Humerus Characteristics in Rank Order

The factor loadings of each analysed distal humerus are plotted in Figure 8.10.

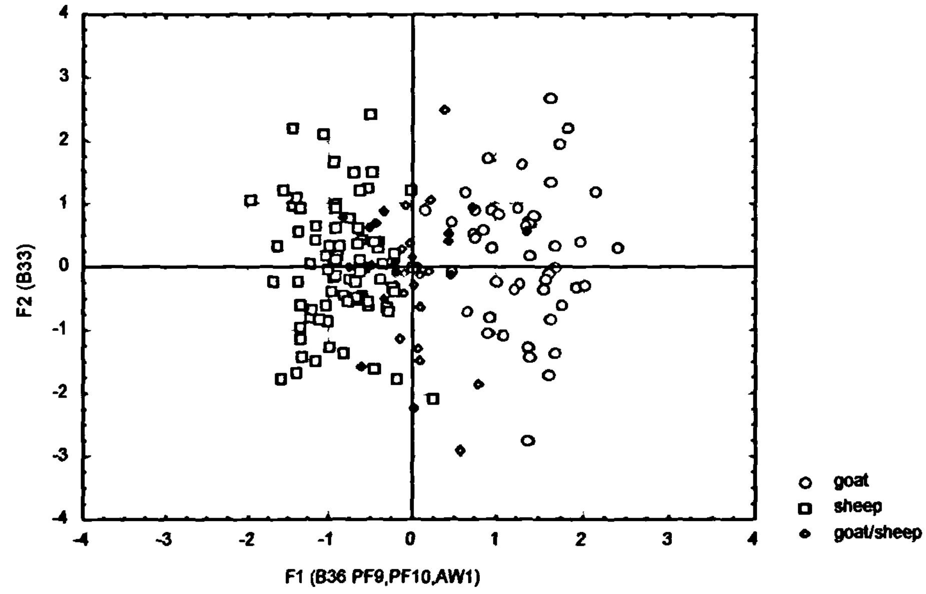


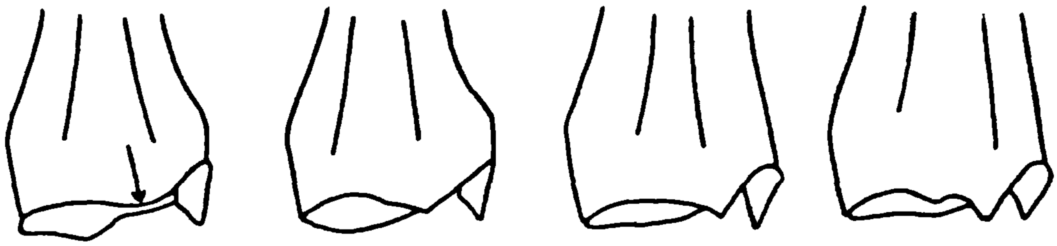
Figure 8.10: Factor Scores of Each Analysed Caprine Distal Humerus

In Figure 8.10 the factor loadings of distal humeri identified to species in the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First

Analysis fall into an intermediate cluster. 21 of these previously unidentified specimens, marked solid in Figure 8.10, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 36 caprine specimens fall in between the goat and sheep clusters and could therefore not be identified to species by this method.

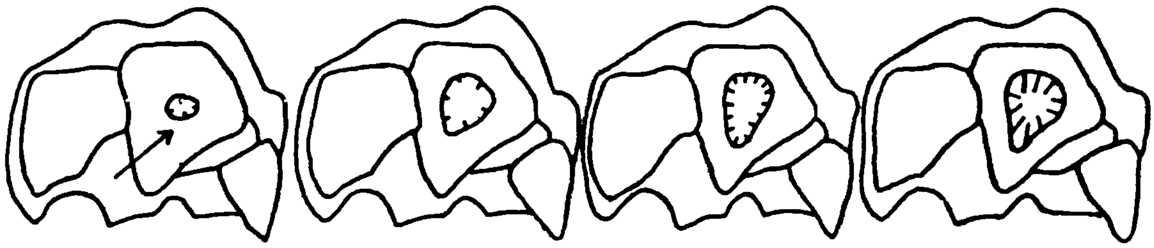
8.4.3: Principal Components Analysis of Caprine Distal Radii:

Schematic drawings of the various distal radius morphological characteristics are provided in Figure 8.11.



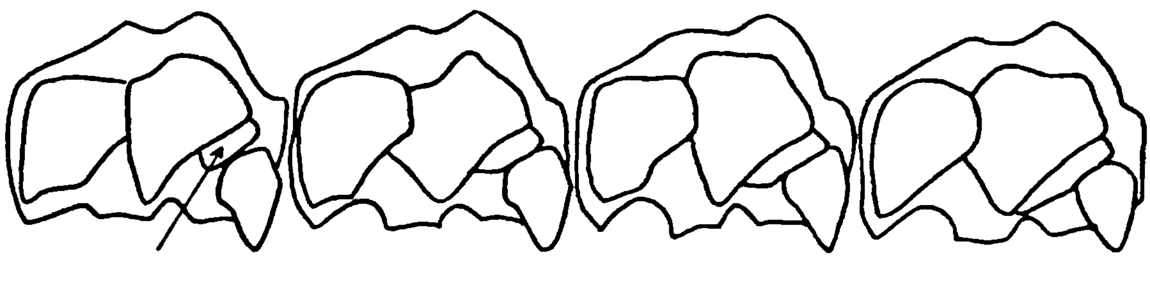
1 None | 2 Slight | 3 Strong | 4 Extreme

Characteristic B904: Distal Extension of Dorsal Edge of Intermedium Facet (Boessneck 1969)



1 Minimal | 2 Shallow | 3 Deep | 4 Very Deep

Characteristic B42: Indentation in Intermedium Facet (Boessneck 1969)



1 Very Short | 2 Short | 3 Long | 4 Very Long

Characteristic B905: Small Facet on Intermedium Facet (Boessneck 1969)

Figure 8.11: Schematic Drawings of Caprine Distal Radius Morphological Characteristics

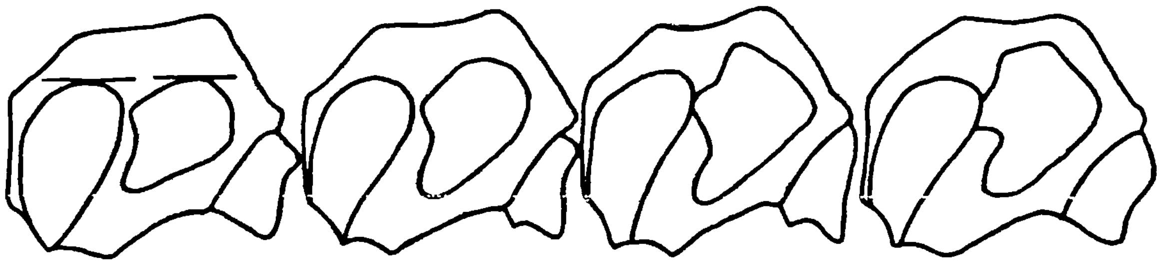
1 Long Drop Shape

2 Short Drop Shape

3 Short, Angular Drop Shape

4 Very Broad and Angular

Characteristic B43: Shape of Radial Facet (Boessneck 1969)



1 Same as Radial Facet

2 Slightly Above Radial Facet

3 Above Radial Facet

4 Well Above Radial Facet

Characteristic B906: Height of Intermedium Facet (Boessneck 1969)

Figure 8.11 (cont): Schematic Drawings of Caprine Distal Radius Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine radii are presented in Tables 8.15 and 8.16 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B904	Goat	28	0	1	13	14	0
B904	Sheep	38	22	14	1	0	1
B904	Goat/Sheep	3	1	0	1	0	1
B42	Goat	28	0	3	16	9	0
B42	Sheep	38	23	14	1	0	0
B42	Goat/Sheep	3	0	0	0	0	3
B905	Goat	28	0	0	13	15	0
B905	Sheep	38	27	11	0	0	0
B905	Goat/Sheep	3	0	0	0	0	3
B43	Goat	28	0	3	14	8	3
B43	Sheep	38	12	20	5	0	1
B43	Goat/Sheep	3	0	1	2	0	0
B906	Goat	28	18	5	3	0	2
B906	Sheep	38	36	1	0	0	1
B906	Goat/Sheep	3	0	0	0	0	3

Key: characteristic=see Figure 8.11, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

8.18: Score Counts for Caprine Radius Characteristics

Characteristic	Factor 1	Factor 2
B904	-0.91866	0.031247
B42	-0 91137	0.087294
B905	-0 88255	0.15383
B43	-0 80794	0.199198
B906	-0.45692	-0 88629
Eigenvalue	3.314989	0 85 445
Prp.Totl	0.662998	0.171489

8.19: Factor Loadings for Caprine Radius Characteristics (Highest Loadings in Red, Eigenvalue <1.0 in Blue)

The relative contribution of each characteristic to the overall morphological variation between distal radii of goats and sheep is demonstrated by the factor loadings in Table 8.19. Factor 1 was affected mainly by B904, B42, B905 and B43 and Factor 2 by B906. Although the eigenvalue of factor 1 is greater than one, that of factor 2 is not. Therefore only the morphological variation incorporated in factor 1 can be regarded as making a significant contribution to overall morphological variation. The four characteristics affecting factor 1 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal radii to species and are presented in rank order of reliability in Table 8.20.

Rank	Characteristic	Description
1	B904	Distal extension of dorsal edge of intermedium facet
2	B42	Indentation in intermedium facet
3	B905	Small facet on intermedium facet
4	B43	Shape of radial facet

Table 8.20: Most Reliable Distal Radius Characteristics in Rank Order

The factor loadings of each analysed distal radius are plotted in Figure 8.12.

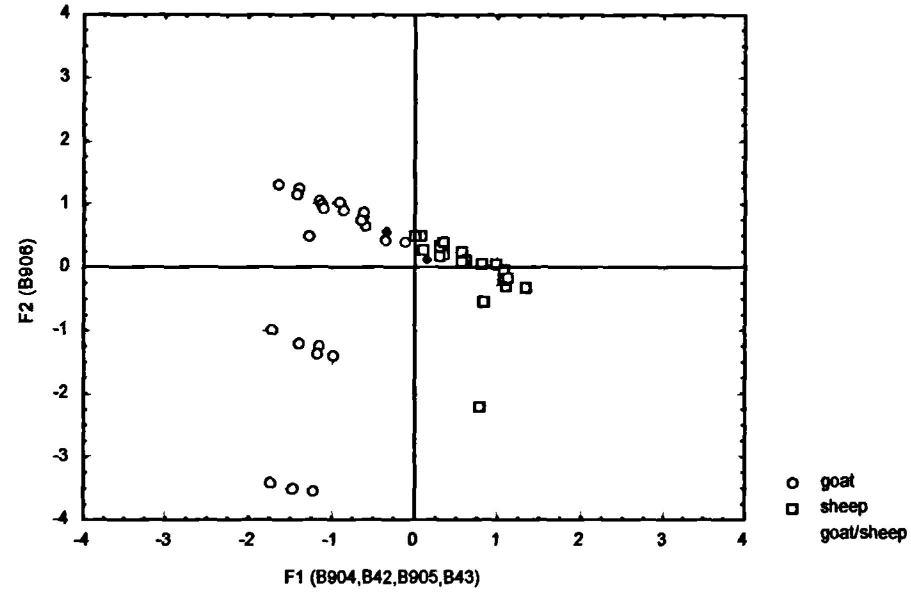
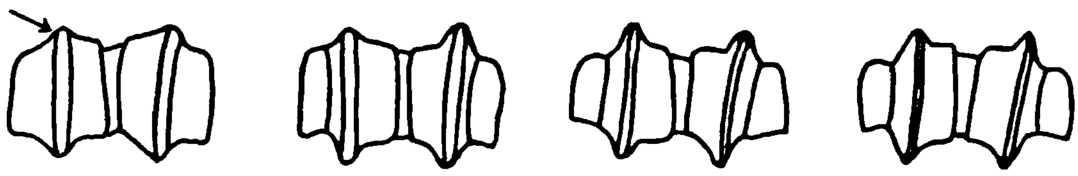


Figure 8.12: Factor Scores of Each Analysed Caprine Distal Radius

When interpreting Figure 8.12 it should be recalled that the eigenvalue of factor 2 for distal radii was less than one (see Table 8.19) and can therefore be ignored. In Figure 8.12 the factor 1 loadings of distal radii identified to species in the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. All of these previously unidentified specimens, marked solid in Figure 8.12, fall within the range of morphological variation of either goats or sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other

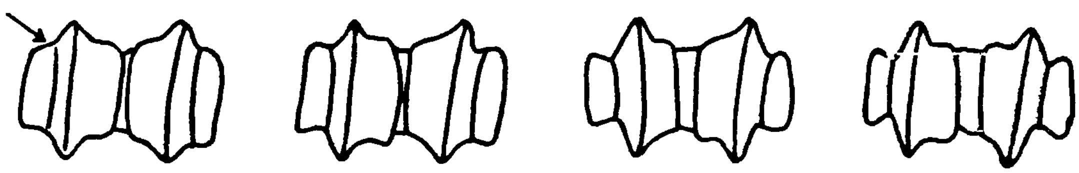
8.4.4: Principal Components Analysis of Caprine Distal Metacarpals:

Schematic drawings of the various distal metacarpal morphological characteristics are provided in Figure 8.13.



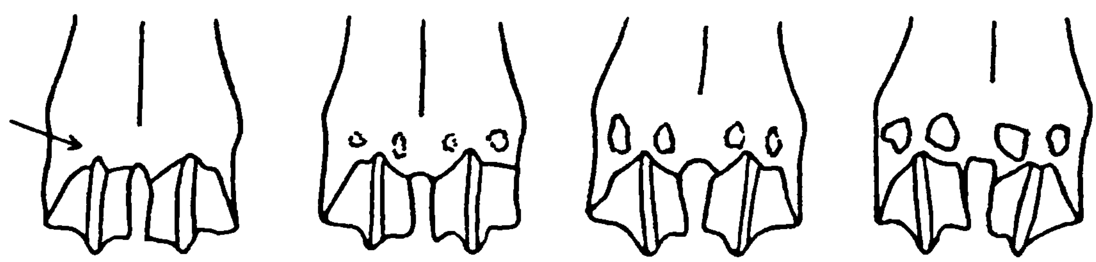
1	2	3	4
Very Rounded	Rounded and Shallow	Sharp and Steep	Very Sharp and Steep

Characteristic B71: Sharpness and Steepness of Verticilli on Trochlea (Boessneck 1969)



1	2	3	4
No Neck	Hint of Neck	Slight Neck	Clear Neck

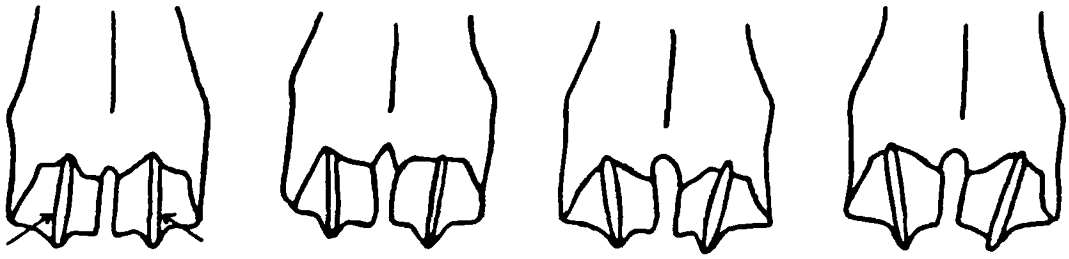
Characteristic B207: Definition of Trochlea by Neck at Verticilli (Boessneck 1969)



1	2	3	4
Minimal	Slightly Developed	Strongly Developed	Very Strongly Developed

Characteristic B208: Extent of Fossulae (Boessneck 1969)

Figure 8.13: Schematic Drawings of Caprine Distal Metacarpal Morphological Characteristics



1 Parallel | 2 Slight Angle | 3 Strong Angle | 4 Very Strong Angle

Characteristic B209: Degree of Convergence of Verticilli (Boessneck 1969)

Figure 8.13 (cont): Schematic Drawings of Caprine Distal Metacarpal Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine metacarpals are presented in Tables 8.21 and 8.22 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B71	Goat	62	0	7	30	17	8
B71	Sheep	61	3	25	30	1	2
B71	Goat/Sheep	1	0	1	0	0	0
B207	Goat	62	1	12	27	21	1
B207	Sheep	61	14	40	6	0	1
B207	Goat/Sheep	1	0	0	1	0	0
B208	Goat	62	2	10	19	28	3
B208	Sheep	61	25	25	6	0	5
B208	Goat/Sheep	1	1	0	0	0	0
B209	Goat	62	0	5	9	5	43
B209	Sheep	61	8	22	0	0	31
B209	Goat/Sheep	1	0	0	0	0	1

Key: characteristic=see Figure 8.13, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.21: Score Counts for Caprine Metacarpal Characteristics

Characteristic	Factor 1	Factor 2
B71	-0.6548	0.275478
B207	-0 81479	0.198062
B208	-0 80357	0.155232
B209	-0.57433	-0 81226
Eigenvalue	2.068217	0 89 8
Prp.Totl	0.517054	0.199745

Table 8.22: Factor Loadings for Caprine Metacarpal Characteristics (Highest Factor Loadings in Red, Eigenvalue <1.0 in Blue)

The relative contribution of each characteristic to the overall morphological variation between distal metacarpals of goats and sheep is demonstrated by the factor loadings in Table 8.22. Factor 1 was affected mainly by B207 and B208 and Factor 2 by B209. Although the eigenvalue of factor 1 is greater than one, that of factor 2 is not. Therefore only the morphological variation incorporated in factor 1 can be regarded as making a significant contribution to overall morphological variation. The two characteristics affecting factor 1 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal metacarpals to species and are presented in rank order of reliability in Table 8.23.

Rank	Characteristic	Description
1	B207	Definition of trochlear by neck at verticilli
2	B208	Extent of fossulae

Table 8.23: Most Reliable Distal Metacarpal Characteristics in Rank Order

The factor loadings of each analysed distal metacarpal are plotted in Figure 8.14.

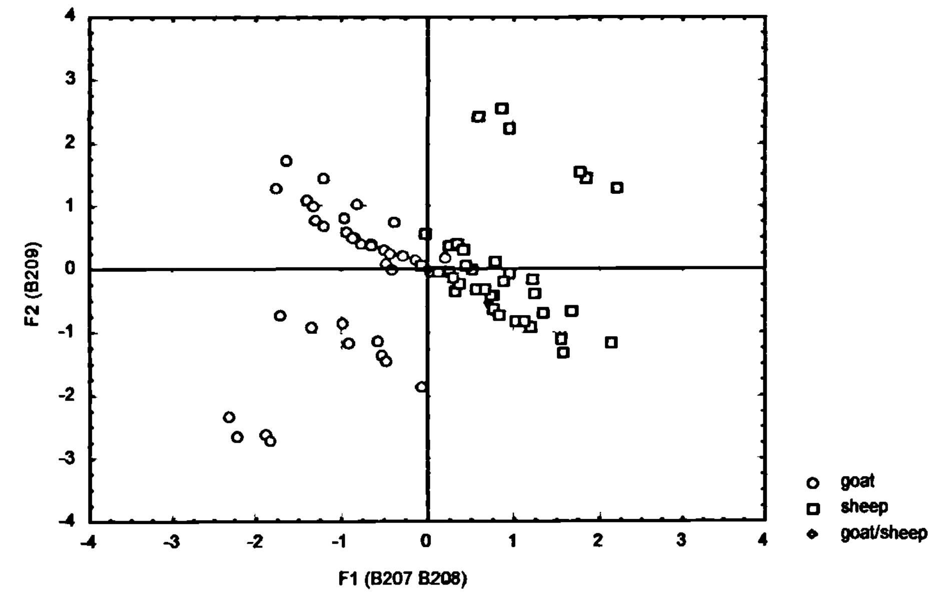
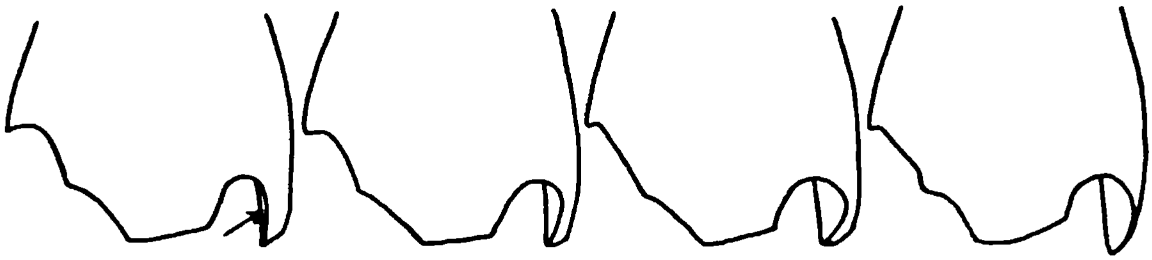


Figure 8.14: Factor Scores of Each Analysed Caprine Distal Metacarpal

When interpreting Figure 8.14 it should be recalled that the eigenvalue of factor 2 for distal metacarpals was less than one (see Table 8.22) and can therefore be ignored. The factor 1 loadings of specimens identified to species in the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species. However, the two clusters overlap slightly and seven specimens identified during the First Analysis lie within the zone of overlap. As a result not all of these identifications can be confirmed by this method. Fortunately in the case of the distal metacarpal, all identifications obtained during the First Analysis were confirmed by the metrical Second Analysis. The single specimen which could not be identified to species during the First Analysis falls within the range of morphological variation of sheep and could therefore be assigned to this species, as it was in the Second Analysis.

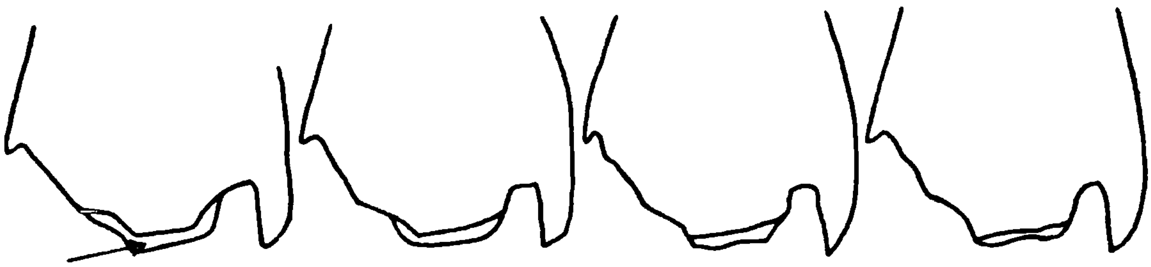
8.4.5: Principal Components Analysis of Caprine Distal Tibiae:

Schematic drawings of the various distal tibia morphological characteristics are provided in Figure 8.15.



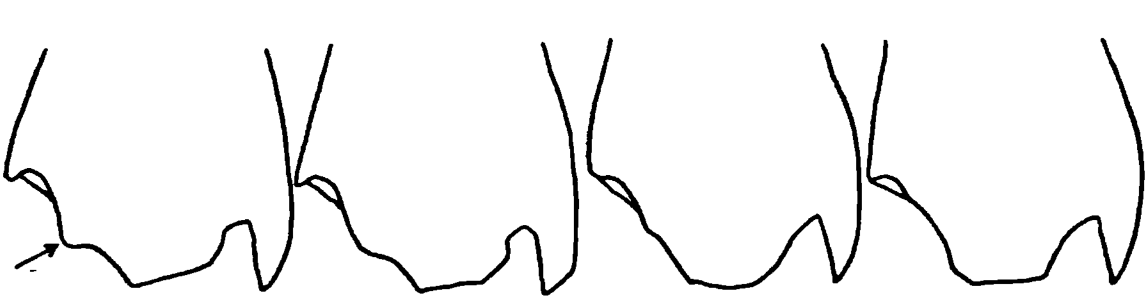
1 2 3 4

Characteristic K1: Periphery of Medial Articular Surface on Prominence (dorsal view) (Kratochvil 1969)



1 2 3 4

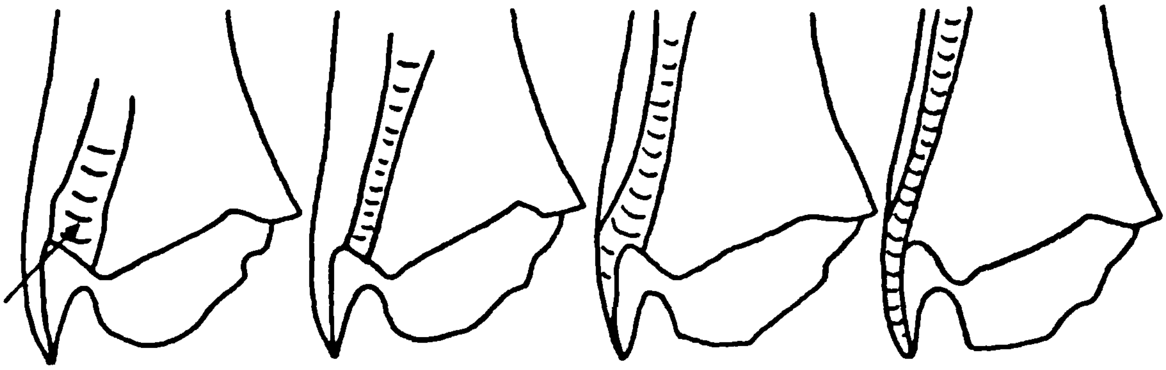
Characteristic K2: Distal Articular Surface (dorsal view) (Kratochvil 1969)



1 2 3 4

Characteristic K3: Periphery of Dorsal Prominence on Lateral Side (dorsal view) (Kratochvil 1969)

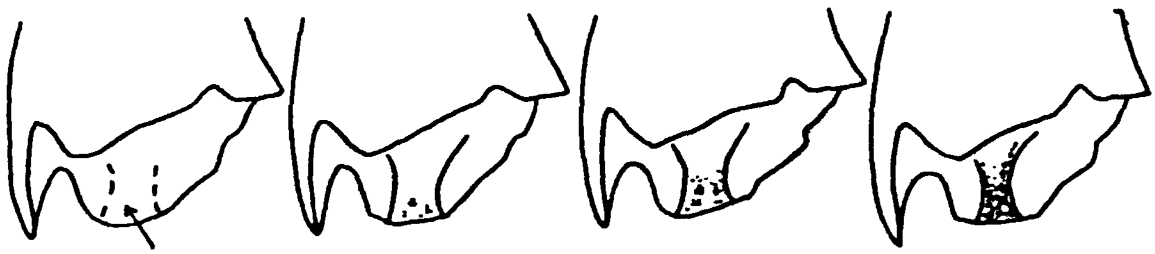
Figure 8.15: Schematic Drawings of Caprine Distal Tibia Morphological Characteristics



1 2 3 4

Characteristic K4: Sulcus Malleolaris (plantar view)

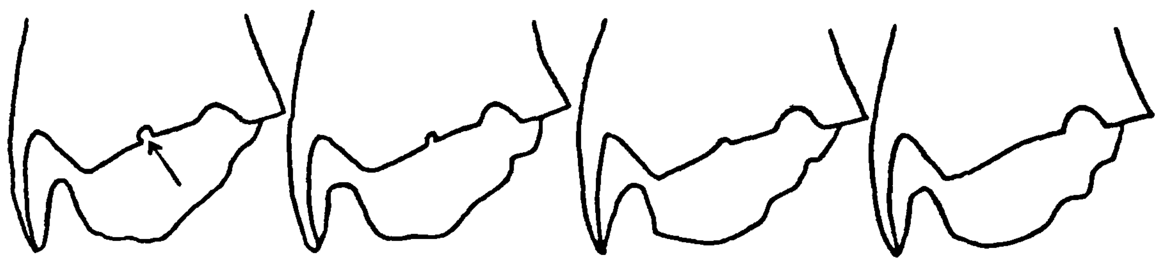
(Kratochvil 1969)



1 2 3 4

Characteristic K5: Articular Surface and Synovial Foveola on Dorsal Prominence (plantar view)

(Kratochvil 1969)

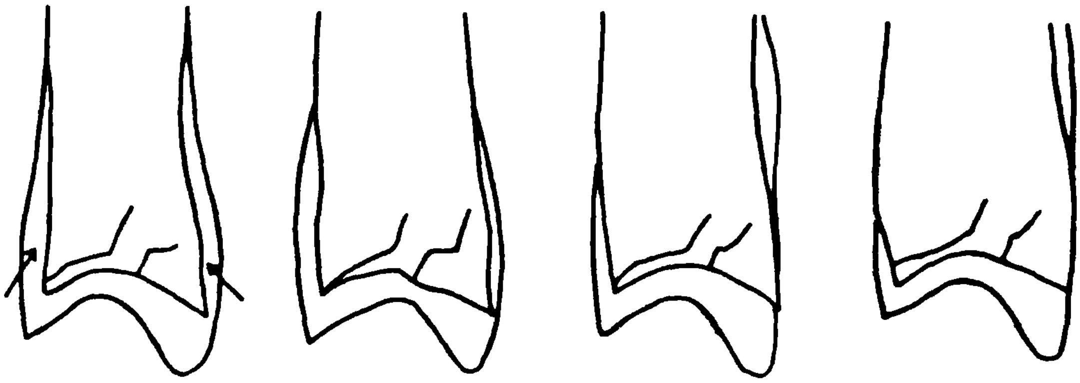


1 2 3 4

Characteristic K6: Prolapse in Middle of Plantar Edge of Articular Surface (palmar view)

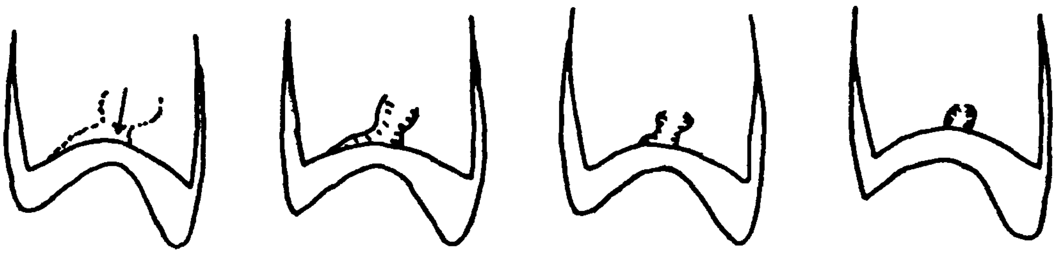
(Kratochvil 1969)

Figure 8.15 (cont): Schematic Drawings of Caprine Distal Tibia Morphological Characteristics



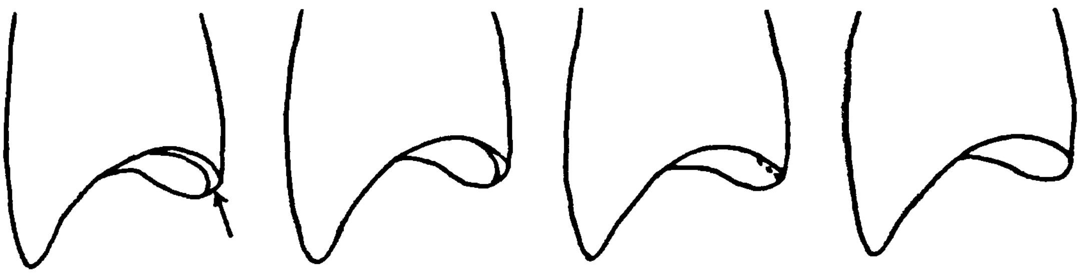
1 2 3 4

Characteristic K7: Visibility of Medial Half of Tibia (lateral view)
(Kratochvil 1969)



1 2 3 4

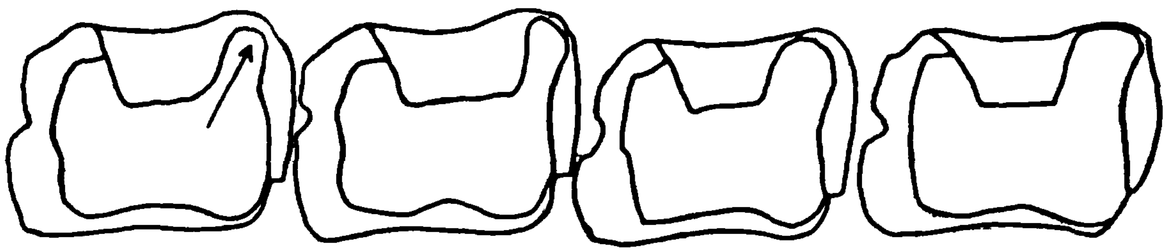
Characteristic K8: Incision and Articular Surface for Os Malleolare (lateral view)
(Kratochvil 1969)



1 2 3 4

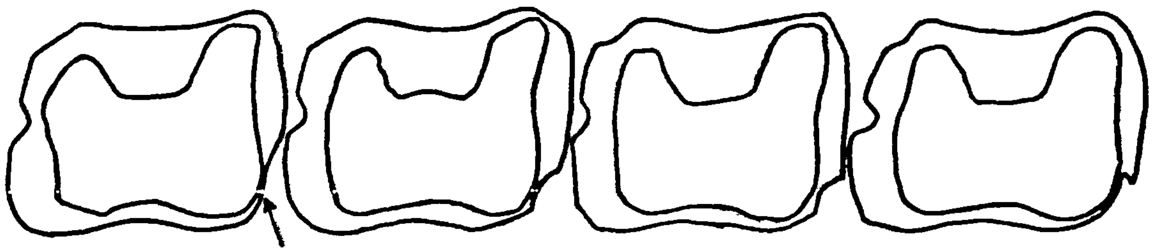
Characteristic K9: Lip on Medio-Plantar Limbus of Articular Surface (medial view)
(Kratochvil 1969)

Figure 8.15 (cont): Schematic Drawings of Caprine Distal Tibia Morphological Characteristics



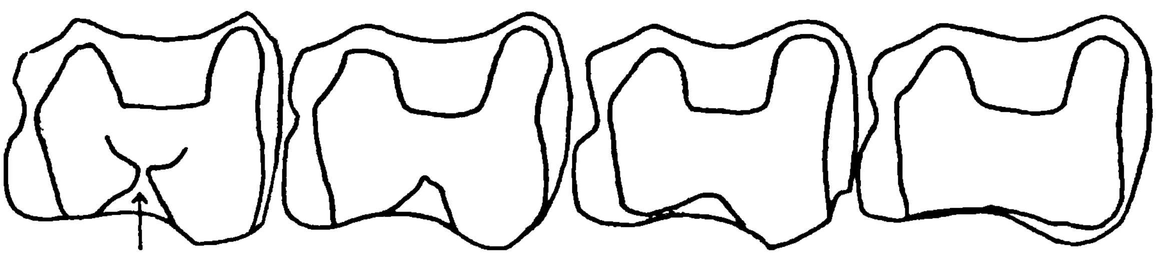
1 2 3 4

Characteristic K10: Dorso-Medial Section of Articular Surface (distal view)
(Kratochvil 1969)



1 2 3 4

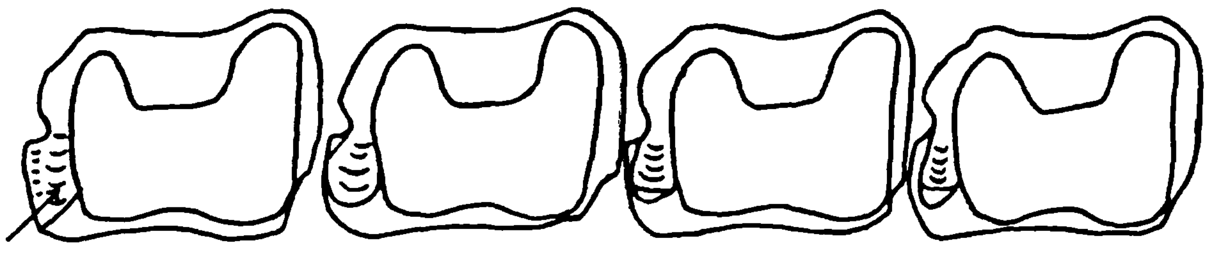
Characteristic K11: Sulcus Malleolaris (distal view)
(Kratochvil 1969)



1 2 3 4

Characteristic K12: Interruption of Plantar Limbus of Articular Surface (distal view)
(Kratochvil 1969)

Figure 8.15 (cont): Schematic Drawings of Caprine Distal Tibia Morphological Characteristics



1 2 3 4

Characteristic K13: Articular Surface for Os Malleolare (distal view)

(Kratochvil 1969)

1 2 3 4

Characteristic K14: Protuberantia on Anterior Face

(Kratochvil 1969)

Figure 8.15 (cont): Schematic Drawings of Caprine Distal Tibia Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine tibiae are presented in Tables 8.24 and 8.25 respectively.

characteristic	Species	n	score 1	score 2	score 3	score 4	missing data
K1	Goat	49	0	0	16	22	11
K1	Sheep	48	5	19	3	0	21
K1	Goat/Sheep	44	1	9	12	5	17
K2	Goat	49	0	7	29	11	2
K2	Sheep	48	22	20	2	0	4
K2	Goat/Sheep	44	10	16	11	2	5
K3	Goat	49	0	9	27	12	1
K3	Sheep	48	8	17	18	4	1
K3	Goat/Sheep	44	7	15	14	5	3
K4	Goat	49	0	7	23	8	11
K4	Sheep	48	22	17	2	0	7
K4	Goat/Sheep	44	4	20	9	1	10
K5	Goat	49	5	11	11	12	10
K5	Sheep	48	10	21	4	1	12
K5	Goat/Sheep	44	6	11	7	3	17
K6	Goat	49	0	0	8	38	3
K6	Sheep	48	3	12	15	17	1
K6	Goat/Sheep	44	1	5	10	24	4
K7	Goat	49	0	0	21	17	11
K7	Sheep	48	12	19	9	1	7
K7	Goat/Sheep	44	3	11	18	3	9
K8	Goat	49	0	3	24	12	10
K8	Sheep	48	9	24	13	1	1
K8	Goat/Sheep	44	4	10	18	3	9
K9	Goat	49	0	1	11	27	10
K9	Sheep	48	6	16	11	4	11
K9	Goat/Sheep	44	2	4	13	8	17
K10	Goat	49	0	7	19	18	5
K10	Sheep	48	14	22	2	0	10
K10	Goat/Sheep	44	7	9	15	1	12
K11	Goat	49	0	17	13	9	10
K11	Sheep	48	18	15	10	1	4
K11	Goat/Sheep	44	7	9	18	8	2
K12	Goat	49	0	4	31	12	2
K12	Sheep	48	18	23	6	0	1
K12	Goat/Sheep	44	6	15	19	1	3
K13	Goat	49	2	13	22	6	6
K13	Sheep	48	13	25	4	0	6
K13	Goat/Sheep	44	9	19	9	0	7
K14	Goat	49	0	9	11	4	25
K14	Sheep	48	16	10	0	0	22
K14	Goat/Sheep	44	2	10	4	0	28

Key: characteristic=see Figure 8.15, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.24: Score Counts for Caprine Tibia Characteristics

Characteristic	Factor 1	Factor 2
K1	0 644 89	0.106749
K2	0 7 87	0.120218
K3	0.368706	-0 40635
K4	0 720177	-0.30098
K5	0.294747	0 5 7 4
K6	0.55653	0.40684
K7	0 85734	0.077343
K8	0.608301	-0.33316
K9	0.584178	-0.1414
K10	0 66053	0.24578
K11	0.471431	-0 42153
K12	0 689869	0.389662
K13	0.604428	-0.2159
K14	0.563579	-0.06267
Eigenvalue	4.957404	1.292784
Prp.Totl	0.3541	0.092342

Table 8.25: Factor Loadings for Caprine Tibia Characteristics (Highest Factor Loadings in Red)

The relative contribution of each characteristic to the overall morphological variation between distal tibiae of goats and sheep is demonstrated by the factor loadings in Table 8.25. Factor 1 was affected mainly by K4, K2, K12, K7, K10 and K1 and Factor 2 by K5, K11 and K3. As the eigenvalue of both factors is greater than one, the morphological variation incorporated in each factor can be regarded as significant. The nine characteristics affecting factors 1 and 2 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal tibiae to species and are presented in rank order of reliability in Table 8.26.

Rank	Characteristic	Description
1	K4	Sulcus malleolaris (plantar view)
2	K2	Distal articular surface (dorsal view)
3	K12	Interruption of plantar limbus of articular surface (distal view)
4	K7	Visibility of medial half of tibia (lateral view)
5	K10	Dorso-medial section of articular surface (distal view)
6	K1	Periphery of medial articular surface on prominence (dorsal view)
7	K5	Articular surface and synoveal foveola on plantar dorsal prominence
8	K11	Sulcus malleolaris (distal view)
9	K3	Periphery of lateral side of dorsal prominence (dorsal view)

Table 8.26: Most Reliable Distal Tibia Characteristics in Rank Order

The factor loadings of each analysed distal tibia are plotted in Figure 8.16

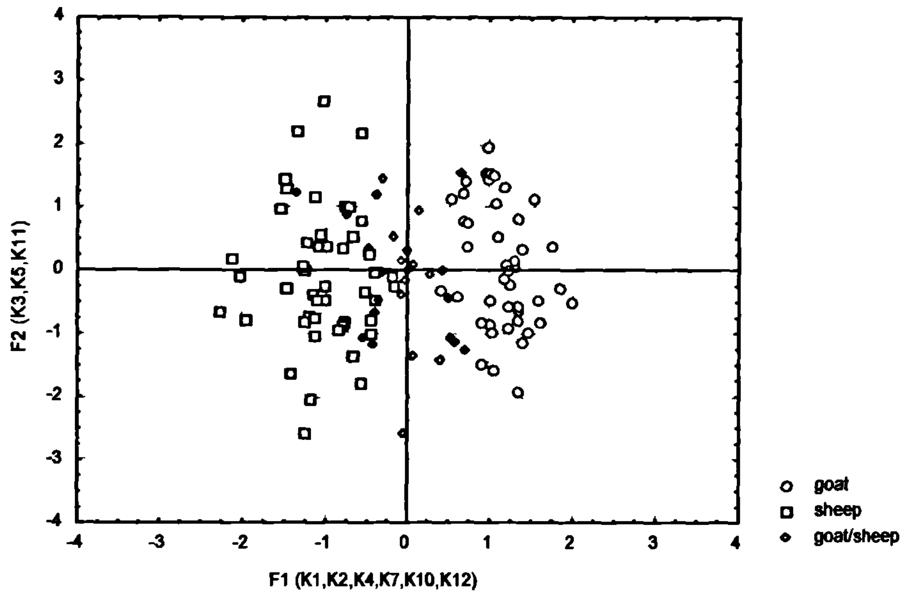
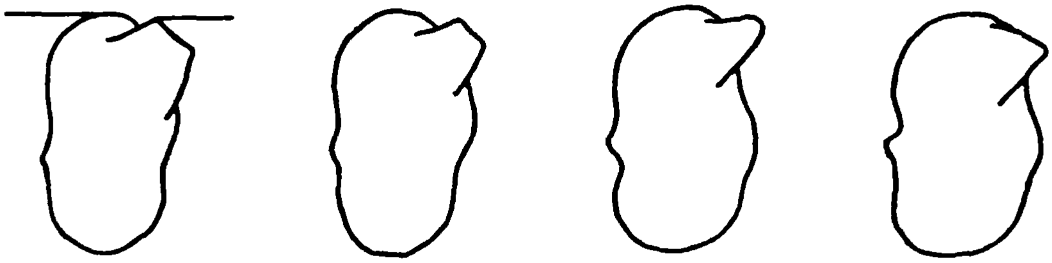


Figure 8.16: Factor Scores of Each Analysed Caprine Distal Tibia

In Figure 8.16 the factor loadings of distal tibiae identified to species in the First Analysis fall into two separate clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. 23 of these previously unidentified specimens, marked solid in Figure 8.16, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 21 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

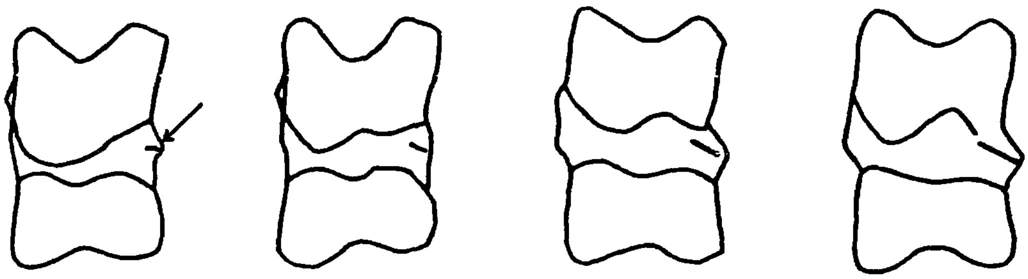
8.4.6: Principal Components Analysis of Caprine Astragali:

Schematic drawings of the various astragalus morphological characteristics are provided in Figure 8.17.



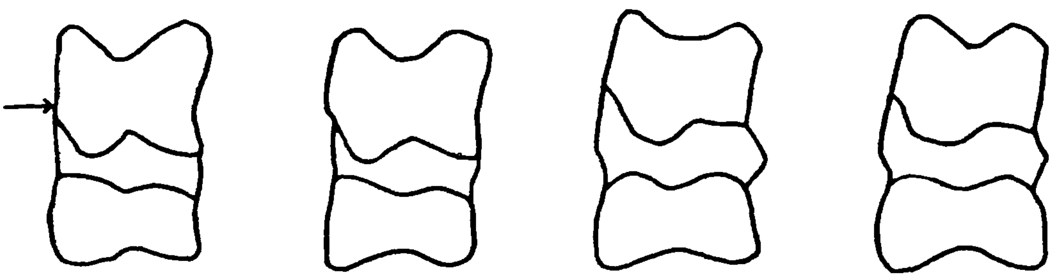
1	2	3	4
Very High	High	Medium	Low

Characteristic B51: Projection at Proximo-Plantar Angle of Medial Articular Ridge (Boessneck 1969)



1	2	3	4
Small and Horizontal	Small and Angled	Large and Angled	Large and Highly Angled

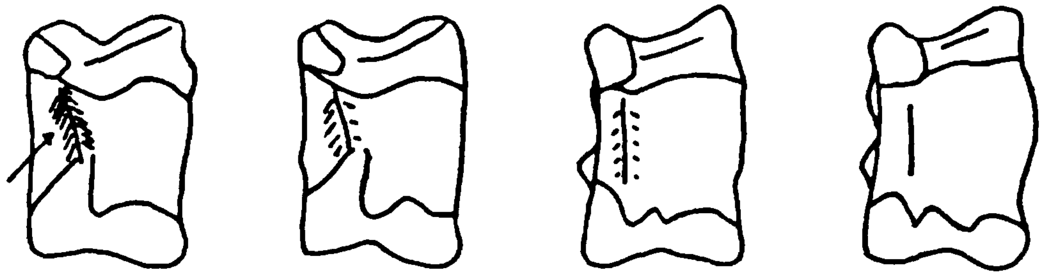
Characteristic B62: Distal End of Medial Articular Ridge (Boessneck 1969)



1	2	3	4
Straight	Slightly Angled	Angled	Highly Angled

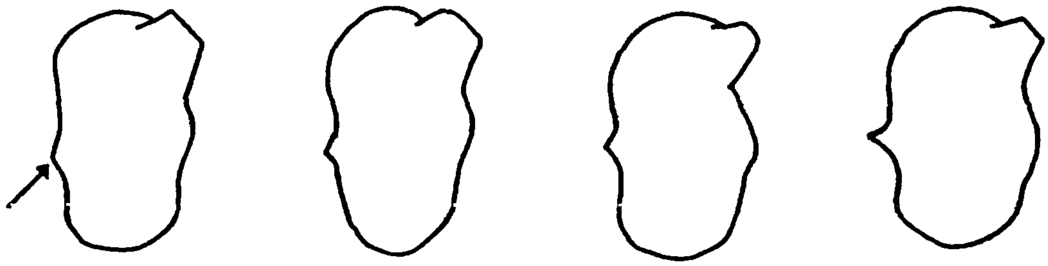
Characteristic B63: Lateral Articular Ridge (Boessneck 1969)

Figure 8.17: Schematic Drawings of Caprine Astragalus Morphological Characteristics



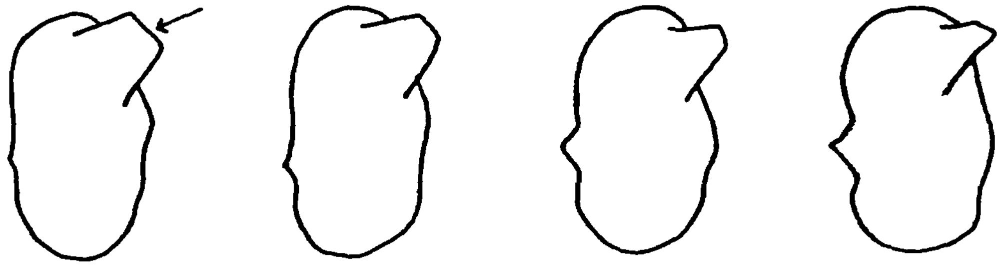
1 Very Strong Ridge — 2 Strong Ridge — 3 Hint of Ridge — 4 No Ridge

Characteristic B64: Articular Surface for Calcaneum (Boessneck 1969)



1 Hint — 2 Weak — 3 Large — 4 Very Large

Characteristic PF26: Protuberance on Medial-Antero Face (Prummel and Frisch 1986)



1 Rectangular — 2 Angular — 3 Pointed — 4 Very Pointed

Characteristic PF27: End of Medial Condyle (Prummel and Frisch 1986)

Figure 8.17 (cont): Schematic Drawings of Caprine Astragalus Morphological Characteristics

Falls Over			**Wobbles but Stays Upright**
1	2	3	4

Characteristic PF28: Capsize Test (Prummel and Frisch 1986)

Figure 8.17 (cont): Schematic Drawings of Caprine Astragalus Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine astragali are presented in Tables 8.27 and 8.28 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B51	Goat	105	0	0	35	51	19
B51	Sheep	90	36	36	11	0	7
B51	Goat/Sheep	25	1	6	3	3	12
B62	Goat	105	0	6	43	42	14
B62	Sheep	90	46	38	3	0	3
B62	Goat/Sheep	25	3	8	7	1	6
B63	Goat	105	2	25	48	20	10
B63	Sheep	90	46	36	4	0	4
B63	Goat/Sheep	25	5	3	7	1	9
B64	Goat	105	0	6	45	47	7
B64	Sheep	90	44	36	4	0	6
B64	Goat/Sheep	25	2	4	8	1	10
PF26	Goat	105	0	30	37	20	18
PF26	Sheep	90	57	20	4	0	9
PF26	Goat/Sheep	25	3	5	4	1	12
PF27	Goat	105	0	13	29	37	26
PF27	Sheep	90	11	44	16	1	18
PF27	Goat/Sheep	25	0	5	4	1	15
PF28	Goat	105	4	1	4	75	21
PF28	Sheep	90	71	3	1	5	10
PF28	Goat/Sheep	25	9	1	0	6	9

Key: characteristic=see Figure 8.17, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.27: Score Counts for Caprine Astragalus Characteristics

Characteristic	Factor 1	Factor 2
B51	0 849438	0.14709
B62	0 846567	0.09876
B63	0.70534	-0 48773
B64	0 808618	-0.20372
PF26	0.788942	0.20899
PF27	0.680041	0 5293 2
PF28	0 7 8753	-0.28123
Eigenvalue	4.312481	0 7 36 8
Prp.Totl	0.616069	0.101957

Table 8.28: Factor Loadings for Caprine Astragalus Characteristics

(Highest Factor Loadings in Red, Eigenvalue <1.0 in Blue)

The relative contribution of each characteristic to the overall morphological variation between astragali of goats and sheep is demonstrated by the factor loadings in Table 8.28. Factor 1 was affected mainly by B51, B62, B64, PF28 and PF26 and Factor 2 by PF27 and B63. Although the eigenvalue of factor 1 is greater than one, that of factor 2 is not. Therefore only the morphological variation incorporated in factor 1 can be regarded as making a significant contribution to overall morphological variation. The five characteristics affecting factor 1 may thus be regarded as the most reliable criteria by which to make an identification of caprine astragali to species and are presented in rank order of reliability in Table 8.29.

Rank	Characteristic	Description
1	B51	Projection at proximo-plantar angle of medial articular ridge
2	B62	Distal end of medial articular ridge
3	B64	Articular surface for calcaneum
4	PF28	Capsize test
5	PF26	Protuberance on medial-antero face

Table 8.29: Most Reliable Astragalus Characteristics in Rank Order

The factor loadings of each analysed astragalus are plotted in Figure 8.18.

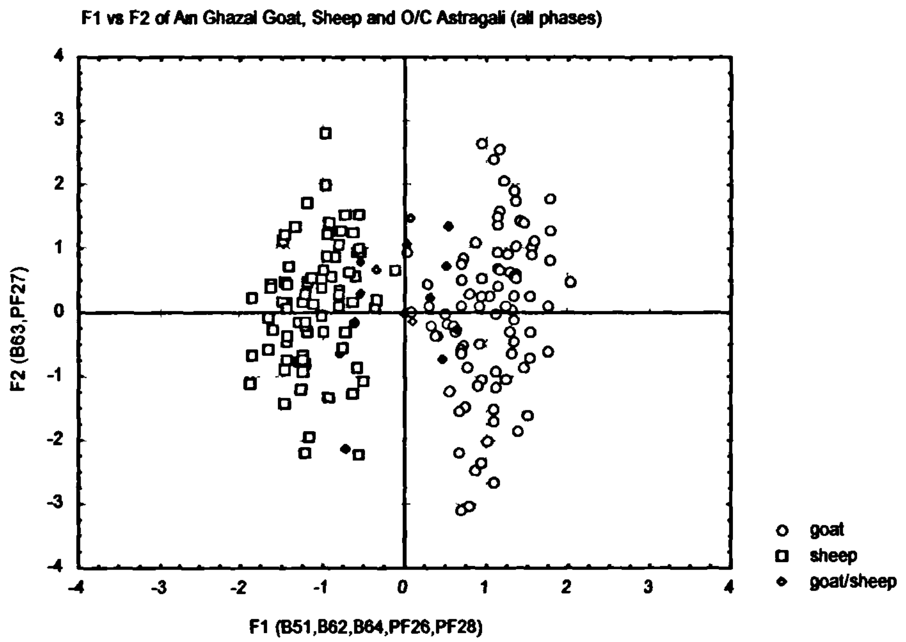
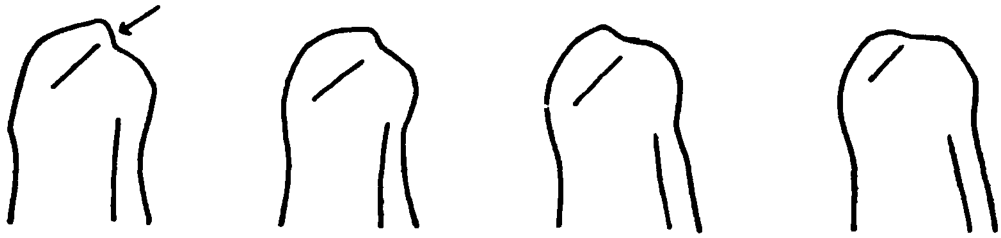


Figure 8.18: Factor Scores of Each Analysed Caprine Astragalus

When interpreting Figure 8.18 it should be recalled that the eigenvalue of factor 2 for astragali was less than one (see Table 8.28) and can therefore be ignored. The factor 1 loadings of astragali identified to species during the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. 15 of these previously unidentified specimens, marked solid in Figure 8.18, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 10 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

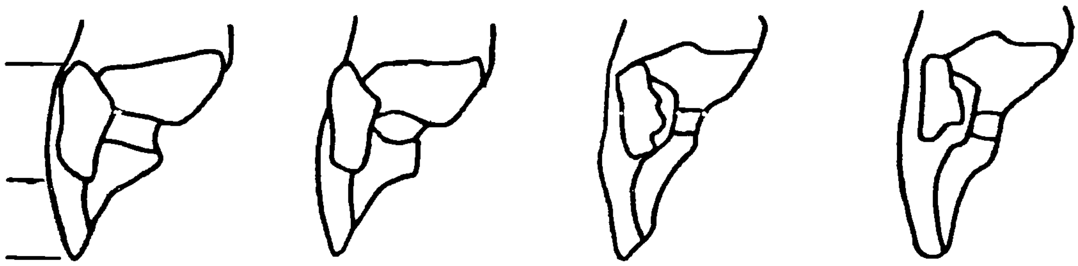
8.4.7: Principal Components Analysis of Caprine Calcanea:

Schematic drawings of the various calcaneum morphological characteristics are provided in Figure 8.19.



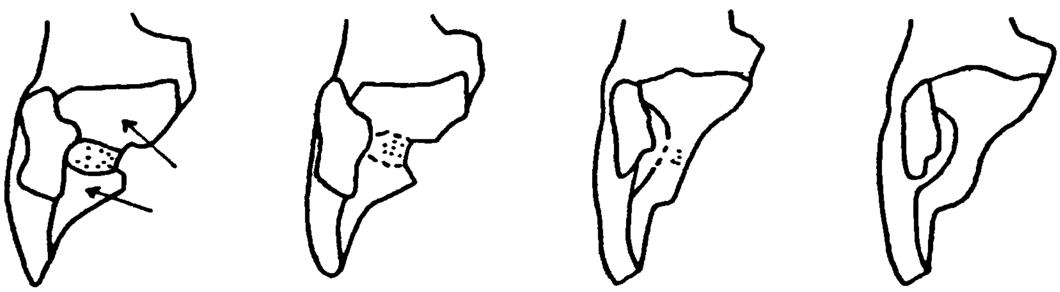
1	2	3	4
Strong Projection	Projection	Weak Projection	Minimal Projection

Characteristic B65: Top of Tuber Calcanei (Boessneck 1969)



1	2	3	4
Much Longer	Longer	About Equal	Shorter

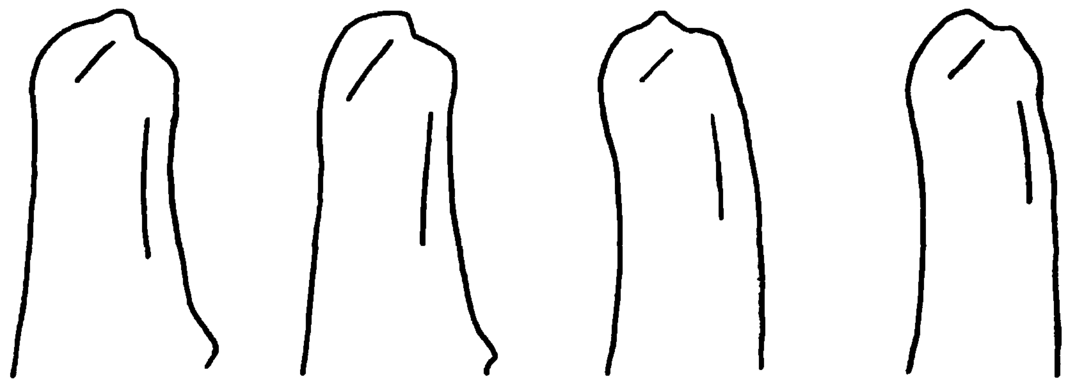
Characteristic B66: Articular Area of Lateral Process (Boessneck 1969)



1	2	3	4
Clearly Separate	Separate but Not Clear	Joined but Not Clear	Clearly Joined

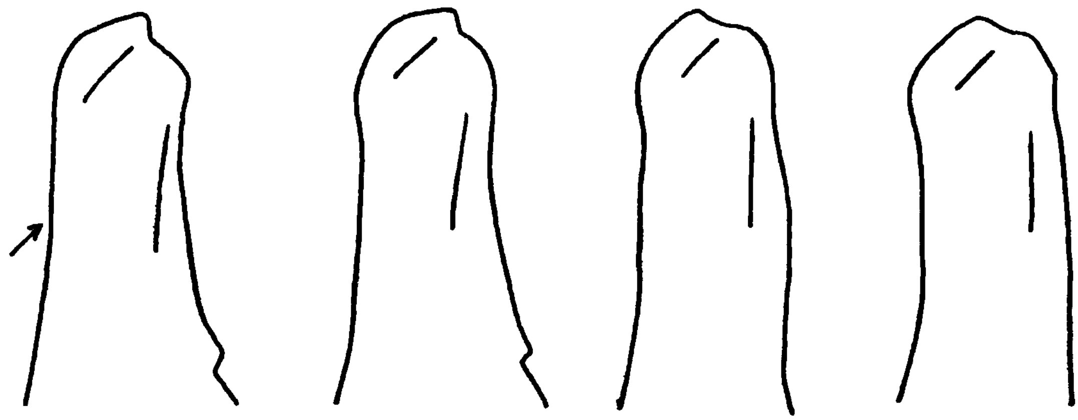
Characteristic B68: Articular Surface for Astragalus (Boessneck 1969)

Figure 8.19: Schematic Drawings of Caprine Calcaneum Morphological Characteristics



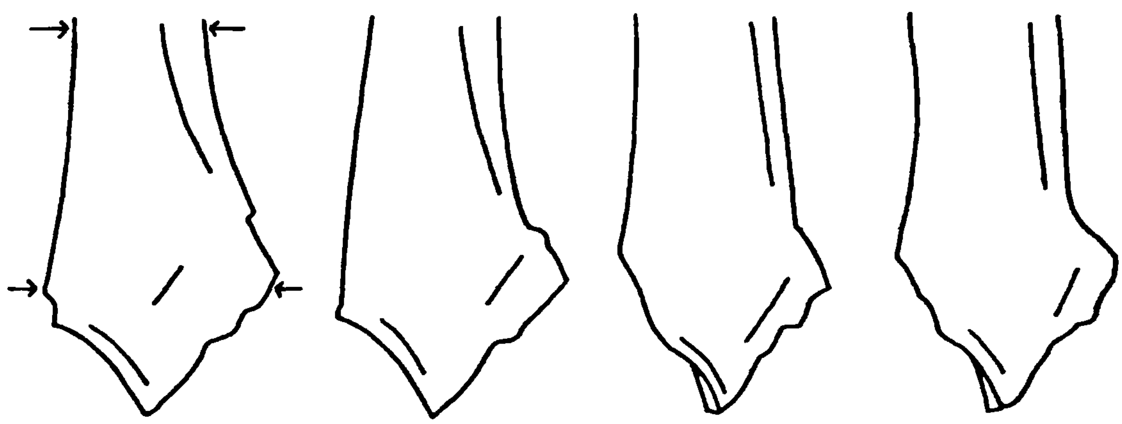
1	2	3	4
Very Broad and Short	Broad and Short	Long and Narrow	Very Long and Narrow

Characteristic B401: Length and Build of Shaft (Boessneck 1969)



1	2	3	4
No Curve	Slight Curve	Strong Curve	Very Strong Curve

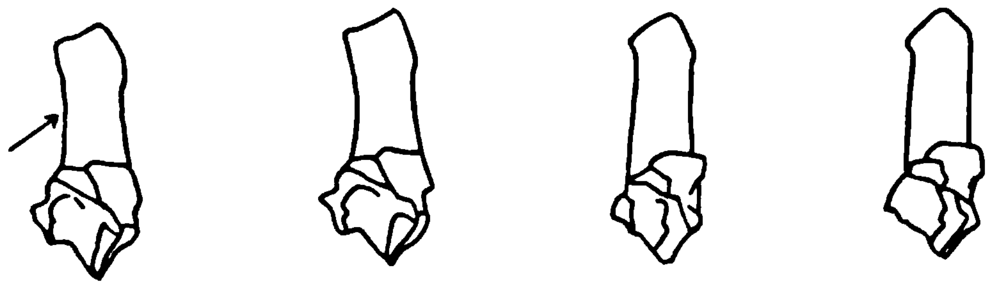
Characteristic B402: Extent of Plantar Curve of Shaft (Boessneck 1969)



1	2	3	4
Much Widening	Some Widening	Slight Widening	Minimal Widening

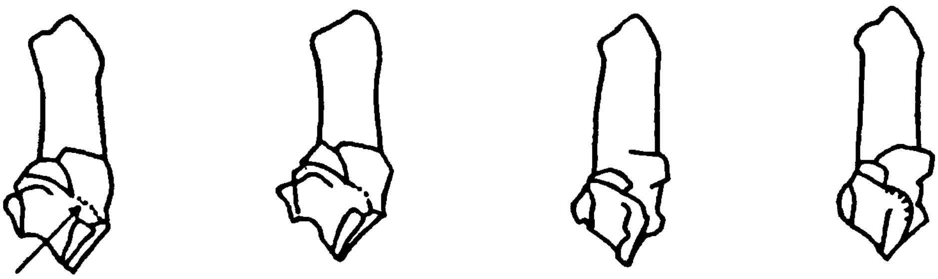
Characteristic B403: Extent of Distal Widening (Boessneck 1969)

Figure 8.19 (cont): Schematic Drawings of Caprine Calcaneum Morphological Characteristics



1 Strongly Concave | 2 Concave | 3 Straight | 4 Convex

Characteristic PF29: Curve of Corpus Calcanei (Prummel and Frisch 1986)



1 Obvious Hollow | 2 Slight Hollow | 3 Ridge | 4 Clear Ridge

Characteristic PF30: Shape Between Sustenaculum Tali and Medial Articular Surface of Processus Anterior (Prummel and Frisch 1986)

Figure 8.19 (cont): Schematic Drawings of Caprine Calcaneum Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine calcanea are presented in Tables 8.30 and 8.31 respectively.

characteristic	Species	n	score 1	score 2	score 3	score 4	missing data
B65	Goat	46	0	4	10	8	24
B65	Sheep	43	2	14	6	0	21
B65	Goat/Sheep	26	0	2	4	0	20
B66	Goat	46	0	1	16	20	9
B66	Sheep	43	12	16	6	0	9
B66	Goat/Sheep	26	2	3	9	3	9
B68	Goat	46	0	0	10	33	3
B68	Sheep	43	23	11	5	1	3
B68	Goat/Sheep	26	3	4	4	2	13
B401	Goat	46	0	3	17	14	12
B401	Sheep	43	5	14	13	2	9
B401	Goat/Sheep	26	0	10	6	2	8
B402	Goat	46	3	16	13	4	10
B402	Sheep	43	19	17	1	0	6
B402	Goat/Sheep	26	7	9	4	0	6
B403	Goat	46	0	7	15	15	9
B403	Sheep	43	8	15	14	0	6
B403	Goat/Sheep	26	2	12	3	3	6
PF29	Goat	46	0	1	19	18	8
PF29	Sheep	43	9	22	5	1	6
PF29	Goat/Sheep	26	1	9	12	0	4
PF30	Goat	46	0	0	12	31	3
PF30	Sheep	43	21	10	7	0	5
PF30	Goat/Sheep	26	3	3	10	2	8

Key: characteristic=see Figure 8.19, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.30: Score Counts for Caprine Calcaneum Characteristics

Characteristic	Factor 1	Factor 2
B65	0.518016	-0.1657
B66	0.592948	0 51324
B68	0 803055	0.439678
B401	0.580298	-0 60799
B402	0.633469	-0.09386
B403	0.702952	-0 52887
PF29	0 763126	-0.16539
PF30	0 7 16	0.427081
Eigenvalue	3.708234	1.352102
Prp.Totl	0.463529	0.169013

Table 8.31: Factor Loadings for Caprine Calcaneum Characteristics

(Highest Factor Loadings in Red)

The relative contribution of each characteristic to the overall morphological variation between calcanea of goats and sheep is demonstrated by the factor loadings in Table 8.31. Factor 1 was affected mainly by B68, PF30 and PF29 and factor 2 by B401, B403 and B66. As the eigenvalue of both factors is greater than one, the morphological variation incorporated in each factor can be regarded as significant. The six characteristics affecting factors 1 and 2 may thus be regarded as the most reliable criteria by which to make an identification of caprine calcanea to species and are presented in rank order of reliability in Table 8.32.

Rank	Characteristic	Description
1	B68	Articular surface for astragalus
2	PF30	Shape between sustenaculum tali and med. artic. surface of anterior process
3	PF29	Curve of corpus calcanei
4	B401	Length and build of shaft
5	B403	Extent of distal widening
6	B66	Articular area of lateral process

Table 8.32: Most Reliable Calcaneum Characteristics in Rank Order

The factor loadings of each analysed calcaneum are plotted in Figure 8.20.

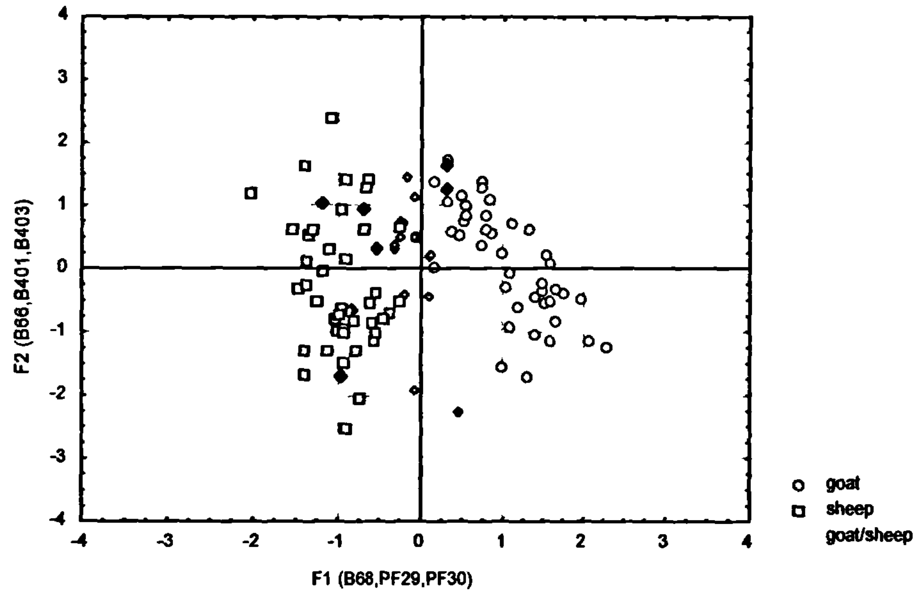
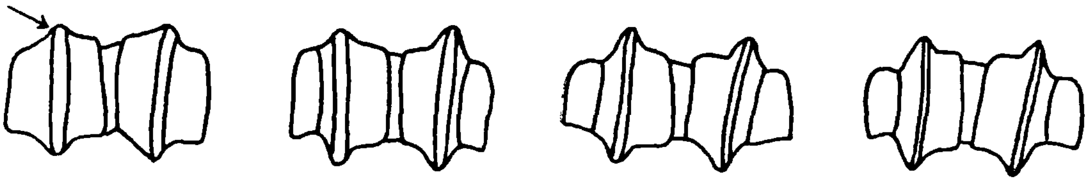


Figure 8.20: Factor Scores of Each Analysed Caprine Calcaneum

In Figure 8.20 the factor loadings of calcanea identified to species in the First Analysis fall into two separate clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. Nine of these previously unidentified specimens, marked solid in Figure 8.20, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 17 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

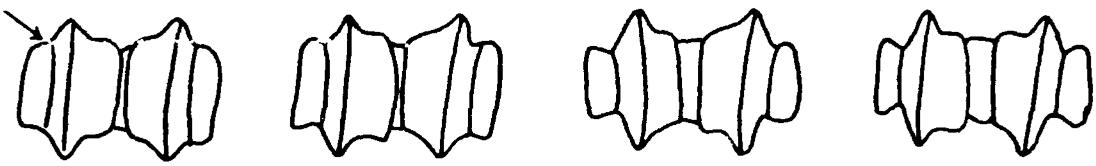
8.4.8: Principal Components Analysis of Caprine Distal Metatarsals:

Schematic drawings of the various metatarsal morphological characteristics are provided in Figure 8.21.



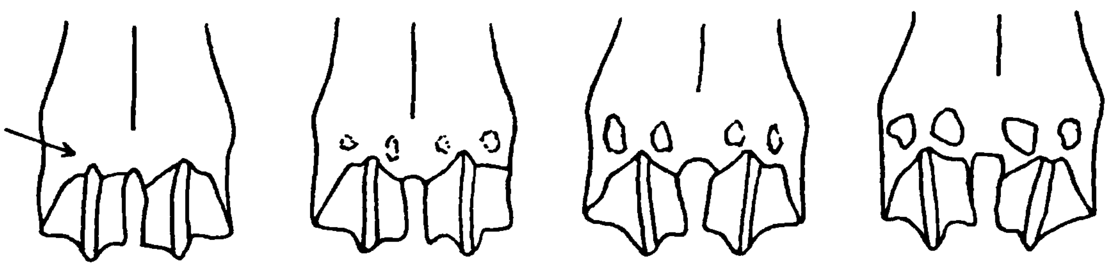
1	2	3	4
Very Rounded	Rounded and Shallow	Sharp and Steep	Very Sharp and Steep

Characteristic B305: Sharpness and Steepness of Verticilli on Trochlea (Boessneck 1969)



1	2	3	4
No Neck	Hint of Neck	Slight Neck	Clear Neck

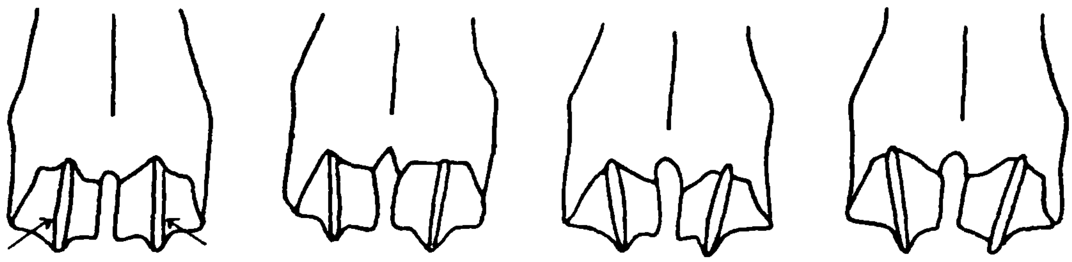
Characteristic B306: Definition of Trochlea by Neck at Verticilli (Boessneck 1969)



1	2	3	4
Minimal	Slightly Developed	Strongly Developed	Very Strongly Developed

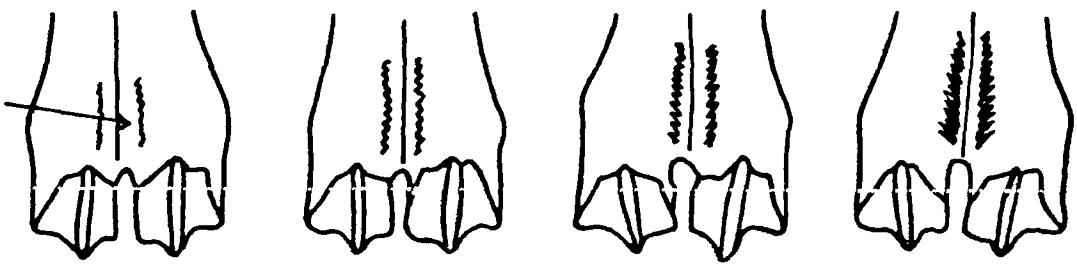
Characteristic B307: Extent of Fossulae (Boessneck 1969)

Figure 8.21: Schematic Drawings of Caprine Distal Metatarsal Morphological Characteristics



1 Parallel | 2 Slight Angle | 3 Strong Angle | 4 Very Strong Angle

Characteristic B308: Degree of Convergence of Verticilli (Boessneck 1969)



1 Very Faint | 2 Faint | 3 Clear and Deep | 4 Very Clear and Deep

Characteristic B309: Clarity of Sulcus at Distal End (Boessneck 1969)

Figure 8.21 (cont): Schematic Drawings of Caprine Distal Metatarsal Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine distal metatarsals are presented in Tables 8.33 and 8.34 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B305	Goat	70	0	8	35	26	1
B305	Sheep	50	2	27	21	0	0
B305	Goat/Sheep	2	0	0	0	0	2
B306	Goat	70	1	22	28	17	2
B306	Sheep	50	25	21	4	0	0
B306	Goat/Sheep	2	0	2	0	0	0
B307	Goat	70	0	11	33	13	13
B307	Sheep	50	16	25	2	0	7
B307	Goat/Sheep	2	0	0	0	0	2
B308	Goat	70	0	23	13	2	32
B308	Sheep	50	11	13	1	0	25
B308	Goat/Sheep	2	0	0	0	0	2
B309	Goat	70	0	6	21	12	31
B309	Sheep	50	20	6	0	0	24
B309	Goat/Sheep	2	0	0	0	0	2

Key: characteristic=see Figure 8.21, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.33: Score Counts for Caprine Metatarsal Characteristics

Characteristic	Factor 1	Factor 2
B305	0.679527	0.404499
B306	0.686587	0.43058
B307	0 753126	-0.0326
B308	0.612531	-0 6642
B309	0 792441	-0.17554
Eigenvalue	2.503515	0 822 57
Prp.Totl	0.500703	0.164411

Table 8.34: Factor Loadings for Caprine Metatarsal Characteristics (Highest Factor Loadings in Red, Eigenvalue <1.0 in Blue)

The relative contribution of each characteristic to the overall morphological variation between distal metatarsals of goats and sheep is demonstrated by the factor loadings in Table 8.34. Factor 1 was affected mainly by B309 and B307 and Factor 2 by B308. However, although the eigenvalue of factor 1 is greater than one, that of factor 2 is not. Only the morphological variation incorporated in factor 1 can be regarded as making a significant contribution to the overall morphological variation. The two characteristics affecting factor 1 may thus be regarded as the most reliable criteria by which to make an identification of caprine distal metatarsals to species and are presented in rank order of reliability in Table 8.35.

Rank	Characteristic	Description
1	B309	Clarity of sulcus at distal end
2	B307	Extent of fossulae

Table 8.35: Most Reliable Distal Metatarsal Characteristics in Rank Order

The factor loadings of each analysed distal metatarsal are plotted in Figure 8.22.

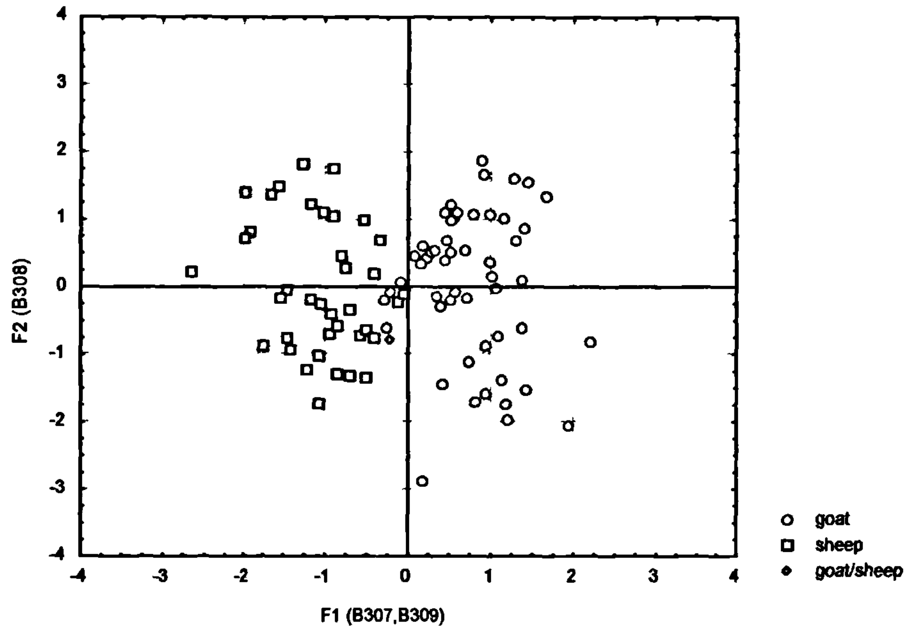
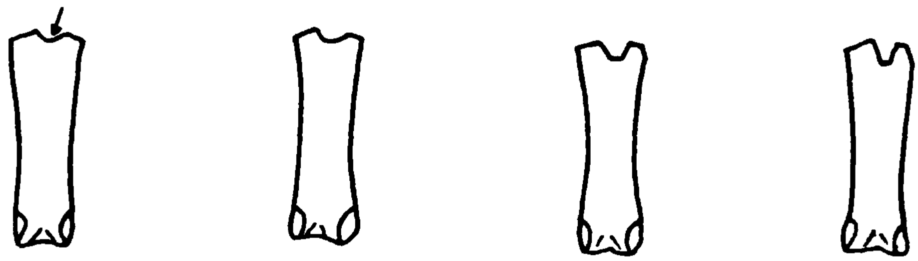


Figure 8.22: Factor Scores of Each Analysed Caprine Distal Metatarsal

When interpreting Figure 8.22 it should be recalled that the eigenvalue of factor 2 for distal metatarsals was less than one (see Table 8.34) and can therefore be ignored. The factor 1 loadings of specimens identified to species in the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species. However, the two clusters overlap slightly and seven specimens identified during the First Analysis lie within the zone of overlap. As a result not all of these identifications can be confirmed by this method. The two specimens unidentified in the First Analysis lie within the area of overlap between previously identified goats and sheep and cannot therefore be identified to species

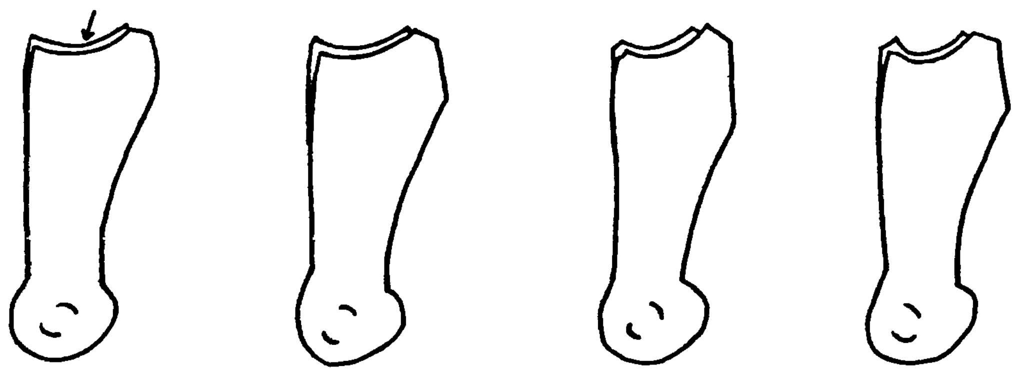
8.4.9: Principal Components Analysis of Caprine First Phalanges:

Schematic drawings of the various first phalanx morphological characteristics are provided in Figure 8.23.



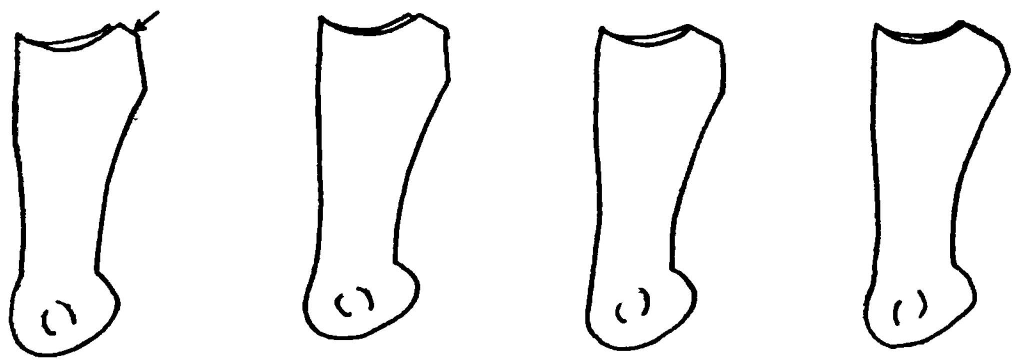
1	2	3	4
Very Shallow	Shallow	Deep	Very Deep

Characteristic B500: Groove at Proximal End (dorsal view) (Boessneck 1969)



1	2	3	4
Very Open Curve	Open Curve	Tight Curve	Very Tight Curve

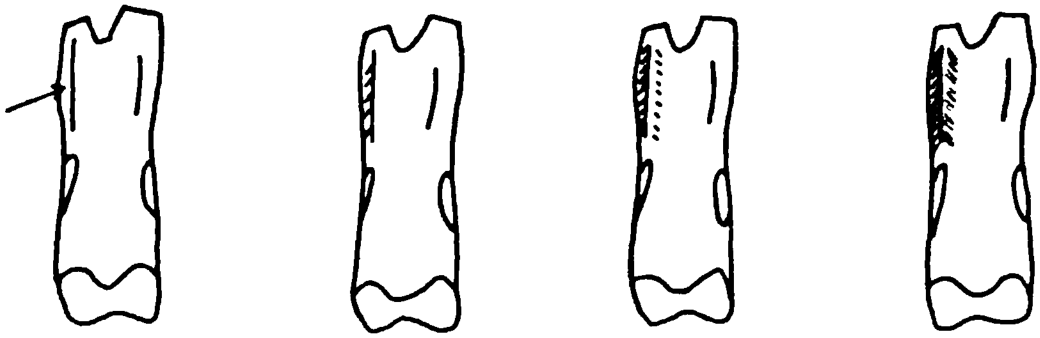
Characteristic B73: Curve of Proximal Articulation (axial view) (Boessneck 1969)



1	2	3	4
Very Small	Small	Large	Very Large

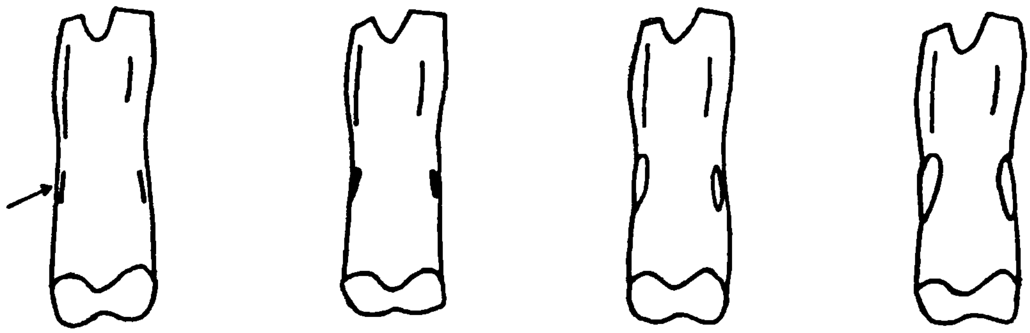
Characteristic B501: Small Articular Surfaces at Proximal End (Boessneck 1969)

Figure 8.23: Schematic Drawings of Caprine First Phalanx Morphological Characteristics



1 Minimal or Absent | 2 Weak Ridge | 3 Strong Ridge | 4 Very Strong Ridge

Characteristic B502: Ridging of Axial Ligament Tubercle (Boessneck 1969)



1 Very Weak | 2 Weak | 3 Strong | 4 Very Strong

Characteristic B75: Originating Points for Ligaments (Boessneck 1969)

Convex | **Slightly Convex** | **Slightly Concave** | **Concave**

1 | 2 | 3 | 4

Characteristic B74: Posterior Side of Shaft (Boessneck 1969)

Figure 8.23 (cont): Schematic Drawings of Caprine First Phalanx Morphological Characteristics

1 Minimal Angle | 2 Obtuse Angle | 3 Right Angle | 4 Acute Angle

Characteristic B76: Angle at Posterior Edge of Distal Articular Surface (Boessneck 1969)

Figure 8.23 (cont): Schematic Drawings of Caprine First Phalanx Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine first phalanges are presented in Tables 8.36 and 8.37 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B500	Goat	118	3	26	59	23	7
B500	Sheep	68	31	34	2	0	1
B500	Goat/Sheep	88	13	36	34	2	3
B73	Goat	118	0	11	61	38	8
B73	Sheep	68	14	38	14	0	2
B73	Goat/Sheep	88	2	29	45	5	7
B501	Goat	118	0	17	41	37	23
B501	Sheep	68	17	36	5	0	10
B501	Goat/Sheep	88	5	27	26	3	27
B502	Goat	118	2	26	55	27	8
B502	Sheep	68	24	35	4	2	3
B502	Goat/Sheep	88	8	34	14	2	30
B75	Goat	118	0	9	37	62	10
B75	Sheep	68	22	29	6	0	11
B75	Goat/Sheep	88	2	26	17	3	40
B74	Goat	118	11	40	56	4	7
B74	Sheep	68	10	40	4	0	14
B74	Goat/Sheep	88	4	22	21	1	40
B76	Goat	118	2	34	44	23	15
B76	Sheep	68	23	30	1	0	14
B76	Goat/Sheep	88	6	19	12	2	49

Key: characteristic=see Figure 8.23, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.36: Score Counts for Caprine First Phalanx Characteristics

Characteristic	Factor 1	Factor 2
B500	0 718488	-0.38801
B73	0 706023	-0.21554
B501	0.660612	-0.31304
B502	0.653839	0.258479
B75	0.7 2 16	0.096529
B74	0.328717	0 825217
B76	0.643846	0.192488
Eigenvalue	2.981867	1.089167
Prp.Totl	0.425981	0.155595

Table 8.37: Factor Loadings for Caprine First Phalanx Characteristics (Highest Factor Loadings in Red)

The relative contribution of each characteristic to the overall morphological variation between first phalanges of goats and sheep is demonstrated by the factor loadings in Table 8.37. Factor 1 was affected mainly by B75, B500 and B73 and factor 2 by B74. As the eigenvalue of both factors is greater than one, the morphological variation incorporated in each factor can be regarded as significant. The four characteristics affecting factors 1 and 2 may thus be regarded as the most reliable criteria by which to make an identification of caprine first phalanges to species and are presented in rank order of reliability in Table 8.38.

Rank	Characteristic	Description
1	B75	Originating points for ligaments
2	B500	Groove at proximal end (dorsal view)
3	B73	Curve of proximal articulation (axial view)
4	B74	Posterior side of shaft

Table 8.38: Most Reliable First Phalanx Characteristics in Rank Order

The factor loadings of each analysed first phalanx are plotted in Figure 8.24.

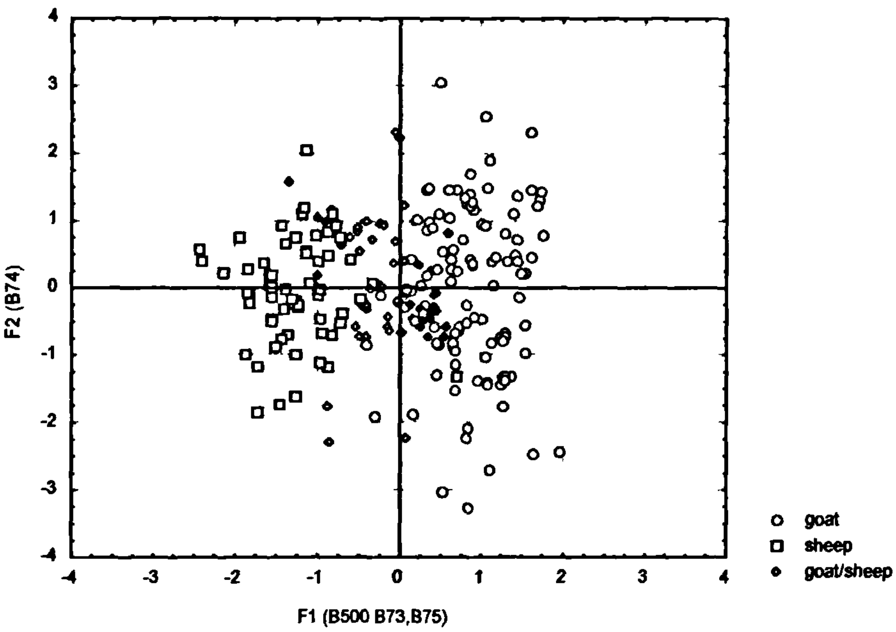


Figure 8.24: Factor Scores of Each Analysed Caprine First Phalanx

In Figure 8.24 the factor loadings of first phalanges identified to species during the First Analysis fall into two clusters, one consisting of specimens previously identified as goats, with one exception, and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species. However, the two clusters overlap slightly and three specimens identified during the First Analysis lie within the zone of overlap. As a result not all of these identifications can be confirmed by this method. The single previously identified sheep in the goat cluster may well have been misidentified and should be re-examined. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. 31 of these previously unidentified specimens, marked solid in Figure 8.24, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 57 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

8.4.10: Principal Components Analysis of Caprine Third Phalanges:

Schematic drawings of the various third phalanx morphological characteristics are provided in Figure 8.25.

Very Blunt	Blunt	Sharp	Very Sharp
1	2	3	4

Characteristic B80: Sharpness of Dorsal Angle (Boessneck 1969)

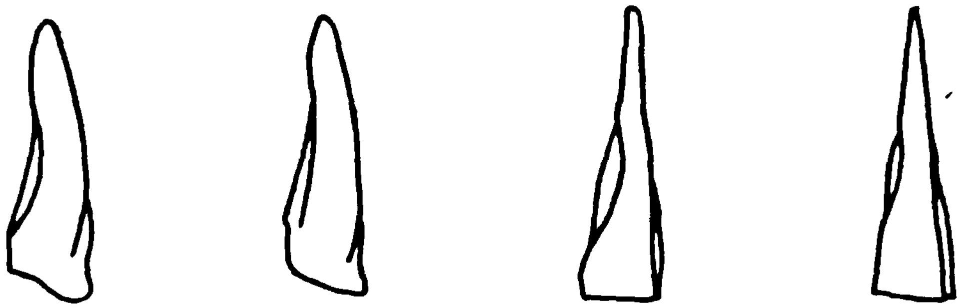
1	2	3	4
Very Slight	Slight	Clear	Very Clear

Characteristic B701 (cross-section): Extent of Pinching on Anterior Half (Boessneck 1969)

1	2	3	4
Very Large	Large	Small	Very Small

Characteristic B81: Size of Processus Extensorius (Boessneck 1969)

Figure 8.25: Schematic Drawings of Caprine Third Phalanx Morphological Characteristics



1	2	3	4
Very Curved	Curved	Triangular and Curved	Triangular and Straight

Characteristic B702: Plan of Sole (Boessneck 1969)

1	2	3	4
Very Curved	Curved	Obtuse Angle	Right Angle

Characteristic B703 (cross-section): Merging of Axial Side into Sole (Boessneck 1969)

Figure 8.25 (cont): Schematic Drawings of Caprine Third Phalanx Morphological Characteristics

The score counts and calculated factor loadings for the various morphological characteristics of caprine third phalanges are presented in Tables 8.39 and 8.40 respectively.

characteristic	species	n	score 1	score 2	score 3	score 4	missing data
B80	Goat	43	0	3	18	4	18
B80	Sheep	23	0	9	8	1	5
B80	Goat/Sheep	41	0	4	6	2	29
B701	Goat	43	0	3	18	15	7
B701	Sheep	23	5	15	0	0	3
B701	Goat/Sheep	41	0	7	6	1	27
B81	Goat	43	0	0	21	18	4
B81	Sheep	23	3	6	5	0	9
B81	Goat/Sheep	41	0	3	11	5	22
B702	Goat	43	0	0	20	23	0
B702	Sheep	23	8	14	1	0	0
B702	Goat/Sheep	41	0	6	12	1	22
B703	Goat	43	0	2	20	20	1
B703	Sheep	23	11	11	0	0	1
B703	Goat/Sheep	41	1	10	19	6	5

Key: characteristic=see Figure 8.25, species=identification obtained in First Analysis, n=NISP, score X=n specimens scoring X for the particular characteristic, missing data=n specimens on which the particular characteristic was not preserved

Table 8.39: Score Counts for Caprine Third Phalanx Characteristics

Characteristic	Factor 1	Factor 2
B80	0.429845	0 88135
B701	0.85562	0.149331
B81	0.648126	-0.17327
B702	0 811073	-0.28209
B703	0 832623	-0.19879
Expl.Var	2.68802	0.948194
Prp.Totl	0.537604	0.189639

Table 8.40: Factor Loadings for Caprine Third Phalanx Characteristics (Highest Factor Loadings in Red, Eigenvalue <1.0 in Blue)

The relative contribution of each characteristic to the overall morphological variation between third phalanges of goats and sheep is demonstrated by the factor loadings in Table 8.40. Factor 1 was affected mainly by B701, B703 and B702 and Factor 2 by B80. However, although the eigenvalue of factor 1 is greater than one, that of factor 2 is not. Only the morphological variation incorporated in factor 1 can be regarded as making a significant contribution to the overall morphological variation. The three characteristics affecting factor 1 may thus be regarded as the most reliable criteria by which to make an identification of caprine third phalanges to species and are presented in rank order of reliability in Table 8.41.

Rank	Characteristic	Description
1	B701	Extent of pinching in anterior half
2	B703	Merging of axial side into sole
3	B702	Plan of sole

Table 8.41: Most Reliable Third Phalanx Characteristics in Rank Order

The factor loadings of each analysed third phalanx are plotted in Figure 8.26

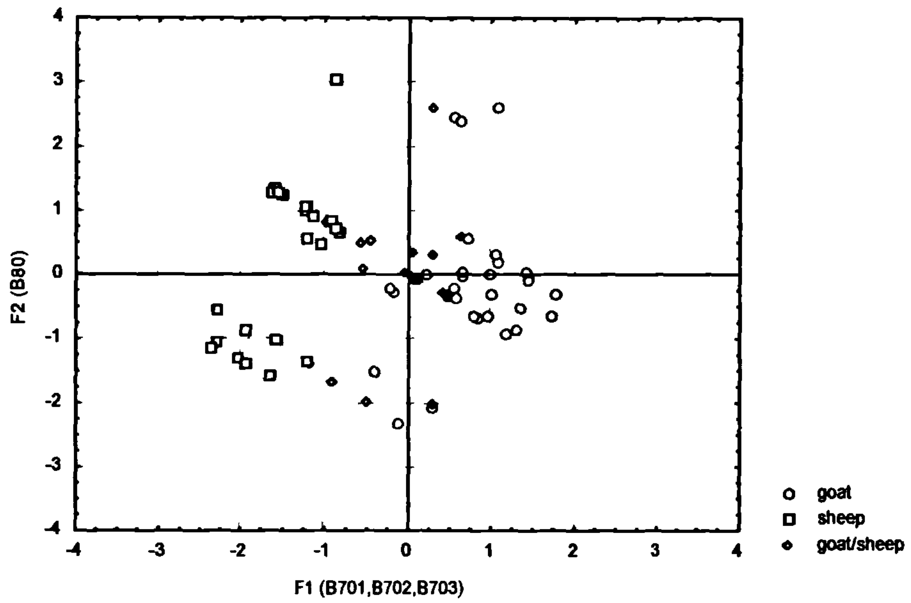


Figure 8.26: Factor Scores of Each Analysed Caprine Third Phalanx

When interpreting Figure 8.26 it should be recalled that the eigenvalue of factor 2 for third phalanges was less than one (see Table 8.40) and can therefore be ignored. The factor 1 loadings of third phalanges identified to species during the First Analysis fall into two clusters, one consisting of specimens previously identified as goats and the other consisting of specimens previously identified as sheep. This confirms that the clusters are a reflection of the morphological variation between the two species and suggests that all identifications obtained during the First Analysis are correct. The factor loadings of caprine specimens which could not be identified to species during the First Analysis fall into an intermediate cluster. 18 of these previously unidentified specimens, marked solid in Figure 8.26, fall within the range of morphological variation of either goats and sheep as represented by the clusters of previously identified specimens and could therefore be assigned to one species or the other. The remaining 23 unidentified specimens fall in between the goat and sheep clusters and could not be identified to species by this method.

8.4.11: Summary of the Most Reliable Morphological Characteristics:

The morphological characteristics identified by the principal components analysis as being the most reliable in yielding an accurate identification to species are summarised for each POSAC in Table 8.42, in decreasing order of reliability from left to right.

POSAC	Most Reliable Characteristics
Distal Scapula	B26/PF6, PF7, HR1, B27/PF8, B23
Distal Humerus	PF10, B36, AW1, PF9, B33
Distal Radius	B904, B42, B905, B43
Distal Metacarpal	B207, B208
Distal Tibia	K4, K2, K12, K7, K10, K1, K5, K11, K3
Astragalus	B51, B62, B64, PF28, PF26
Calcaneum	B68, PF30, PF29, B401, B403, B66
Distal Metatarsal	B309, B307
Proximal Phalanx	B75, B500, B73, B74
Distal Phalanx	B701, B703, B702

Table 8.42: The Most Reliable Morphological Characteristics on Each POSAC

The most reliable characteristic on each POSAC is that whose score count is the most likely to be at the extremes of the range of observed morphological variation i.e. 1 or 4, rather than in the middle of the range i.e. 2 or 3. A clear separation of goats from sheep, with a low proportion of intermediate specimens, should therefore be obtained from the most reliable characteristics.

The results in Table 8.42 may therefore serve as a guide to the individual morphological characteristics which should be relied on for preference when separating samples of goat and sheep bone. However the extent to which these results may be specific to the caprine sample from 'Ain Ghazal remains unknown

8.4.12: Independent Check of Identifications Obtained in the First Analysis by Principal Components Analysis:

The percentage of identifications obtained in the First Analysis confirmed by the principal components analysis as being correct is presented for each POSAC in Table 8.43.

POSAC	n	n i.d.	n c.	n ic.	N unc.	% c.
Distal Scapula	153	96	96	0	0	100.0
Distal Humerus	189	132	132	0	0	100.0
Distal Radius	69	66	66	0	0	100.0
Distal Metacarpal	124	123	116	0	7	94.3
Distal Tibia	141	97	97	0	0	100.0
Astragalus	220	195	195	0	0	100.0
Calcaneum	115	89	89	0	0	100.0
Distal Metatarsal	122	120	113	0	7	94.2
First Phalanx	274	186	182	1	3	97.8
Third Phalanx	107	66	66	0	0	100.0
TOTAL	**1514**	**1170**	**1152**	**1**	**17**	**98.5**

Key: n NISP, n i.d.=n identified to species in First Analysis, n c.=n First Analysis identifications shown to be correct by Third Analysis, n ic.= n First Analysis identifications shown to be incorrect by Third Analysis, n unc.=n First Analysis identifications unconfirmed as correct or incorrect by Third Analysis, % c.=% First Analysis identifications shown to be correct by Third Analysis

Table 8.43: Independent Check of Identifications Obtained in First Analysis by Principal Components Analysis

The results in Table 8.43 confirm that well over 90% of the identifications of each POSAC obtained in the First Analysis were correct. The actual proportion of correct identifications may be even higher. The fact that only one specimen out of a total 1170 had been incorrectly identified means there is little reason to assume that the identifications of the 17 unconfirmed specimens were in fact incorrect. The results of the principal components analysis demonstrate that although subjective, traditional methods of separating goat and sheep bones can result in specimens of the same morphology being consistently identified as the same species. As all the morphological characteristics on which this analysis was based were formulated with reference to modern material of known species one can be reasonably confident that accurate identifications are being obtained.

8.4.13: Potential of Principal Components Analysis to Identify a Greater Proportion of Caprine POSACs to Species than Traditional Methods:

The proportion of each POSAC identified to species in the First Analysis is compared with the proportion potentially identifiable through principal components analysis in Table 8.44. The POSACs are listed in rank order of the proportion identified to species in the First Analysis (see Table 8.2).

POSAC	n	n i.d. 1	% i.d. 1	n i.d. 3	% i.d. 3	% inc.
Distal Metacarpal	124	123	99.2	124	100	0.8
Distal Metatarsal	122	120	98.4	120	98.4	0.0
Distal Radius	69	66	95.7	67	97.1	1.4
Astragalus	220	195	88.6	210	95.5	6.8
Calcaneum	115	89	77.4	98	85.2	7.8
Distal Humerus	189	132	69.8	153	81.0	11.1
First Phalanx	274	186	67.9	217	79.2	11.3
Distal Tibia	141	97	68.8	120	85.1	16.3
Distal Scapula	153	96	62.7	113	73.9	11.1
Third Phalanx	107	66	61.7	84	78.5	16.8

Key: n=NISP, n i.d. 1=n identified to species in First Analysis, % i.d. 1=% identified to species in First Analysis, n i.d. 3=n identified to species in Third Analysis, % i.d. 3=% identified to species in Third Analysis, % inc.=% increase in n identified specimens in Third Analysis compared to First Analysis

Table 8.44: Comparison of Proportions of Caprine POSACs Identified to Species By Traditional Methods and Principal Components Analysis

It should be noted that as the sub-sample of specimens selected for principal components analysis was better preserved than average, the proportion of the sub-sample identified to species in the First Analysis is higher than that of the sample of caprine bones from 'Ain Ghazal as a whole. From the results in Table 8.44 it is clear that in the case of each POSAC a higher percentage of specimens could potentially be identified to species using principal components analysis than by using traditional methods. Furthermore, it is also apparent that this percentage is proportionally higher in those POSACs which were less easily identifiable using traditional methods, and as a result there is less overall variation in the proportion of each POSAC identified to species. This suggests that this type of principal components analysis may be one way to tackle the problems associated with variation in the proportion of each POSAC identified using traditional methods (see 8.2.4 and 8.2.5).

However, although the sub-sample selected was better preserved than average and therefore more amenable to this type of analysis, as at least two morphological characteristics could be recorded on each selected specimen, the actual potential percentage increase in the number of identifiable specimens is relatively low. As missing data is replaced by mean values in this type of principal components analysis, which draws the calculated factor loadings towards 0, the inclusion of large numbers of poorly preserved specimens on which only one morphological characteristic could be recorded is unlikely to result in the identification to species of a significantly larger number of specimens.

A further problem with this type of principal components analysis is that although a clear separation of goats and sheep may be made on the basis of a single reliable characteristic, when that characteristic is combined into a single factor with others the initial clear separation may blur into a continuum of morphological variation. This phenomenon can be seen extremely clearly by examining the score counts of distal radius characteristics and the associated plot of factor scores (Table 8.18 and Figure 8.12).

8.5: CONCLUSIONS:

These three analyses undertaken on the 'Ain Ghazal caprine bones have been effective in fulfilling the objectives set out in 8.1, namely: to generate reliable quantitative diachronic archaeozoological data for each species, and to identify the individual morphological characteristics on each POSAC with which an accurate identification to species could be made.

56.5% of caprine bones were identified to species in the First Analysis, which used traditional methods based on comparisons with published and unpublished morphological criteria, and modern reference material. The Second and Third Analyses suggest that virtually all of these identifications were correct and that they can confidently be used as the basis of this zooarchaeological investigation of caprines at 'Ain Ghazal.

Unfortunately 43.5% of the sample of caprine bones proved impossible to identify to species by traditional methods. The unidentified specimens are unevenly distributed throughout the skeleton, with some POSACs being consistently harder to identify than others. Study of this phenomenon has demonstrated that goat to sheep ratios obtained from samples with a high proportion of unidentified specimens are more likely to deviate from the norm and should therefore be treated with caution. In addition, this phenomenon leads to difficulties in constructing separate age profiles for each species. The proportion of unidentified specimens is dependent on the state of bone preservation as well as skeletal element.

Payne's (1969) metrical separation of caprine distal metacarpals proved highly effective in identifying those specimens on which w.cond and w.troch measurements could be taken, however this applied to only 39% of distal metacarpal POSACs.

Finally, the results of the principal components analysis suggest that this method has only limited potential to increase the proportion of caprine bones identified to species as it only works effectively on well preserved specimens which can in most cases be identified by traditional methods. Furthermore, the time required to record the requisite data for this type of analysis precludes its use on large assemblages. The real value of the principal components analysis lies in its ability to identify the morphological characteristics which are most reliable in yielding an accurate identification.

The results of these three analyses suggest that traditional methods can generate accurate and highly consistent data. However, confidence in the identifications thus obtained could be improved by a preliminary principal components analysis of a sub-sample of better preserved specimens in order to identify the individual morphological characteristics which are most reliable for the particular assemblage under analysis. These could then form the basis of an separation of goats and sheep using traditional methods. Inevitably it will be impossible to identify all archaeological caprine bones to species. However, rather than developing ever more time-consuming methods of identification it is probably more effective to focus on those skeletal elements and morphological characteristics on which an accurate identification can relatively quickly and simply be obtained and to be aware of the limitations which the presence of unidentified specimens imposes on interpretation.

CHAPTER 9: REPRESENTATION OF TAXA AT 'AIN GHAZAL

9.1: INTRODUCTION:

Although this zooarchaeological analysis of the faunal assemblage from 'Ain Ghazal is focused primarily on caprines, the bones of several other taxa were quantified using the same methodology to allow the changing representation of goats and sheep at the site to be discussed in the context of the wider faunal economy. As not all of the small mammal, reptile and bird bone were available for analysis, it was decided to confine this analysis to the main medium and large ungulates ~~herbivores~~ found in the assemblage, namely: goat, sheep, gazelle, cattle, pig and equid.

In her analysis of part of the 'Ain Ghazal faunal assemblage which was excavated between 1982 and 1989, Köhler-Rollefson found that these six taxa comprised the great majority of identified specimens: 80.8% in the MPPNB, 97.0% in the LPPNB, 98.1% in the PPNC and 97.7% in the Yarmoukian (Köhler-Rollefson et al. 1993, p.96). More recent work by von den Driesch and Wodtke on the 'Ain Ghazal faunal assemblage excavated between 1993 and 1995 has yielded similar results. The proportion of these six taxa in their samples of identified specimens was 98.2% in the late MPPNB/early LPPNB, 97.9% in the LPPNB, 99.0% in the transitional LPPNB/PPNC, 99.3% in the PPNC and 98.1% in the Yarmoukian (von den Driesch and Wodtke, 1997, p.542). As virtually all of the bones analysed by Köhler-Rollefson and a large proportion of those analysed by von den Driesch and Wodtke were included in this analysis of the 'Ain Ghazal faunal assemblage, it was thought reasonable to assume that goats, sheep, gazelle, cattle, pigs and equids would make up a similarly high proportion of the assemblage analysed during the course of this study.

Although not all taxa were examined during the course of this study, it is clear those which were made by far the most significant contribution to the 'Ain Ghazal faunal economy. Although it is important not to underestimate the potential significance of minor taxa such as fox, hare, felid or canid, they were present in such low numbers in the results of Köhler-Rollefson and in the results of von den Driesch and Wodtke, that their impact on the changing representation of goats and sheep at the site was felt to be relatively insignificant.

It was therefore decided that it would be acceptable to draw on the representation of minor taxa in the published results of Köhler-Rollefson et al. (1988, 1993) and von den Driesch and Wodtke (1997). However, it should be noted that the taxa counts and percentages of Köhler-Rollefson and of von den Driesch and Wodtke are not directly compatible with those of this study because different systems were used to record and count the material.

As this study focuses on the caprine remains from 'Ain Ghazal, gazelle, cattle, pigs and equids were not examined in detail. They were quantified solely to provide a backdrop against which the changing representation of goats and sheep could be discussed and were only identified to genus level. Fortunately, these genera have been examined in more detail in the previous work of Köhler-Rollefson and von den Driesch and Wodtke; as a result the range of species present at the site within each genus is reasonably clear.

This chapter consists of three main sections. The first discusses the late Pleistocene and early Holocene zoogeography of gazelle, cattle, pigs and equids, and makes some comments on their ecology and ethology (the late Pleistocene and early Holocene zoogeography of caprines has already been discussed in detail in Chapter 6). The full range of non-caprine medium and large herbivore species (i.e.: gazelle, cattle, pigs and equids) identified during the course of previous work on the faunal assemblage are described, as are the results of previous attempts to establish the wild or domestic status of cattle and pigs at the site (the wild or domestic status of the 'Ain Ghazal caprines is discussed separately in Chapter 10). The second section describes the representation of the six main medium and large herbivore taxa in the results of the analysis of the 'Ain Ghazal faunal assemblage which was undertaken as part of this study. The third section describes the representation of minor taxa in the results of Köhler-Rollefson and of von den Driesch and Wodtke, and discusses the problems involved in interpreting this data and integrating it with the results of this study.

9.2: LATE PLEISTOCENE AND EARLY HOLOCENE ZOOGEOGRAPHY OF THE FOUR MAIN NON-CAPRINE, MEDIUM AND LARGE HERBIVORE TAXA REPRESENTED AT 'AIN GHAZAL:

As discussed in Chapter 6, zoogeographical and zooarchaeological data suggest that of the caprines only wild goat *Capra aegagrus*, domestic goat *Capra hircus*, and domestic sheep *Ovis aries* should be anticipated in the faunal assemblage from 'Ain Ghazal. This section therefore discusses the remaining four main, non-caprine medium and large herbivore taxa (i.e.: gazelle, cattle, pigs and equids) in an attempt to assess which other species should also be anticipated in this part of the faunal assemblage.

9.2.1: Gazelle:

Three species of gazelle are known to have occurred in southwest Asia: the mountain gazelle *Gazella gazella*, the dorcas gazelle *Gazella dorcas* and the goitred gazelle *Gazella subgutturosa*. All still exist in limited numbers in the wild today. The mountain gazelle inhabits a wide range of moister environments throughout the region, which include mountains, low hills and the coastal plain. The dorcas gazelle favours more arid environments such as gravel plains and occasionally sand deserts; its distribution largely coincides with that of *Acacia* spp.. Examination of modern (Harrison and Bates 1991) and ancient (Uerpmann 1987) distribution maps for these species suggests that both can be expected in the faunal assemblage from 'Ain Ghazal. The goitred gazelle inhabits sand deserts, gravel plains and limestone plateaux. Although the area around 'Ain Ghazal is close to the western limits of its distribution (Harrison and Bates 1991, p.203) its presence in the steppe to the east of the site cannot, in contrast to the view of von den Driesch and Wodtke (1997, p.519), be discounted on zoogeographical grounds. Far from being confined to "the northern mountain regions of the Fertile Crescent" (von den Driesch and Wodtke 1997, p.519), the goitred gazelle is known to have inhabited the eastern deserts of Jordan and has in relatively recent times been identified in the vicinity of al-Qatrana, approximately 100km to the south of the site (Harrison and Bates 1991, p.203). The post-cranial skeletal elements of the genus *Gazella* are extremely similar and "only differences in size can give some hints as to the specific identity of archaeological gazelle remains" (Uerpmann 1987, p.90, but see also Compagnoni 1978, pp.119-128). Of the three gazelle species under discussion goitred gazelle is the largest and dorcas gazelle the smallest. However, identification of gazelle remains to species is most reliably achieved not on the basis of size but on the basis of horncore morphology.

The gazelle horncores from 'Ain Ghazal examined by von den Driesch and Wodtke (1997, p.524) consisted predominantly of mountain gazelle alongside lower frequencies of dorcas gazelle. These identifications are tentatively supported by their metrical analysis of the post-cranial skeleton, which suggests that larger and smaller specimens are present. However, their assertion that the larger gazelle bones from 'Ain Ghazal consist exclusively of mountain gazelle fails to take into account the fact that Uerpmann (in Köhler-Rollefson et al. 1988, p.425) claims to have identified a number of goitred gazelle horncores in the faunal assemblage from 'Ain Ghazal excavated between 1982 and 1989. The possibility that some of the larger post-cranial elements in the sample are in fact goitred gazelle cannot therefore be ruled out. This rather contradictory available evidence therefore suggests that the gazelle remains from 'Ain Ghazal consist predominantly of mountain gazelle, alongside some dorcas gazelle and potentially goitred gazelle as well. The relative abundance of mountain gazelle is unsurprising, as the area around 'Ain Ghazal in the early Holocene would have coincided well with its favoured habitat.

9.2.2: Cattle:

Although extinct since 1627 the wild ancestor of domestic cattle *Bos taurus*, the aurochs *Bos primigenius*, is known to have inhabited parts of southwest Asia well into the historical period (Uerpmann 1987, p.72). The former wide range of this animal attests to its tolerance of a variety of different environments. In the southern Levant although it probably inhabited open woodland or dense grassland, its distribution was probably restricted more by the availability of water than by any specific vegetation (Uerpmann 1979, p.125 and 1987, p.72). The steppe wisent *Bison bison* and the wild ancestor of the water buffalo *Bubalus arnee* are also known to have inhabited parts of southwest Asia during the early Holocene (Uerpmann 1987), although neither are found in the region today. Neither species can be anticipated in the faunal assemblage from 'Ain Ghazal on zoogeographical grounds. The steppe wisent favoured open grasslands and on the basis of admittedly limited data seems only to have inhabited the northern Levant and Anatolia (Uerpmann 1987, pp.76-78, von den Driesch and Wodtke 1997, p.528). The water buffalo has more restricted environmental requirements and would have been confined to riverine forests and fresh-water swamps, neither of which are found in the vicinity of the site (Uerpmann 1987, p.78). It can therefore be assumed that of the large *Bovinae* only the aurochs is likely to have inhabited the area around 'Ain Ghazal. This assumption is supported by the results of von den Driesch and Wodtke (1997, p.528). Despite checking the cattle bones from the site against the limited osteological criteria by the which the aurochs and steppe wisent can be separated (Boessneck et al. 1963) they found no evidence for the presence of the latter species. No evidence for the presence of hartebeest *Alcelaphus buselaphus* has been found in the 'Ain Ghazal faunal assemblage.

In general, the cattle bones from 'Ain Ghazal were highly fragmented and poorly preserved. As a result von den Driesch and Wodtke (1997, pp.528-530) encountered difficulties in establishing the wild or domestic status of cattle at the site. The few teeth which could be assessed for dental wear suggested that extremely young animals were not present, although this may have been at least partially the effect of differential preservation. However, examination of epiphyseal fusion yielded similar results: specimens from animals over one and a half years of age were predominant and the proportion of animals over three years of age was over 30% in all phases except the Yarmoukian. Few measurements could be taken on the cattle bones owing to the generally poor state of preservation and the majority of the measurements which were taken came from early fusing elements which continue to grow after fusion has taken place. Von den Driesch and Wodtke's sample of cattle bone measurements from 'Ain Ghazal is therefore small and potentially unreliable. Notwithstanding these problems, their comparison of 'Ain Ghazal cattle bone measurements with those of 9th and 8th millennia b.c. aurochs from Denmark and Mureybet, and Bronze Age and Iron Age domestic cattle from Lidar Höyük and Bastam II has demonstrated that the cattle bones from 'Ain Ghazal were much larger than the domestic comparative specimens, but very slightly smaller than the comparative aurochs specimens (von den Driesch and Wodtke 1997, p.529). Surprisingly, the largest specimens at 'Ain Ghazal came from the Yarmoukian, whilst the smallest came from the PPNC. Von den Driesch and Wodtke have therefore argued that: "the villagers of 'Ain Ghazal had already captured aurochs calves and tried to breed them in the settlement in the PPNB. The descendants of these animals no longer attained the sizes of their wild relatives. We certainly can suppose that people with experience in goat domestication and breeding sheep and goats were able to try domesticating aurochs. That this process took a long time and had setbacks, that aurochs calves again and again escaped or died, and that eventually this process at the end was not successful, is evidenced by the high proportion of young animals and the measurements for the Yarmoukian, in which bone sizes increase again" (von den Driesch and Wodtke 1997, p.530). If this supposition is correct then the cattle bones from 'Ain Ghazal can be assumed to represent a mixture of aurochs and early domestic cattle.

9.2.3: Pig:

The wild boar, *Sus scrofa,* has been the only member of its genus to inhabit southwest Asia for approximately 50,000 years (Uerpmann 1987, p.42) and survives in large numbers in parts of the region today. Although it is primarily an inhabitant of riverine thickets and reed beds, it is adapted to a wide variety of environments and is also found in wooded hills, forests and occasionally in semi-desert (Dar 1976, Harrsion and Bates 1991), however it does not inhabit the arid deserts. A large population of wild boar inhabited the reed beds along the Wadi Zarqa until relatively recently (Merrill 1881, p.396).

The work of von den Driesch and Wodtke (1997, pp.525-529) on the pig remains from 'Ain Ghazal failed to identify the presence of domesticates with any degree of certainty. Although the proportion of juvenile animals in their sample was extremely high, between 92% and 97.5% of specimens came from animals which died before the age of three years and between 15% and 40% from animals which died at one year or under, they suggest that this is more likely to be a reflection of the natural population structure in wild pigs than selective culling of domestic animals. Furthermore, the measurements of pig bones from 'Ain Ghazal were much larger than Bronze Age domestic pigs from Lidar Höyük, being similar in size to pigs from Hesban interpreted as wild. Von den Driesch and Wodtke have therefore concluded that the pig remains from 'Ain Ghazal most probably consist entirely of wild *Sus scrofa*, predominantly easily hunted piglets, which would have inhabited thickets and reed beds along the Wadi Zarqa close to the site.

9.2.4: Equid:

Four species of equid are known to have inhabited southwest Asia during the late Pleistocene: the wild horse *Equus ferus*, the onager *Equus hemionus*, the wild ass *Equus africanus* and the european wild ass *Equus hydruntinus*. However, both the wild horse and european wild ass appear to have become extinct in the Levant by the end of the Pleistocene, although the former and possibly the latter survived into the Holocene in Anatolia (Uerpmann 1987). In contrast, the onager was widespread across the more arid areas of Levant during the early Holocene and only became extinct between 50 and 60 years ago. Its range seems to have been restricted to the eastern slopes of the Levantine mountains and the steppe beyond. Its distribution overlapped with early Holocene range of the wild ass, which is likewise believed to be extinct in the region today though the difficulty of distinguishing it from feral donkeys makes it difficult to be certain. Like the onager the wild ass would have inhabited relatively arid areas. However, whereas the former preferred open steppe with firm soils the latter would have favoured more rocky, dissected terrain (Uerpmann 1987, p.37). Both environments can be found in the vicinity of 'Ain Ghazal.

Although extremely similar, the remains of onager and wild ass can be distinguished on the basis of differences in the pattern of enamel folds on the molars and differences in the proportions of the metacarpals (Davis 1987, pp.33-34). The detailed work of von den Driesch and Wodtke (1997, pp.530-533) on the equid remains from 'Ain Ghazal suggested that both species are represented in the assemblage. Although they found no complete metacarpals in their sample, all of the equid teeth which could be identified to species belonged to the wild ass. However, measurements taken on a range of post-cranial skeletal elements suggest that the equid remains fall into two size categories. The larger is interpreted by von den Driesch and Wodtke (1997, p.531) as representing the remains of onager and the smaller the remains of wild ass. However, it is admitted that these identifications should be regarded as tentative owing to the poor state of preservation and small number of measurements. However, zoogeographic evidence suggests that the presence of both onager and wild ass in the faunal assemblage from 'Ain Ghazal would not be entirely unexpected.

9.3: REPRESENTATION OF THE SIX MAIN MEDIUM AND LARGE HERBIVORE TAXA IN THE RESULTS OF THIS STUDY:

9.3.1: Comparison Between NISP and Adjusted NISP Counts:

NISP and adjusted NISP counts for the main medium and large herbivore taxa in the 'Ain Ghazal faunal assemblage identified during the course of this study, and less precisely identified specimens categorised as goat/sheep or small ruminant, are presented below in Tables 9.1 and 9.2. As discussed in Chapter 2, adjusted NISP counts form the basic unit of quantification throughout this study, as they take varying anatomical frequencies of metapodia and phalanges into account.

Comparison of the NISP counts in Table 9.1 with the adjusted NISP counts in Table 9.2 demonstrates that there is actually very little difference between the two sets of results. However, as the adjusted NISP count will continue to produce consistent results even if the large samples from each phase are broken down into smaller sub-samples, which may potentially contain higher than normal frequencies of metapodia and phalanges, it has been retained as the basic unit of quantification.

	MPPNB		LPPNB		LPPNB/PPNC		PPNC		Yarmoukian	
taxon	n	%	n	%	n	%	n	%	n	%
goat	1240	37.0	154	21.9	56	17.2	236	12.1	165	11.5
sheep	8	0.2	120	17.0	72	22.1	526	27.0	340	23.6
goat/sheep	819	24.4	184	26.1	79	24.2	515	26.4	491	34.1
gazelle	830	24.8	88	12.5	30	9.2	208	10.7	138	9.6
sm.rum.	183	5.5	40	5.7	31	9.5	121	6.2	82	5.7
cattle	147	4.4	26	3.7	27	8.3	80	4.1	53	3.7
pig	120	3.6	79	11.2	27	8.3	215	11.0	86	6.0
equid	4	0.1	13	1.8	4	1.2	50	2.6	85	5.9
TOTAL	3351	100.0	704	100.0	326	100.0	1951	100.0	1440	100.0

Table 9.1: Representation of Taxa in the Results of this Study (NISP)

	MPPNB		LPPNB		LPPNB/PPNC		PPNC		Yarmoukian	
taxon	n	%	n	%	n	%	n	%	n	%
goat	1134	35.8	138.5	20.9	48	15.9	220	11.8	153	10.8
sheep	7	0.2	113.5	17.1	64.5	21.4	483.5	25.9	321	22.7
goat/sheep	803.5	25.4	182	27.5	78	25.9	513	27.5	488	34.5
gazelle	790	25.0	78	11.8	25.5	8.5	194	10.4	135	9.5
sm.rum.	176	5.6	39	5.9	30.5	10.1	119	6.4	81	5.7
cattle	141	4.5	25	3.8	24.5	8.1	72	3.9	52	3.7
pig	109	3.4	71	10.7	25	8.3	205	11.0	81	5.7
equid	5	0.2	16	2.4	5	1.7	57	3.1	103	7.3
TOTAL	3165.5	100.0	663	100.0	301	100.0	1863.5	100.0	1414	100.0

Table 9.2: Representation of Taxa in the Results of this Study (adjusted NISP)

9.3.2: Representation of the Six Main Medium and Large Herbivore Taxa in the Results of this Study:

The adjusted NISP percentage counts in Table 9.2 are plotted by phase in Figure 9.1.

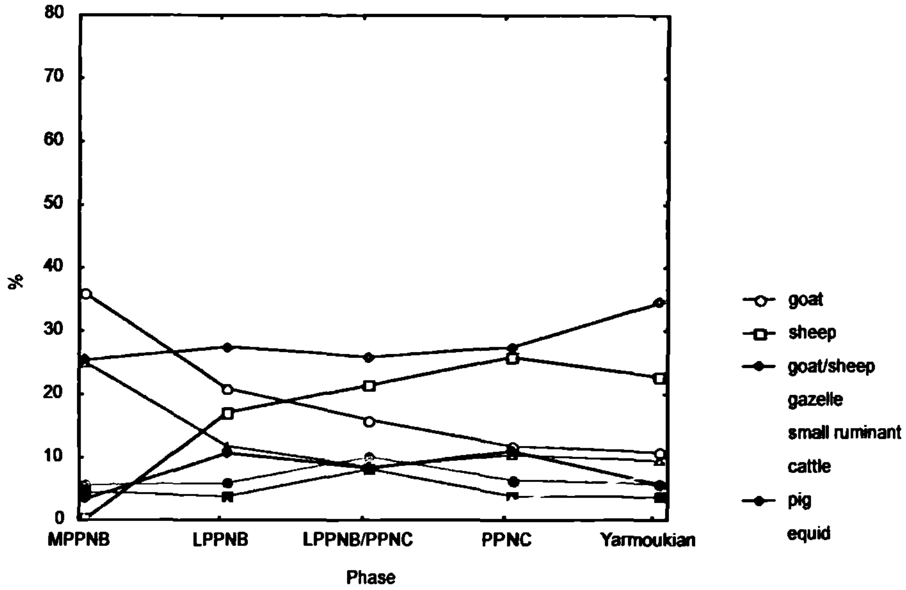


Figure 9.1: Representation of Taxa in the Results of this Study (adjusted NISP)

A number of temporal trends in the representation of the six main medium and large herbivore taxa at 'Ain Ghazal are visible in Figure 9.1: the proportions of goat and gazelle steadily decrease, the proportions of sheep and equid steadily increase and the proportions of cattle and pig appear to fluctuate. The clear increase in the proportion of goat/sheep during the Yarmoukian can be attributed to the higher levels of calcretion affecting much of this material.

However, as Figure 9.1 includes the adjusted NISP percentage counts of specimens categorised as goat/sheep or small ruminant these trends are partially obscured, as it is difficult to establish what the overall proportion of goat, sheep and gazelle in each phase might have been. However, the metrical separation of goat and sheep distal metacarpals demonstrated that the goat to sheep ratios obtained for each phase are reasonably representative of the sample as whole (see Chapter 8, Table 8.10). It was therefore decided to divide the specimens identified only as goat/sheep and small ruminant amongst the goats, sheep and gazelle according to the relative proportions of these three species in the identified sample. The results of this calculation are presented in Table 9.3 and are plotted in Figure 9.2.

	MPPNB		LPPNB		LPPNB/PPNC		PPNC		Yarmoukian	
taxon	n	%	n	%	n	%	n	%	n	%
goat	2036	64.3	254.9	38.4	91.9	30.5	409.6	22.0	330.8	23.4
sheep	12.5	0.4	208.9	31.5	123.5	41.0	900.2	48.3	694.2	49.1
gazelle	862	27.2	87.2	13.2	31.1	10.3	219.7	11.8	153	10.8
cattle	141	4.5	25	3.8	24.5	8.1	72	3.9	52	3.7
pig	109	3.4	71	10.7	25	8.3	205	11.0	81	5.7
equid	5	0.2	16	2.4	5	1.7	57	3.1	103	7.3
TOTAL	3165.5	100.0	663	100.0	301	100.0	1863.5	100.0	1414	100.0

Table 9.3: Representation of the Six Main Medium and Large Herbivore Taxa in the Results of this Study (adjusted NISP with Goat/Sheep and Small Ruminant Divided Between Goat, Sheep and Gazelle)

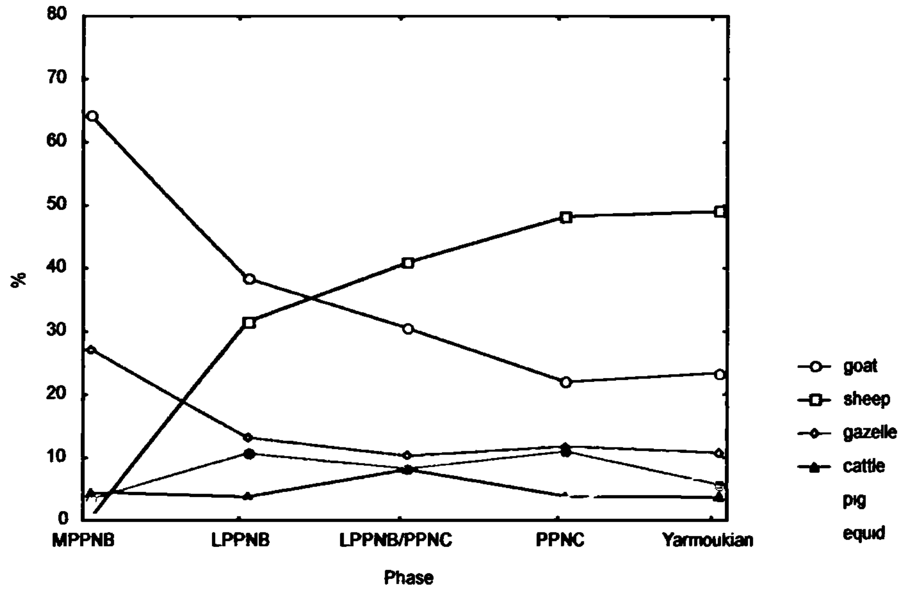


Figure 9.2: Representation of the Six Main Medium and Large Herbivore Taxa in the Results of this Study (adjusted NISP with Goat/Sheep and Small Ruminant Divided Between Goat, Sheep and Gazelle)

The basic trends already noted in the data in Table 9.2 and Figure 9.1 are greatly clarified with the division of the goat/sheep and small ruminant specimens between goats, sheep and gazelle in Table 9.3 and Figure 9.2. The latter data therefore form the basis of the following discussion.

9.3.2.1: Goat:

It is clear that goats were present at 'Ain Ghazal from the beginning of its occupation and that they were the predominant species during the MPPNB, when they comprised 64.3% of the sample. However, the frequency of the species subsequently decreased, dropping to 38.4% in the LPPNB, 30.5% in the transitional LPPNB/PPNC and 22% in the PPNC. At this point the decline in the frequency of goat appears to have stabilised, as it maintained a similar proportion, 23.4%, into the Yarmoukian.

9.3.2.2: Sheep:

Sheep comprised only 0.4% of the MPPNB sample. It is therefore tempting to regard these 12.5 POSACs as intrusive from later phases, given the widespread pit digging and terracing characteristic of the PPNC and Yarmoukian at 'Ain Ghazal, were it not for the fact that several came from sealed MPPNB contexts. The presence of very small numbers of sheep at 'Ain Ghazal during the MPPNB therefore seems likely. However, the frequency of the species subsequently increased enormously; sheep comprised 31.5% of the LPPNB sample and by the transitional LPPNB/PPNC had replaced goat as the predominant species at the site, when they comprised 41% of the sample. The increase in the frequency of sheep continued into the PPNC, rising to 48.3% of the sample, after which it maintained a similar frequency, 49.1%, into the Yarmoukian.

9.3.2.3: Gazelle:

During the MPPNB gazelle was the second most common species at 'Ain Ghazal, comprising 27.2% of the sample from this phase. However, its frequency had declined sharply by the LPPNB, when it comprised 13.2% of the sample, and continued to do so into the transitional LPPNB/PPNC when its decline stabilised at 10.3%. The frequency of gazelle then continued at similar levels, 11.8% and 10.8% respectively, throughout the PPNC and Yarmoukian.

9.3.2.4: Cattle:

With the exception of the transitional LPPNB/PPNC, the proportion of cattle was relatively stable during the main phases of occupation at 'Ain Ghazal. The frequency of cattle was similar during the MPPNB and LPPNB, comprising 4.5% and 3.8% of these respective samples. This proportion jumped to 8.1% during the transitional LPPNB/PPNC before dropping back to 3.9% and 3.7% respectively in the PPNC and

Yarmoukian samples. The unusually high proportion of cattle during the transitional LPPNB/PPNC may be associated with the smaller sample size from this phase, despite the fact that it is clear in Figure 9.2 that the frequency of goat, sheep, gazelle and equid in this phase are all in line with long term trends.

9.3.2.5: Pig:

The frequency of pig at 'Ain Ghazal appears to have fluctuated throughout the main phases of occupation at the site. It was most common during the LPPNB, transitional LPPNB/PPNC and PPNC, comprising 10.7%, 8.3% and 11% respectively, and was least common during the MPPNB and Yarmoukian, when it comprised 3.4% and 5.7% of these respective samples. Of these fluctuations, the increase in its frequency between the MPPNB and LPPNB and the decrease between the PPNC and Yarmoukian are clearly the most significant.

9.3.2.6: Equid:

The frequency of equids at 'Ain Ghazal exhibited a general upward trend throughout the main phases of the occupation, rising from 0.2% in the MPPNB to 2.4% in the LPPNB. Although during the transitional LPPNB/PPNC it dropped back to 1.7%, by the PPNC it had risen again to 3.1% and by the Yarmoukian to 7.3% when it was more common at the site than either cattle or pig.

9.3.3: Summary of the Representation of the Six Main Medium and Large Herbivore Taxa in the Results of this Study:

Drawing on the results presented in 9.3.2 above it is possible to summarise the main temporal trends in the representation of the six main medium and large herbivore taxa at 'Ain Ghazal. Throughout the entire period of the site's occupation caprines were by far the dominant species, comprising over 60% of the analysed sample in all phases. Their frequency exhibited a steady, though relatively slight, increase over time which was interrupted only by a barely discernible drop during the PPNC. Although the caprine assemblage was made up almost entirely of goats during the MPPNB, over time they were largely replaced by sheep. During the PPNC and Yarmoukian sheep outnumbered goats by approximately 2 to 1. Cattle and pigs were much less common at 'Ain Ghazal than caprines and neither exceeded 11% in any phase Both increased in frequency from their relatively low MPPNB representation during intermediate periods of occupation at

'Ain Ghazal, but by the time of the Yarmoukian had declined back to approximately their frequency during the MPPNB. Although the rise in the frequency of pigs had occurred by the LPPNB and continued at a similarly high level until the PPNC, cattle were only present in higher than normal numbers during the transitional LPPNB/PPNC and this apparent increase may well be linked to the small sample size. Of the species known for certain to have been wild throughout the period of occupation at 'Ain Ghazal, gazelle were by far the most abundant and represented almost 30% of the MPPNB sample. However, their frequency declined significantly between the MPPNB and transitional LPPNB/PPNC, after which they maintained a low, though stable, presence at just over 10%. In contrast to gazelle, equids increased in frequency over time from 0.2% of the MPPNB sample to over 7% by the Yarmoukian; the most significant increases were between the MPPNB and LPPNB and between the PPNC and Yarmoukian.

It is apparent from Figure 9.2 that the increases in the proportion of caprines and pigs between the MPPNB and LPPNB was primarily at the expense of gazelle, and that the increase in the proportion of caprines at this time was associated with the introduction of large numbers of sheep. Between the LPPNB and Yarmoukian the proportion of caprines was relatively stable, demonstrating that subsequent increases in the number of sheep were met by a corresponding decline in numbers of goats. The apparent increase in the frequency of cattle during the transitional LPPNB/PPNC was primarily at the expense of pigs and gazelle, both of which increased back to roughly their LPPNB levels in the PPNC proper. Finally, the increase in the proportion of equids between the PPNC and Yarmoukian was associated with a sharp drop in the number of pigs, although gazelle also declined slightly at this point.

9.4: REPRESENTATION OF MINOR TAXA IN THE PUBLISHED RESULTS OF KÖHLER-ROLLEFSON ET AL. (1988 AND 1993) AND VON DEN DRIESCH AND WODTKE (1997):

Between them, the six taxa quantified during the course of this study and discussed above make up the greater part of the faunal assemblage from 'Ain Ghazal (see 9.1). However, the previous work of Köhler-Rollefson et al. (1988 and 1993) and von den Driesch and Wodtke (1997) has demonstrated that a wide range of minor taxa are also represented in the faunal assemblage, though in relatively small numbers. Although these minor taxa were not analysed during the course of this study, it has been possible to draw on the published results of Köhler-Rollefson et al. (1993) and von den Driesch and Wodtke (1997) to investigate their representation at the site and the extent this may have been linked to any changes in the representation of the six main medium and large herbivore taxa.

Unfortunately for three reasons the species counts and percentages of Köhler-Rollefson and of von den Driesch and Wodtke are not directly compatible with those obtained from this study. Firstly, their results are based on the analysis of all zones of all skeletal elements using NISP counts and percentages as the basic unit of quantification, rather than the adjusted NISP counts and percentages of a restricted set of POSACs used here. Secondly, the material analysed by von den Driesch and Wodtke and, to a lesser extent, by Köhler-Rollefson, includes samples from different areas of the site to those which form the basis of this study. Thirdly, the phasing of the material analysed by von den Driesch and Wodtke differs slightly from that analysed here. The MPPNB is not represented in their material, the earliest of which belongs to a transitional late MPPNB/early LPPNB phase from the East Field which is conversely not represented in the material from the South, Central and North Fields on which this study is based.

It is therefore only possible to use the results of Köhler-Rollefson's and von den Driesch and Wodtke's analyses of the minor taxa as a rough guide to the results which might have been expected had the POSACs of minor taxa been examined during the course of this study. Köhler-Rollefson's data on the representation of minor taxa at 'Ain Ghazal is reproduced in Table 9.4 and presented graphically in Figures 9.3 and 9.4. The data of von den Driesch and Wodtke is reproduced in Table 9.5 and presented graphically in Figures 9.5 and 9.6.

taxon	MPPNB n	MPPNB %	LPPNB n	LPPNB %	PPNC n	PPNC %	Yarmoukian n	Yarmoukian %
6main taxa	5681	80.80	886	96.94	2519	97.98	1523	97.69
small carnivore	532	7.57	1	0.11	0	0.00	2	0.13
Vulpes sp.	201	2.86	6	0.66	10	0.39	4	0.26
Testudo sp.	176	2.50	7	0.77	12	0.47	4	0.26
Lepus sp.	146	2.08	2	0.22	7	0.27	4	0.26
bird	132	1.88	4	0.44	2	0.08	3	0.19
rodent	53	0.75	0	0.00	4	0.16	6	0.38
Felis sp.	47	0.67	3	0.33	2	0.08	1	0.06
insectivore	19	0.27	0	0.00	0	0.00	2	0.13
Canis sp.	13	0.18	2	0.22	3	0.12	4	0.26
reptile	10	0.14	1	0.11	2	0.08	0	0.00
Cervus sp.	8	0.11	0	0.00	0	0.00	0	0.00
Meles sp.	6	0.09	1	0.11	0	0.00	0	0.00
crab	4	0.06	0	0.00	1	0.04	0	0.00
Vivirridae	2	0.03	0	0.00	0	0.00	0	0.00
Spalax sp.	1	0.01	1	0.11	0	0.00	4	0.26
Cervus sp. ?	0	0.00	0	0.00	3	0.12	0	0.00
Martes sp.	0	0.00	0	0.00	3	0.12	2	0.13
Herpestes sp.	0	0.00	0	0.00	1	0.04	0	0.00
amphibian	0	0.00	0	0.00	1	0.04	0	0.00
fish	0	0.00	0	0.00	1	0.04	0	0.00
TOTAL	**7031**	**100.0**	**914**	**100.0**	**2571**	**100.0**	**1559**	**100.0**

Table 9.4: Representation of Minor Taxa (NISP and %NISP) in the Results of Köhler-Rollefson et al. (1993)

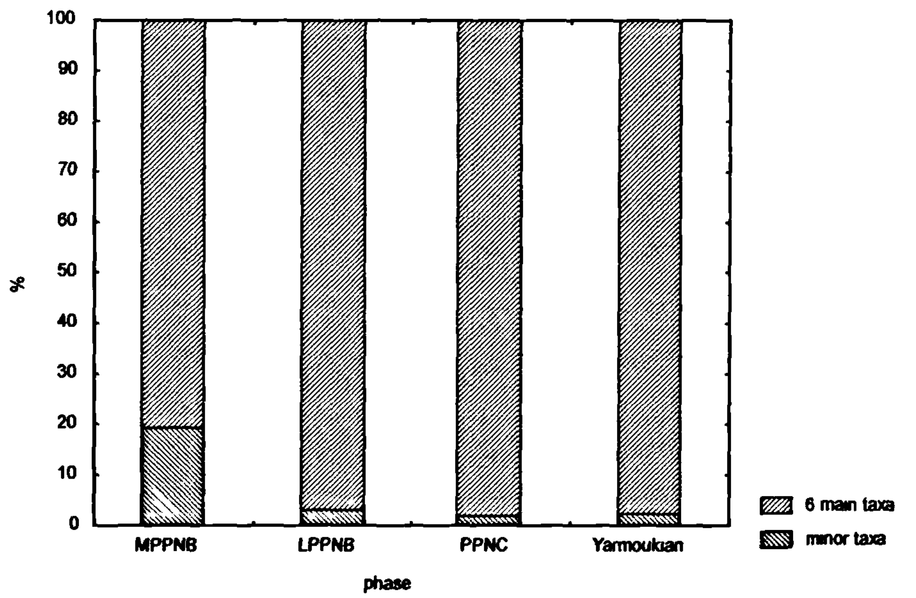


Figure 9.3: Proportion of Minor Taxa (% NISP) in Each Phase in the Results of Köhler-Rollefson et al. (1993)

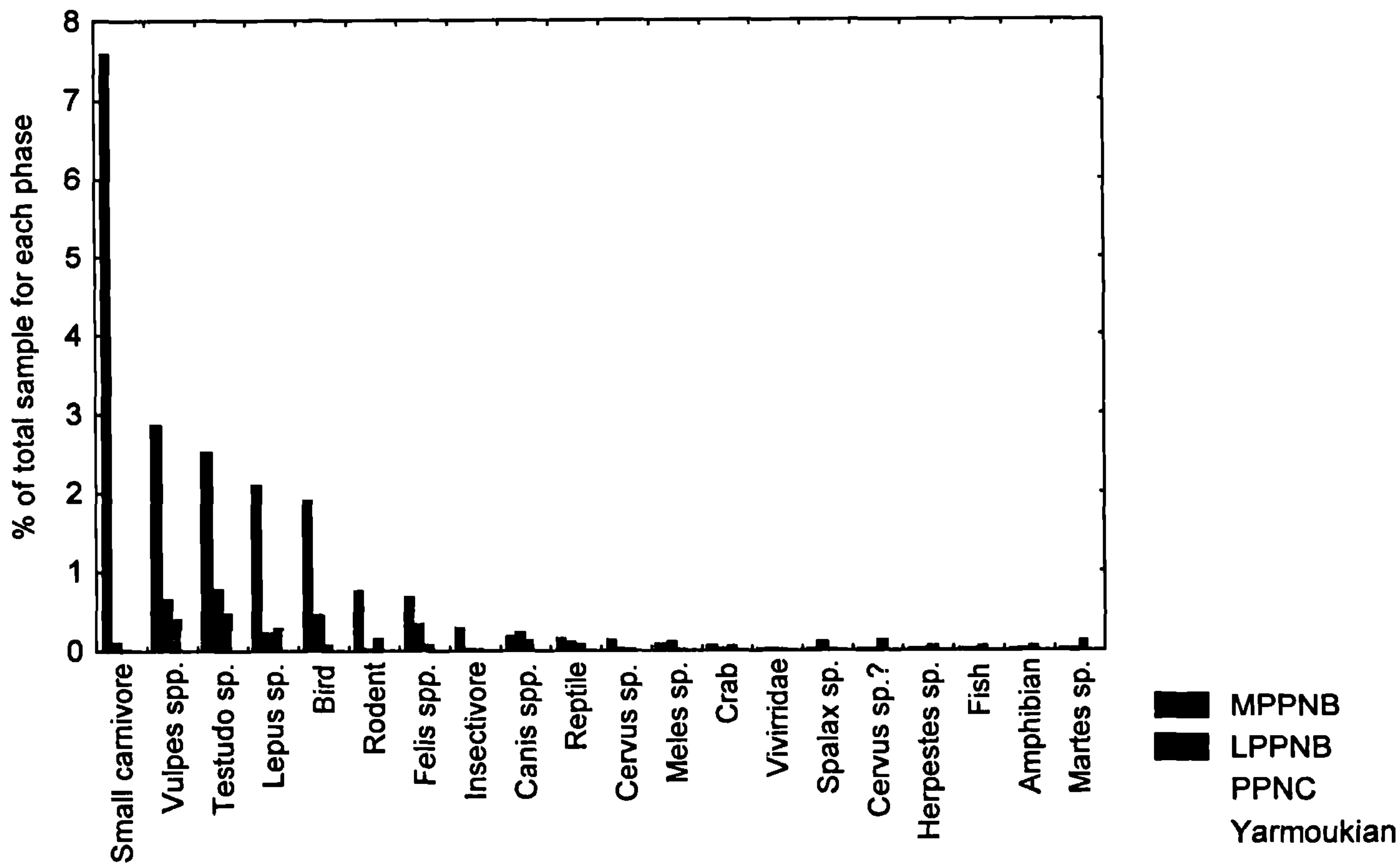
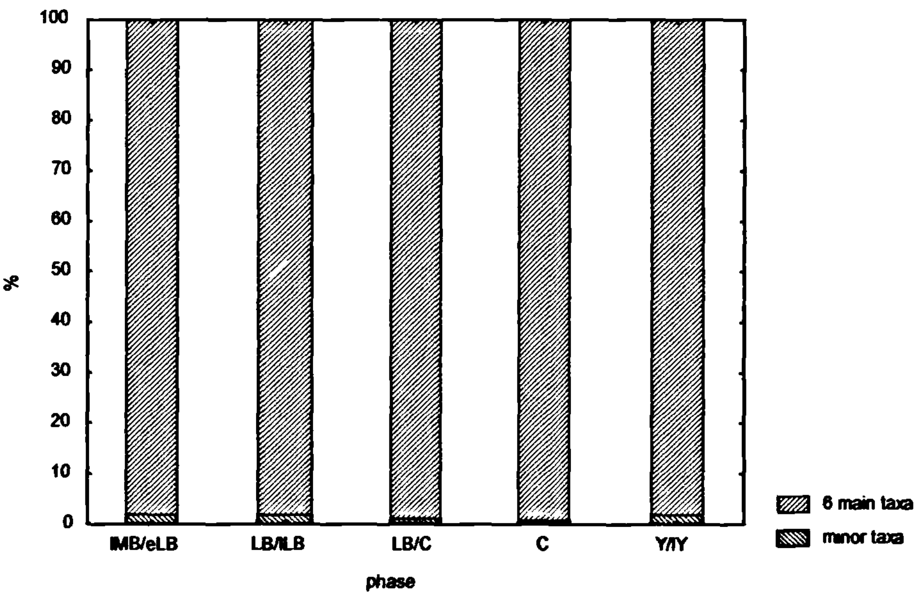


Figure 9.4: Representation of Minor Taxa (% NISP) in the Results of Köhler-Rollefson et al. (1993)

taxon	lMB/eLB n	lMB/eLB %	LB/lLB n	LB/lLB %	LB/C n	LB/C %	C n	C %	Y/lY n	Y/lY %
6 main taxa	3066	98.17	4242	97.92	2760	99.03	4959	99.34	5020	98.1
Vulpes vulpes	20	0.64	46	1.06	8	0.29	8	0.16	24	0.47
Bird	11	0.35	6	0.14	1	0.04	2	0.04	1	0.02
Lepus capensis	7	0.22	12	0.28	1	0.04	0	0.00	4	0.08
Felis silvestris	6	0.19	5	0.12	2	0.07	3	0.06	2	0.04
Testudo graeca	4	0.13	1	0.02	2	0.07	4	0.08	2	0.04
Canis aureus/Dog	2	0.06	1	0.02	0	0.00	0	0.00	8	0.16
Erinacaeus concolor	2	0.06	1	0.02	2	0.07	0	0.00	2	0.04
Crab (*Potamon* sp.)	2	0.06	1	0.02	0	0.00	0	0.00	0	0.00
Canis aureus	1	0.03	0	0.00	0	0.00	1	0.02	1	0.02
Dog	1	0.03	10	0.23	5	0.18	8	0.16	25	0.49
Mellivora capensis	1	0.03	1	0.02	0	0.00	0	0.00	1	0.02
Cervus elaphus	0	0.00	0	0.00	2	0.07	0	0.00	1	0.02
Vulpes rüpelli	0	0.00	0	0.00	1	0.04	0	0.00	0	0.00
Canis lupus	0	0.00	2	0.05	0	0.00	2	0.04	0	0.00
Panthera pardus	0	0.00	1	0.02	0	0.00	0	0.00	0	0.00
Felis caracal	0	0.00	0	0.00	0	0.00	0	0.00	1	0.02
Meles meles	0	0.00	3	0.07	2	0.07	1	0.02	7	0.14
Martes foina	0	0.00	0	0.00	0	0.00	1	0.02	0	0.00
Spalax ehrenbergi	0	0.00	0	0.00	0	0.00	0	0.00	2	0.04
Hemiechinus auritus	0	0.00	0	0.00	0	0.00	0	0.00	1	0.02
Mollusc	0	0.00	0	0.00	1	0.04	3	0.06	15	0.29
TOTAL	**3123**	**100.0**	**4332**	**100.0**	**2787**	**100.0**	**4992**	**100.0**	**5117**	**100.0**

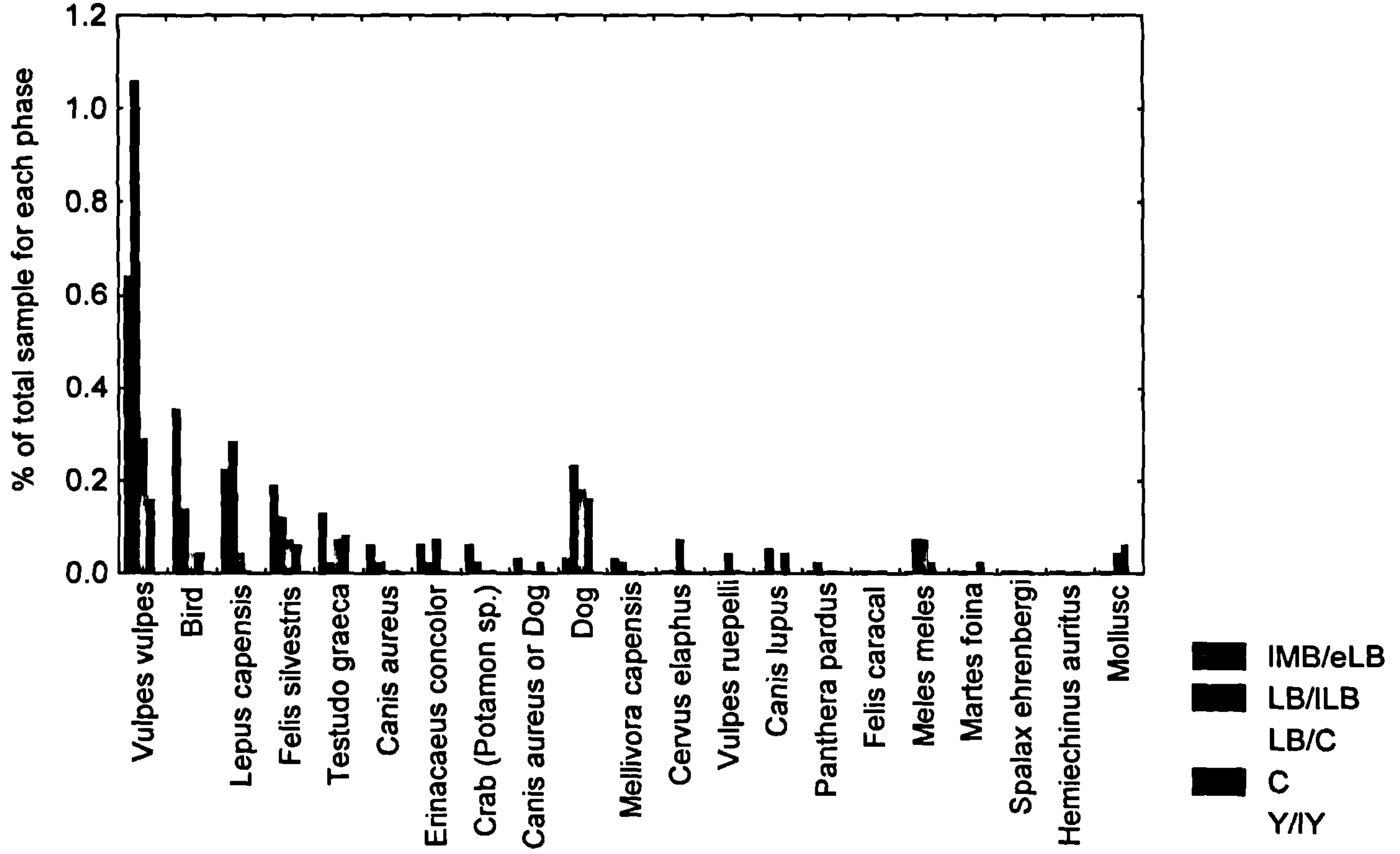
Key: lMB/eLB=late MPPNB/early LPPNB, LB/lLB=LPPNB/late LPPNB,
LB/C=LPPNB/PPNC, C=PPNC, Y/lY=Yarmoukian/late Yarmoukian

Table 9.5: Representation of Minor Taxa (NISP and % NISP) in the Results of von den Driesch and Wodtke (1997)



Key: lMB eLB=late MPPNB/early LPPNB, LB/lLB=LPPNB/late LPPNB, LB/C=LPPNB/PPNC,
C=PPNC, Y/lY=Yarmoukian/late Yarmoukian

Figure 9.5: Proportion of Minor Taxa (%NISP) in Each Phase in the Results of von den Driesch and Wodtke (1997)



Key: lMB/eLB=late MPPNB/early LPPNB, LB/lLB=LPPNB/late LPPNB, LB/C=LPPNB/PPNC, C=PPNC, Y/lY=Yarmoukian/late Yarmoukian

Figure 9.6: Representation of Minor Taxa (% NISP) in the Results of von den Driesch and Wodtke (1997)

Comparison of Figures 9.4 and 9.6 demonstrates that although a similar range of minor taxa are represented in the results of Köhler-Rollefson and of von den Driesch and Wodtke, there are significant differences in their proportional representation. In general, minor taxa are more frequent in the samples analysed by Köhler-Rollefson than in those analysed by von den Driesch and Wodtke, especially in the earliest phase of each set of results (see Figures 9.3 and 9.5). As the earliest phase of von den Driesch and Wodtke, the transitional late MPPNB/early LPPNB, is slightly later than the earliest phase of Köhler-Rollefson et al., the MPPNB proper, it is possible that a decline in the frequency of minor taxa had occurred prior to the transitional late MPPNB/early LPPNB. This would mean that an important shift in the representation of these taxa is not represented in the results of von den Driesch and Wodtke (1997). In an attempt to establish which set of results would most closely replicate the results which might have been expected had the POSACs of minor taxa been analysed in this study, the representation of the six main medium and large herbivore taxa in the published results of Köhler-Rollefson et al. (1993) and von den Driesch and Wodtke (1997) were compared with the representation of the same six main medium and large herbivore taxa in the results of this study (see Table 9.3 and Figure 9.2).

9.4.1: Representation of the Six Main Medium and Large Herbivore Taxa in the Published Results of Köhler-Rollefson et al. (1993) and von den Driesch and Wodtke (1997):

The published NISP counts and percentages of Köhler-Rollefson et al. (1993) for the six main medium and large herbivore taxa are presented in Table 9.6 and are plotted in Figure 9.7 together with the adjusted NISP counts and percentages for the same six taxa obtained during this study (see Table 9.3 and Figure 9.2). As Köhler-Rollefson did not attempt to identify her caprine sample to species, the goat and sheep counts from this study have been combined into a single goat/sheep sample in Figure 9.7 for the purpose of comparison. Also, the data from the transitional LPPNB/PPNC phase has been omitted in Table 9.6 and Figure 9.7 as Köhler-Rollefson analysed no material from this phase.

	MPPNB		LPPNB		PPNC		Yarmoukian	
taxon	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
goat/sheep	3585	63.1	647	73.0	1700	67.5	1085	71.2
gazelle	1090	19.2	60	6.8	220	8.7	100	6.6
cattle	583	10.3	52	5.9	182	7.2	104	6.8
pig	415	7.3	113	12.7	341	13.4	140	9.2
equid	8	0.1	14	1.6	76	3.0	94	6.2
TOTAL	**5681**	**100.0**	**886**	**100.0**	**2519**	**100.0**	**1523**	**100.0**

Table 9.6: NISP Counts and Percentages for the Six Main Medium and Large Herbivore Taxa in the Results of Köhler-Rollefson et al. (1993)

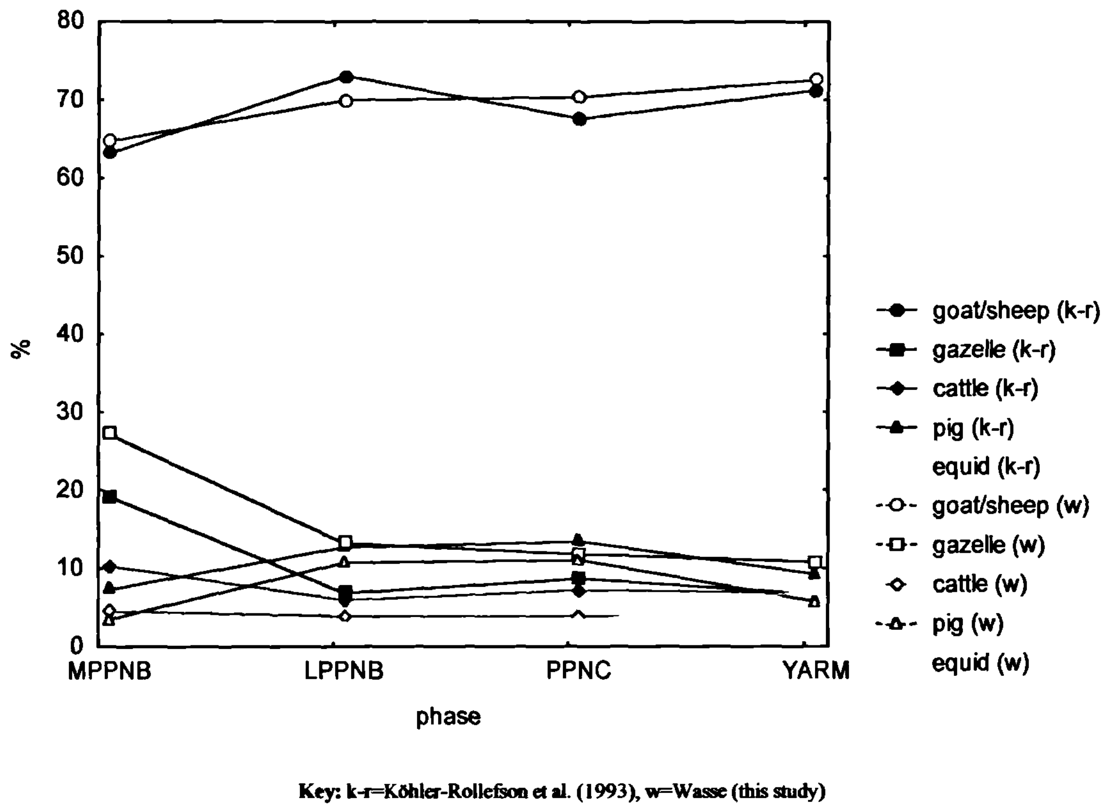


Figure 9.7: Comparison of the NISP Percentages of Köhler-Rollefson et al. (1993) and the Adjusted NISP Percentages from this Study for the Six Main Medium and Large Herbivore Taxa

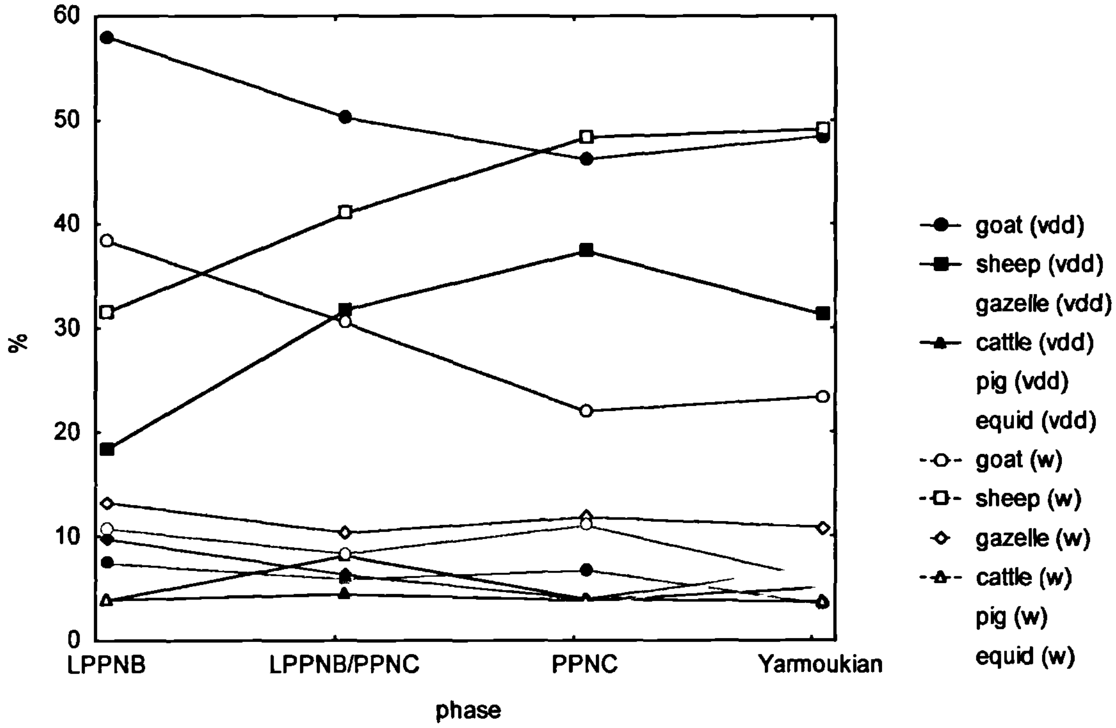
It is clear from Figure 9.7 that the general trends in the representation of the six main medium and large herbivore taxa in the results of this study and those of Köhler-Rollefson are broadly comparable, although there are some differences in detail. Most of these differences can be explained by the use of different methodologies to sample and quantify the material. The slightly lower representation of equids and slightly higher representation of pigs in Köhler-Rollefson's NISP percentages is almost certainly linked to the modification, to take their anatomical frequency into account, of equid and pig metapodial and phalanx counts in the adjusted NISP percentages used in this study. This discrepancy would be further magnified by the fact that the NISP percentages of Köhler-Rollefson include second phalanges, which as non-POSACs were excluded from this analysis. The higher representation of cattle, especially in the MPPNB sample, and lower representation of gazelle in results of Köhler-Rollefson is harder to explain. With regard to cattle, it is possible that the highly fragmented state of this material has contributed to this discrepancy, as in this study a POSAC was only counted if more than half of it was present. The exclusion of second phalanges from this analysis may also have had an effect, as this element survives well and would therefore feature strongly in Köhler-Rollefson's NISP percentages. With regard to gazelle, it is possible that similar factors may have been at work; on the whole the gazelle remains from 'Ain Ghazal were less fragmented than those of other taxa, which may have led to the over-representation of gazelle POSACs in the adjusted NISP percentages of this study for the same reasons.

To summarise, the representation of the six main medium and large herbivore taxa in the results of Köhler-Rollefson is broadly comparable with the representation of the same six taxa in the results of this study. The minor differences between these two sets of results can be attributed to the use of different methodologies. These results are unsurprising given that the samples analysed by Köhler-Rollefson formed a significant part of the material analysed in this study.

The published NISP counts and percentages of von den Driesch and Wodtke (1997) for the six main medium and large herbivore taxa are presented in Table 9.7 and are plotted in Figure 9.8 together with the adjusted NISP counts and percentages for the same six taxa obtained during this study (see Table 9.3 and Figure 9.2). As the results of von den Driesch and Wodtke contained an extremely large proportion of caprine specimens which were not identified to species, these were divided amongst the goats and sheep according to the relative proportions of these two species in the identified sample. In addition, as the MPPNB is not represented in their material and as their transitional late MPPNB/early LPPNB phase is not represented in the material analysed in this study, both phases are omitted in Table 9.7 and Figure 9.8.

species	LPPNB n	LPPNB %	LPPNB/PPNC n	LPPNB/PPNC %	PPNC n	PPNC %	Yarmoukian n	Yarmoukian %
goat	2460	58.0	1387	50.3	2292	46.2	2432	48.4
sheep	777	18.3	876	31.7	1855	37.4	1570	31.3
gazelle	410	9.7	173	6.3	194	3.9	345	6.9
cattle	163	3.8	122	4.4	188	3.8	251	5.0
pig	313	7.4	160	5.8	332	6.7	171	3.4
equid	119	2.8	42	1.5	98	2.0	251	5.0
TOTAL	**4242**	**100.0**	**2760**	**100.0**	**4959**	**100.0**	**5020**	**100.0**

Table 9.7: NISP Counts and Percentages for the Six Main Medium and Large Herbivore Taxa in the Results of von den Driesch and Wodtke (1997)



Key: vdd=von den Driesch and Wodtke (1997), w=Wasse (this study)

Figure 9.8: Comparison of the NISP Percentages of von den Driesch and Wodtke (1997) and Adjusted NISP Percentages from this Study for the Six Main Medium and Large Herbivore Taxa

It is clear from Figure 9.8 that there are some major differences in the representation of the six main medium and large herbivore taxa in the results of von den Driesch and Wodtke (1997) and in the results of this study. The most significant discrepancy concerns the proportions of goats and sheep in the two sets of results. The key difference is not so much in the overall proportion of caprines, but in the goat to sheep ratios. These are consistently more heavily skewed in favour of goats in von den Driesch and

Wodtke's results. Three factors could potentially have caused these differences; these are critically discussed below:

1) The fact that horncores are included in von den Driesch and Wodtke's NISP counts would almost certainly have led to goats being over-represented, owing to the preservational biases acting against sheep horncores. However, it is clear from their results (von den Driesch and Wodtke 1997, p.542 Table 2) that this alone is not enough to account for the differences between the two sets of data.

2) The differences between the two sets of results could be a reflection of spatial variation in the goat to sheep ratios in samples from different areas of the site. As exactly the same transitional LPPNB/PPNC material was analysed in both studies, von den Driesch and Wodtke's goat to sheep ratio for this phase was compared with that obtained during this study. Of the 2263 transitional LPPNB/PPNC caprine bones analysed by von den Driesch and Wodtke, 182 were identified as goat and 115 as sheep (von den Driesch and Wodtke 1997, p.542 Table 2), giving a goat to sheep ratio of 1:0.6. This compares with a goat to sheep ratio of 1:1.3 obtained during this study (see Chapter 7, Table 7.1). The fact that von den Driesch and Wodtke obtained a higher goat to sheep ratio from their analysis of exactly the same material examined in this study suggests that their results are consistently more heavily skewed in favour of goat regardless of the area of the site from which their samples originated. The transitional LPPNB/PPNC goat to sheep ratio of 1:1.3 obtained in the First Analysis of this study (see Chapter 8) using traditional methods of separation was confirmed by the metrical separation of goat and sheep distal metacarpals of the Second Analysis of this study (see Chapter 8). The Second Analysis resulted in the identification to species of the entire sample of transitional LPPNB/PPNC caprine distal metacarpals and gave an identical goat to sheep ratio for this phase of 1:1.3 (see Figure 8.4 and Table 8.10).

3) A more likely reason for the discrepancies between these two sets of goat to sheep ratios is that different methodologies were used to identify and quantify the material. Specifically, von den Driesch and Wodtke included elements and parts of elements in their analysis which can, given long experience, be identified as caprine (von den Driesch and Wodtke 1997, p.515) but can rarely be identified to species (e.g.:

proximal ends and shafts of long bones, vertebrae, ribs, carpals, some tarsals and sesamoids). This raises the possibility that the proportion of caprine specimens identified to species may have been too low for their goat to sheep ratios to be representative of their samples as a whole (see Chapter 8). The likelihood that this is indeed the case is increased by the fact that their identifications of caprine astragali (of which 68.6% were identified to species compared to 12.8% of their caprine sample as a whole (calculated from data in von den Driesch and Wodtke 1997, p.542 Table 2)) show sheep to have outnumbered goats at 'Ain Ghazal from the transitional LPPNB/PPNC onwards.

In addition to differences in the representation of goats and sheep in the results of von den Driesch and Wodtke (1997) and those of this study, there are also significant differences in the representation of other taxa. The proportions of gazelle, pigs and equids in von den Driesch and Wodtke's samples are lower in all phases, including the transitional LPPNB/PPNC material which was also analysed in this study (see Figure 9.8).

The lower proportion of pigs in the results of von den Driesch and Wodtke is difficult to explain, as it is exactly the opposite trend which would be expected if it were primarily the result of the difference between NISP and adjusted NISP percentages and the inclusion of second phalanges in their samples. It also should be noted that there is no sign of any rise in the proportion of cattle in the results of von den Driesch and Wodtke during the transitional LPPNB/PPNC. This suggests the rise in the proportion of cattle during the transitional LPPNB/PPNC which was documented in the results of this study is probably linked to the small sample size, as caused by the exclusion of non-POSACs from this analysis.

There are further discrepancies which are difficult to attribute to the use of different methdologies or the effects of sample size. In particular the pattern of rise and fall over time in the proportions of some species, such as gazelle between the transitional LPPNB/PPNC and Yarmoukian, differs significantly in the two sets of results (see Figure 9.8). The fact that the material analysed in this study includes PPNC and Yarmoukian samples from the South Field not examined by von den Driesch and Wodtke, and that their material included transitional late MPPNB/early LPPNB samples from the East

Field not included here, raises the possibility that some of these differences may be a reflection of intra-site variation in taxonomic representation.

In sum, whilst most of the differences between the representation of the six main medium and large herbivore taxa in the results of this study and those of von den Driesch and Wodtke can be attributed to the use of different methodologies, significant discrepancies remain which are more likely to be a reflection of intra-site spatial variation in taxonomic representation.

To conclude, this comparison has demonstrated that the representation of the six main medium and large herbivore taxa in the results of this study is more comparable with the representation of the same six taxa in the published results of Köhler-Rollefson et al. (1988 and 1993) than in the published results of von den Driesch and Wodtke (1997). This strongly suggests that the proportions of minor taxa in the results of Köhler-Rollefson are more likely to reflect their probable proportions in the samples which form the basis of this study, had the material been examined. For this reason, and the fact that the MPPNB proper is not represented in the results of von den Driesch and Wodtke, it was decided to use the NISP counts and percentages of Köhler-Rollefson (see Table 9.4) as the quantitative basis for the following discussion of the representation of the minor taxa at 'Ain Ghazal. However, as some of the categories of taxa quantified by Köhler-Rollefson et al. (1993) are rather broad (e.g.: *Canis* sp., *Felis* sp.) the results of von den Driesch and Wodtke (1997) are also referred to where more detailed identification is required.

9.4.2: Representation of Minor Taxa at 'Ain Ghazal:

Two aspects of the proportions of minor taxa in the results of Köhler-Rollefson stand out. Firstly, it appears that minor taxa were most common during the MPPNB but had decreased sharply in frequency by the LPPNB and continued to be present at the site in similarly small numbers during the PPNC and Yarmoukian. The results of von den Driesch and Wodtke suggest that the decline in the proportion of minor taxa had probably occurred by the transitional late MPPNB/early LPPNB. Secondly, one of the reasons why minor taxa were relatively frequent in Köhler-Rollefson's MPPNB sample is that the faunal assemblage from a single MPPNB house, in square 3082, was dominated by the bones of small carnivores (Köhler-Rollefson 1989b, p.23).

Although it is clear that the overall proportion of minor taxa in the MPPNB was increased by the composition of this particular assemblage, it does not necessarily mean that their relatively high frequency during this phase is an departure from the norm. Even if entirely different MPPNB structures had been excavated it is still possible that one or even more of them may have produced a faunal assemblage similarly dominated by minor taxa.

The interpretation of these two factors is complicated by the fact that many of these minor taxa may have been hunted and trapped for resources other than their meat, such as fur. If it is assumed that these minor taxa were trapped and hunted primarily for consumption, the decline in their frequency may indicate that game had become depleted in the vicinity of the site by the end of the MPPNB, or that cultural preferences had led to the development of a faunal economy dominated by the six main medium and large herbivore taxa, predominantly goats and sheep (Köhler-Rollefson 1989b, p.23). However, if it assumed that many of these minor taxa were also trapped and hunted for resources other than meat, the decrease in their numbers over time might also indicate that some of resources, such as hides and leather, were subsequently obtained from the increasing number of domesticates at the site (von den Driesch and Wodtke 1997, p.534). It should be noted that disentangling the exploitation of animals for consumption and for other activities on the basis of a part of the faunal assemblage which was not analysed during this study is problematic and as such warrants a separate study of its own.

Having discussed some of the problems associated with the interpretation of the remains of many minor taxa, their representation in the published results of Köhler-Rollefson et al. (1993) is described below. Taxa are described in declining order of their frequency in the MPPNB sample (see Table 9.5 and Figure 9.4). It should be noted that the percentage NISPs of these taxa are extremely low, often less than 1%, owing to the predominance of the six main medium and large herbivore taxa in the faunal assemblage. Consequently, the variation documented in the representation of minor taxa may be more significant that the percentage NISPs at first suggest.

9.4.2.1: Small Carnivores:

As *Vulpes* spp., *Felis* spp. and *Canis* spp. bones in the MPPNB sample excavated during 1983 were not identified to genus or species, they were categorised as 'small carnivore' instead (Köhler-Rollefson 1993, p.96). These three genera are therefore under-represented in the MPPNB NISP counts and percentages. This shortfall is made up by the 'small carnivore' category. The representation of small carnivores mirrors the general pattern for minor taxa as a whole. From a MPPNB peak of 7.57%, the proportion of small carnivores decreased sharply to 0.11% in the LPPNB, 0% in the PPNC and 0.13% in the Yarmoukian. However, as the small carnivore category is primarily applicable to the MPPNB sample excavated in 1983, the small carnivore NISP counts and percentages for the subsequent three phases are of little relevance.

9.4.2.2: *Vulpes* spp.:

Fox was easily the most common of the minor taxa at 'Ain Ghazal in all phases. The frequency of this genus declined rapidly from 2.86% in the MPPNB, to 0.66% in the LPPNB and subsequently more steadily to 0.39% and 0.26% in the PPNC and Yarmoukian samples respectively. The proportion of fox in the MPPNB sample was actually much higher than the figure of 2.86% suggests, for the reasons outlined in 9.4.2.1 above. Preliminary metrical analysis of the fox remains by Köhler-Rollefson (1989b, p.22) demonstrated that although the red fox *Vulpes vulpes* was predominant, a smaller species was also present in the assemblage. The more detailed metrical analysis by von den Driesch and Wodtke (1997, p.534) ascribed the majority of fox bones to the small red fox sub-species *Vulpes vulpes palaestina* and a minority of smaller specimens to sand fox *Vulpes ruepelli*.

9.4.2.3: *Testudo* sp.:

Amongst the minor taxa identified to species, the remains of the Moorish tortoise, *Testudo graeca*, were second only to fox in frequency within the MPPNB sample analysed by Köhler-Rollefson, comprising 2.5% of the sample. However, its frequency declined steadily over time to 0.77% in the LPPNB, 0 47% in the PPNC and 0.26% in the Yarmoukian samples. The relative abundance of tortoise during the MPPNB hints at the systematic exploitation of their carapaces for containers (Köhler-Rollefson et al. 1988, p.424).

9.4.2.4: *Lepus* sp.:

Like the majority of other minor taxa, the frequency of hare declined sharply from 2.08% during the MPPNB to 0.22% by the LPPNB and maintained comparable frequencies of 0.27% and 0.26% into the PPNC and Yarmoukian respectively. Metrical analysis by von den Driesch and Wodtke (1997, p.534) has demonstrated that the hare remains are relatively small, as the southerly location of 'Ain Ghazal would suggest.

9.4.2.5: Bird:

Bird bone was also relatively well represented in the MPPNB sample at 1.88%, despite the preservational biases acting against this material, but subsequently declined to 0.44% in the LPPNB, 0.08% in the PPNC and 0.19% in the Yarmoukian samples. A variety of game birds, such as quail, partridge and rock dove, and corvids have been identified, but in addition the remains of large birds of prey such as eagles, hawks and vultures were also relatively common, especially during the MPPNB (Köhler-Rollefson et al. 1988, p.424, Gillespie 1984 and 1986). It is therefore conceivable that birds may have been hunted as much for their feathers as their meat (von den Driesch and Wodtke 1997, p.535).

9.4.2.6: Small Rodents:

Although the proportion of small rodent bones was relatively low in the majority of excavated sediments, which were sieved through a 5mm. mesh, analysis of flotation samples suggests that they may have been much more common than their representation in the sieved samples examined by Köhler-Rollefson suggests (Gillespie 1984, p.11). It is doubtful that small rodents were procured for consumption and all the evidence suggests that their excavated remains represent wild animals living and dying within the area of the site. The great majority of small rodent specimens have been identified as the house mouse *Mus musculus*, suggesting that this species was a commensal occupant of the site and potentially quite a pest (Gillespie 1984, p.11), although squirrels *Sciurus* sp., voles *Microtus* sp., jirds *Meriones* sp. and rats *Rattus* sp. have also been identified in small numbers. The proportion of small rodents in the samples analysed by Köhler-Rollefson ranged between 0% and 0.75%.

9.4.2.7: *Felis* spp.:

The proportion of felid remains in the faunal assemblage declined steadily over time, from 0.67% in the MPPNB to 0.06% in the Yarmoukian, and thus follows the typical pattern for minor taxa. The proportion of felids in the MPPNB sample was actually much higher than the figure of 0.67% suggests, for the reasons outlined in 9.4.2.1 above The great majority of felid remains from 'Ain Ghazal have been ascribed to wild cat *Felis sylvestris* (Köhler-Rollefson 1989b, p.22), although single specimens each of lynx *Felis lynx* and caracal *Felis caracal* have also been identified (Köhler-Rollefson 1989b, p.23, von den Driesch and Wodtke 1997, p.534).

9.4.2.8: Insectivore:

Insectivores are represented in the faunal assemblage from 'Ain Ghazal by two species of hedgehog: the long-eared hedgehog *Hemiechinus auritus*, and the european hedgehog *Erinaceus europaeus* (Köhler-Rollefson et al. 1988, p.424) or eastern hedgehog *Erinaceus concolor* (von den Driesch and Wodtke 1997, p.534). These were most frequent during the MPPNB, when they comprised 0.27% of the sample, but subsequently declined in frequency.

9.4.2.9: *Canis* spp.:

The proportion of canid remains in the faunal assemblage from 'Ain Ghazal departs from the typical trend for minor taxa of decline over time. Instead, Köhler-Rollefson found the highest proportion of canids in the Yarmoukian period, as did von den Driesch and Wodtke (1997) to an even greater extent. In the results of Köhler-Rollefson, canid remains comprised 0.18% of the MPPNB, 0.22% of the LPPNB, 0.12% of the PPNC and 0.26% of the Yarmoukian samples. The proportion of canid during the MPPNB was probably slightly higher, as a number of specimens identified only as small carnivore may belong to this genus (Köhler-Rollefson et al. 1993, p.96) (see 9.4.2.1 above).

Interpretation of the representation of canid remains at 'Ain Ghazal is complicated by the fact that three species have been identified within this category: the domestic dog *Canis familiaris*, the wolf *Canis lupus* and the jackal *Canis aureus* (von den Driesch and Wodtke 1997, Quintero and Köhler-Rollefson 1997). Of the three canid species, the domestic dog was easily the most common; it has been identified at 'Ain Ghazal in all phases of occupation on the basis of metrical (von den Driesch and Wodtke 1997, p.533) and morphological (Quintero and Köhler-Rollefson 1997) criteria. The results of von den Driesch and Wodtke (1997, p.533) demonstrate that the increase in the proportion of canids during the Yarmoukian was made up by an increase in the frequency of domestic dog, rather than wolf or jackal, and suggest that this may have been linked to their use in connection with animal herding. Wolf and jackal bones have been identified in extremely small numbers in most phases of occupation (von den Driesch and Wodtke 1997, p.534).

9.4.2.10: Others:

The nine taxa described above make up the great majority of the already tiny proportion of minor taxa in the faunal assemblage from 'Ain Ghazal. However, both Köhler-Rollefson and von den Driesch and Wodtke have in addition identified a handful of specimens belonging to the following species: red deer *Cervus elaphus*, badger *Meles meles*, molerat *Spalax ehrenbergi*, beech marten *Martes foina*, mongoose *Herpestes* sp., leopard *Panthera pardus*, fresh-water crab *Potamon* sp., and assorted Vivirridae (civets/genets), reptiles, amphibians, molluscs and fish. As these are present in such small numbers (see Tables 9.5 and 9.6) their representation is not discussed further here.

9.4.3: Summary of the Representation of Minor Taxa at 'Ain Ghazal:

On the basis of the published results of Köhler-Rollefson et al. (1993), it appears that by far the most common minor taxon at 'Ain Ghazal was fox, followed by tortoise, hare, bird, assorted small rodents, felid, hedgehog and canid. With the exception of dog, the sole domesticate amongst them, the representation of all of these minor taxa followed the same pattern of decline over time. This decline was most pronounced between the MPPNB and LPPNB, but continued into the PPNC and Yarmoukian, and mirrors the decline in the goats and gazelle which dominated the MPPNB faunal economy. In addition extremely small quantities of reptile, cervid, badger, genet/civet, molerat, mongoose, marten, amphibian and fish bone have also been identified at the site. Some of these may have been exploited by the inhabitants of 'Ain Ghazal, however it is also possible that some of specimens are intrusive from comparatively recent times; for example the molerat, which lives underground, is most common in Yarmoukian strata which generally lie extremely close to the modern ground surface.

9.5: CONCLUSIONS:

If the proportions of the six main medium and large herbivore taxa in the 'Ain Ghazal faunal assemblage obtained during the course of this study are combined with the proportions of minor taxa published by Köhler-Rollefson et al. (1993) the tables which form the basis of Chapter 5 can be updated to include the information presented in Tables 9.8 and 9.9.

To do so the total proportion of the six main medium and large herbivore taxa for each phase obtained by Köhler-Rollefson (see Table 9.4 and Figure 9.3) has been divided according to the proportions of these taxa obtained in this study (see Table 9.3). The total proportions of minor taxa for each phase obtained by Köhler-Rollefson (see Table 9.4 and Figure 9.3) have been divided according to her proportions of the relevant minor taxa. The small carnivore category for each phase has been divided between *Canis* spp., *Vulpes* spp. and *Felis* spp. according to their proportions in her identified sample. Although the adjusted NISP percentages of this study and the NISP percentages of Köhler-Rollefson are not entirely compatible, the proportions of minor taxa in the 'Ain Ghazal faunal assemblage are so low that this was not felt to pose a serious problem.

Site	Period	Area	n	Equ	Bos	Sus	Gaz	Alc	C+O	(C/O)	(Cpr)	(Ovi)	Cer	Dam	Cap	Lep	Can	Vul	Fel	Mus	Eri	Source
'Ain Ghazal	3	JH	>3351	0.2	3.6	2.7	22.0		52.3		52.0	0.3	0.1			2.9	0.5	11.9	2.8	0.1	0.4	Wasse (this study)/Köhler-Rollefson et al (1993)
'Ain Ghazal	4	JH	>704	2.3	3.7	10.4	12.8		67.8		37.2	30.5				0.4	0.4	1.3	0.8	0.2		Wasse (this study)/Köhler-Rollefson et al (1993)
'Ain Ghazal	4 5	JH	>326	1.7	8 1	8.3	10.3		71.5		30.5	41.0										Wasse (this study)/Köhler-Rollefson et al (1993)
'Ain Ghazal	5	JH	1951	3 0	3 8	10 8	11 6		68.9		21.6	47.3				0.6	0.2	0.8	0 2	0.2		Wasse (this study)/Köhler-Rollefson et al (1993)
'Ain Ghazal	6	JH	1440	7.1	3 6	5.6	10.6		70.8		22.9	48.0				0.6	0.6	0.6	0.2	0.2	0.2	Wasse (this study)/Köhler-Rollefson et al (1993)

S.Levant Area Codes: JH Jordanian Highlands
Taxa Codes: Equ *Equus* spp., Bos *Bos* spp., Sus *Sus* spp., Gaz=*Gazella* spp., Alc=*Alelaphus buselaphus*, C+O=total Subfamily Caprinae i.e. C/O+Cpr+Ovi, (C O)=*Capra* spp. or *Ovis* spp., (Cpr)=*Capra* spp., (Ovi)=*Ovis* spp., Cer=*Cervus elaphus*, Dam *Dama mesopotamica*, Cap=*Capreolus capreolus*, Lep=*Lepus capensis*, Can=*Canis* spp., Vul=*Vulpes* spp., Fel–Family Felidae, Mus Family Mustelidae, Eri Family Erinaceidae
Quantitative Data: Equ, Bos, Sus, Gaz, C+O, (Cpr) and (Ovi)–adjusted % NISP, all other taxa=% NISP

Table 9.8: Proportions of Taxa in Faunal Assemblage from 'Ain Ghazal between Periods 3 and 6

Site	Period	Area	n	Hrb	Equ	Bos	Sus	Gaz	C+O	(Cpr)	(Ovi)	(C:O)	(id)	Cer	Dam	Cap	Source
'Ain Ghazal	3	JH	3351	80.8	0.2	4.5	3.4	27 2	64.7	64.2	0.4	1:0.01	58.7	0.1			Wasse (this study)
'Ain Ghazal	4	JH	>704	96 9	2.4	3.8	10.7	13.2	69.9	38.4	31.5	1:0.8	58.1				Wasse (this study)
'Ain Ghazal	4 5	JH	326	100.0	1.7	8.1	8.3	10.3	71.6	30.5	41.0	1:1.3	59.1				Wasse (this study)
'Ain Ghazal	5	JH	>1951	98.0	3.1	3.9	11.0	11.8	70.3	22.0	48.3	1:2.2	57.8				Wasse (this study)
'Ain Ghazal	6	JH	>1440	97.7	7.3	3.7	5.7	10 8	72.5	23.4	49.1	1:2.1	49.3				Wasse (this study)

S.Levant Area Codes: JH Jordanian Highlands
Taxa Codes: Hrb=% of major medium and large herbivores in n, Equ *Equus* spp., Bos *Bos* spp., Sus=*Sus* spp., Gaz=*Gazella* spp., C+O=total Subfamily Caprinae, spp., (id) % of total Subfamily Caprinae identified to genus, Cer=*Cervus elaphus*, Dam *Dama mesopotamica*, Cap=*Capreolus capreolus*
Quantitative Data: all % adjusted NISP

Table 9.9: Proportions of Major Medium and Large Herbivores in Faunal Assemblage from 'Ain Ghazal Between Periods 3 and 6

CHAPTER 10: CAPRINE DOMESTICATION AND MORE SPECIALISED PASTORAL ECONOMIES AT 'AIN GHAZAL

10.1: INTRODUCTION:

As described in Chapter 6, the zooarchaeology of caprines in south-west Asia between 12,500b.p. and 5,200b.p. has been dominated by two key themes: firstly, the initial emergence of caprines as major early domesticates and secondly, the subsequent role of domestic caprines in the development of more specialised pastoral economies. This chapter therefore discusses the 'Ain Ghazal caprine remains in detail in an attempt to establish their wild or domestic status, and to examine whether there is any evidence to suggest that these animals were managed within the context of a more specialised pastoral economy.

10.2: THE WILD OR DOMESTIC STATUS OF CAPRINES AT 'AIN GHAZAL:

This section discusses the caprine remains from 'Ain Ghazal which were examined during this study in the context of the main criteria by which zoological domesticates can be identified in archaeological faunal assemblages (see Chapter 6). The 'Ain Ghazal caprine remains are tested against each of these criteria, with the exception of pathology which did not form part of this study, in an attempt to establish the wild or domestic status of caprines at the site during each of the main phases of occupation.

10.2.1: Import of a Foreign Species and Changes in the Frequency of Species:

Any examination of whether caprines were imported to 'Ain Ghazal as foreign species will inevitably be based on examination of zoogeographical data. This section therefore aims to assess whether wild goats and mouflon would have inhabited the area around the site during the early Holocene, and whether there were any significant changes in their frequency during the period of the site's occupation which might relate to their presence as domesticates.

The present environmental setting of 'Ain Ghazal has already been described in Chapter 7. Reconstructions of environmental conditions in the vicinity of the site during the early Holocence are now discussed below.

All available data suggests that environmental conditions around 'Ain Ghazal during the early Holocene would have been rather similar to that of today, prior to recent deforestation. Many small mammal and non-mammal species are ecologically specific and can thus be used to reconstruct environmental conditions in the vicinity of the site. The MPPNB small mammal and non-mammal assemblage from 'Ain Ghazal contains both woodland species such as vole, squirrel, badger, European hedgehog and goshawk, and steppic species such as Egyptian mongoose, long-eared hedgehog and chukar partridge (Köhler-Rollefson and Rollefson 1990, p.4). In addition, analysis of MPPNB charred wood fragments has provided evidence for the presence of oak, tamarisk and poplar in the vicinty of the site (Rollefson 1984, p.152). These data strongly suggest that during the Early Holocene 'Ain Ghazal was located close to the boundary between the Mediterranean and Irano-Turanian phyto-geographical zones, as it is today. The low mountains to the north, west and south of the site would probably have been dominated by evergreen broad-leaved and mixed forests, whilst the more open terrain to the east would probably have been dominated by a combination of steppic dwarf-shrublands and grasslands. The presence of poplar suggests that gallery forests would have been found along the Wadi Zarqa and its tributaries.

The geographical and environmental setting of 'Ain Ghazal during the early Holocene would therefore not have corresponded with the cool, high mountainous terrain and cold deciduous forest vegetation in which wild goat seems to have been especially abundant during the late Pleistocene and early Holocene (see Chapter 6). However, limited numbers of wild goat may well have inhabited the evergreen broad-leaved and mixed forests which are thought to have covered the low mountains to the north, west and south of the site, though perhaps only on a seasonal basis. Unfortunately no faunal assemblages dating to Periods 1 and 2 are available from the immediate vicinity of 'Ain Ghazal against which this hypothesis can be tested. However, it should be noted that the Period 2 site of Iraq ed Dubb, located further to the north in an area of the Jordanian Highlands which would also have supported evergreen broad-leaved and mixed forests during the early Holocene, has yielded a faunal assemblage dominated by gazelle, although wild caprines were also present in lower frequencies (Kuijt et al. 1991).

The undulating hill-country and plains to the east and north-east of 'Ain Ghazal, which would probably have supported dwarf-shrubland and grass-land vegetation during the early Holocene, correspond well with the favoured habitat of the mouflon elsewhere in south-west Asia (see Chapter 6). However, as there is currently no evidence for the presence of mouflon in the moist and dry steppe zones of the Jordanian plateau and western parts of the Syrian desert during the early Holocene, its presence around 'Ain Ghazal at this time must be considered extremely unlikely.

In sum, although it is probable that wild goat would have been present in low numbers in the vicinity of 'Ain Ghazal during the early Holocene, mouflon would probably have been absent. The data relating to changes in caprine frequency at 'Ain Ghazal, which are presented below in Table 10.1, should therefore be viewed in this context. These data are based on the proportion of caprines within the assemblage of major medium and large herbivores from 'Ain Ghazal (see Chapter 9, Table 9.9).

Site	Period	n	Hrb	C+O	Cpr	Ovi
'Ain Ghazal (MPPNB)	3	3165.5	100.0	**64.7**	**64.3**	0.4
'Ain Ghazal (LPPNB)	4	663	100.0	**69.9**	**38.4**	31.5
'Ain Ghazal (LPPNB/PPNC)	4/5	301	100.0	**71.6**	30.6	**41.0**
'Ain Ghazal (PPNC)	5	1863.5	100.0	**70.3**	22.0	**48.3**
'Ain Ghazal (Yarmoukian)	6	1414	100.0	**72.5**	23.4	**49.1**

Taxa Codes: Hrb=% of major medium and large herbivores in n, C+O=total *Capra aegagrus, Capra hircus, Ovis orientalis* and *Ovis aries*, Cpr=*Capra aegagrus* or *Capra hircus*, Ovi=*Ovis orientalis* or *Ovis aries*
Quantitative Data: all % Adjusted NISP, Bold Type=most common taxon in faunal assemblage

Table 10.1: Changes in Caprine Frequency at 'Ain Ghazal

Goats were the most common taxon at 'Ain Ghazal during the MPPNB, comprising 64.3% of the faunal assemblage. This extremely high frequency strongly suggests that fully domesticated goats were present at the site from the time of its first occupation at c.9,250b.p.. It should be stressed that no Period 1 or 2 site in any part of the southern Levant has yielded a faunal assemblage in which wild goat is known to have been present in frequencies in excess of 17% (see Chapter 6, Table 6.1). In contrast, sheep were virtually absent at 'Ain Ghazal during the MPPNB, comprising only 0.4% of the faunal assemblage. Significantly, sheep were entirely absent during the last quarter of the tenth millennium b.p. in sub-phases MPPNB 1 and 2 (Rollefson, Simmons and Kafafi 1992, p.445 Table 1), and first appeared in extremely low frequencies during the first half of the 9th millennium b.p. in sub-phases MPPNB 3 and 4 (Rollefson, Simmons and Kafafi 1992, p.445 Table 1). Subsequently the frequency of sheep at 'Ain Ghazal rapidly increased, reaching 31.5% during the LPPNB and 41.0% by the transitional

LPPNB/PPNC, by which time they had replaced goats as the most common taxon. This suggests firstly that mouflon were not present in the vicinity of the site during the early Holocene and, secondly, that sheep were introduced as domesticates in extremely small numbers during the first half of the 9^{th} millennium b.p..

10.2.2: Size Change in Caprines at 'Ain Ghazal:

Although the sample sizes of individual measurements of caprine remains from 'Ain Ghazal appear to be reassuringly large at first glance, the exclusion of unfused and fusing specimens, burnt specimens and specimens in the goat/sheep category vastly reduces the amount of data available. When the remaining specimens are categorised by phase, sample sizes for each phase are relatively small, especially during the LPPNB and transitional LPPNB/PPNC. The problem of sample size is accentuated still further by the fact that goats are less common in the later phases of occupation and that sheep are less common in the earlier. Humerus Bd measurements of specimens identified as goat and sheep are plotted in Figures 10.1 and 10.4 respectively to illustrate the problem of sample size if individual measurements are considered separately.

It was therefore decided to use a log ratio method, by which small samples of individual measurements can be combined through comparison with a 'standard animal', to examine size change in caprine remains from 'Ain Ghazal. The methodology and 'standard animal' measurements described by Uerpmann and Uerpmann (1994) were used in this study. The results are plotted by phase in Figures 10.2 and 10.5 for goats and sheep respectively.

The same method was used to generate log ratios of caprine measurements from a series of south-west Asian sites dating from the late Pleistocene to the mid Holocene with which to compare the results from 'Ain Ghazal. These sites were selected on the basis that published individual measurements of specimens identified as goat or sheep were required to generate the log ratios, that where possible the comparative material should originate from the Levant rather than other areas of south-west Asia, that the wild or domestic status of the caprine remains should not be in doubt and that sample sizes for each species should ideally be in excess of 15. The selection of comparative measurements was effectively determined by the fact that an extremely limited number of sites fulfilled all of these criteria.

Unfortunately, this approach meant that it was not possible to restrict the selection of comparative measurements to those collected and described according to the system of von den Driesch (1976a) which was used on the caprine remains from 'Ain Ghazal. However, it was felt more acceptable to risk small inconsistencies resulting from the use of comparative measurements collected and described according to slightly different systems, but restricted to the Levant, rather than to risk the potentially greater inconsistencies which may have resulted from the inclusion of comparative measurements collected and described to the system of von den Driesch (1976a), but originating from widely varying geographical and climatic regions of south-west Asia.

The log ratios of goat measurements from 'Ain Ghazal are therefore compared to log ratios of wild goat measurements from Natufian Mallaha I (Bouchud 1987), Natufian Saaïde II (Churcher 1994) and, as these sample sizes are comparatively small, to wild goat measurements from Early Neolithic Tepe Asiab in the Zagros Uplands (Bökönyi 1977), and to log ratios of domestic goat measurements from LPPNB Bouqras (Clason 1980) and Late Neolithic/Chalcolithic Arjoune (Grigson 1996).

The log ratios of sheep measurements from 'Ain Ghazal are compared to log ratios of mouflon measurements from Natufian Wadi Judayid 2 (Henry and Turnbull 1985) and Natufian/PPNA Mureybet Ia, II and III ((Helmer 1991a, Ducos et al. 1978), and to log ratios of domestic sheep measurements from LPPNB Bouqras (Clason 1980), FPPNB Umm el Tlel (Helmer 1993) and Late Neolithic/Chalcolithic Arjoune (Grigson 1996). These log ratios of comparative measurements are plotted in Figures 10.3 and 10.6 for goats and sheep respectively. As many of these samples of comparative measurements are included in Helmer's (1989) and Legge's (1996) reviews of size change in caprines from all areas of south-west Asia, which are summarised in Chapter 6, Tables 6.12, 6.13, 6.14 and 6.15, it is possible to relate the data from 'Ain Ghazal to additonal data not included in Figures 10.3 and 10.6.

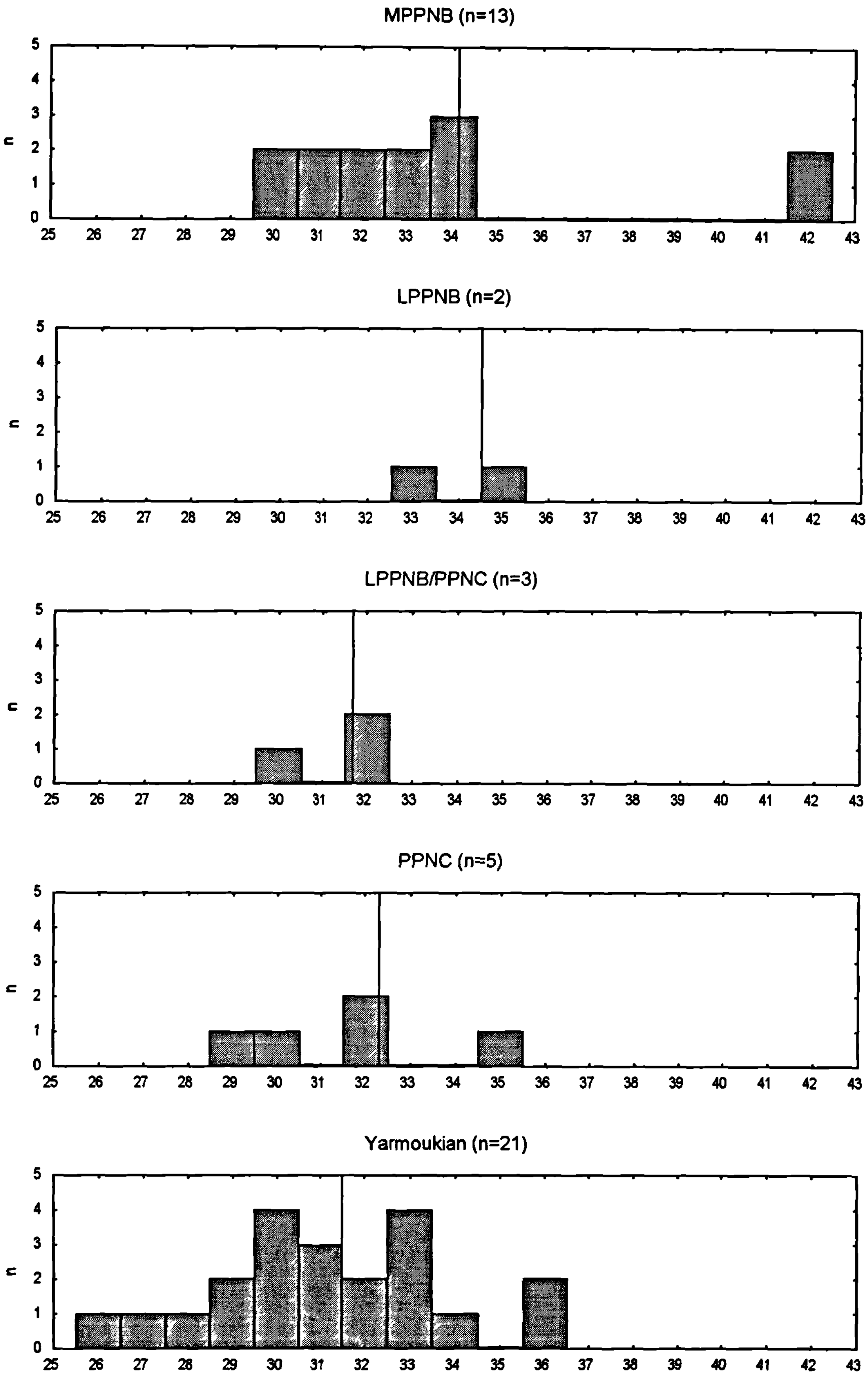


Figure 10.1: 'Ain Ghazal Goat Humerus Bd by Phase (mm)

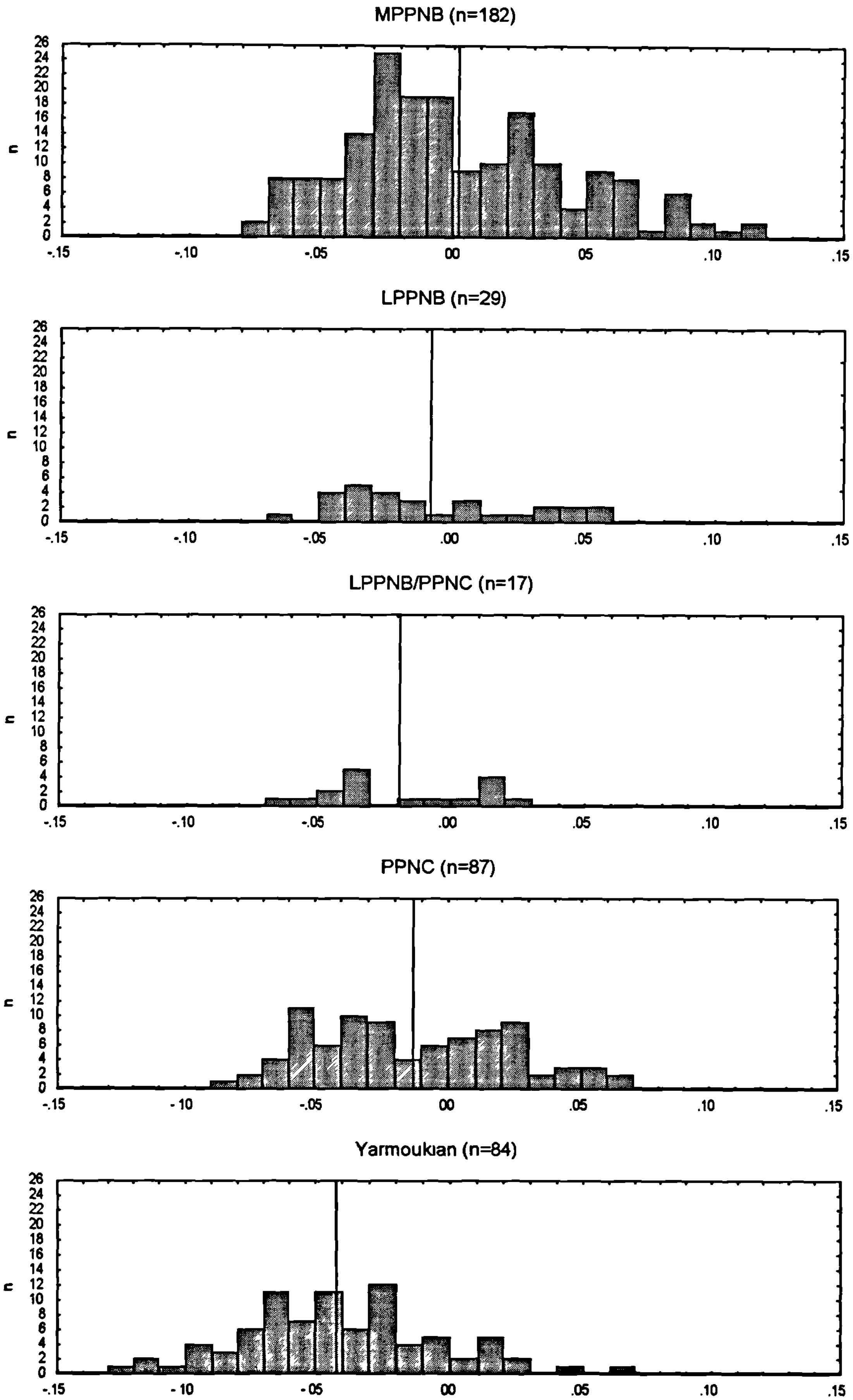


Figure 10.2: 'Ain Ghazal Goat Measurements (log ratios and mean by phase)

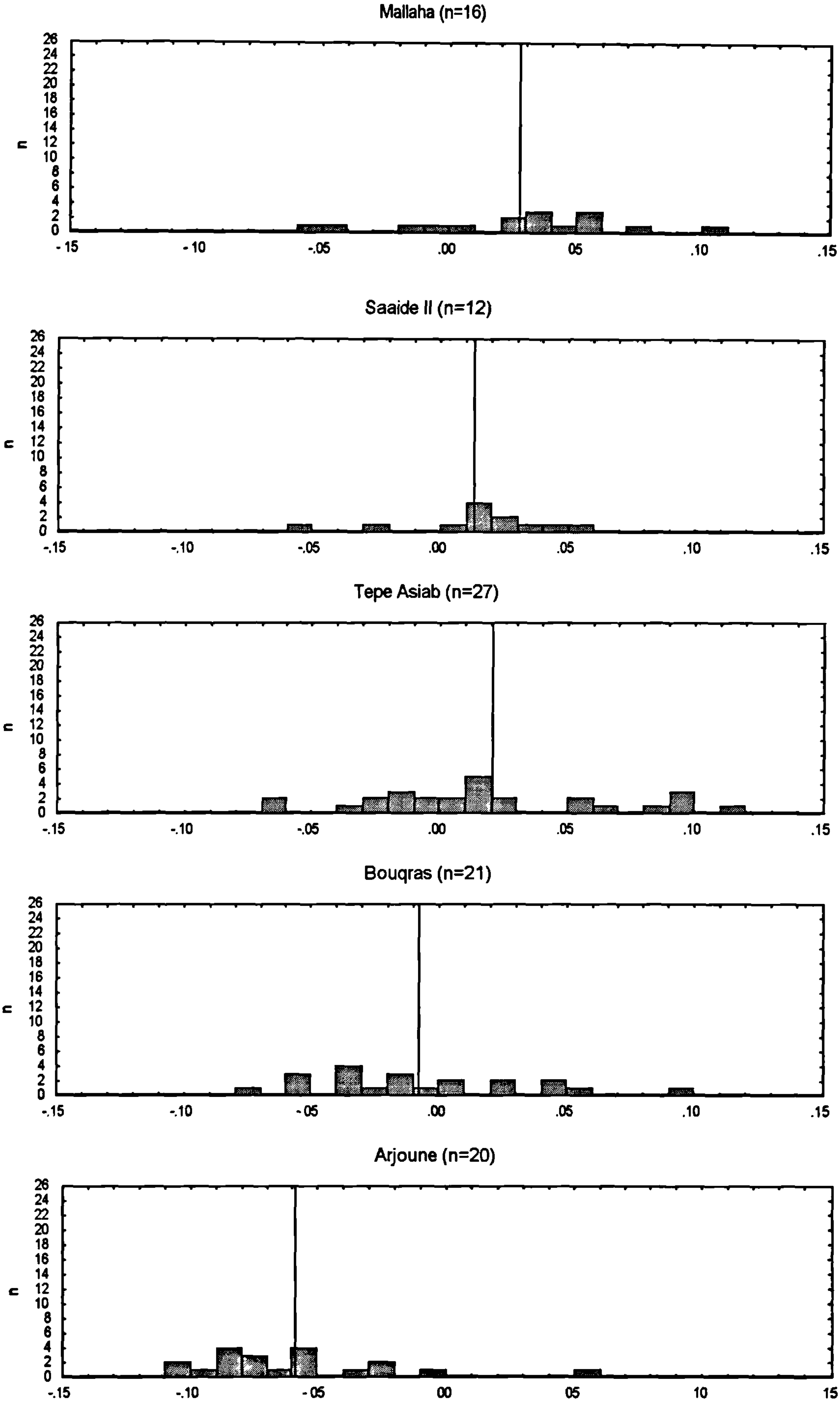


Figure 10.3: Comparative Goat Measurements (log ratios and mean by site)

The data in Figure 10.2 demonstrates that there were significant changes in the size of the goat remains from 'Ain Ghazal across the various periods of occupation at the site. The MPPNB goat measurements display a wide range of variation, including some extremely large specimens, but are clearly biased towards the smaller end of the range. Notwithstanding the fact that LPPNB and transitional LPPNB/PPNC sample sizes are rather small, it seems that the LPPNB, LPPNB/PPNC and PPNC goat measurements are all relatively similar. The range of variation is much lower than in the MPPNB goat measurements. Although the minimum size is almost unchanged, the extremely large specimens evident during the MPPNB are absent. In addition, the bias towards the smaller end of the range is no longer apparent. There is relatively little difference between the means of the MPPNB, LPPNB, LPPNB/PPNC and PPNC goat measurements. The Yarmoukian goat measurements are generally smaller than those of the preceding phases. Although the maximum end of the range is unchanged, there is a significant reduction in both the minimum end of the range and the mean. A slight bias in favour of the smaller measurements is thus apparent. These trends are also apparent in the goat humerus Bd measurements from 'Ain Ghazal in Figure 10.1, even though these sample sizes are relatively small.

It is clear from the comparative goat measurements in Figure 10.3 that the wild goat measurements from Mallaha, Saaïde II and Tepe Asiab all display a similarly wide range of variation. Although the mean of the early domestic goat measurements from Bouqras is much lower, the minimum end of the range is virtually unchanged from that of the comparative wild goat measurements. This suggests that the size reduction which was almost certainly linked to the process of domestication occurred mainly at the larger end of the range and was thus primarily associated with males. It may thus have been that sexual dimorphism in early domestic goats was lower than in wild goats, and that both wild and early domestic females were of a similar size. The Late Neolithic/Chalcolithic domestic goat measurements from Arjoune are generally smaller than those of the early domestic goats from Bouqras, especially at the minimum end of the range, which hints at size reduction in females as well as males by this time.

The wide range of variation evident in the MPPNB goat measurements from 'Ain Ghazal extends across the full range of variation of both wild and early domestic goats. Although the mean of the MPPNB goat measurements from 'Ain Ghazal is slightly lower than those of the wild goats from Mallaha, Saaïde II and Tepe Asiab, being similar to that of the early domestic goats from Bouqras, it should be stressed that the largest MPPNB specimens from 'Ain Ghazal are as large as the largest wild goat specimens from Tepe Asiab in the Zagros Uplands. As both wild and early domestic female goats appear to have been of similar size, the MPPNB goat measurements from 'Ain Ghazal could therefore represent an entirely wild population, with a clear bias in favour of females, or combination of wild and early domestic goats, with a clear bias in favour of early domesticates. Zoogeographical considerations and the high frequency of goats at 'Ain Ghazal during the MPPNB suggest that the latter scenario is more likely to be correct. If correct, the data in Figure 10.3 suggest firstly that hunting of wild goats at 'Ain Ghazal was restricted to the MPPNB, secondly that there was virtually no size change in domestic goats at 'Ain Ghazal between the MPPNB and PPNC, with these specimens being of a similar size to early domestic goats from Bouqras, and thirdly that there was a significant reduction in the size of some domestic goats at 'Ain Ghazal during the Yarmoukian. The smaller Yarmoukian goat measurements from 'Ain Ghazal are of a similar size to the Late Neolithic/Chalcolithic domestic goat measurements from Arjoune, whilst the larger specimens are of a similar size to the early domestic goat measurements from Bouqras.

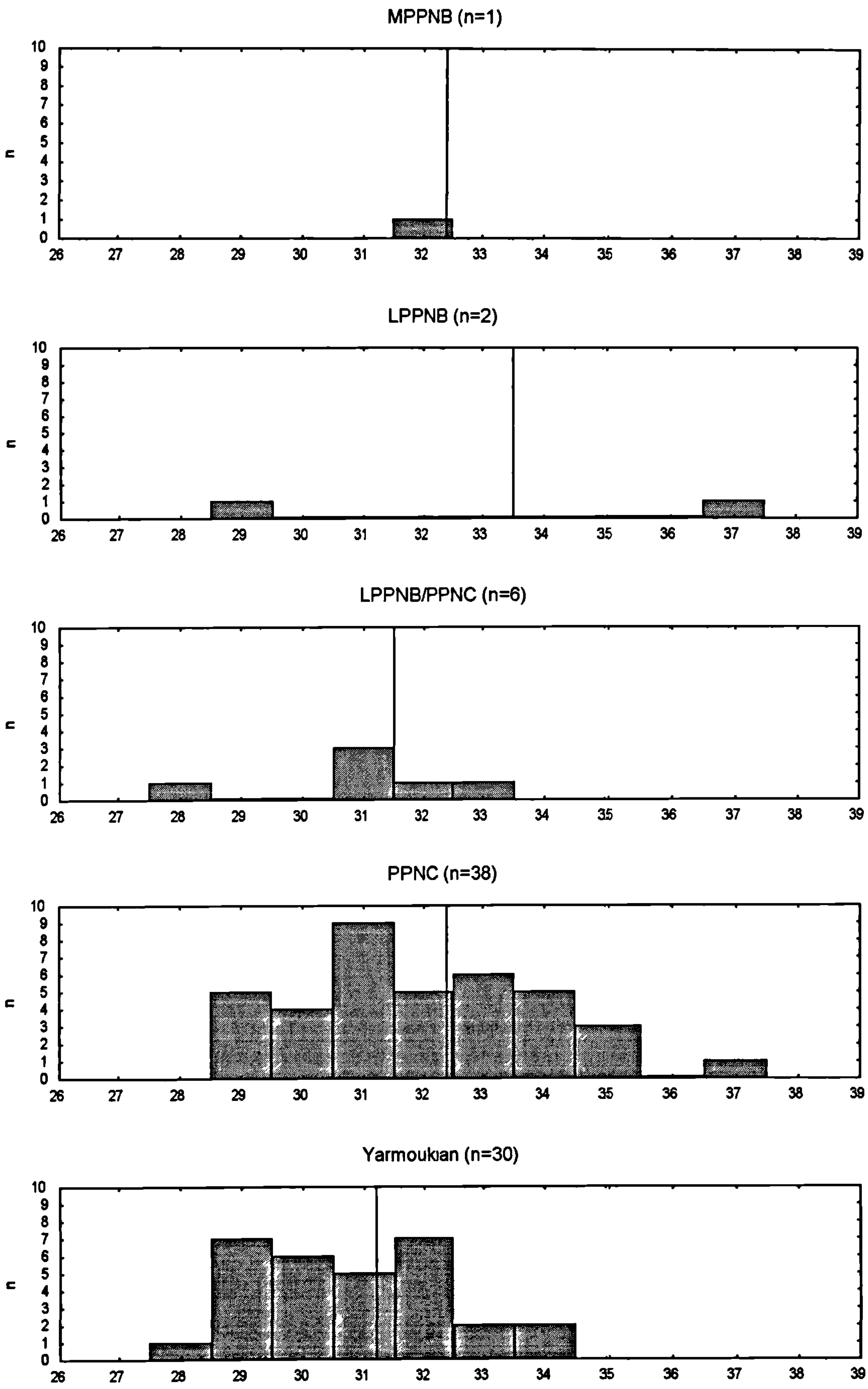


Figure 10.4: 'Ain Ghazal Sheep Humerus Bd by Phase (mm)

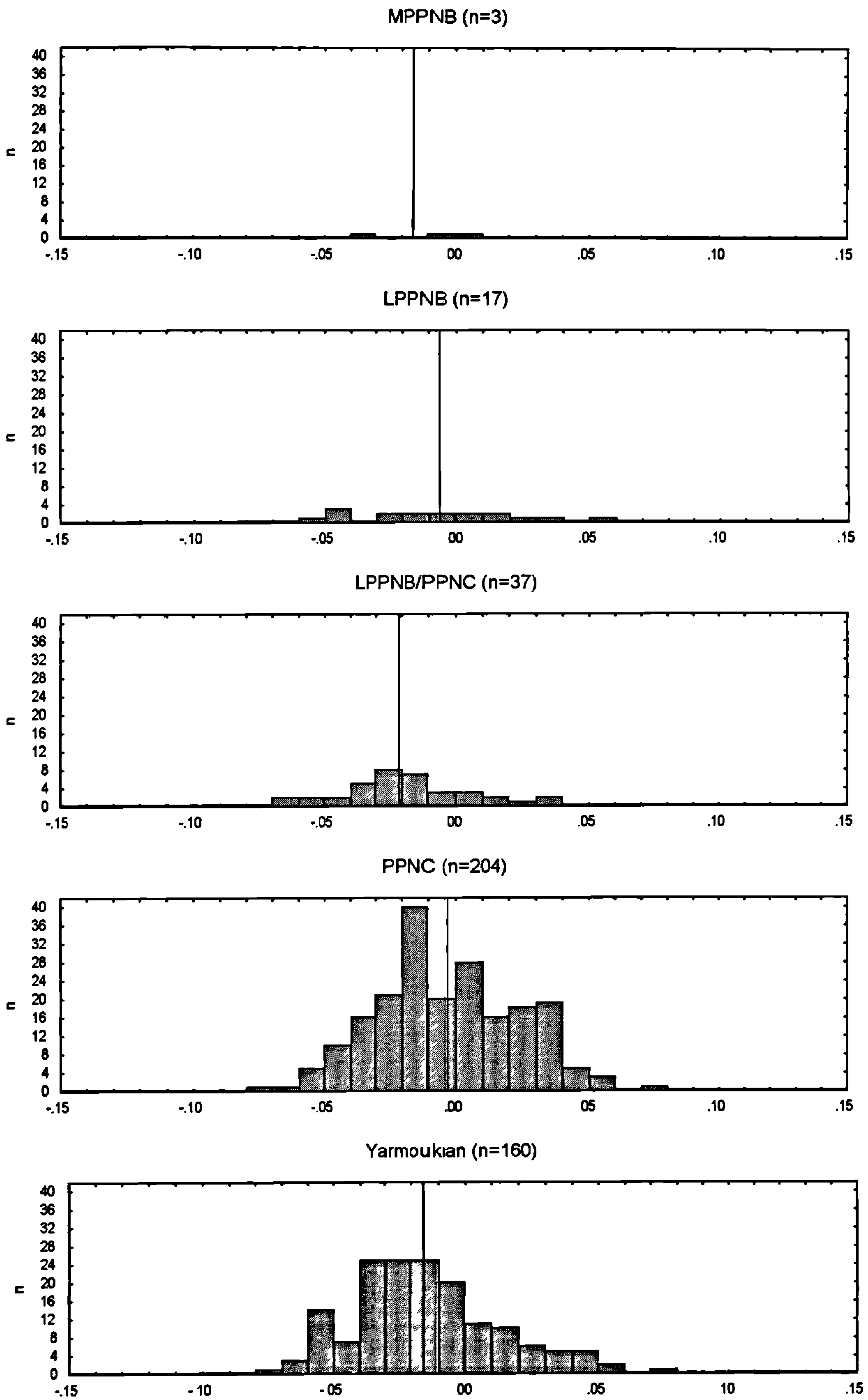


Figure 10.5: 'Ain Ghazal Sheep Measurements (log ratios and mean by phase)

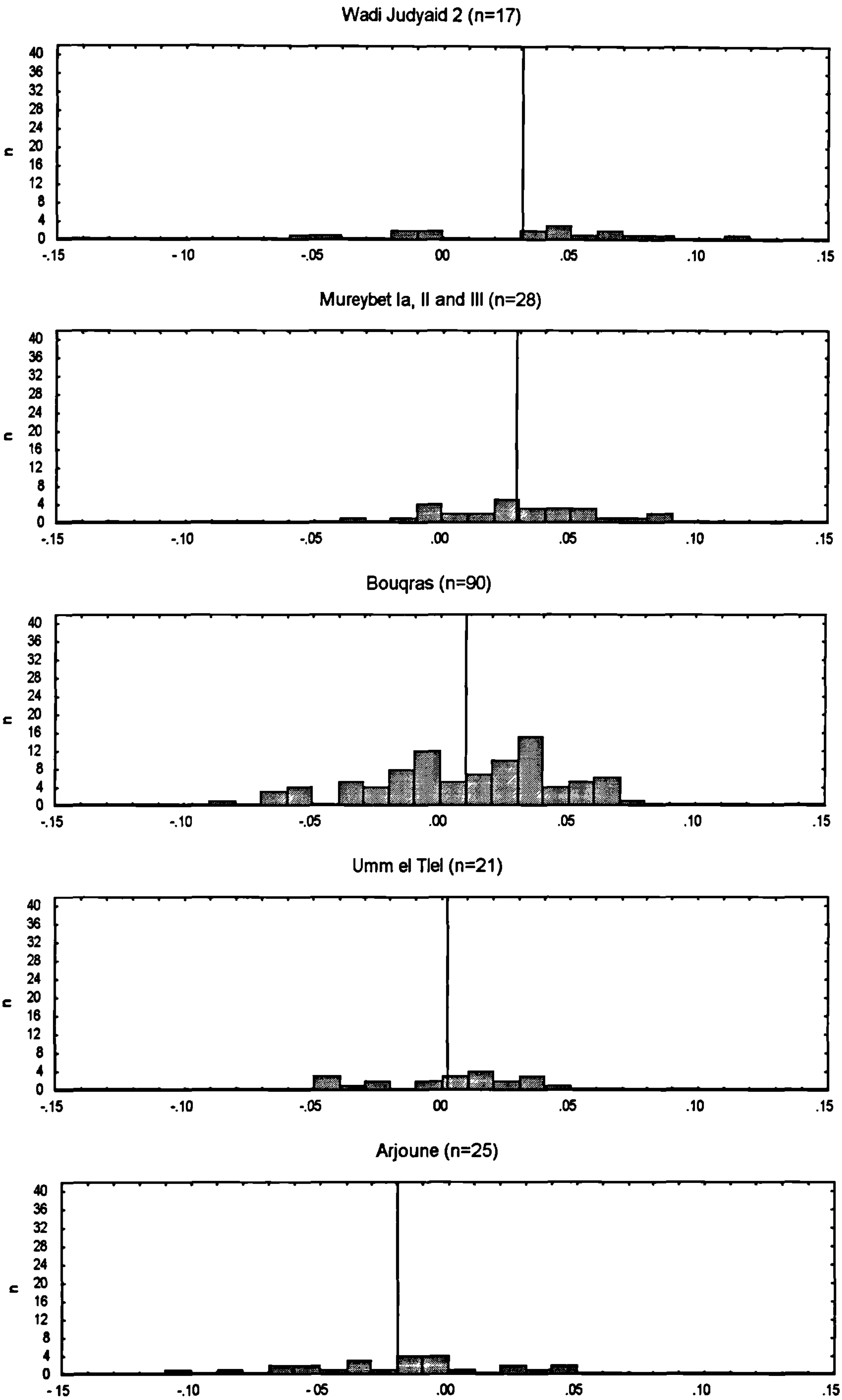


Figure 10.6: Sheep Comparative Measurements (log ratios and mean by site)

It is clear from the data in Figure 10.5 that there were no significant changes in the size of the sheep remains from 'Ain Ghazal across the various periods of occupation at the site. Although the sample sizes of MPPNB, LPPNB and LPPNB/PPNC sheep measurements from 'Ain Ghazal are relatively small, which probably accounts for the fluctuations in the means of these phases, it is clear that they all fall within the range of the much larger samples of PPNC and Yarmoukian sheep measurements. However, there seems to have been a significant shift in the distribution of sheep measurements between the MPPNB, LPPNB, LPPNB/PPNC and PPNC sheep measurements on the one hand and the Yarmoukian sheep measurements on the other. During the earlier phases larger and smaller measurements seem to be fairly evenly distributed, whereas during the Yarmoukian there appears to have been a clear bias in favour of the smaller specimens. These trends are also apparent in the sheep humerus Bd measurements from 'Ain Ghazal in Figure 10.4, even though these sample sizes are relatively small.

It is clear from the comparative sheep measurements in Figure 10.6 that the size reduction associated with the process of domestication was much less extensive in sheep than goats. Th~~is~~e reasons for this are not entirely clear, but could potentially have been associated with the more extreme sexual dimorphism of wild goats. Nevertheless, it is clear that the early domestic sheep measurements from Bouqras and Umm el Tlel are rather smaller than the mouflon measurements from Wadi Judayid 2 and Mureybet 1a, II and III, at both the maximum and minimum ends of the range. This suggests that male and female early domestic sheep may both have been slightly smaller than their wild progenitors. The Late Neolithic/Chalcolithic domestic sheep measurements from Arjoune are generally smaller than those of early domestic sheep from Bouqras and Umm el Tlel, which hints at further size reduction in males and females by this time.

The means and ranges of variation in sheep measurements from all phases of occupation at 'Ain Ghazal are similar to those of early domestic sheep from Bouqras and Umm el Tlel. They are slightly smaller than the measurements of mouflon from Wadi Judayid 2 and Mureybet 1a, II and III and are rather larger than the measurements of Late Neolithic/Chalcolithic domestic sheep from Arjoune. This suggests firstly that sheep were introduced to 'Ain Ghazal as early domesticates, and secondly that there was subsequently no change in their size at the site. The further size reduction in domestic sheep hinted at by the Late Neolithic/Chalcolithic measurements from Arjoune may well have occurred after the end of the Yarmoukian. Although there seems to have been no size change in early domestic sheep at 'Ain Ghazal the clear bias in favour of the smaller specimens, i.e. adult females, in the Yarmoukian sheep measurements suggests that there may well have been a shift towards selective culling of young males during this period.

10.2.3: Population Structure of Caprines at 'Ain Ghazal:

The population structure of caprines at 'Ain Ghazal was assessed through examination of dental wear and epiphyseal fusion.

Mandibular teeth were assessed for eruption/wear and categorised according to the method described by Payne (1973). Although it is occasionally possible to identify some deciduous caprine teeth to species (Payne 1985b), this is rarely possible in the case of permanent teeth. Rather than attempt to assess the dental wear of goats and sheep separately on the basis of the few teeth which could be identified to species, it was decided to lump all caprine teeth from 'Ain Ghazal into a single combined goat/sheep category in an attempt to ensure that the sample sizes for each phase were as large as possible. The proportions of caprine teeth from 'Ain Ghazal in each of Payne's (1973) wear stages are listed by phase in Table 10.2, alongside calculated percentage survival rates. Both sets of data are plotted by phase in Figure 10.7.

Stage	Months	MB		LB		LB/C		C		Yarm	
		% n	% sv	% n	% sv	% n	% sv	% n	% sv	% n	% sv
A	0-2	0.0	100.0	1.5	98.5	0.0	100.0	0.0	100.0	0.0	100.0
B	2-6	0.0	100.0	0.0	98.5	0.0	100.0	0.0	100.0	4.9	95.1
C	6-12	7.3	92.7	20.5	78.0	19.8	80.2	25.5	74.5	14.8	80.3
D	12-24	22.0	70.7	26.9	51.1	42.7	37.5	14.4	60.1	26.5	53.8
E	24-36	26.5	44.2	14.6	36.5	0.0	37.5	22.2	37.9	12.5	41.3
F	36-48	31.1	13.0	33.2	3.3	24.9	12.5	24.3	13.6	26.2	15.1
G	48-72	13.0	0.0	1.1	2.2	12.5	0.0	7.1	6.5	14.1	1.0
H	72-96	0.0	0.0	1.1	1.1	0.0	0.0	5.9	0.5	0.0	1.0
I	96-120	0.0	0.0	1.1	0.0	0.0	0.0	0.5	0.0	1.0	0.0
	n	142		65		55		236		406	

Key: %n=% of teeth in each wear stage, % sv=percentage survival beyond stage x, MB=MPPNB, LB=LPPNB, LB/C=LPPNB/PPNC, C=PPNC, Yarm=Yarmoukian

Table 10.2: Mandibular Tooth Wear by Phase in Caprines (Goat, Sheep and Goat/Sheep Combined) from 'Ain Ghazal

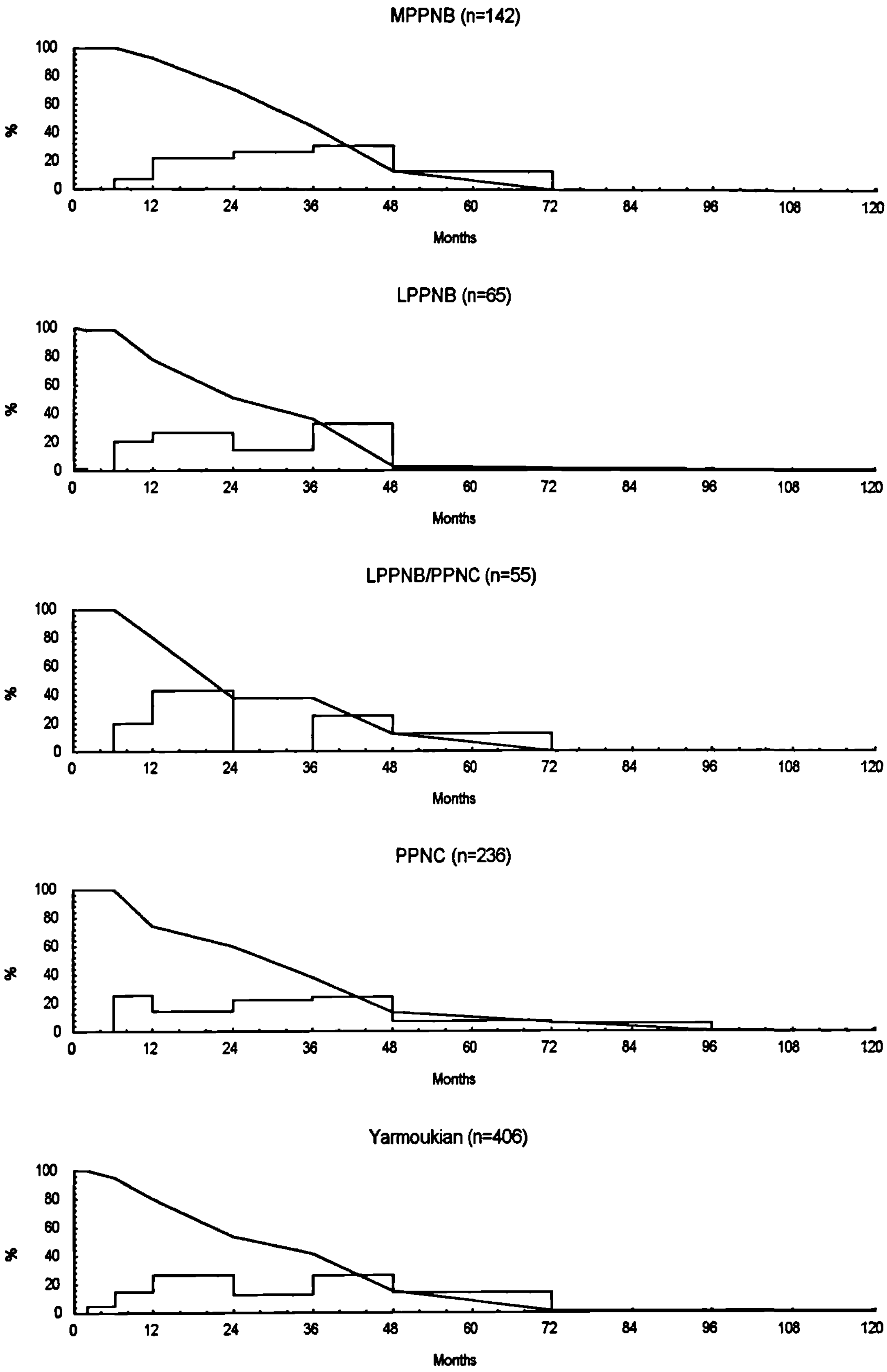


Figure 10.7: Mandibular Tooth Wear in Caprines (Goat, Sheep and Goat/Sheep Combined) from 'Ain Ghazal by Phase

(Data Taken from Table 10.2: Line Graph = % n, Histogram = % sv)

Although age profiles of the type presented in Figure 10.7 are notoriously difficult to interpret, a number of general trends are apparent in the mandibular tooth wear of caprines from ‘Ain Ghazal.

1) The general rate of juvenile mortality is extremely high in all phases, with 60% to 65% of animals being killed before the age of 3 years, i.e. before stage F. This corresponds well with the rate of juvenile mortality in a number of early domestic caprine populations from south-west Asia, e.g.: Ganj Dareh (Hesse 1978), Abu Hureyra 2A and 2B (Legge 1996), Beidha (Hecker 1975), Gritille (Stein 1989), and tentatively suggests that the caprines from ‘Ain Ghazal may have been domestic during all phases of occupation.

2) The proportion of caprines killed before the age of six months, i.e. during stages A and B, appears to be extremely low in all phases. The possibility that the teeth of extremely young animals may have been more severely affected by taphonomic processes than the teeth of older animals should however be borne in mind.

3) The proportion of animals surviving beyond the age of four years, i.e. beyond stage F, is extremely low in all phases. It is therefore apparent that most caprines were killed between the age of six months and four years, i.e. between stages C and F, during all phases of occupation at ‘Ain Ghazal.

4) In all phases except the MPPNB, varying degrees of bimodality are apparent in the proportions of teeth in each of Payne’s (1973) wear stages. In the LPPNB, LPPNB/PPNC and Yarmoukian there seem to be peaks in mortality between one and two years, i.e. during stage D, and between three and four years, i.e. during stage F. Similarly, in the PPNC there seem to be slight peaks in mortality between six months and one year, i.e. during stage C, and between two years and four years, i.e. during stages E and F.

5) In the MPPNB, the proportion of animals killed between six months and one year, i.e. during stage C, is significantly lower than in subsequent phases. In addition, the proportions of teeth in each of Payne’s (1973) wear stages steadily increase between six months and four years, i.e. from stage C to stage F, with no bimodality.

Unfortunately it is difficult to assess whether these differences between the MPPNB and subsequent phases are significant, as it seems that the MPPNB caprine sample contains a proportion of hunted wild goat in addition to early domestic goats. The age classes of wild goat hunted by the MPPNB inhabitants of 'Ain Ghazal may well have differed from those of herded early domestic goats. It is also unclear whether the timing of mandibular tooth eruption in these two species is comparable.

In extremely general terms, the population structure of caprines during all phases of occupation at 'Ain Ghazal, as evidenced by mandibular tooth wear, is reminiscent of a fully domestic herd. The management of these animals, as evidenced by mandibular tooth wear, is discussed in detail in 10.3 below.

The population structure of the caprine remains from 'Ain Ghazal was also assessed by comparing the ratio of fused to fusing/unfused specimens of earlier and later fusing skeletal elements. Unfortunately there are a number of problems with the use of epiphyseal fusion to assess the population structure of caprines. Unlike dental wear stages, many of which can be attributed to a relatively well defined period of time with clear upper and lower limits, examination of epiphyseal fusion can only demonstrate whether a specimen is older or younger than the age at which the skeletal element is known to fuse. Once all skeletal elements have fused, which in caprines has generally occurred by about four years, there is no further means of ageing the animal.

In addition, although the sequence in which the various skeletal elements fuse is genetically predetermined for each species and does not usually vary, the age at which the various skeletal elements fuse is subject to a great deal of poorly understood variation. Available data (Silver 1969, Noddle 1974) suggests that wild or feral caprines tend to fuse later than domestic caprines, that males tend to fuse later than females and that goats tend to fuse later than sheep. Factors such as nutritional circumstances and local environmental conditions may also affect the age at which the various skeletal elements fuse. Later fusing elements seem to be subject to more variation in the age at which they fuse than early fusing elements. It should also be noted that unfused bones are more fragile than fused bones and may therefore be under-represented in archaeological faunal assemblages.

In sum, assessment of population structure through epiphyseal fusion tends to be less accurate and subject to much wider variation than assessment of population structure through dental eruption and wear. It does however have the advantage that many of the earlier and later fusing skeletal elements in caprines can relatively easily be identified to species, allowing the population structure of goats and sheep to be considered separately.

Epiphyseal fusion in the 'Ain Ghazal caprines was assessed on the basis of four POSACs which fuse at different ages. The ages of fusion are based on Noddle's (1974) data relating to various British domestic goats and to feral goats from Galloway and Rhum. The selected POSACs and their approximate age at fusion were: the distal scapula diaphysis (9 to 12 months), distal tibia epiphysis (18 to 24 months), distal metapodial epiphysis (24 to 26 months) and distal radius epiphysis (36 to 48 months).

The distal humerus and first phalanx, which are also commonly used in analyses of epiphyseal fusion in caprines, were excluded from this analysis. The POSACs on these elements, i.e. the distal epiphysis and proximal epiphysis respectively (see Chapter 2), can be extremely fragile and may well be under-represented in the highly fragmented faunal assemblage from 'Ain Ghazal. The proportions of fused specimens in the 'Ain Ghazal caprine remains, i.e.: goat, sheep and goat/sheep combined, are listed and plotted below by phase for each of the four selected POSACs in Table 10.3 and Figure 10.8 respectively.

Phase	POSAC	Months	n F	n fg/uf	Total	% F
MPPNB	Distal Scapula	9-12	58	21	79	73.4
	Distal Tibia	18-24	74	53	98	58 .3
	Distal Metapodial	24-36	105	135	240	43.8
	Distal Radius	36-48	14	67	81	17.3
LPPNB	Distal Scapula	9-12	37	7	44	84.1
	Distal Tibia	18-24	34	9	43	79.1
	Distal Metapodial	24-36	45.5	20.5	66	68.9
	Distal Radius	36-48	8	10	18	44.4
LPPNB/PPNC	Distal Scapula	9-12	6	4	10	60.0
	Distal Tibia	18-24	21	3	24	87.5
	Distal Metapodial	24-36	18	9	27	66.7
	Distal Radius	36-48	2	4	6	33.3
PPNC	Distal Scapula	9-12	89	22	111	80.2
	Distal Tibia	18-24	81	22	103	78.6
	Distal Metapodial	24-36	95	46.5	141.5	66.9
	Distal Radius	36-48	24	23	47	51.1
Yarmoukian	Distal Scapula	9-12	66	26	92	71.7
	Distal Tibia	18-24	80	8	88	90.9
	Distal Metapodial	24-36	73	21.5	94.5	77.2
	Distal Radius	36-48	12	10	22	54.5

Key: n=n adjusted NISP, F=fused, fg=fusing, uf=unfused

Table 10.3: Epiphyseal Fusion Stages (Noddle 1974) and Percentage Survivorship of 'Ain Ghazal Caprines by Phase (Goat, Sheep and Goat/Sheep combined)

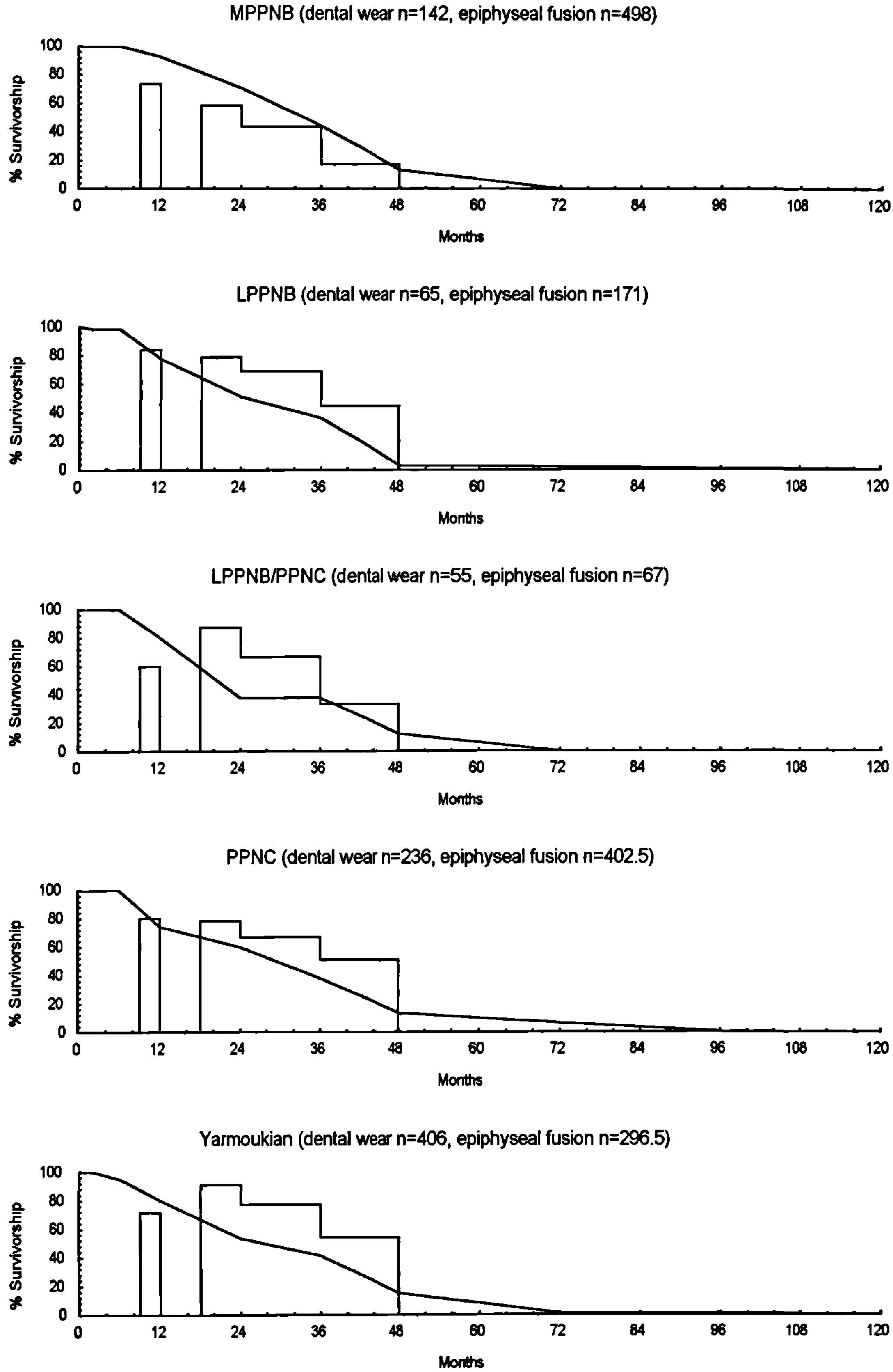


Figure 10.8: Percentage Survivorship of 'Ain Ghazal Caprines (Goat, Sheep and Goat/Sheep combined) by Phase According to Mandibular Tooth Wear (line graph) and Epiphyseal Fusion (histogram)

The population structures of caprines from 'Ain Ghazal as evidenced by epiphyseal fusion are rather ambiguous, owing to the fact that there are some significant differences between them and the population structures evidenced by dental eruption and wear.

In the MPPNB, these two lines of evidence are in broad agreement, if allowance is made for the inevitable inconsistencies associated with assessment of population structure by different methods. Epiphyseal fusion suggests that juvenile mortality in the MPPNB was high, with 56.2% of caprines being killed before the age of three years and only 17.3% surviving beyond the age of four years. Dental wear provides similar proportions of 65.8% and 13.0% respectively. Figure 10.8 suggests that in the MPPNB epiphyseal fusion in caprines may well have been occurring at or just beyond the later end of the range for each element.

However, epiphyseal fusion suggests in subsequent phases of occupation at 'Ain Ghazal the proportion of caprines surviving into adulthood was significantly greater than in the MPPNB. In the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian the proportion of caprines that seem to have been killed before the age of three years ranges from 22.8% to 33.3%, with the proportion surviving beyond the age of four years ranging from 45.5% to 66.7%. Dental wear, in contrast, suggests that juvenile mortality was as high in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian as is was in the MPPNB.

Several different factors could account for these differences between the population structures evidenced by epiphyseal fusion in LPPNB, LPPNB/PPNC, PPNC and Yarmoukian and those evidenced by dental wear.

1) Cranial and post-cranial elements could come from different animals. It is however difficult to envisage a scenario which would have caused only the cranial elements of young animals and post-cranial elements of older animals to be deposited on-site.

2) Unfused epiphyses could be under-represented in the faunal assemblage owing to poor preservation. This seems unlikely as the proportion of unfused epiphyses is consistently higher in the oldest phase, i.e. the MPPNB, which predates the youngest, i.e. the Yarmoukian, by approximately two millennia.

3) The increased frequencies of sheep in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian could have led to an increase in the number of fused specimens of any given element in these phases, as there is some evidence to suggest that sheep fuse earlier than goats (Silver 1969, Noddle 1974).

4) Goats and sheep could both be fusing earlier in the LPPNB, LPPNB, LPPNB/PPNC, PPNC and Yarmoukian. There is some evidence to suggest that domestic caprines fuse earlier than wild or feral caprines (Noddle 1974). Furthermore, evidence for wild caprines at 'Ain Ghazal seems to be restricted to the MPPNB.

In order to test the possibility that sheep may have been fusing earlier than goats during the later phases of occupation at 'Ain Ghazal, epiphyseal fusion in PPNC/Yarmoukian goats and sheep was assessed separately. Fused and fusing/unfused caprine specimens which could not be identified to species were allocated to goats and sheep respectively on the basis of the relative proportions of identifiable fused and fusing/unfused specimens, using the method described by Grigson (1987b). These results are presented in Table 10.4 and Figures 10.9 and 10.10.

POSAC	Months	Taxon	Raw		Corrected		n Total	% F	% sp.
			n F	n fg/uf	n F	n fg/uf			
Distal Scapula	9-12	Goat	28	2	46	11	57	80.7	28.1
		Sheep	66	7	109	37	146	74.7	71.9
		Goat/Sheep	61	39					
		Total	155	48	155	48	203	76.4	
Distal Tibia	18-24	Goat	17	2	36	6	42	85.7	22.0
		Sheep	59	8	125	24	149	83.9	78.0
		Goat/Sheep	85	20					
		Total	161	30	161	30	191	84.3	
Distal Metapodial	24-36	Goat	56	22	56	23.5	79.5	70.4	33.7
		Sheep	111	41.5	112	44.5	156.5	71.6	66.3
		Goat/Sheep	1	4.5					
		Total	168	68	168	68	236	71.2	
Distal Radius	36-48	Goat	9	8	10	9	19	52.6	27.5
		Sheep	25	21	26	24	50	52.0	72.5
		Goat/Sheep	2	4					
		Total	36	33	36	33	69	52.2	

Key: n=adjusted NISP, F=fused, fg/uf=fusing/unfused, % sp.=% of each species i.e. goat and sheep

Table 10.4: Epiphyseal Fusion in PPNC/Yarmoukian Goats and Sheep from 'Ain Ghazal

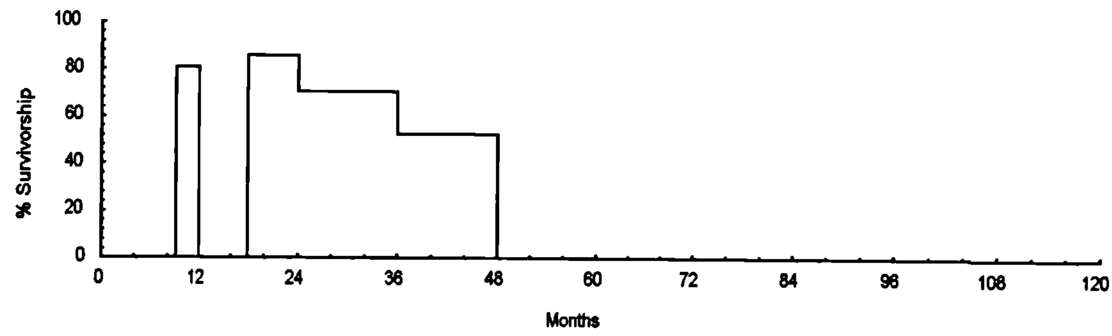


Figure 10.9: Epiphyseal Fusion in PPNC/Yarmoukian Goats from 'Ain Ghazal

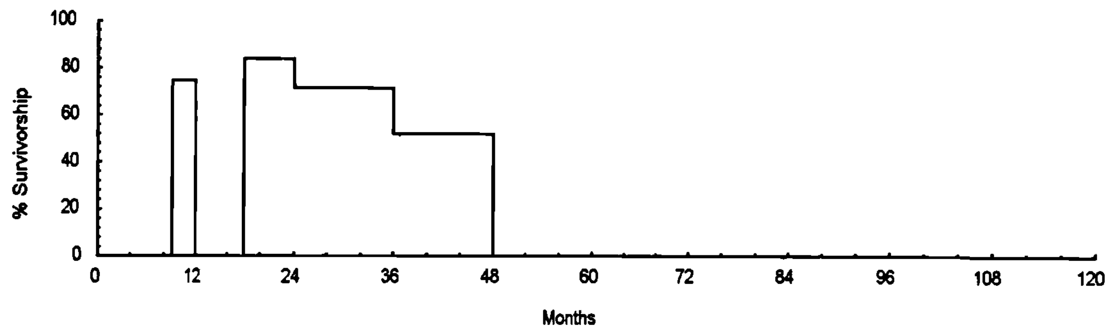


Figure 10.10: Epiphyseal Fusion in PPNC/Yarmoukian Sheep from 'Ain Ghazal

It is immediately apparent from the data in Table 10.4 and Figures 10.9 and 10.10 that there is no difference between the population structures of goats and sheep in the PPNC/Yarmoukian, as evidenced by epiphyseal fusion. The proportion of animals killed before the age of three years and surviving beyond the age of four years is 29.6% and 52.6% respectively in goats, and 28.4% and 52.0% respectively in sheep. This strongly suggests that increased frequencies of sheep in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian does not account for the differences between the population structures as evidenced by epiphyseal fusion and dental wear during these phases. It therefore seems that the most likely explanation for these differences is that goats and sheep were both fusing earlier in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian than goats were fusing in the MPPNB.

Two factors may have been associated with this phenomenon. Firstly, analysis of size change in caprines at 'Ain Ghazal has suggested that the MPPNB sample contains both wild and early domestic goats. If wild goats were fusing at a later age than early domestic goats or sheep, the proportion of unfused specimens in the MPPNB sample would naturally be higher than in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian samples, even if the actual age at which the animals were slaughtered was relatively constant through time, as suggested by dental wear.

Secondly, it is clear from Figure 10.8 that even if the potential later fusing of wild goats is taken into account, the proportion of adult animals in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian as evidenced by epiphyseal fusion is still significantly higher than the proportion of adult animals evidenced by dental wear. However, if it is assumed that the skeletal elements of domestic goats and sheep at 'Ain Ghazal were fusing at or just below the lower ends of the age ranges suggested by Noddle (1974), and that the skeletal elements of wild goats were fusing at or just above the upper ends of the age ranges, it is possible that fusing/unfused specimens of domestic goats and sheep may have been younger and consequently more fragile than fusing/unfused specimens of wild goat. This could potentially have led to young animals being under-represented in the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian caprine samples from 'Ain Ghazal.

In sum, the population structures of caprines at 'Ain Ghazal as evidenced by epiphyseal fusion are extremely ambiguous and difficult to interpret. As numerous inter-connected and poorly understood factors are known to affect the relative proportions of fused to fusing/unfused specimens in any faunal assemblage, it is felt that the population structures evidenced by dental wear are probably a more accurate reflection of the actual population structures of caprines at 'Ain Ghazal. These suggest that juvenile mortality in caprines was extremely high during all phases of occupation, resembling the levels of juvenile mortality found in a number of other early domestic caprine populations from south-west Asia (see Chapter 6, Tables 6.16 and 6.17).

Unfortunately the uncertainty surrounding the ages at which the various caprine skeletal elements of caprines were fusing makes it extremely difficult to reliably assess the relative proportions of juvenile male and female goats in the faunal assemblage from 'Ain Ghazal. Any attempt to calculate the proportion of unfused specimens which are larger than adult female specimens and can thus be attributed to juvenile males (c.f. Hesse 1984) could be affected by the facts that unfused MPPNB goat specimens could potentially be the exactly the same age as fused goat specimens from later phases, and that unfused goat specimens from later phases could be under-represented owing to differential preservation. This type of analysis was therefore not attempted as part of this study.

10.2.4: Morphological Change in Caprines at 'Ain Ghazal:

As sheep horncores are extremely poorly preserved in the faunal assemblage from 'Ain Ghazal, no attempt has been made to assess morphological change in the sheep remains. However, well-preserved goat horncore fragments are much more numerous and are therefore discussed in more detail below.

The maximum and minimum basal diameters of the goat horncores from 'Ain Ghazal are plotted below in Figure 10.11. It should be noted that goat horncores on which it was possible to measure maximum and minimum basal diameters represent a relatively small proportion of the total number of goat horncore fragments from the site. Comparative horncore measurements of modern wild goats (Stampfli 1983), early Holocene wild goats from Jarmo (Stampfli 1983) and Tepe Asiab (Bökönyi 1977), and early to mid Holocene domestic goats from Jarmo (Stampfli 1983), Tepe Sarab (Bökönyi 1977) and Arjoune (Grigson 1996) are plotted in Figures 10.12 and 10.13 respectively.

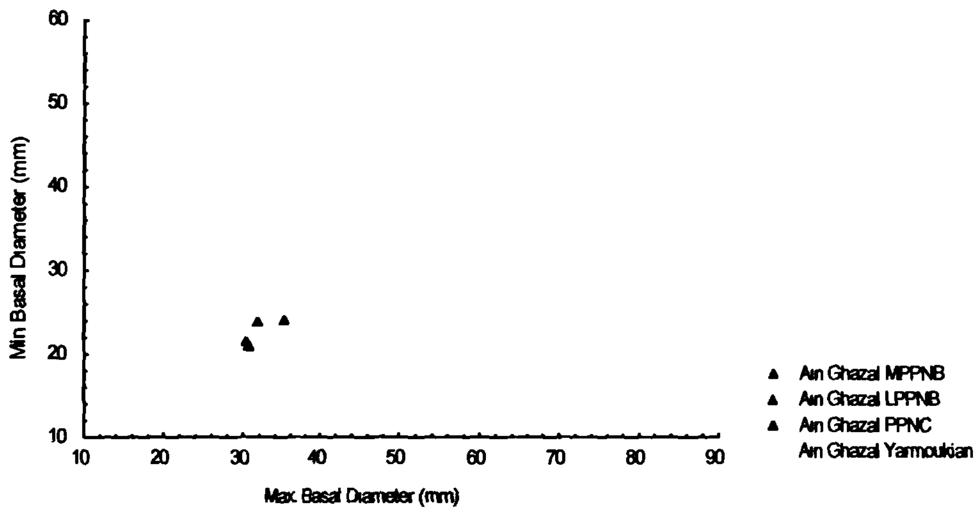


Figure 10.11: Goat Horncore Max BD and Min MD from 'Ain Ghazal by Phase

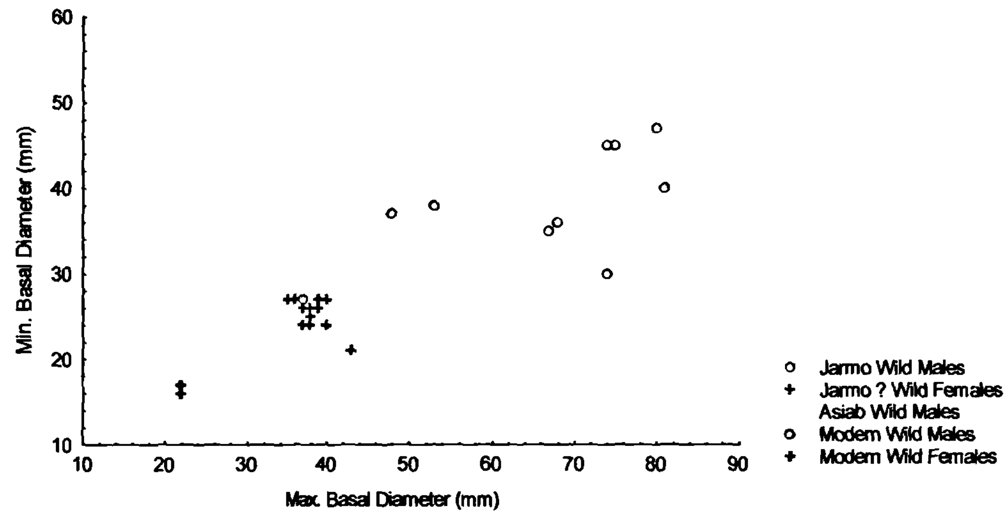


Figure 10.12: Comparative Wild Goat Horncore Max BD and Min BD

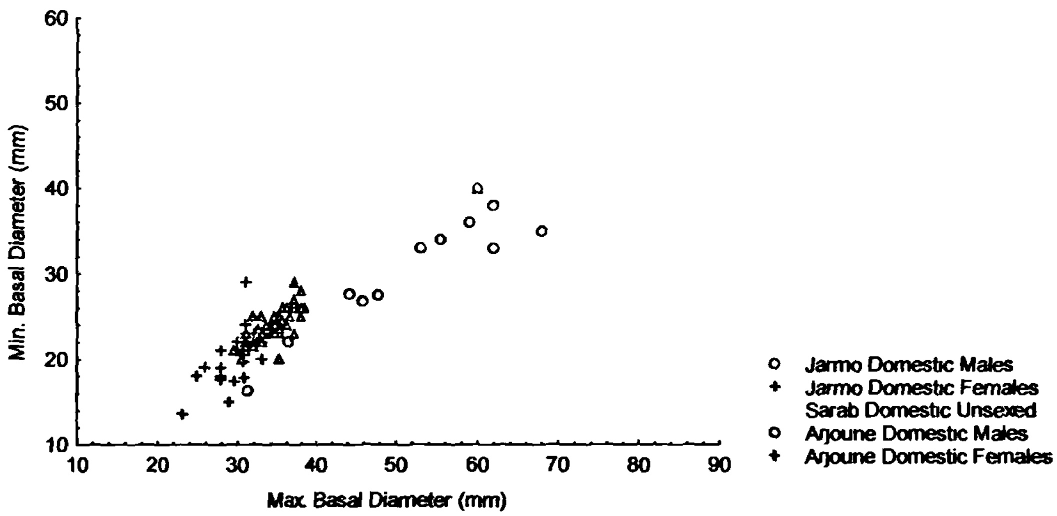


Figure 10.13: Comparative Domestic Goat Horncore Max BD and Min BD

Figure 10.11 demonstrates that the measurable goat horncores from 'Ain Ghazal are extremely small in all phases, falling within the range of wild and domestic adult females and of wild and domestic juvenile males. No measurable goat horncores from 'Ain Ghazal fall within the range of adult wild males or adult domestic males. Although sample sizes are extremely small, this observation forms the strongest evidence at 'Ain Ghazal for the preferential culling of juvenile males and adult females typically associated with domestic goat populations. Although there is no overall size change in the goat horncores from 'Ain Ghazal over the various phases of occupation, a decrease in the minimum diameter is apparent in the Yarmoukian. This is almost certainly linked to the appearance of medial flattening (see below).

As the samples of measurable goat horncores were so small, the cross-sections of all specimens in which more than 75% of the basal portion, lower third or mid third of the horncore was preserved were drawn in attempt to assess changes in goat horncore morphology in more detail. Although sample sizes are again relatively small, a simple seriation of horncore cross-sections demonstrated the existence of five shape categories, albeit with some overlap between them, which are described below. The number of specimens in each group are listed by phase in Table 10.5, and samples of horncore cross-sections in each shape category are drawn in Figures 10.14 to 10.18 (anterior to top of page, lateral to right of page, cross-sections taken from the same horncore joined by a line). The LPPNB/PPNC yielded no well preserved goat horncores at all and is therefore excluded.

Group A: Cross-sections typically associated with wild goat, whether on the basis of size, quadrilateral shape or pronounced antero-lateral concavity.

Group B: Assymetrical triangular or almond-shaped cross-sections with a sharp anterior keel, relatively flat antero-lateral surface and a clear angle between the antero-lateral and postero-lateral surfaces.

Group C: Relatively symmetrical oval cross-sections, with a reduced anterior keel or rounded anterior surface.

Group D: Symmetrical lozenge or almond-shaped cross-sections, with a sharp anterior keel and relatively sharp posterior surface. Typically associated with slight anti-clockwise twisting of the right horncore and slight clockwise twisting of the left (seen from above).

Group E: Assymmetrical cross-sections with an extremely flat medial face, sharp anterior ridge and relatively flat antero-lateral surface.

Group	MPPNB	LPPNB	PPNC	Yarmoukian
A	3	1	absent	absent
B	6	5	4	4
C	3	1	2	5
D	absent	absent	absent	8
E	absent	absent	absent	8

Table 10.5: Numbers of Goat Horncores from 'Ain Ghazal in Each Shape Category by Phase

The data in Table 10.5 suggest that there were significant changes in goat horncore morphology over the various phases of occupation at 'Ain Ghazal which are not immediately apparent in the small sample of measurable specimens.

Horncores of Group A, which probably represent wild goat or extremely early domestic goat, are most common in the MPPNB (including one unequivocal adult male wild goat horncore fragment), much rarer in the LPPNB and absent in the PPNC and Yarmoukian. This fits well with the metrical data, which suggest that in the 'Ain Ghazal faunal assemblage wild goats were restricted to the MPPNB. It is extremely unlikely that the entire MPPNB goat sample consisted of wild goat as Group A horncores were outnumbered by Group B and Group C horncores. Group B and Group C horncores are the most common category at 'Ain Ghazal and, most significantly, are found in all phases of occupation. The fact that Group B and Group C horncores were the only categories found in the PPNC, during which there is no metrical evidence for the presence of wild goat, strongly suggests that they represent early domestic goats. In addition it is clear that the Group B and Group C goat horncore cross-sections from 'Ain Ghazal closely resemble Period 5 early domestic goat horncore cross-sections from Tepe Sarab (Bökönyi 1977) (see Figures 10.15 and 10.16). It therefore seems that the MPPNB goat sample from 'Ain Ghazal consists of a few wild goats and substantially more early domestic goats, whose horncore cross-sections fall into two shape categories.

With the exception of a single LPPNB Group A horncore, the LPPNB and PPNC samples consist entirely of Groups B and C which, as described above, probably represent early domestic goats. Although the Group B horncores have the sharp anterior ridge typically associated with males and the Group C horncores have the symmetrical oval cross-section typically associated with females it is clear from the illustrations in Figures 10.15 and 10.16 that they are of a similar size. It is therefore possible that Group B represents juvenile males and that Group C represents adult females. If this supposition is correct, it is clear from the data in Table 10.5 that juvenile male early domestic goats would have outnumbered adult female early domestic goats at 'Ain Ghazal in the MPPNB, LPPNB and PPNC. This provides additional evidence for the preferential culling of juvenile males which is typically associated with domestic herds.

Although the Group B and Group C horncores of early domestic goats were present in the Yarmoukian sample, these were outnumbered by two new categories of horncore shape, i.e. Groups D and E. The fact that Group D and E horncores are only found in the Yarmoukian suggests that they developed for the first time during this phase. The small size of these horncores suggests that, like Groups B and C, they represent domestic goats. In addition, the slight twisting and pronounced medial flattening of Group D and E respectively are both characteristics typically associated with domesticates. This suggests that the size reduction evident in the Yarmoukian goat remains may have been accompanied by changes in horncore morphology. However, the fact that slight twisting and pronounced medial flattening first appear almost two millennia after the earliest evidence for the presence of domestic goats at 'Ain Ghazal suggests that these characteristics were associated with a relatively late stage of the domestication process and were not a feature of early domestic goats. These data therefore suggest that a smaller breed of domestic goat with Group D and Group E type horncores may have been present at 'Ain Ghazal during the Yarmoukian, alongside slightly larger early domestic goats with Group B and Group C type horncores.

In sum, horncore morphology provides a good deal of information about the goat populations at 'Ain Ghazal during the various phases of occupation, despite the fact that sample sizes are relatively small. Domestic goats were clearly present at 'Ain Ghazal from the MPPNB onwards. In the MPPNB, LPPNB and PPNC (probable) juvenile male early domestic goats with Group B horncores seem to have outnumbered (probable) adult female early domestic goats with Group C horncores. Although some wild goats were being hunted in the MPPNB, this practice subsequently declined in importance and seems to have been abandoned altogether by the end of the LPPNB. Domestic goats with Group D and Group E horncores appeared at 'Ain Ghazal for the first time in the Yarmoukian. These animals may well have been slightly smaller than the early domestic goats of the MPPNB, LPPNB and PPNC. However, it is clear that (probable) juvenile male and (probable) adult female early domestic goats with Group B and Group C horncores were also present at 'Ain Ghazal during this phase.

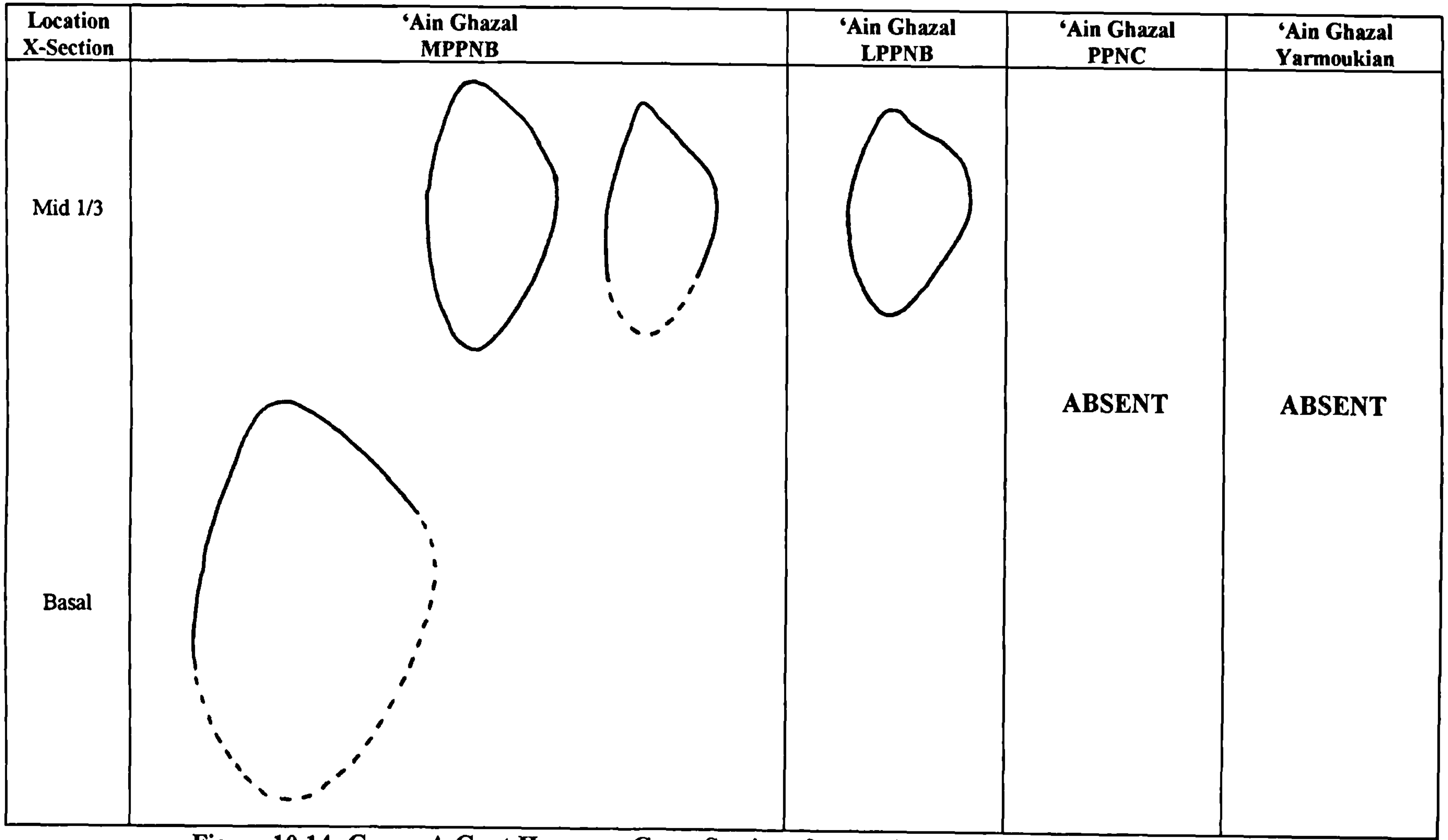


Figure 10.14: Group A Goat Horncore Cross-Sections from 'Ain Ghazal (Probable Wild Goat)

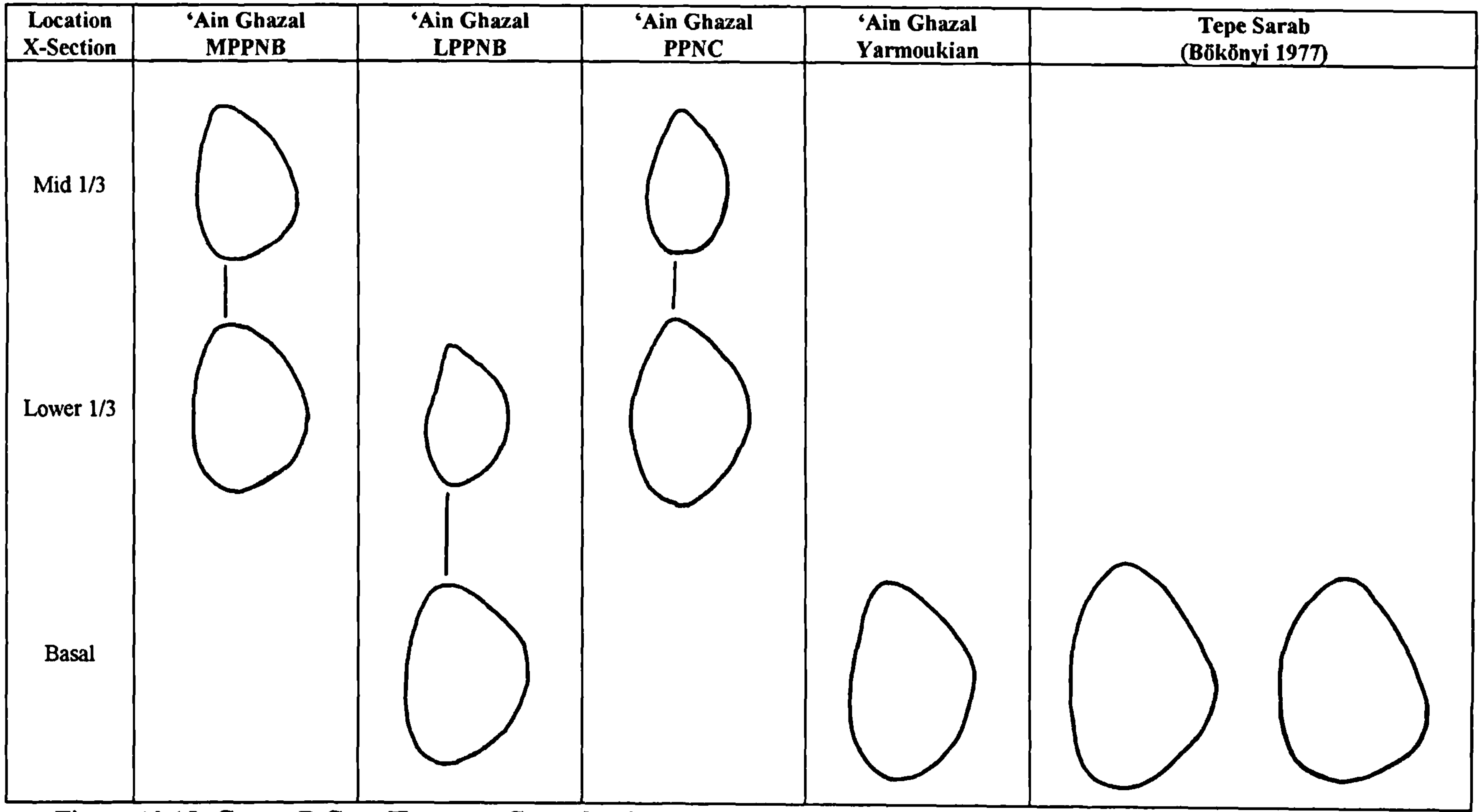


Figure 10.15: Group B Goat Horncore Cross-Sections from 'Ain Ghazal (Probable Juvenile Male Early Domestic Goat)

and Tepe Sarab

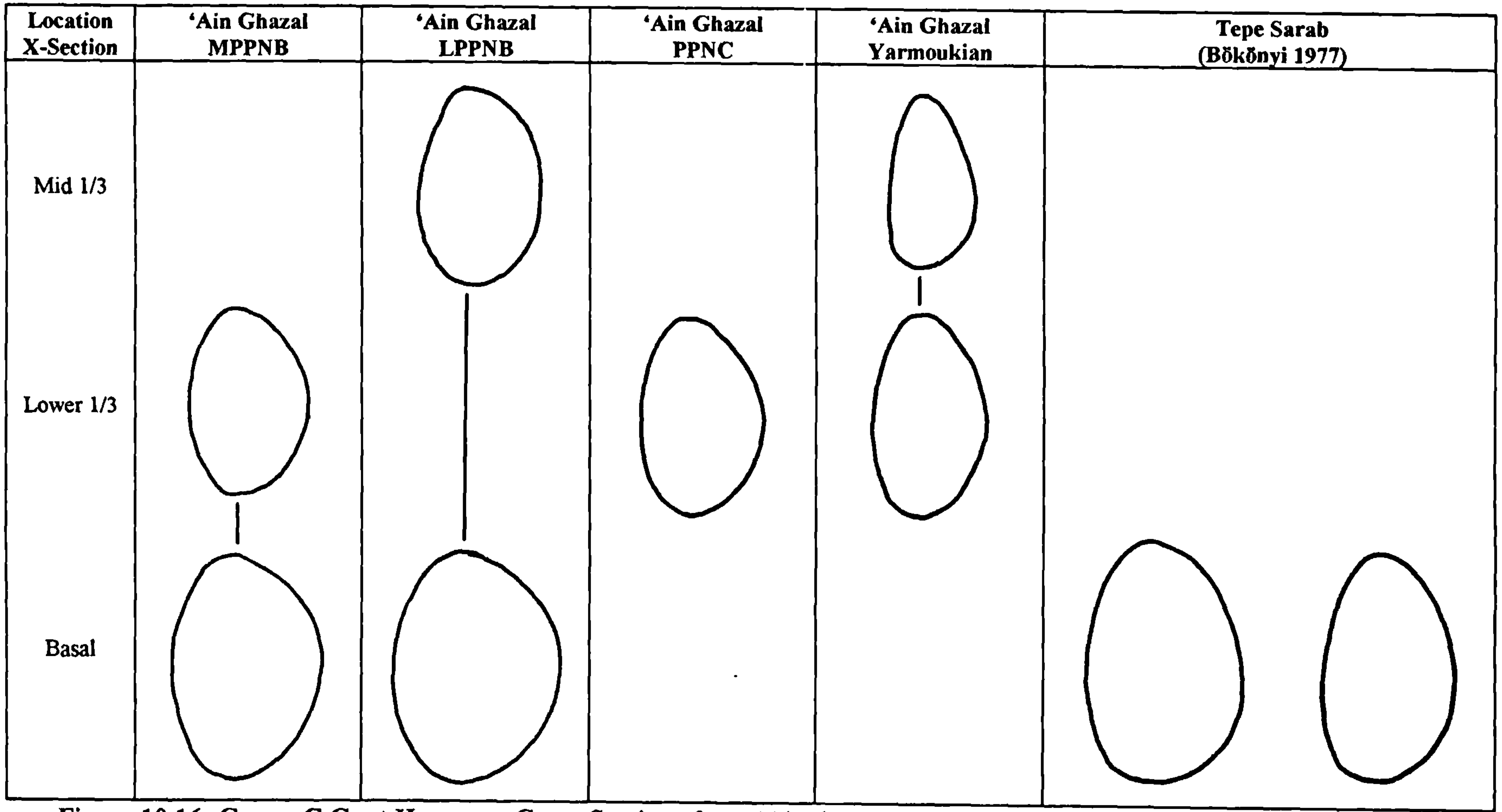


Figure 10.16: Group C Goat Horncore Cross-Sections from 'Ain Ghazal (Probable Adult Female Early Domestic Goat)
and Tepe Sarab

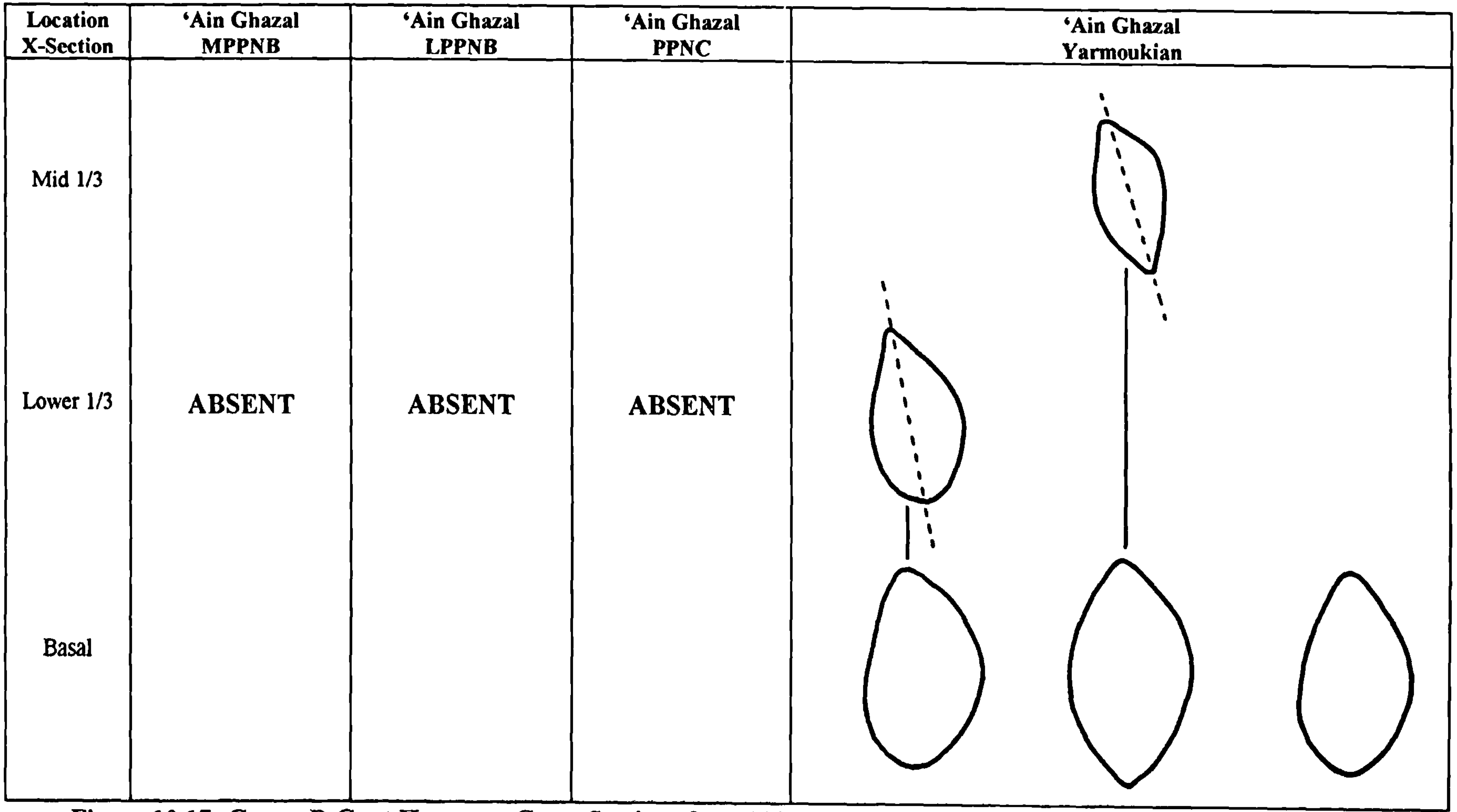


Figure 10.17: Group D Goat Horncore Cross-Sections from 'Ain Ghazal (Probable Smaller Breed of Domestic Goat)

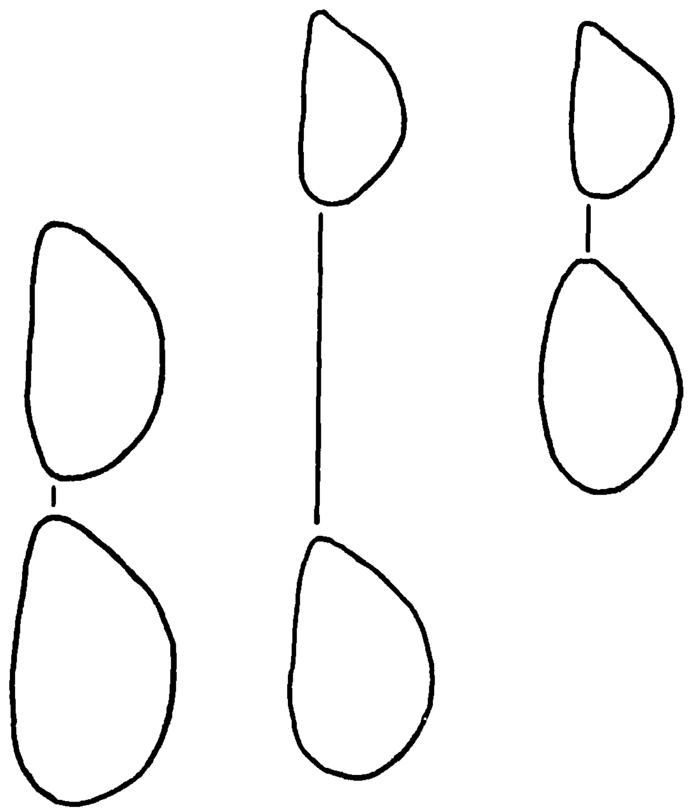
Location X-Section	'Ain Ghazal MPPNB	'Ain Ghazal LPPNB	'Ain Ghazal PPNC	'Ain Ghazal Yarmoukian
Mid 1/3				
Lower 1/3	ABSENT	ABSENT	ABSENT	
Basal				

Figure 10.18: Group E Goat Horncore Cross-Sections from 'Ain Ghazal (Probable Smaller Breed of Domestic Goat)

10.2.5: Conclusions:

This assessment of the wild or domestic status of the 'Ain Ghazal caprines strongly suggests that zoologically domestic goats were present at the site from the beginning of its occupation at c.9,250b.p.. During the MPPNB exploitation of domestic goats seems to have been backed up by the hunting of a smaller proportion of wild goats, but by the LPPNB this practice seems to have been largely abandoned. Zoologically domestic sheep seem to have been introduced to 'Ain Ghazal in extremely small numbers during the latter part of the MPPNB, during the first half of the 9th millennium b.p., and subsequently their numbers rapidly increased. There is no evidence for the presence of mouflon in the 'Ain Ghazal faunal assemblage. There is some evidence to suggest that a smaller breed of domestic goat may have appeared at 'Ain Ghazal during the Yarmoukian Pottery Neolithic. It is possible that the appearance of these animals may be linked to the appearance of medially flattened and slightly twisted goat horncores in the faunal assemblage at the same time.

10.3: MORE SPECIALISED PASTORAL ECONOMIES AT 'AIN GHAZAL:

One of the key variables manipulated by pastoralists according to the type of pastoral economy being practised is the population structure, or age and sex ratios, of the herd. Fortunately, this variable tends to be reflected in archaeological caprine assemblages. Although it can be difficult to produce reliable sex ratios for archaeological caprine assemblages, it is comparatively easy to produce age ratios, or survivorship curves, on the basis of either mandibular tooth eruption and wear or on the basis of epiphyseal fusion.

Typically, the population structure of a domestic herd is largely a reflection of the primary goals of the herder. Within the recent past, the more specialised the type of pastoral economy, the greater the focus on production of secondary products has tended to be. This is because secondary products, such as milk or milk products, can be both consumed by the herder or exchanged for carbohydrates in the form of agricultural products without affecting the size or security of the herd, as their production does not involve the slaughter of any component of that herd.

Researchers have therefore produced modelled caprine survivorship curves for a variety of production strategies, against which archaeological caprine survivorship curves can be compared. It was therefore decided to compare the 'Ain Ghazal caprine survivorship curves, based on mandibular tooth wear rather than epiphyseal fusion (see 10.2.3 above) with published, modelled caprine survivorship curves for generalised, subsistence orientated meat production (Payne 1973), specialised milk production (Payne 1973), and specialised wool production (Payne 1973), herd security (Redding 1981), and specialised meat production within an exchange economy (Stein 1988). The rationale behind these modelled survivorship curves is fully discussed in the publications listed above, and will not be repeated here. However, the cumulative survivorship curves themselves, and histograms of the relative proportions of animals in each age class, are reproduced in Figure 10.19 below.

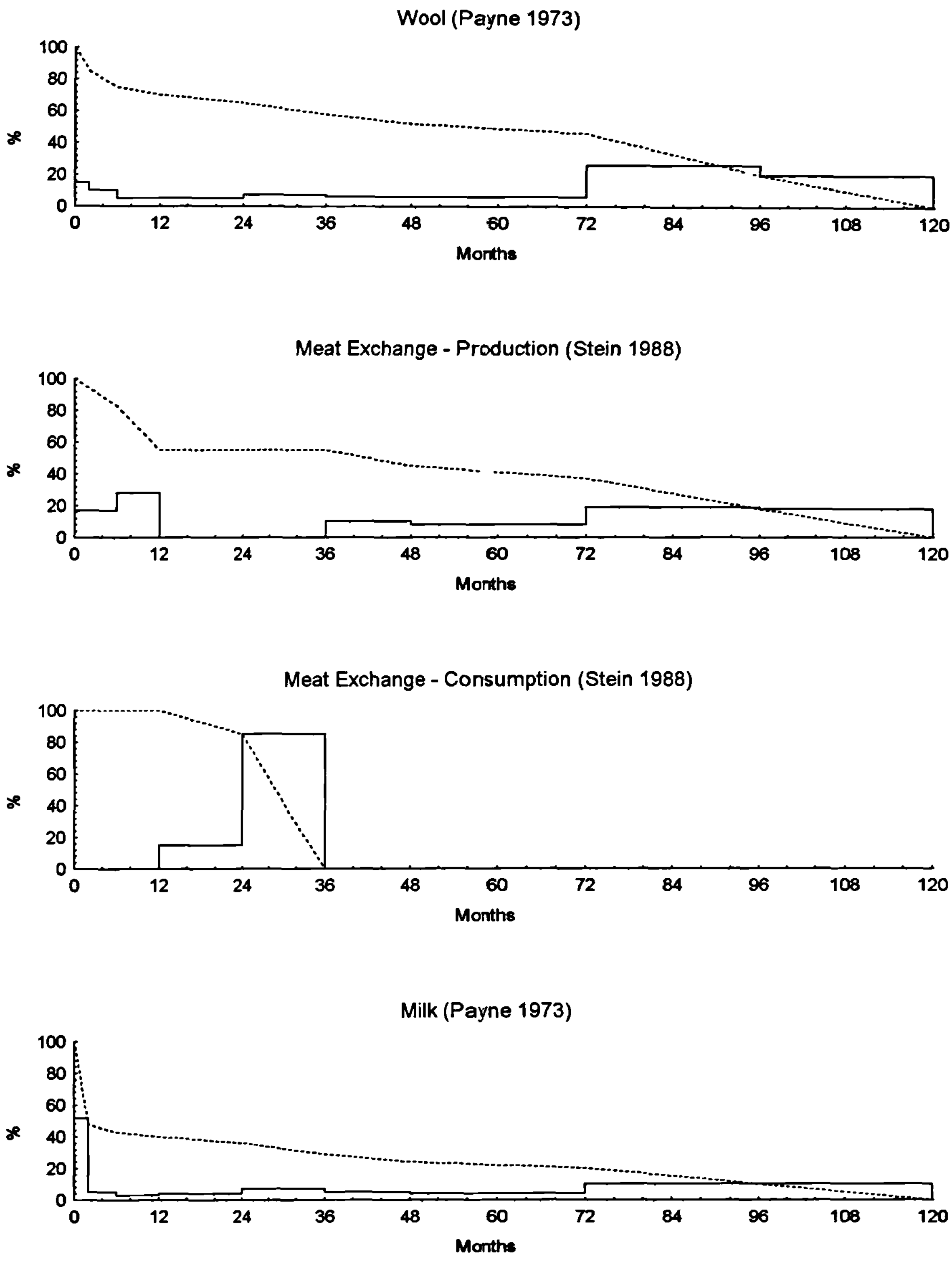


Figure 10.19: Published Modelled Caprine Survivorship Curves for Different Production Strategies (continued overleaf)

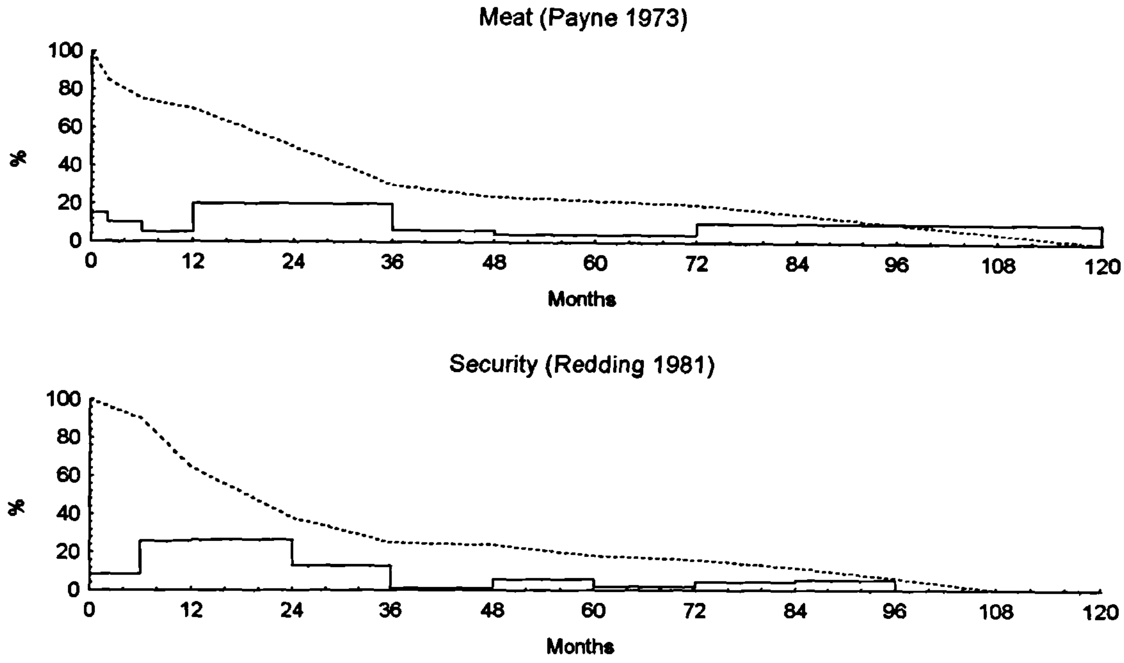


Figure 10.19 (cont.): Published Modelled Caprine Survivorship Curves for Different Production Strategies

10.3.1: Comparison of 'Ain Ghazal Caprine Survivorship Curves with Published, Modelled Survivorship Curves for Different Production Strategies:

The 'Ain Ghazal caprine survivorship curves, as evidenced by mandibular tooth eruption and wear (goat, sheep and goat/sheep combined, see Table 10.2 and Figure 10.7), are plotted against the modelled survivorship curves for generalised, subsistence orientated meat production (Payne 1973), specialised milk production (Payne 1973), specialised wool production (Payne 1973), herd security (Redding 1981), and specialised meat production within an exchange economy (Stein 1988) in Figure 10.20. It should be noted that the population structure of a herd may often be a reflection of more than one of these goals, with the result that the differences between the modelled population structures may be more ambiguous in reality. This should be borne in mind when interpreting these results.

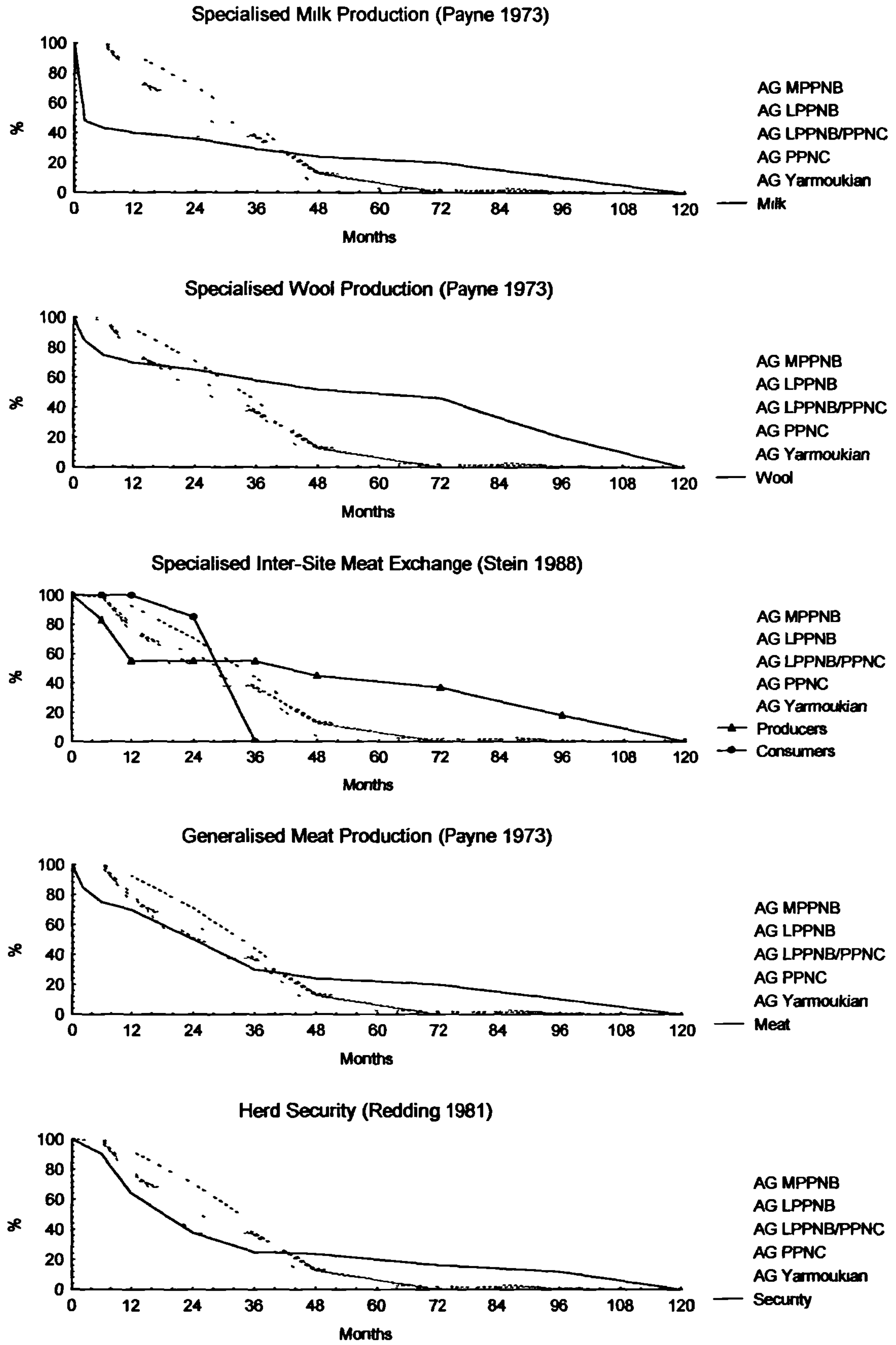


Figure 10.20: Comparison of 'Ain Ghazal Caprine Survivorship Curves with Published Modelled Caprine Survivorship Curves for Different Production Strategies

It is immediately clear that the survivorship curves of the 'Ain Ghazal caprines do not fit well with the modelled curves for strategies focused on the production of secondary products, i.e. milk or wool, or of meat for exchange during any phase of occupation. The extremely high survivorship of 'Ain Ghazal caprines during the first year of life does not conform to strategies which emphasise milk production (Payne 1973), whilst the extremely low survivorship among 'Ain Ghazal caprines older than four years does not conform to strategies emphasising wool production (Payne 1973). The fact that prime-aged animals in the two to three year age range are well represented at 'Ain Ghazal means that the survivorship curves do not conform to strategies emphasising meat production for exchange (Stein 1988).

A rather better fit is obtained if the 'Ain Ghazal caprine survivorship curves are compared with the modelled curves for generalised, subsistence orientated strategies emphasising meat production for local consumption (Payne 1973) or herd security (Redding 1981). Payne (1973) has argued that the type of bimodality evident at 'Ain Ghazal in the proportions of caprine teeth in each wear stage during the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian (see Figure 10.7) may, in herds managed primarily for generalised, subsistence orientated meat production, be a reflection of the preferential slaughter of young males not required for breeding and of barren adult females.

However, it should be noted that these later peaks in mortality at 'Ain Ghazal are at least three years earlier than the modelled later peak which, it is suggested (Payne 1973), occurs between six and ten years. Furthermore, at 'Ain Ghazal the proportion of animals killed, or dying of natural causes, before the age of six months is much lower than the modelled curve for generalised, subsistence orientated meat production.

There are, however, a number of similarities between the 'Ain Ghazal caprine survivorship curves and the modelled curve for consumers in a system of meat exchange (Stein 1988). The virtual absence of animals less than six months old and more than four years old during all phases of occupation at 'Ain Ghazal is broadly compatible with a system of production in which prime-aged animals were supplied to the site by producers maintaining extremely young animals and older breeding stock elsewhere. However, at

'Ain Ghazal the killing of animals seems to have started earlier and continued for longer than in Stein's (1988) modelled curve.

This comparison of modelled caprine survivorshop curves for a variety of production strategies with those from 'Ain Ghazal strongly suggests that during no phase of the site's occupation were caprines being managed to emphasise the specialised production of meat or secondary products for exchange. Instead, the 'Ain Ghazal caprine survivorship curves from all phases of occupation seem to fit well with production strategies aimed at maintaining the supply of meat to the site and ensuring herd security. What is unclear is the extent to which the 'Ain Ghazal caprine survivorship curves represent subsistence orientated meat production for local consumption within a system of sedentary animal husbandry centred on the settlement (Payne 1973), the maintenance of herd security (Redding 1981), or the consumption of meat supplied to the settlement from elsewhere (Stein 1988).

Although the 'Ain Ghazal caprine survivorship curves fit reasonably well with those of strategies emphasising subsistence-orientated meat production for local consumption and herd security, they also display a number of characteristics which raise the possibility that the inhabitants of 'Ain Ghazal may have been obtaining at least part of their meat supply from elsewhere. In a typical subsistence orientated strategy of meat production all age groups should be represented in the resulting faunal assemblage. Natural juvenile mortality should result in the presence of animals less than one year old, the slaughter of most males on reaching their maximum meat weight should result in the presence of animals between two and three years old, whilst the slaughter of barren females should result in the presence of animals between five and eight years old (Payne 1973, p.301). However, the 'Ain Ghazal caprine survivorship curves suggest that the proportion of animals younger than six months and older than four years was extremely low during all phases of occupation. This could be accounted for by a number of factors.

1) The mandibles and teeth of animals less than six months old could be under-represented in the faunal assemblage from 'Ain Ghazal owing to preservational biases. It should however be noted that these would not account for the under-representation of animals older than four years. Furthermore, the density of mandibles and teeth is known to be relatively high (Payne 1973, Binford and Bertram 1977, Lyman 1994).

2) The inhabitants of 'Ain Ghazal may have slaughtered breeding females at a relatively early age, despite the fact that this would have seriously reduced the reproductive security of the herd.

3) Neolithic domestic herds kept under conditions of restricted mobility may have faced lower levels of nutrition and higher levels of disease, than the modern herds on which the modelled curves are based (e.g.: Meadow 1989a). It is therefore possible that few 'Ain Ghazal caprines survived beyond the age of four years owing to the severity of the conditions under which they were kept

4) An alternative explanation might be that animals between the age of one and four years were brought to 'Ain Ghazal for slaughter from herds maintained elsewhere. This would fit well with the fluctuating village model of Köhler-Rollefson and Rollefson (1993a). If the 'Ain Ghazal caprines were, as suggested by Köhler-Rollefson and Rollefson, being maintained in the dry steppe and sub-desert zones to the north-east and east of 'Ain Ghazal during the autumn, winter and spring, birthing would have occurred off-site (Lancaster and Lancaster 1991) with the result that animals less than six months old would be under-represented in the faunal assemblage from the settlement itself. It is at least conceivable that prime-meat animals may have been supplied to 'Ain Ghazal on a regular basis from herds maintained off-site for the greater part of the year by small groups of specialist herders, who for their part could have secured a stable supply of meat by slaughtering barren females. This would result in the under-representation of older animals in the faunal assemblage from the settlement itself. Although the proportion of animals younger than six months and older than four years is extremely low during all phases of occupation at 'Ain Ghazal, and not just the PPNC phase with which the fluctuating village model of Köhler-Rollefson and Rollefson is primarily associated, it should be noted that the proportion of animals killed between the age of six months and one year seems to have been slightly higher during the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian than during the MPPNB (see Figure 10.7). Although the reasons for this slight shift in survivorship are unclear, it is conceivable that in the context of the fluctuating village model of Köhler-Rollefson and Rollefson a proportion of each year's crop of young animals might have been slaughtered during their first summer on site, i.e.: between six months and one year of age if a late winter/early spring birth is assumed (Lancaster

and Lancaster 1991), to provide young meat for the permanent inhabitants of the 'Ain Ghazal. Therefore, if a fluctuating village of the type modelled by Köhler-Rollefson and Rollefson (1993a) existed at all at 'Ain Ghazal, the balance of evidence suggests that is most likely to have emerged during the LPPNB and would therefore have coincided with the significant increase in the frequency of sheep at 'Ain Ghazal during this period. Although it is accepted that most of the discussion in the above paragraph is based more on guesswork than hard evidence, it should be stressed that the 'Ain Ghazal caprine survivorship curves provide no evidence, e.g.: in the form of high proportions of extremely young animals that could only have been born in the immediate vicinity of the site, that such a fluctuating village economy did not exist.

10.3.2: Conclusions:

This examination of the 'Ain Ghazal caprine survivorship curves strongly suggests that caprines were being managed to maximise meat production and herd security during all phases of occupation. There are also extremely tentative hints, primarily from the LPPNB, LPPNB/PPNC, PPNC and Yarmoukian, that at least some breeding stock may have been maintained off-site for a substantial part of the year, which would have included the late winter/early spring birthing period. The 'Ain Ghazal caprine survivorship curves provide no evidence for the exploitation of secondary products during any phase of occupation. As all available data (e.g.: Khazanov 1984, Lancaster and Lancaster 1991) suggests that high levels of pastoral specialisation are linked to the production of secondary products both for consumption and exchange, it seems most likely that the 'Ain Ghazal caprines were managed within a system of sedentary animal husbandry focused on generalised, subsistence orientated meat production and herd security. There is some evidence to suggest that a system of distant pastures husbandry, i.e.: a more specialised pastoral economy, also focused on generalised, subsistence orientated meat production and herd security, may have developed during the LPPNB. However, it should be stressed that this evidence, such as it is, is far from conclusive.

CHAPTER 11: DISCUSSION AND CONCLUSIONS

11.1: INTRODUCTION:

This chapter discusses the results of the zooarchaeological analysis of the 'Ain Ghazal faunal assemblage in the context of the baseline interpretations of the emergence of caprine as major early domesticates and the development of more specialised pastoral economies in the Levant, and presents the major conclusions of this study. However, it should also be noted that this study has also yielded some important zooarchaeological methodological conclusions relating to the identification of caprine remains to species (see Chapter 8). These are briefly discussed below.

Firstly, it has been demonstrated that the proportion of caprine remains identified to species has a clear impact on the goat to sheep ratios thus generated. In samples with a high proportion of specimens remaining in the goat/sheep category, the goat to sheep ratio is more likely to diverge from the actual goat to sheep ratio than in samples with a low proportion of specimens remaining in the goat/sheep category. This means that goat to sheep ratios generated from samples in which the proportion of specimens identified to species is low should be treated with caution.

Secondly, this study has demonstrated that traditional methods of identifying caprine remains to species, based on comparisons with published/unpublished morphological criteria established on modern reference material of known species and/or on comparisons with modern reference material itself, can generate highly accurate and consistent results.

Thirdly, the results of this study suggest that principal components analysis of caprine bone morphology has only a limited potential to identify a greater proportion of caprine remains to species than traditional methods. However, the value of principal components analysis of caprine bone morphology lies in its ability to identify the particular morphological characteristics which are most reliable in yielding an accurate identification of caprine remains to species.

Having thus summarised the main conclusions of this study which relate to zooarchaeological methodology, the results of the zooarchaeological analysis of the 'Ain

Ghazal faunal assemblage presented in Chapters 9 and 10 are discussed below in the context of the two baseline interpretations presented in Chapter 6.

11.2: THE EMERGENCE OF CAPRINES AS MAJOR EARLY DOMESTICATES IN THE LEVANT:

The baseline interpretation presented in Chapter 6 suggested that goat domestication first occurred in or immediately adjacent to the Lebanon or Anti-Lebanon Mountains during the PPNA (i.e.: Period 2), in response to resource stress linked to the establishment of earliest agricultural villages. However, it argues that the PPNA inhabitants of early agricultural villages in the southern Levant may have responded to this resource stress in a different manner, through a combination of intensified gazelle hunting and exploitation of a wider range of species than hitherto, owing to the scarcity of wild goat in this region. The baseline interpretation suggests that domestic goats, or at least the concept of domestication, did not appear in the southern Levant until the Middle PPNB (i.e.: Period 3). Within this region domestic goats seem to have appeared in the southern Levantine Corridor up to a millennium before they appeared in the woodland and moist steppe zones to its west (see Chapter 6). The appearance of domestic goats in the southern Levantine Corridor seems to have been followed shortly afterwards, during the latter part of the Middle PPNB and during the Late PPNB (i.e.: late Period 3 and Period 4) by the appearance of domestic sheep. These are thought to have diffused south from the piedmont zone of the Taurus Mountains and the upper Euphrates Valley, where they seem to have been first domesticated during the second half of the Middle PPNB (i.e.: the second half of Period 3) (see Chapter 6).

The data from 'Ain Ghazal fits extremely well with this interpretation. Substantial numbers of zoologically domestic goats have been identified in the Middle PPNB faunal assemblage from the site (see Chapters 9 and 10). The initial domestication of these animals is unlikely to have been a southern Levantine phenomenon, owing to the extreme scarcity of wild goats in all Natufian and PPNA faunal assemblages from the region. It must therefore be considered likely that goats were first domesticated elsewhere, probably in or immediately adjacent to the Lebanon and Anti-Lebanon Mountains (see Chapter 6), prior to their appearance in substantial numbers in the southern Levantine Corridor at sites such as 'Ain Ghazal by at least c.9,250b.p..

During the MPPNB at 'Ain Ghazal, exploitation of domestic goats was accompanied by the hunting of an extremely wide range of other species, predominantly gazelle, however subsequently this practice rapidly declined (e.g.: Köhler-Rollefson et al. 1988 and 1993, von den Driesch and Wodtke 1997). The results of von den Driesch and Wodtke (1997) suggest that this decline in the importance of hunting and in the range of species exploited may have started by the transitional Middle PPNB/Late PPNB (i.e.: during the latter part of the first half of the 9^{th} millennium b.p.). It is possible that the high frequencies of gazelle and minor taxa in the 'Ain Ghazal Middle PPNB faunal assemblage may have been a final manifestation of the intensified gazelle hunting and exploitation of a wider range of species by which the PPNA inhabitants of the southern Levant seem to have responded to the resource stress commonly linked to the emergence of the earliest sedentary agricultural communities (see Chapter 6). It is perhaps unsurprising that following the first appearance of domestic goats these interim responses to resource stress were rapidly abandoned in favour of this more effective means securing and increasing supplies of protein.

Data from 'Ain Ghazal suggest that domestic sheep had been introduced to the southern Levantine Corridor (see Chapter 6) in extremely small numbers towards the end of the Middle PPNB, and that subsequently their numbers rapidly increased (see Chapters 9 and 10). By the transitional Late PPNB/PPNC domestic sheep were the most common species in the 'Ain Ghazal faunal assemblage and had displaced goats from their former predominance. The decline in the frequency of goat at 'Ain Ghazal from the end of the Middle PPNB onwards is complicated by the fact that during the Middle PPNB exploitation of domestic goats seems to have been accompanied by the hunting of wild goats (see Chapter 10). It is therefore possible that this apparent decline in the frequency of goat may have been at least partially due to the virtual abandonment of wild goat hunting by the end of the Middle PPNB, which was clearly a reflection of the general decline in the significance of hunting at this time (see Chapter 5), rather than in the large-scale replacement of domestic goats by domestic sheep.

Data from 'Ain Ghazal demonstrate that despite the virtual abandonment of wild goat hunting by the end of the Middle PPNB, the overall frequency of caprines increased into the Late PPNB and beyond (see Chapter 9), and that this increase was primarily the result of an influx of large numbers of domestic sheep. This in turn suggests that exploitation of domestic caprines intensified once it was possible to maintain mixed herds of goats and sheep, rather than herds made up of goats alone. It is entirely possible that the Middle PPNB system of mixed farming, in which agriculture and goat husbandry were integrated into a single sedentary system of production, may have led to the type of environmental degradation described by Rollefson and Köhler-Rollefson (e.g.: Köhler-Rollefson 1988 and 1992, Köhler-Rollefson and Rollefson 1990, Rollefson and Köhler-Rollefson 1989 and 1993a, Rollefson 1996). The well known adverse effects of goat husbandry in an agricultural context may have effectively precluded any intensification of this system of production until sheep, which are commonly regarded as being easier to control than goats (tending to bunch together rather than spreading out across the landscape (e.g.: Ducos 1993a, p.169)) which may therefore have made them more desirable in areas supporting crop cultivation, became available. Another reason for the rapid rise to predominance of sheep in the 'Ain Ghazal faunal assemblage may have been that sheep, which prefer to graze annuals (Lancaster and Lancaster 1991, p.130), would have had a considerable advantage over goats, which prefer to graze perennials, in the type of degraded woodland environment thought by Rollefson and Köhler-Rollefson (see above) to have characterised the vicinity of 'Ain Ghazal from the beginning of the Late PPNB onwards.

11.3: THE DEVELOPMENT OF MORE SPECIALISED PASTORAL ECONOMIES IN THE LEVANT:

The baseline interpretation presented in Chapter 6 suggested that exploitation of the earliest caprine domesticates was likely to have been a form of sedentary animal husbandry focused on generalised, subsistence orientated meat production. Although there is evidence to suggest that some specialisation may have occurred during the Neolithic period, in the form of the possible development of distant pastures husbandry (though still focused on generalised, subsistence orientated meat production), there is no evidence for any increased specialisation, in the form of the possible development of semi-nomadic pastoralism, until after the secondary products revolution of the Chalcolithic period. Whatever the degree of pastoral specialisation that developed in the Levant during the Neolithic and Chalcolithic periods, it seems clear that highly mobile types of extremely specialised pastoral economies known from the recent past could not have developed until the widespread adoption of horses and camels as riding animals during the late fourth and early third millennia b.p..

Again, the data from 'Ain Ghazal fit extremely well with this interpretation. It is clear that the caprine survivorship curves from 'Ain Ghazal do not fit well with modelled survivorship curves for strategies focused on the exploitation of secondary products during any of the main periods of occupation. Instead, the 'Ain Ghazal caprine survivorship curves fit well with modelled survivorship curves of strategies focused on generalised, subsistence orientated meat production and on herd security during all phases (see Chapter 10).

There are however some extremely tentative hints in the 'Ain Ghazal caprine survivorship curves that from the Late PPNB onwards the inhabitants of the site may have been obtaining at least part of their meat supply from elsewhere, as consumers in a primitive system of meat exchange (see Chapter 10). If this was indeed the case, it would fit well with Rollefson and Köhler-Rollefson's sugg stion that a fluctuating village economy developed at 'Ain Ghazal in response to environmental degradation caused by the combination during the MPPNB of agriculture and goat husbandry in a single sedentary system of mixed farming (e.g.: Köhler-Rollefson 1992, Rollefson and Köhler-Rollefson 1993a, Rollefson 1996). Furthermore, the general trend of increased frequencies of equid remains in the 'Ain Ghazal faunal assemblage over time (see Chapter 9) hints at an intensification in the exploitation of the dry-steppe zone lying immediately to the east and north-east of the site.

The 'Ain Ghazal caprine survivorship curves therefore suggest that if such a fluctuating village economy developed at all, it did so during the Late PPNB. If this was the case, it would have been associated with the introduction of large numbers of domestic sheep at the site and would tend to support the suggestions of Perrot (1993a) and Ducos (1993a) that more mobile forms of pastoralism than sedentary animal husbandry developed in association with sheep, rather than goat, herding.

In sum, the data from 'Ain Ghazal tend to confirm that caprine husbandry during the Neolithic was based on sedentary animal husbandry focused on generalised, subsistence orientated meat production, and that any potential pastoral specialisation during this period was restricted to the development of distant pastures husbandry which, if it existed at all, would have remained focused on generalised, subsistence orientated meat production throughout the Neolithic.

11.4: CONCLUSIONS:

The zooarchaeological analysis of the 'Ain Ghazal faunal assemblage has, as described above, yielded data which strongly support the baseline interpretations presented in Chapter 6 of the emergence of caprines as major early domesticates and the development of more specialised pastoral economies in the Levant. Acceptance of these interpretations raises two key issues:

11.4.1: The 'Gap' Between the Establishment of the Earliest Agricultural Economies and the Development of Animal Husbandry:

The results of this study suggest that the long held belief that the establishment of the earliest agricultural economies preceded the development of animal husbandry by up to a millennium may need to be reconsidered. The examination of published zooarchaeological data from Tell Aswad I (Ducos 1993a) in Chapter 6 suggests that in the central Levantine Corridor domestic goats were being exploited in significant numbers from at least c.9,800b.p., or in other words from the time of or shortly after the establishment of the earliest permanent agricultural villages in this area. Zoogeographical considerations suggest that the most likely initial centre of goat domestication would have been in or immediately adjacent to the Lebanon and Anti-Lebanon Mountains (see Chapter 6).

It is possible that the concept of there having been a gap of up to a millennium between the establishment of the earliest agricultural villages and the beginnings of animal husbandry may have been the result of the concentration of archaeological research in the southern Levant. The apparent gap between the establishment of the earliest agricultural villages and the appearance of the earliest animal domesticates in this area may well be a reflection of the time taken for domestic goats, or at least the concept of domestication, to diffuse through the Levantine Corridor into this region from the central Levant.

11.4.2: The Existence of Long Periods of 'Loose Herding' Prior to the First Appearance of Zoologically Domestic Caprines in the Southern Levant:

A number of researchers have argued that long periods of loose herding, variously described as 'cultural control' (Hecker 1975), 'proto-élevage' (Ducos 1993a) or 'incipient domestication' (Horwitz 1989), may have characterised human exploitation of caprines in the southern Levant during the 9th millennium b.p. prior to the eventual appearance of zoologically domestic caprines at the beginning of the 8th millennium b.p.. This scenario is considered unlikely on three counts. Firstly, data from the Damascus Basin suggests that the establishment of permanent agricultural vlg s the and domestication of wild goats were almost simultaneous events. Secondly, this study has yielded good evidence for the presence of zoologically domestic goats in the southern Levantine Corridor at 'Ain Ghazal during the last quarter of the 10th millennium b.p.. Thirdly, implicit in the concepts of 'cultural control', 'proto-élevage' or 'incipient domestication' is the assumption that the wild progenitors of eventual domesticates were present in sufficient numbers to be intensively exploited in a manner that approached, but fell just short of, full domestication. However, the examination of late Pleistocene and early Holocene caprine zoogeography which forms part of this study has suggested that mouflon were absent from the southern Levant during the early Holocene and that wild goats, if not absent during this period, were either relatively rare or only present on a seasonal basis.

It is possible that one of the reasons why researchers have experienced difficulties in identifying zoologically domestic caprines in the southern Levant prior to the 8th millennium b.p. (e.g.: Horwitz 1989) may be that prior to the intensification in exploitation of domestic caprines associated with introduction of substantial numbers of domestic sheep (see above), which occurred during the Late PPNB in the southern Levantine Corridor but not until after the end of the PPNC in the woodland and moist steppe zones to its west (see Chapter 6), exploitation of domestic goats was commonly accompanied by continued hunting of a range of wild taxa. In the southern Levant the range of wild taxa thus exploited would often have included a proportion of wild goat. Any faunal assemblage containing both wild and domestic goat remains would to a certain extent combine characteristics of both hunting and herding strategies (see also Helmer 1989). Consequently interpretations such as 'cultural control' (Hecker 1975), 'proto-élevage' (Ducos 1993a) or 'incipient domestication' (Horwitz 1989), which attempt to reconcile the blurring of boundaries between wild and domestic, may have seemed appropriate.

11.5: POSTSCRIPT:

This study has attempted to highlight the extent to which the physical and environmental diversity of the Levant has been reflected in the diversity of subsistence strategies that human groups developed during the late Epipalaeolithic, Neolithic and Chalcolithic periods to ensure survival. The emergence of caprines as major early domesticates and the development of more specialised pastoral economies were an integral part of this process, and as such reflect the same geographical and chronological variation.

BIBLIOGRAPHY

AKKERMANS, P. (ed). 1996. Tel Sabi Abyad: the Late Neolithic Settlement Nederlands Historisch-Archaeologisch Institut te Istanbul, Istanbul.

AL-EISAWI, D. 1985. Vegetation in Jordan. In: HADIDI, A (ed). Studies in the History and Archaeology of Jordan 2. Department of Antiquities, Amman: 45-57.

ANDREWS, I. 1995. The Birds of the Hashemite Kingdom of Jordan. Ian Andrews, Musselburgh.

ANGRESS, S. 1959. Mammal Remains from Horvat Beter (Beersheba). Atiqot, 2: 53-71.

AURENCHE, O., CAUVIN, J., CAUVIN, M.-C., COPELAND, L., HOURS, F. and SANLAVILLE, P. 1981. Chronologie et Organisation de l'Espace dans le Proche Orient de 12,000 à 5,600 avant J.C.. In: CAUVIN, J. and SANLAVILLE, P. (eds). Préhistoire du Levant. C.N.R.S., Paris: 571-601.

BAHARAV, D. 1974. Notes on the Population Structure and Biomass of the Mountain Gazelle *Gazella gazella gazella*. Israel Journal of Zoology 23: 39-44.

BAIRD, D. 1993. Neolithic Chipped Stone Assemblages from the Azraq Basin, Jordan and the Significance of the Neolithic of the Arid Zones of the Levant. Unpublished Ph.D. Thesis, University of Edinburgh.

BANNING, E. and BYRD, B. 1984. The Architecture of PPNB Ain Ghazal, Jordan. Bulletin of the American Schools of Oriental Research 255: 15-20.

BANNING, E. and BYRD, B. 1987. Houses and the Changing Residential Unit: Domestic Architecture at PPNB 'Ain Ghazal. Proceedings of the Prehistoric Society 53: 309-325.

BAR-YOSEF, O. 1970. The Epipalaeolithic Cultures of Palestine. Unpublished Ph.D. Thesis, Hebrew University.

BAR-YOSEF, O. 1981a. The Pre-Pottery Neolithic period in the Southern Levant. In: CAUVIN, J. and SANLAVILLE, P. (eds). Préhistoire du Levant. C.N.R.S., Paris: 551-569.

BAR-YOSEF, O. 1981b. The Epipalaeolithic Complexes in the Southern Levant. In: CAUVIN, J. and SANLAVILLE, P. (eds). Préhistoire du Levant. C.N.R.S., Paris: 389-408.

BAR-YOSEF, O. 1981c. Neolithic Sites in Sinai. In: FREY, W. and UERPMANN, H.-P. (eds). Beiträge zur Umweltgeschichte des Vorderen Orients. Dr. L. Reichert Verlag, Wiesbaden: 217-235.

BAR-YOSEF, O. 1986. The Walls of Jericho: An Alternative Interpretation. Current Anthropology 27: 157-162.

BAR-YOSEF, O. 1991. The Early Neolithic of the Levant: Recent Advances. The Review of Archaeology 12(2): 1-18.

BAR-YOSEF, O. 1995. Earliest Food Producers - Pre Pottery Neolithic (8000-5500). In: LEVY, T. (ed). The Archaeology of Society in the Holy Land. Leicester University Press, London: 191-204.

BAR-YOSEF, O. and BELFER-COHEN, A. 1989a. The Origins of Sedentism and Farming Communities in the Southern Levant. Journal of World Prehistory 3(4): 447-496.

BAR-YOSEF, O. and BELFER-COHEN, A. 1989b. The Levantine PPNB Interaction Sphere. In: HERSHKOVITZ, I. (ed). People and Culture in Change. B.A.R. International Series 508(i), Oxford: 59-72.

BAR-YOSEF, O. and KHAZANOV, A. 1992. Introduction. In: BAR-YOSEF, O. and KHAZANOV, A. (eds). Pastoralism in the Levant: Archaeological Materials in Anthropological Perspectives. Prehistory Press, Madison Wisconsin: 1-9.

BAR-YOSEF, O. and KISLEV, M. 1989. Early Farming Communities in the Jordan Valley. In: HARRIS, D. and HILLMAN, G. (eds). From Foraging to Farming. Unwin and Hyman, London: 632-642.

BAR-YOSEF, O. and MEADOW, R. 1995. The Origins of Agriculture in the Near East. In: PRICE, T. and GEBAUER, A. (eds). Last Hunters First Farmers: New Perspectives on the Prehistoric Transition to Agriculture. School of American Research Press, Santa Fe: 39-94.

BAR-YOSEF, O. and TCHERNOV, E. 1966. Archaeological Finds and the Fossil Faunas of the Natufian and Microlithic Industries at Hayonim Cave (Western Galilee, Israel). Israel Journal of Zoology, 15: 104-140.

BAR-YOSEF, O., GOLDBERG, P. and LEVESON, T. 1974. Late Quaternary Stratigraphy and Prehistory in Wadi Fazael, Jordan Valley. Paléorient 2: 415-428.

BAR-YOSEF, O., GOPHER, A., TCHERNOV, E. and KISLEV, M. 1991. Netiv Hagdud; an Early Neolithic Site in the Jordan Valley. Journal of Field Archaeology 18: 405-424.

BARUCH, U. 1994. Late Quaternary Pollen Record of the Near East. In: BAR-YOSEF, O. and KRA, R. (eds.) Late Quaternary Chronology and Paleoclimates of the Eastern Mediterranean. Radiocarbon, Tucson: 103-120.

BARUCH, U. n.d. Hula Pollen Diagram Unpublished Drawing Shown in Lecture 10th November 1996

BARUCH, U. and BOTTEMA, S. 1991. Palynological Evidence for Climatic Changes in the Levant ca.17,000-9,000 B.P.. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant. International Monographs in Prehistory, Ann Arbor: 11-20.

BECKER, C. 1991. The Analysis of Mammalian Bones from Basta, a Pre-Pottery Neolithic Site in Jordan: Problems and Potential. Paléorient 17(1): 59-75.

BENDER, F. 1974. Geology of Jordan. Gebrüder Borntraeger, Berlin and Stuttgart.

BENDER, B. 1978. Gatherer-Hunter to Farmer: A Social Perspective. World Archaeology 10: 204-222.

BESANÇON, J. 1981. Stratigraphie et Chronologie du Quaternaire Continental du Proche Orient. In: CAUVIN, J. and SANLAVILLE, P. (eds). Préhistoire du Levant. C.N.R.S., Paris: 146-163.

BETTS, A. 1993. The Neolithic Sequence in the East Jordan Badia: A Preliminary Overview. Paléorient 19(1): 43-54.

BINFORD, L. 1968. Post-Pleistocene Adaptations. In: BINFORD, S. and BINFORD, L. (eds). New Perspectives in Archaeology. Aldine, Chicago: 313-341.

BINFORD, L. 1983. In Pursuit of the Past. Thames and Hudson, London.

BINFORD, L. and BERTRAM, J. 1977. Bone Frequencies and Attritional Processes. In: BINFORD, L. (ed). For Theory Building in Archaeology. Academic Press, New York: 77-153.

BOESSNECK, J. 1969. Osteological Differences Between Sheep (*Ovis aries* Linné) and Goat (*Capra hircus* Linné). In: BROTHWELL, D. and HIGGS, E. (eds). Science in Archaeology, 2nd Edition. Thames and Hudson, London: 351-358.

BOESSNECK, J. and DRIESCH, A. VON DEN 1978. Preliminary Analysis of the Animal Bones from Tell Hesban. Andrews University Seminary Studies 16: 259-287.

BOESSNECK, J. and DRIESCH, A. VON DEN 1979. Die Tierknochenfunde aus der Neolithischen Siedlung auf dem Fikirtepe bei Kadiköy am Marmarameer. Munich.

BOESSNECK, J. and DRIESCH, A. VON DEN 1981. Tierknochen vom Hassek-Höyük. Istanbuler Mitteilungen 31: 88-89.

BOESSNECK, J., JÉQUIER, J.-P. and STAMPFLI, H. 1963. Seeberg, Burgaschisee-Sud Teil 3: Die Tierreste. Acta Bernensia II, Bern .

BOESSNECK, J., MÜLLER, H. and TEICHERT, M. 1964. Osteologische Unterscheidungsmerkmale Zwischen Schaf (*Ovis aries* Linné) und Ziege (*Capra hircus* Linné). Kühn Archiv 78: Band, Heft 1-2.

BOTTEMA, S. and ZEIST, W. VAN 1981. Palynological Evidence for the Climate History of the Near East, 50,000-6,000 BP. In: CAUVIN, J. and SANLAVILLE, P. (eds). Préhistoire du Levant. C.N.R.S., Paris: 111-132.

BÖKÖNYI, S. 1969. Archaeological Problems and Methods of Recognising Animal Domestication. In: UCKO, P. and DIMBLEBY, G. (eds). The Domestication and Exploitation of Plants and Animals. Duckworth, London: 219-229.

BÖKÖNYI, S. 1973. The Fauna of Umm Dabaghiyeh: a Preliminary Report. Iraq 35: 9-11.

BÖKÖNYI, S. 1977. The Animal Remains from Four Sites in the Kermanshah Valley, Iran: Asiab, Sarab, Dehsavar and Siahbid. B.A.R. Supplementary Series 34, Oxford.

BÖKÖNYI, S. 1978. Environmental and Cultural Differences as Reflected in the Animal Bone Samples from Five Early Neolithic Sites in Southwest Asia. In: MEADOW, R. and ZEDER, M. (eds). Approaches to Faunal Analysis in the Middle East. Peabody Museum of Archaeology and Ethnology, Cambridge Massachusetts: 57-62.

BOUCHUD, J. 1987. Les Mammifères et la Petite Faune du Gisement Natoufien de Mallaha (Eynan). In: BOUCHUD, J. (ed). La Faune du Gisement Natoufien de Mallaha (Eynan) Israel. Association Paléorient, Paris: 1-150.

BOURKE, S. 1997. The 'Pre-Ghassulian' Sequence at Tuleilat Ghassul: Sydney University Excavations 1975-1995. In: GEBEL, H.-G., KAFAFI, Z. and ROLLEFSON, G. (eds). The Prehistory of Jordan II. Perspectives from 1997. Ex Oriente, Berlin.

BOWMAN, D. and GROSS, T. 1992. The Highest Stand of Lake Lisan: -150m Below MSL. Israel Journal of Earth Sciences 41: 233-237.

BRAIDWOOD, R. 1975. Prehistoric Men. Scott and Foresman, Glenview Illinois.

BRAIDWOOD, R. and BRAIDWOOD, L. 1950. Jarmo: a Village of Early Farmers in Iraq. Antiquity 24: 189-195.

BUITENHUIS, H. 1988. Archeozoologisch Onderzoek Langs de Midden-Eufraat: Onderzoek van het Faunamateriaal uit zes Nederzettingen in Zuidoost-Turkije en Noord-Syrie Daterend van ca. 10,000 B.P. tot 1400 A.D. Unpublished Ph.D. Thesis, Biologisch-Archaeologisch Instituut, Rijksuniversiteit.

BUITENHUIS, H., 1995. A Quantitative Approach to Species Determination of Ovicapridae. In: BUITENHUIS, H. and UERPMANN, H.-P. (eds). Archaeozoology of the Near East II. Backhuys, Leiden: 140-155.

BUTLER, B., TCHERNOV, E., HIETALA, H. and DAVIS, S. 1977. Faunal Exploitation During the Late Epipalaeolithic in the Har-Harif. In: MARKS, A. (ed). Prehistory and Paleoenvironments in the Central Negev, Israel. Volume II: The Avdat/Aqev Area and the Har-Harif. S.M.U. Press, Dallas: 327-344.

BYRD, B. 1987. Beidha and the Natufian: Variability in Levantine Settlement and Subsistence. Unpublished Ph.D. Thesis, University of Arizona.

BYRD, B. 1989. The Natufian: Settlement Variability and Economic Adaptations in the Levant at the End of the Pleistocene. Journal of World Prehistory 3(2): 159-197.

BYRD, B. 1992. The dispersal of food production across the Levant. In: GEBAUER. A.and PRICE. T. (eds). Transitions to Agriculture in Prehistory. Prehistory Press, Madison Wisconsin: 49-61.

BYRD, B. and COLLEDGE, S. 1991. Early Natufian Occupation along the Edge of the Southern Jordanian Steppe. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant, International Monographs in Prehistory, Ann Arbor: 265-276.

BYRD, B. and MONAHAN, C. 1995. Death, Mortuary Ritual, and Natufian Social Structure. Journal of Anthropological Archaeology 14: 251-287.

CAPPERS, R., BOTTEMA, S. and WOLDRING, H. In Press. Problems in Correlating Pollen Diagrams of the Near East: a Preliminary Report. In: DAMANIA, A. (ed). Origins of Agriculture and the Domestication of Crop Plants in the Near East: the Haarlem Symposium. ICARDA/IPGRI, Rome.

CAUVIN, J. 1987. Chronologies Relative et Absolue dans la Néolithique du Levant Nord et d'Anatolie entre 10,000 et 8,000 B.P.. In: AURENCHE, O., EVIN, J. and HOURS, F. (eds). Chronologies du Proche Orient. B.A.R. International Series 379, Oxford: 325-342.

CAUVIN, J. 1990. Nomadisme Néolithique en Zone Aride: l'Oasis d'El Kowm (Syrie). In: MATTHIAE, P., VAN LOON, M. and WEISS, H. (eds). Resurrecting the Past, Mélange: A.Bounni. Nederlands Historisch-Archaeologisch Institut te Istanbul, Istanbul: 41-47.

CAUVIN, J. 1994. Naissances des Divinités. Naissances de l'Agriculture. C.N.R.S., Paris.

CAVALLO, C. 1996. The Animal Remains - A Preliminary Account. In: AKKERMANS, P. (ed). Tel Sabi Abyad: the Late Neolithic Settlement Volume 2. Nederlands Historisch-Archaeologisch Institut te Istanbul, Istanbul: 475-520.

CHANG, C. and KOSTER, H. 1986. Beyond Bones: Towards and Archaeology of Pastoralism. Advances in Archaeological Method and Theory 9: 97-148.

CHILDE, V.G. 1928. The Most Ancient East: the Oriental Prelude to European Prehistory. Kegan Paul, Trench and Trubner, London.

CHILDE, V.G. 1936. Man Makes Himself. C.A.Watts, London.

CHURCHER, P. 1994. The Vertebrate Fauna from the Natufian Level at Jebel es-Saaïde (Saaïde II), Lebanon. Paléorient 20(2): 35-58.

CLASON, A. 1980. The Animal Remains from Tell es Sinn Compared with those from Bouqras. Anatolica 7: 35-53.

CLASON, A. and BUITENHUIS, H. 1978. A Preliminary Report on the Faunal Remains of Nahr el Homr, Hadidi and Ta'as in the Tabqa Dam Region in Syria. Journal of Archaeological Science 5: 75-83.

CLUTTON-BROCK, J. 1971. The Primary Food Animals of the Jericho Tell from the Proto-Neolithic to the Byzantine Period. Levant 3:41-45.

CLUTTON-BROCK, J. 1979. The Mammalian Remains from the Jericho Tell. Proceedings of the Prehistoric Society 45: 135-157.

CLUTTON-BROCK, J. 1985. Mammalian Remains from Tel Molla Assad, Syria. In: SANLAVILLE, P. (ed). Holocene Settlement in North Syria. B.A.R. International Series 238, Oxford. 163-166.

CLUTTON-BROCK, J. 1987. A Natural History of Domesticated Mammals. Cambridge University Press and British Museum of Natural History, Cambridge and London.

CLUTTON-BROCK, J. (ed). 1989. The Walking Larder. Unwin Hyman, London.

CLUTTON-BROCK, J., DENNIS-BRYAN, K., ARMITAGE, P. and JEWELL, P. 1990. Osteology of the Soay Sheep. Bulletin of the British Museum of Natural History 56(1): 2-56.

COHEN, M. 1977. The Food Crisis in Prehistory. Yale University Press, New Haven.

COLLEDGE, S. 1994. Plant Exploitation on Epipalaeolithic and Early Neolithic Sites in the Levant. Unpublished Ph.D. Thesis, University of Sheffield.

COMPAGNONI, B. 1978. The Bone Remains of *Gazella subgutturosa* from Shahr-i-Sokhta. In: MEADOW, R. and ZEDER, M. (eds). Approaches to Faunal Analysis in the Middle East. Peabody Museum of Archaeology and Ethnology, Cambridge Massachusetts: 119-128.

CONTESON, H. DE 1982. Early Agriculture in Western Asia. In: CUYLER YOUNG, T., SMITH, P. and MORTENSEN, P. (eds). The Hilly Flanks and Beyond. Oriental Institute University of Chicago, Chicago: 57-74.

COPE, C. 1991. Gazelle Hunting Strategies in the Southern Levant. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant. International Monographs in Prehistory , Ann Arbor:341-358.

CRABTREE, P. 1993. Early Animal Domestication in the Middle East and Europe. Archaeological Method and Theory 5: 201-245.

CRABTREE, P., CAMPANA, D., BELFER-COHEN, A. and BAR-YOSEF, D. 1991. First Results of the Excavations at Salibiya I, Lower Jordan Valley. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant. International Monographs in Prehistory, Ann-Arbor Michigan: 161-172.

CRIBB, R. 1984. Greener Pastures: Mobility, Migration and the Pastoral Mode of Subsistence. Production Pastorale et Societe 14: 11-46.

CRIBB, R. 1991. Nomads in Archaeology. Cambridge University Press, Cambridge.

CROWFOOT-PAYNE, J. 1976. The Terminology of the Aceramic Neolithic Period in the Levant. In: WENDORF, F. (ed). Deuxieme Colloque sur la Terminologie de la Préhistoire du Proche-Orient. C.N.R.S., Paris: 131-137.

CROWFOOT-PAYNE, J. 1983. The Flint Industry of Jericho. In: KENYON, K. and HOLLAND, T. (eds). The Excavations at Jericho Volume 5: the Pottery Phases of the Tell and Other Finds. British School of Archaeology in Jerusalem. London: 622-659.

DAR, S. 1976. The Wild Pigs of the Alexander River. Israel - Land and Nature 1(2): 58-59.

DAVIS, S. 1978. Etude de la Faune. In: LECHEVALLIER, M. (ed). Abou Gosh et Beisamoun. Association Paléorient, Paris: 195-197.

DAVIS, S. 1980. Late Pleistocene and Holocene Equid Remains from Israel. Zoological Journal of the Linnaean Society 70: 289-312.

DAVIS, S. 1981. The Effects of Temperature Change and Domestication on the Body Size of Late Pleistocene to Holocene Mammals of Israel. Paleobiology 7(1): 101-114.

DAVIS, S. 1983. The Age Profiles of Gazelles Predated by Ancient Man in Israel: Possible Evidence for a Shift from Seasonality to Sedentism in the Natufian. Paléorient 9(1): 55-62.

DAVIS, S. 1984. The Advent of Milk and Wool Production in West-Central Iran. In: GRIGSON, C. and CLUTTON-BROCK, J. (eds). Animals in Archaeology, Volume 3: Early Herders and their Flocks. B.A.R. International Series 202, Oxford: 265-278.

DAVIS, S. 1985. A Preliminary Report of the Fauna from Hatoula: a Natufian-Khiamian (PPNA) Site near Latroun, Israel. In: LECHEVALLIER, M. and RONEN, A. (eds). Le Site Natoufien-Khiamien de Hatoula, près de Latroun, Israel: Fouilles 1980-1982. Cahiers du Centre de Recherche Français de Jerusalem 1, Jerusalem: 71-98.

DAVIS, S. 1987. The Archaeology of Animals. Routledge, London.

DAVIS, S. 1992. A Rapid Method for Recording Information about Mammal Bones from Archaeological Sites. Unpublished Report, Ancient Monuments Laboratory English Heritage.

DAVIS, S. and VALLA, F. 1978. Evidence for Domestication of the Dog 12,000 Years Ago in the Natufian of Israel. Nature 276: 608-610.

DAVIS, S., GORING-MORRIS, N. and GOPHER, A 1982. Sheep bones from the Negev Epipalaeolithic. Paléorient 8(1): 87-93.

DAVIS, S., LERNAU, O and PICHON, J 1994. The Animal Remains: New Light on the Origin of Animal Husbandry. In: LECHEVALLIER, M. and RONEN, A. (eds). Le Gisement de Hatoula en Judée Occidentale, Israel. Association Paléorient, Paris: 83-131.

DAYAN, T., TCHERNOV, E., BAR-YOSEF, O. and YOM-TOV, Y. 1986. Animal Exploitation in Ujrat el-Mehed, a Neolithic Site in Southern Sinai. Paléorient 12(2): 105-116.

DOLLFUSS, G., KAFAFI, Z., REWERSKI, J., VAILLANT, N., COGNEUGHIOT, R., DESSE, J. and NEEF, R. 1988. Abu Hamid, an Early 4th Millennium site in the Jordan Valley. In: GARRARD, A. and GEBEL, H.-G. (eds). The Prehistory of Jordan. The State of Research in 1986. B.A.R. International Series 396 (ii), Oxford: 567-601.

DRIESCH, A.VON DEN 1976a. A Guide to the Measurement of Animal Bone from Archaeological Sites. Peabody Museum Bulletin 1, Harvard University, Cambridge.

DRIESCH, A.VON DEN 1976b. Zu den Tierknochenfunden vom Körtepe. Keban Project 1972 Activities. Middle Eastern Technical University Keban Project Publications Series 1 Number 5, Ankara: 35-39.

DRIESCH, A. VON DEN and WODTKE, U. 1997. The Fauna of 'Ain Ghazal, a Major PPN and Early PN Settlement in Central Jordan. In: GEBEL, H.-G., KAFAFI, Z and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 511-556.

DUCOS, P. 1968. L'Origine des Animaux Domestiques en Palestine. Publications de l'Institut de Préhistoire de l'Universite de Bordeaux Memoire No 6, Bordeaux.

DUCOS, P. 1978a. La Faune d'Abou Gosh; Proto-Élevage de la Chèvre au Neolithique Pré-Ceramique. In: LECHEVALLIER, M. (ed). Abou Gosh et Beisamoun. Association Paléorient, Paris: 107-120.

DUCOS, P. 1978b. Tell Mureybet - Étude Archéozoologique et Problemes d'Écologie Humaine. Editions du C.N.R.S., Paris.

DUCOS, P. 1991. La Faune de Tell Turlu (Turquie) et les Animaux Domestiques dans la Culture de Halaf. Akkadica 72: 1-19.

DUCOS, P. 1993a. Proto-Élevage et Élevage au Levant Sud au VIIe Millénaire b.c.: les Données de la Damascène. Paléorient 19(1): 153-173.

DUCOS, P. 1993b. Some Remarks About Ovis, Capra and Gazella Remains from Two PPNB sites from Damascène, Syria, Tell Aswad and Ghoraife. In: BUITENHUIS, H. and CLASON, A. (eds). Archaeozoology of the Near East. Universal Book Services, Leiden: 37-45.

DUCOS, P. 1994. À Propos du Modèle du Pastoralism PPNC Proposé par G.Rollefson et I.Köhler-Rollefson. Paléorient 20(2): 165-166.

DUCOS, P. 1997. A Re-Evaluation of the Fauna from Neolithic Levels of El-Khiam. Journal of the Israel Prehistoric Society 27: 75-81.

DUCOS, P. and HORWITZ, L. 1997. The Influence of Climate on Artiodactyl Size during the Late Pleistocene - Early Holocene of the Southern Levant. Paléorient 23(2): 229-247.

ECHEGARAY, J. 1966. Excavation en la Terraza de El-Khiam (Jordania). Casa Espanola de Santiago en Jerusalem Volume 2, Madrid.

EDWARDS, P. 1989. Revising the Broad Spectrum Revolution: and its Role in the Origins of Southwest Asian Food Production. Antiquity 63 (239): 225-246.

EDWARDS, P. 1991. More Than One, Less Than Five Hundred: Comments on Campana and Crabtree, and Communal Hunting. Journal of Mediterranean Archaeology 4(1): 109-120.

EDWARDS, P., BOURKE, S., COLLEDGE, S., HEAD, J. and MACUMBER, P. 1988. Late Pleistocene Prehistory in Wadi al-Hammeh, Jordan Valley. In: GARRARD, A. and GEBEL, H.-G. (eds). The Prehistory of Jordan. The State of Research in 1986. B.A.R. International Series 396 (ii), Oxford: 525-565.

FELLNER, R. 1995. Cultural Change and the Epipalaeolithic of Palestine. B.A.R. International Series 599, Oxford.

FLANNERY, K. 1968. Archaeological Systems Theory and Early Mesoamerica. In: MEGGERS, B. (ed). Anthropological Archaeology in the Americas. Anthropological Society of Washington, Washington D.C.: 67-87.

FLANNERY, K. 1969. Origins and Ecological Effects of Early Domestication in Iran and the Near East. In: UCKO, P. and DIMBLEBY, G. (eds). The Domestication and Exploitation of Plants and Animals. Duckworth, London: 73-100.

FLANNERY, K. and CORNWALL, I. 1969. The Fauna from Ras al Amiya, Iraq: a Comparison with the Deh Luran Sequence. In: HOLE, F., FLANNERY, K. and NEELY, J. (eds). Prehistory and Human Ecology of the Deh Luran Plain: an Early Village Sequence from Khuzistan, Iran. Museum of Anthropology University of Michigan, Ann Arbor: 435-438.

GALILI, E., WEINSTEIN-EVRON, M. and ZOHARY, D. 1973. Appearance of Olives in Submerged Neolithic Sites along the Carmel Coast. Journal of the Israel Prehistoric Society 22: 95-97.

GALILI, E., WEINSTEIN-EVRON, M., HERSHKOVITZ, I., GOPHER, A., KISLEV, M., LERNAU, O., KOLSKA-HORWITZ, L. and LERNAU, H. 1993. Atlit-Yam: a Prehistoric Site on the Sea Floor off the Israeli Coast. Journal of Field Archaeology 20: 133-157.

GARFINKEL, Y. 1994. The PPNC Flint Assemblage from Tel 'Ali. In: KOZLOWSKI, H. and GEBEL, H.-G. (eds). Neolithic Chipped Stone Industries of the Fertile Crescent. Ex Oriente, Berlin: 543-562.

GARFUNKEL, Z. 1988. The Pre-Quaternary Geology of Israel. In: YOM-TOV, Y. and TCHERNOV, E. (eds). The Zoogeography of Israel. Dr. W. Junk Publishers, Dordrecht: 7-34.

GARRARD, A. 1980. Man-Animal-Plant Relationships During the Upper Pleistocene and Early Holocene of the Levant. Unpublished Ph.D. Thesis, University of Cambridge.

GARRARD, A. 1984. The Selection of South-West Asian Animal Domesticates. In: GRIGSON, C. and CLUTTON-BROCK, J. (eds). Animals and Archaeology, Volume 3: Early Herders and their Flocks. B.A.R. International Series 202, Oxford: 117-131.

GARRARD. A. 1999. Charting the Emergence of Cereal and Pulse Domestication in South-West Asia. Environmental Archaeology 4: 57-76.

GARRARD, A., BAIRD, D. and BYRD, B. 1994. The Chronological Basis and Significance of the Late Palaeolithic and Neolithic Sequence in the Azraq Basin, Jordan. In: BAR-YOSEF, O. and KRA, R. (eds). Late Quaternary Chronology and Palaeoclimates of the Eastern Mediterranean. Radiocarbon, Tucson: 177-199.

GARRARD, A., COLLEDGE, S. and MARTIN, L. 1996. The Emergence of Crop Cultivation and Caprine Herding in the 'Marginal Zone' of the Southern Levant. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 204-226.

GARROD, D. 1930. The Palaeolithic of Southern Kurdistan: Excavations in the Caves of Zarzi and Hazar Merd. Bulletin of the American School of Prehistoric Research 6: 8-23.

GARROD, D. 1932. A New Mesolithic Industry: the Natufian of Palestine. Journal of the Royal Anthropological Institute 62: 257-270.

GARROD, D. and BATE, D. 1942. Excavations at the Cave of Shuqbah, Palestine 1928. Proceedings of the Prehistoric Society 8: 1-20.

GAUTIER, A. 1990. La Domestication, et l'Homme Créa l'Animal. Editions Errance, Brussels.

GEBAUER, A. and PRICE, T. (eds). 1992. Transitions to Agriculture in Prehistory. Monographs in World Archaeology 4. Prehistory Press, Madison Wisconsin.

GILEAD, I. 1988. The Chalcolithic Period in the Levant. Journal of World Prehistory 2(4): 397-443.

GILLESPIE, W. 1984. Preliminary Analysis of Small Mammals and Non-Mammals from Ain Ghazal, 1983 season. Unpublished Report, Department of Geosciences University of Arizona.

GILLESPIE, W. 1986. Small Mammals, Amphibians, Reptiles and Birds from Ain Ghazal: Material from the 1982, 1984 and 1985 Excavations. Unpublished Report, Department of Geosciences University of Arizona.

GOLDBERG, P. 1994. Interpreting Late Quaternary Continental Sequences in Israel. In: BAR-YOSEF, O. and KRA, R. (eds). Late Quaternary Chronology and Paleoclimates of the Eastern Mediterranean. Radiocarbon, Tucson: 89-102.

GOLBERG, P. and ROSEN, S. 1987. Early Holocene Paleoenvironments of Israel. In: LEVY, T. (ed). Shiqmim I: Studies Concerning Chalcolithic Societies in the Northern Negev Desert, Israel (1982-1984). B.A.R. International Series 356 (i): 23-34.

GOPHER, A. 1994. Arrowheads of the Neolithic Levant: A Seriation Analysis. Eisenbrauns, Winona Lake Indiana.

GOPHER, A. 1995. Early pottery-bearing groups in Israel - the Pottery Neolithic Period. In: LEVY, T. (ed). The Archaeology of Society in the Holy Land. Leicester University Press, London: 205-225.

GOPHER, A. and GOPHNA, R. 1993. Cultures of the 8th and 7th Millennia B.P. in the Southern Levant: A Review for the 1990s. Journal of World Prehistory 7(3): 297-353.

GORING-MORRIS, A. 1987. At the Edge: Terminal Pleistocene Hunter-Gatherers in the Negev and Sinai. B.A.R. International Series 361, Oxford.

GORING-MORRIS, N. 1993. From Foraging to Herding in the Negev and Sinai: the Early to Late Neolithic Transition. Paléorient 19(1): 65-90.

GORING-MORRIS, A. and BELFER-COHEN, A. 1997. The Articulation of Cultural Processes and Late Quaternary Environmental Changes in Cisjordan. Paléorient 23(2): 71-94.

GORING-MORRIS, A. and GOPHER, A. 1983. Nahal Issaron: A Neolithic Settlement in the Southern Negev. Israel Exploration Journal 33: 149-162.

GORING-MORRIS, A., GOREN, Y., HORWITZ, L., HERSHKOVITZ, I., LIEBERMAN, R., SAREL, J. and BAR-YOSEF, D. 1996. The 1992 Season of Excavations at the Pre-Pottery Neolithic B Settlement of Kfar-Hahoresh. Journal of the Israel Prehistoric Society 26: 74-121.

GRAYSON, D. 1979. On the Quantification of Vertebrate Archeofaunas. Advances in Archaeological Method and Theory 2: 199-237.

GRIGSON, C. 1987a. Shiqmim: Pastoralism and Other Aspects of Animal Management in the Chalcolithic of the Northern Negev. In: LEVY, T. (ed). Shiqmim I: Studies Concerning Chalcolithic Societies in the Northern Negev Desert, Israel (1982-1984). B.A.R. International Series 356 (I), Oxford: 219-241.

GRIGSON, C. 1987b. Different Herding Strategies for Sheep and Goats in the Chalcolithic of Beersheva. Archaeozoologia 1(2): 115-126.

GRIGSON, C. 1989. Size and Sex: Evidence for the Domestication of Cattle in the Near East. In: MILLES, A., WILLIAMS, D. and GARDNER, N. (eds). The Beginnings of Agriculture. B.A.R. International Series 496 Oxford: 77-109.

GRIGSON, C. 1991. Preliminary Report on the Human and Animal Bones from Sataf. Levant 23: 49-50.

GRIGSON, C. 1995a. Plough and Pasture in the Early Economy of the Southern Levant. In: LEVY, T. (ed). The Archaeology of Society in the Holy Land. Leicester University Press, London: 245-263.

GRIGSON, C. 1995b. Cattle Keepers of the Northern Negev: Animal Remains from the Chalcolithic Site of Grar. In: GILEAD, I. (ed). Grar: A Chalcolithic Site in the Northern Negev. Ben Gurion University of the Negev Press, Beersheva: 377-452.

GRIGSON, C. 1996. Animal Husbandry in the Late Neolithic and Chalcolithic at Arjoune- The Secondary Products Revolution Revisited. In: PARR, P. (ed). Excavations at Arjoune, Syria. (In Prep).

GRIGSON, C. and CLUTTON-BROCK, J. (eds). 1984. Animals and Archaeology, Volume 3: Early Herders and their Flocks. B.A.R. International Series 202, Oxford.

HALSTEAD, P. n.d. Ovis-Capra Distinctions. Unpublished Notes.

HARRIS, D. 1969. Agricultural Systems, Ecosystems and the Origins of Agriculture. In: UCKO, P. and DIMBLEBY, G. (eds). The Domestication of Plants and Animals. Duckworth, London: 3-15.

HARRIS, D. 1977. Alternative Pathways Toward Agriculture. In: REED, C. (ed). Origins of Agriculture. Mouton, The Hague: 179-243.

HARRIS, D. 1990. Settling Down and Breaking Ground: Rethinking the Neolithic Revolution. Stichting Nederlands Museum voor Anthropologie en Praehistorie, Amsterdam.

HARRIS, D. 1996. Themes and Concepts in the Study of Early Agriculture. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 1-9.

HARRIS, D. and HILLMAN, G. (eds). 1989. Foraging and Farming. The Evolution of Plant Exploitation. Unwin and Hyman, London.

HARRISON, D. and BATES, P. 1991. The Mammals of Arabia. Harrison Zoological Museum, Sevenoaks.

HAYDEN, B. 1990. Nimrods, Piscators, Pluckers, and Planters: The Emergence of Food Production. Journal of Anthropological Archaeology 9: 31-69.

HECKER, H. 1975. The Faunal Analysis of the Primary Food Animals from Pre-Pottery Neolithic Beidha. University Microfilms International 36/12-A. Ph.D. Thesis, Columbia University.

HECKER, H. 1982. Domestication Revisited: Its Implications for Faunal Analysis. Journal of Field Archaeology 9: 217-236.

HECKER, H. 1989. Appendix C: Beidha Natufian Faunal Report. In: BYRD, B. (ed). The Natufian Encampment at Beidha. Jutland Archaeological Society Publications XXIII:1, Aarhus: 97-101.

HELBAEK, H. 1969. Plant Collecting, Dry Farming, and Irrigation Agriculture in Prehistoric Deh Luran. In: HOLE, F., FLANNERY, K. and NEELY, J. (eds). Prehistory and Human Ecology of the Deh Luran Plain: An Early Village Sequence from Khuzistan, Iran. Museum of Anthropology University of Michigan: Memoir 1, Ann Arbor Michigan: 383-426.

HELLWING, S. 1989. Animal Bones from Tel Tsaf. Tel Aviv 15/16: 47-51.

HELMER, D. 1985a. Étude de la Faune de Tell Assouad (Djézireh-Syrie), Sondage J.Cauvin. Cahiers de l'Euphrate 4: 275-285.

HELMER, D. 1985b. Étude Preliminaire de la Faune de Cafer Höyük (Malatya-Turquie). Cahiers de l'Euphrate 4: 117-120.

HELMER, D. 1989. Le Développement de la Domestication au Proche-Orient de 9500 à 7500 B.P.: Les Nouvelles Données d'el Kowm et de Ras Shamra." Paléorient 15: 111-121.

HELMER, D. 1991a. Étude de la Faune de la Phase IA (Natoufien Final) de Tell Mureybet (Syrie), Fouilles Cauvin. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant. International Monographs in Prehistory, Ann Arbor, Michigan: 359-370.

HELMER, D. 1991b. Les Changements des Strategies de Chasse dans le Neolithique Préceramique de Cafer Höyük Est (Turquie). Cahiers de l'Euphrate 5-6: 131-137.

HELMER, D. 1992. La Domestication des Animaux par les Hommes Prehistoriques. Masson, Paris.

HELMER, D. and ROCHETEAU, M. 1994. Atlas du Squelette Appendiculaire des Principaux Genres Holocènes de Petits Ruminants du Nord de la Mediterranée et du Proche-Orient. Fiches d'Osteologie Animale Pour l'Archaelogie, Serie B No.4: Mammiferes. Centre de Recherches Archeologiques du C.N.R.S., Juan-les-Pins.

HELMER, D. and SAÑA, M. 1993. Étude de la Faune PPNB d'Umm el Tlel (El Kowm, Syrie), Fouilles M.Molist. Cahiers de l'Euphrate 7: 93-105.

HELMS, S. 1981. Jawa, Lost City of the Black Desert. Methuen, London.

HENRY, D. 1973. The Natufian of Palestine: its material culture and ecology. Unpublished Ph.D. Thesis, Southern Methodist University.

HENRY, D. 1975. The Fauna in Near Eastern Archaeological Deposits. In: WENDORF, F. and MARKS, A. (eds). Problems in Prehistory: North Africa and the Levant. Southern Methodist University Press, Dallas Texas: 379-385.

HENRY, D. 1989. From Foraging to Agriculture: the Levant at the end of the Ice Age. University of Pennsylvania Press, Philadelphia.

HENRY, D. 1995. Prehistoric Cultural Ecology and Evolution: Insights from Southern Jordan. Plenum Press, New York.

HENRY, D. and TURNBULL, P. 1985. Archaeological and Faunal Evidence from Natufian and Timnian Sites in Southern Jordan. Bulletin of the American Schools of Oriental Research 257: 45-64.

HENRY, D. and GARRARD, A. 1988. Tor Hamar: an Epipalaeolithic Rockshelter in Southern Jordan. Palestine Exploration Quarterly 120: 1-25.

HENRY, D., LEROI-GOURHAN, A. and DAVIS, S. 1981. The Excavation of Hayonim Terrace: An Examination of Terminal Pleistocene Climatic and Adpative Changes. Journal of Archaeological Science 8: 33-58.

HESSE, B. 1978. Evidence for Husbandry from the Early Neolithic Site of Ganj Dareh in Western Iran. University Microfilms International. Ph.D. Thesis, Department of Anthropology Columbia University.

HESSE, B. 1984. These Are Our Goats: The Origins of Herding in West Central Iran. In: GRIGSON, C. and CLUTTON-BROCK, J. (eds). Animals and Archaeology, Volume 3: Early Herders and their Flocks. B.A.R. International Series 202, Oxford: 243-264.

HESSE, B. and WAPNISH, P. 1985. Animal Bone Archaeology. Manuals on Archaeology 5. Taraxacum Inc., Washington.

HIGGS, E. (ed). 1975. Palaeoeconomy. Cambridge University Press, Cambridge.

HIGGS, E. and JARMAN, M. 1969. The Origins of Agriculture: a Reconsideration. Antiquity 43: 31-41.

HIGGS, E. and JARMAN, M. 1972. The Origins of Animals and Plant Husbandry. In: HIGGS, E. (ed). Papers in Economic Prehistory. Cambridge University Press, Cambridge: 3-13.

HILLMAN, G. 1996. Late Pleistocene Changes in Wild Plant-Foods Available to Hunter-Gatherers of the Northern Fertile Crescent: Possible Preludes to Cereal Cultivation. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 159-203.

HILLMAN, G., COLLEDGE, S and HARRIS, D 1989. Plant Food Economy During the Epipalaeolithic Period at Tell Abu Hureyra, Syria: Dietary Diversity, Seasonality, and Modes of Exploitation. In: HARRIS, D. and HILLMAN, G. (eds). Foraging and Farming: The Evolution of Plant Exploitation. Unwin Hyman, London: 240-268.

HILLSON, S. 1992. Mammal Bones and Teeth. Archetype, London.

HODDER, I. 1990. The Domestication of Europe: Structure and Contingency in Neolithic Societies. Basil Blackwell, Oxford.

HOLE, F. 1974. Tepe Tula'I, an Early campsite in Khuzistan, Iran. Paléorient 2(2): 219-242.

HOLE, F. 1987. Chronologies in the Iranian Neolithic. In: AURENCHE, O., EVIN, J. and HOURS, F. (eds). Chronologies in the Near East. B.A.R. International Series 379 (I), Oxford: 353-379.

HOLE, F. 1996. The Context of Caprine Domestication in the Zagros Region. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 263-281.

HOLE, F., FLANNERY, K. and NEELY, J. 1969. Prehistory and Human Ecology of the Deh Luran Plain: An Early Village Sequence from Khuzistan, Iran. Museum of Anthropology University of Michigan: Memoir 1, Ann Arbor, Michigan.

HOROWITZ, A. 1971. Climatic and Seasonal Developments in Northeastern Israel during Upper Pleistocene-Holocene Times. Pollen et Spores 13: 255-278.

HORWITZ, L. 1987a. The Fauna from the PPNB Site of Yiftahel: New Perspectives on Domestication. Journal of the Israel Prehistoric Society 20: 114-118.

HORWITZ, L. 1987b. Animal Remains from the Pottery Neolithic Levels at Tel Dan. Journal of the Israel Prehistoric Society 20: 114-118.

HORWITZ, L. 1988. Bone Remains from Neve Yam. A Pottery Neolithic Site off the Carmel Coast. Journal of the Israel Prehistoric Society 21: 99-108.

HORWITZ, L. 1989. A Reassessment of Caprovine Domestication in the Levantine Neolithic: Old Questions, New Answers. In: HERSHKOVITZ, I. (ed). People and Culture in Change. B.A.R. International Series 508 (I), Oxford: 153-181.

HORWITZ, L. 1990. Animal Bones from the Site of Horvat Hor: a Chalcolithic Cave Dwelling. Journal of the Israel Prehistoric Society 23: 153-161.

HORWITZ, L. and GARFINKEL, Y. 1991. Animal Remains from the Site of Gesher, Central Jordan Valley. Journal of the Israel Prehistoric Society 24: 64-76.

HORWITZ, L. and SMITH, P. 1991. A Study of Diachronic Change in Bone Mass of Sheep and Goats from Jericho (Tel es-Sultan). Archaeozoologia 4(1): 29-38.

HOURS, F., AUREMCHE, O., CAUVIN, J., CAUVIN, M-C., COPELAND, L. and SANLAVILLE, P. 1994. Atlas des Sites du Proche Orient. Travaux de la Maison de l'Orient Méditerranéen No.24, Lyon.

HOVERS, E. and BAR-YOSEF, O. 1987. A Prehistoric Survey of Eastern Samaria - Preliminary Report. Israel Exploration Journal 33: 77-87.

ISAAC, E. 1970. Geography of Domestication. Prentice-Hall, Englewood Cliffs New Jersey.

JARMAN, M. and WILKINSON, P. 1972. Criteria of Animal Domestication. In: HIGGS, E. (ed.) Papers in Economic Prehistory. Cambridge University Press, Cambridge: 83-96.

JOSIEN, T. 1955. La Faune Chalcolithique des Gisements Palestiniens de Bir es-Safadi et Bir Abou Matar. Israel Exploration Journal 5: 246-256.

KAFAFI, Z. 1987. The Pottery Neolithic in Jordan in connection with other Near Eastern regions. In: HADIDI, A (ed). Studies in the History and Archaeology of Jordan 3. Department of Antiquities, Amman: 33-39.

KAFAFI, Z. 1988. Jebel Abu Thawwab: A Pottery Neolithic Village in North Jordan. In: GARRARD, A. and GEBEL, H.-G. (eds). The Prehistory of Jordan. The State of Research in 1986. B.A.R. International Series 396 (ii), Oxford: 451-471.

KAFAFI, Z. 1992. Pottery Neolithic Settlement Patterns in Jordan. In: ZAGHLOUL, M. and AMR, K. (eds). Studies in the History and Archaeology of Jordan 4. Department of Antiquities, Amman: 115-122.

KAFAFI, Z. 1993. The Yarmoukians in Jordan. Paléorient 19(1): 101-114.

KAFAFI, Z. 1998. The Late Neolithic in Jordan. In: HENRY, D. (ed). The Prehistoric Archaeology of Jordan. B.A.R. International Series 705, Oxford: 137-161.

KAFAFI, Z. and ROLLEFSON, G. 1995. The 1994 excavations at 'Ain Ghazal: Preliminary Report. Annual of the Department of Antiquities of Jordan 39: 13-29

KAFAFI, Z., ROLLEFSON, G. and SIMMONS, A. 1990. The 1989 season at Ain Ghazal Preliminary Report. Annual of the Department of Antiquities of Jordan 34: 11-25.

KAPLAN, J. 1958. Neolithic and Chalcolithic Settlement in Tel Aviv and Neighbourhood. Unpublished Ph.D. Thesis, Hebrew University.

KENYON, K. 1957. Digging Up Jericho. Ernest Benn, London.

KENYON, K. 1960. Jericho and the Origins of Agriculture. The Advancement of Science 66: 118-120.

KENYON, K. 1979. Archaeology in the Holy Land. Ernest Benn, London.

KERSTEN, A. 1989. The Epipalaeolithic Remains from Ksar Akil: Some Preliminary Results. In: HERSHKOVITZ, I. (ed). People and Culture in Change. B.A.R. International Series 508 (I), Oxford.

KHAZANOV, A. 1984. Nomads and the Outside World. Cambridge University Press, Cambridge.

KIRKBRIDE, D. 1966. Five Seasons at the Pre-Pottery Neolithic Village of Beidha in Jordan. Palestine Exploration Quarterly 98: 8-72.

KIRKBRIDE, D. 1968. Beidha: Early Neolithic Village Life South of the Dead Sea. Antiquity 42: 263-274.

KISLEV, M. 1987. Chalcolithic Plant Husbandry and Ancient Vegetation at Shiqmim. In: LEVY, T. (ed). Shiqmim I: Studies Concerning Chalcolithic Societies in the Northern Negev Desert, Israel (1982-1984). B.A.R. International Series 356 (I), Oxford:251-279.

KÖHLER, I. 1981. Animal Remains. In: HELMS, S. Jawa. Lost City of the Black Desert. Methuen, London: 249-252.

KÖHLER-ROLLEFSON, I. 1983. Jordanian Goat Husbandry in the PPNB and Today. Paper Presented at the Annual Meeting of the American Schools of Oriental Research, Dallas.

KÖHLER-ROLLEFSON 1988. The Aftermath of the Levantine Neolithic Revolution in the Light of Ecological and Ethnographic Evidence. Paléorient 14(1): 87-93.

KÖHLER-ROLLEFSON, I. 1989a. Changes in Goat Exploitation at 'Ain Ghazal Between the Early and Late Neolithic: A Metrical Analysis. Paléorient 15(1): 141-146.

KÖHLER-ROLLEFSON, I. 1989b. Small game hunting at Neolithic 'Ain Ghazal. Anthroquest 40: 22-23.

KÖHLER-ROLLEFSON, I. 1989c. Resolving the Revolution: Late Neolithic Refinements of Economic Strategies in the Eastern Levant. Archaeozoologia 3(1/2): 201-208.

KÖHLER-ROLLEFSON, I. 1992. The Development of Pastoralism on the Transjordanian Plateau. In: BAR-YOSEF, O. and KHAZANOV, A. (eds.). Pastoralism in the Levant: Archaeological Materials in Anthropological Perspectives. Prehistory Press, Madison Wisconsin.

KÖHLER-ROLLEFSON, I. 1997. Proto-Élevage, Pathologies, and Pastoralism: a Post-Mortem of the Process of Goat Domestication. In: GEBEL, H.-G., KAFAFI, Z and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 557-565.

KÖHLER-ROLLEFSON, I., GILLESPIE, W and METZGER, M 1988. The Fauna from Neolithic 'Ain Ghazal. . In: GARRARD, A. and GEBEL, H.-G. (eds). The Prehistory of Jordan. The State of Research in 1986. B.A.R. International Series 396 (ii), Oxford: 423-430.

KÖHLER-ROLLEFSON, I., QUINTERO, L., and ROLLEFSON, G. 1993. A Brief Note on the Fauna from Neolithic 'Ain Ghazal. Paléorient 19(2): 95-97.

KÖHLER-ROLLEFSON, I. And ROLLEFSON, G. 1990. The Impact of Neolithic Subsistence Strategies on the Environment: the Case of Ain Ghazal, Jordan. In: BOTTEMA, S., ENTJES-NIEBORG, G. and ZEIST, W. VAN (eds). Man's Role in the Shaping of the Eastern Mediterranean Landscape. Balkema, Rotterdam: 3-14.

KOZLOWSKI, S. 1994. Radiocarbon Dates from Aceramic Iraq. In: BAR-YOSEF, O. and KRA, R. (eds). Late Quaternary Chronology and Paleoclimates of the Eastern Mediterranean. Radiocarbon, Tucson: 255-264.

KOZLOWSKI, S. and GEBEL. H.-G. 1994. Editors' Concluding Remarks on Chipped Lithics Techno-Taxa and Interaction Spheres Throughout the 9th to 6th Millennium B.C.. In: GEBEL. H.-G. and KOZLOWSKI, S. (eds). Neolithic Chipped Stone Industries of the Fertile Crescent. Ex Oriente, Berlin: 595-600.

KRATOCHVIL, Z. 1969. Species Criteria on the Distal Section of the Tibia in *Ovis ammon* f. *aries* l. and *Capra aegagrus* f. *hircus* l. Acta Veterinaria (Brno) 38: 483-490.

KUIJT, I. 1994. Pre-Pottery Neolithic A Settlement Variability: Evidence for Sociopolitical Developments in the Southern Levant. Journal of Mediterranean Archaeology 7(2): 165-192.

KUIJT, I. 1997. Trying to Fit Round Houses into Square Holes: Re-examining the Timing of the South-Central Levantine Pre-Pottery Neolithic A and Pre-Pottery Neolithic B Transition. In: GEBEL, H.-G., KAFAFI, Z. and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1996. Ex Oriente, Berlin: 193-202.

KUIJT, I., MABRY, J. and PALUMBO, G. 1991. Early Neolithic Use of Upland Areas of Wadi el-Yabis: Preliminary Evidence from the Excavation of 'Iraq ed-Dubb, Jordan. Paléorient 17(1): 99-108.

KÜRSCHNER, H. 1986. A Physiognomical-Ecological Classification of the Vegetation of Southern Jordan. In: KÜRSCHNER, H.(ed). Contributions to the Vegetation of South-West Asia. Dr. Ludwig Reichert Verlag, Wiesbaden: 45-79.

KUSATMAN, B. 1991. The Origins of Pig Domestication with Particular Reference to the Near East. Unpublished Ph.D. Thesis, University of London.

LAFFER, J. 1983. The Faunal Remains from Banahilk. In: BRAIDWOOD, L., BRAIDWOOD, R., HOWE, B., REED, C. and WATSON, P. (eds). Prehistoric Archaeology along the Zagros Flanks. Oriental Institute of the University of Chicago, Chicago: 629-643.

LANCASTER, W. and LANCASTER, F. 1991. Limitations on Sheep and Goat Herding in the Eastern Badia of Jordan: An Ethno-Archaeological enquiry. Levant 23: 125-138.

LAWRENCE, B. 1982. Principal Food Animals at Çayönü. In: BRAIDWOOD, L. and BRAIDWOOD, R. (eds). Prehistoric Village Archaeology in South East Turkey. B.A.R. International Series 138, Oxford: 175-199.

LEES, S. and BATES, D. 1974. The Origins of Specialised Nomadic Pastoralism: A Systematic Model. American Antiquity 39(2).

LEGGE, A. 1972. Prehistoric Exploitation of the Gazelle in Palestine. In: HIGGS, E. (ed). Papers in Economic Prehistory. Cambridge University Press, Cambridge: 119-124.

LEGGE, A. 1975. The Fauna of Tell Abu Hureyra: A Preliminary Analysis. Proceedings of the Prehistoric Society 41: 74-76.

LEGGE, A. 1996. The Beginnings of Caprine Domestication in Southwest Asia. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 238-262.

LEGGE, A. and ROWLEY-CONWY, P. 1987. Gazelle Killing in Stone Age Syria. Scientific American 255(8): 88-95.

LEVY, T. 1983. The Emergence of Specialised Pastoralism in the Southern Levant. World Archaeology 15: 15-36.

LEVY, T. 1992. Transhumance, Subsistence and Social Evolution in the Northern Negev Desert. In: BAR-YOSEF, O. and KHAZANOV, A. (eds). Pastoralism in the Levant: Archaeological Materials in Anthropological Perspectives. Prehistory Press, Madison Wisconsin: 65-82.

LIEBERMAN, D. 1994. The Biological Basis for Seasonal Increments in Dental Cementum and their Application to Archaeological Research. Journal of Archaeological Science 21: 525-539.

LYMAN, R. 1994. Vertebrate Taphonomy. Cambridge University Press, Cambridge.

MACADAM, E. 1997. The Figurines from the 1982-5 Seasons of Excavations at Ain Ghazal. Levant 29: 115-145.

MAHASNEH, H. 1997. The 1995 Season at the Neolithic Site of Es-Sifiya, Wadi Mujib, Jordan. In: GEBEL, H.-G., KAFAFI, Z. and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 203-214.

MARTIN, L. 1994. Hunting and Herding in a Semi-Arid Region: An Archaeozoological and Ethological Analysis of the Faunal Remains from the Epipalaeolithic and Neolithic of the Eastern Jordanian Steppe. Unpublished Ph.D. Thesis, Department of Archaeology and Prehistory, University of Sheffield.

MARTIN, L. In Press. Mammal Remains from the Eastern Jordanian Neolithic, and the Nature of Caprine Herding in the Steppe. Paléorient 25(2).

MARTIN, L. n.d. Gazelle and Sheep/Goat Separation. Unpublished Notes.

MARTIN, L. n.d. Sheep/Goat Separation: Metrical Analysis of the Astragalus. Unpublished Notes.

MCARDLE, J. 1990. Halafian Fauna at Girikihaciyan. In: WATSON, P. and LE BLANC, S. (eds). Girikihaciyan - a Halafian Site in Southeastern Turkey. U.C.L.A. (Institute of Archaeology) Monograph 33, Los Angeles: 109-120.

MCCORRISTON, J. and HOLE, F. 1991. The Ecology of Seasonal Stress and the Origins of Agriculture in the Near East. American Anthropologist 93(1): 46-69.

MEADOW, R. 1983. The Vertebrate Faunal Remains from Hasanlu Period X at Hajji Firuz. In: DYSON, R. (ed). Hasanlu Excavation Reports Volume I: Hajji Firuz Tepe, Iran: the Neolithic Settlement. University Museum Monograph 50 University of Pennsylvania, Philadelphia: 369-422.

MEADOW, R. 1989a. Osteological Evidence for the Process of Animal Domestication. In: CLUTTON-BROCK, J. (ed). The Walking Larder. Unwin Hyman, London: 80-89.

MEADOW, R. 1989b. Prehistoric Wild Sheep and Sheep Domestication on the Eastern Margin of the Middle East. In: CRABTREE, P., CAMPANA, D. and RYAN, K. (eds). Early Animal Domestication and its Cultural Context. The University Museum of Archaeology and Anthropology University of Pennsylvania, Philadelphia: 25-36.

MELAART, J. 1958. Excavations at Hacilar: first preliminary report. Anatolian Studies 8: 127-156.

MELAART, J. 1962. Excavations at Çatal Hüyük. Anatolian Studies 12: 41-65.

MERRILL, S. 1881. East of Jordan. A Record of Travel and Observation in the Countries of Moab, Gilead and Bashan. Richard Bentley and Son, London.

MOORE, A. 1973. The Late Neolithic in Palestine. Levant 5: 36-68.

MOORE, A. 1978. The Neolithic of the Levant. Unpublished Ph.D. Thesis, University of Oxford.

NADLER, C., KOROBITSINA, K., HOFFMANN, R. and VORONTSOV, N. 1973. Cytogenetic Differentiation, Geographic Distribution and Domestication in Palearctic Sheep (*Ovis*). Zeitschrift für Saugertierkunde 38: 109-125.

NIKLEWSKI, J. and ZEIST, W. VAN 1970. A Late Quaternary Pollen Diagram from Northwestern Syria. Acta Botanica Neerlandica 19: 737-754.

NODDLE, B. 1974. Epiphyseal Closure in Goats. Journal of Archaeological Science 1: 195-204.

NOY, T., LEGGE, A. and HIGGS, E. 1973. Recent Excavations at Nahal Oren, Israel. Proceedings of the Prehistoric Society 39: 75-99.

NOY, T., SCHULDENREIN, J. and TCHERNOV, E. 1980. Gilgal, a Pre-Pottery Neolithic A site in the Lower Jordan Valley. Israel Exploration Journal 30: 63-82.

PALES, L. and GARCIA, M. 1981. Atlas Ostéologique des Mammifères. Editions du C.N.R.S., Paris.

PAYNE, S. 1969. A Metrical Distinction Between Sheep and Goat Metacarpals. In: UCKO, P. and DIMBLEBY, G. (eds). The Domestication and Exploitation of Plants and Animals. Duckworth, London: 295-305.

PAYNE, S. 1973. Kill-Off Patterns in Sheep and Goats: the Mandibles from Asvan Kale. Anatolian Studies 23: 281-303.

PAYNE, S. 1985a. Animal Bones from Asikli Hüyük. Anatolian Studies 35: 109-122.

PAYNE, S. 1985b. Morphological Distinctions Between the Mandibular Teeth of Young Sheep (*Ovis*) and Goats (*Capra*) Journal of Archaeological Science 12: 139-147.

PAYNE, S. 1988. Animal Bones from Tell Rubeidheh. In: KILLICK, R. (ed). Tell Rubeidheh, an Uruk Village in the Jebel Hamrin. Aris and Phillips, Warminster: 98-135.

PERKINS, D. 1964. Prehistoric Fauna from Shanidar, Iraq. Scientific American 144: 1565-1566.

PERLES, C. and PHILLIPS, J. 1991. The Natufian Conference: Discussion. In: BAR-YOSEF, O. and VALLA, F. (eds). The Natufian Culture in the Levant. International Monographs in Prehistory, Ann Arbor: 637-644.

PERROT, J. 1993. Remarques Introductives. Paléorient 19(1): 9-21.

PERROT, J. 1993. Commentaires. Paleorient 19(1): 175-177.

PRUMMEL, W. and FRISCH, H.-J. 1986. A Guide for the Distinction of Species, Sex and Body Side in Bones of Sheep and Goat. Journal of Archaeological Science 13: 567-577.

QUINTERO, L. and KÖHLER-ROLLEFSON, I. 1997. The 'Ain Ghazal Dog: A Case for the Neolithic Origin of *Canis familiaris* in the Near East. In: GEBEL, H.-G., KAFAFI, Z and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 567-574.

REDDING, R. 1981. Decision Making in Subsistence Herding of Sheep and Goats in the Middle East. Unpublished Ph.D. Thesis, University of Michigan.

REED, C. 1959. Animal Domestication in the Prehistoric Near East. Science 130: 1629-1639.

REED, C. 1960. A Review of the Archaeological Evidence on Animal Domestication in the Prehistoric Near East. In: BRAIDWOOD, R. and HOWE, R. (eds). Prehistoric Investigations in Iraqi Kurdistan. Studies in Ancient Oriental Civilisation 31. University of Chicago Press, Chicago: 119-145.

REED, C. and SCHAFFER, W. 1972. How to Tell the Sheep From the Goats. Bulletin of the Field Museum of Natural History 43(3): 2-7.

REITZ, E. and WING, E. 1999. Zooarcheology. Cambridge University Press. Cambridge.

RICHARDSON, J. 1997. An Analysis of the Faunal Assemblages from Two Pre-Pottery Neolithic Sites in the Wadi Fidan, Jordan. In: GEBEL, H.-G., KAFAFI, Z. and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Berlin, Ex Oriente: 497-510.

RINDOS, D. 1984. The Origins of Agriculture: an Evolutionary Perspective. Academic Press, Orlando Florida

ROLLEFSON, G. 1983. Ritual and Ceremony at Neolithic Ain Ghazal (Jordan). Paléorient 9(2): 29-38.

ROLLEFSON, G. 1984. 'Ain Ghazal: an Early Neolithic Community in Highland Jordan, near Amman. Bulletin of the American Schools of Oriental Research 255: 3-14.

ROLLEFSON, G. 1986. Neolithic 'Ain Ghazal (Jordan): Ritual and Ceremony, II. Paléorient 12(1): 45-52.

ROLLEFSON, G. 1989. The late Aceramic Neolithic of the Levant: A Synthesis. Paléorient 15(1): 168-173.

ROLLEFSON, G. 1993a. The Neolithic village of 'Ain Ghazal, Jordan: Preliminary Report on the 1989 Season. Annual of the American Schools of Oriental Research 51: 107-126.

ROLLEFSON, G. 1993b. The Origins of the Yarmoukian at 'Ain Ghazal. Paléorient 19(1): 91-100.

ROLLEFSON, G. 1996. The Neolithic Devolution: Ecological Impact and Cultural Compensation at 'Ain Ghazal, Jordan. In: SEGER, J. (ed). Retrieving the Past: Essays on Archaeological Research and Methodology in Honor of Gus W. van Beek. Cobb Institute of Archaelogy, Mississippi State University, Winona Lake Indiana: 219-229.

ROLLEFSON, G. 1998a. The Aceramic Neolithic of Jordan. In: HENRY, D. (ed). The Prehistoric Archaeology of Jordan. B.A.R. International Series 705, Oxford: 103-135.

ROLLEFSON, G. 1998b. 'Ain Ghazal (Jordan): Ritual and Ceremony III. Paléorient 24(1): 43-58.

ROLLEFSON, G. and KAFAFI, Z. 1996. The 1995 Season at 'Ayn Ghazal: A Preliminary Report. Annual of the Department of Antiquities of Jordan 40: 11-28.

ROLLEFSON, G. and KAFAFI, Z. 1997. The 1996 Season at 'Ayn Ghazal: Preliminary Report. Annual of the Department of Antiquities of Jordan 41: 27-48.

ROLLEFSON, G. and KÖHLER-ROLLEFSON, I. 1989. The Collapse of Early Neolithic Settlements in the Southern Levant. In: . HERSHKOVITZ, I. (ed). People and Culture in Change. B.A.R. International Series 508 (I), Oxford: 73-89.

ROLLEFSON, G. and KÖHLER-ROLLEFSON, I. 1993a. PPNC Adaptations in the First Half of the 6th Millennium B.C., Paléorient 19(1): 31-40.

ROLLEFSON, G. and KÖHLER-ROLLEFSON, I. 1993b. Reply to Comments by Hans Nissen and Jean Perrot. Paléorient 19(1): 183-185.

ROLLEFSON, G. and SIMMONS, A. 1985. The Early Neolithic Village of 'Ain Ghazal, Jordan: Preliminary Report on the 1983 season. Bulletin of the American Schools of Oriental Research Supplement 23: 35-52.

ROLLEFSON, G. and SIMMONS, A. 1986. The Neolithic Village of 'Ain Ghazal, Jordan: Preliminary Report on the 1984 Season. Bulletin of the American Schools of Oriental Research Supplement 24: 145-164.

ROLLEFSON, G. and SIMMONS, A. 1987. The Neolithic Village of 'Ain Ghazal, Jordan: Preliminary Report on the 1985 Season. Bulletin of the American Schools of Oriental Research Supplement 25: 93-106.

ROLLEFSON, G., KAFAFI, Z. and SIMMONS, A. 1990. The Neolithic Village of 'Ain Ghazal, Jordan: Preliminary Report on the 1988 Season. Bulletin of the American Schools of Oriental Research Supplement 27: 97-118.

ROLLEFSON, G., KAFAFI, Z. and WADA, H. 1994. The 1993 Season at 'Ain Ghazal: Preliminary Report. Annual of the Department of Antiquities of Jordan 38: 11-32.

ROLLEFSON, G., SIMMONS, A. and KAFAFI, Z. 1992. Neolithic Cultures at 'Ain Ghazal, Jordan. Journal of Field Archaeology 19: 443-470.

ROLLEFSON, G., BANNING, E., BYRD, B., KAFAFI, Z., KÖHLER, I., PETOCZ, D., ROLSTON, S. and VILLIERS, L. 1984. The Pre-Pottery Neolithic B Village of Ain Ghazal (Jordan): Preliminary Report of the 1982 Excavation Season. Mitteilungen der Deutschen Orient-Gesellschaft 116: 139-183.

ROLLEFSON, G., SIMMONS, A., DONALDSON, M., GILLESPIE, W., KAFAFI, Z., KÖHLER-ROLLEFSON, I., MCADAM, E., ROLSTON, S. and TUBB, K. 1985. Excavations at the Pre-Pottery Neolithic B village of 'Ain Ghazal (Jordan), 1983. Mitteilungen der Deutschen Orient-Gesellschaft 117: 69-115.

ROSEN, S. 1984. Kvish Harif: Preliminary Investigation at a Late Neolithic Site in the Central Negev. Paléorient 10(2): 111-121.

ROSEN, S. 1988. Notes on the Origins of Pastoral Nomadism: a Case from the Negev and Sinai. Current Anthropology 29(3): 498-506.

ROSENBERG, M., NESBITT, R., REDDING, R. and PEASNALL, B. 1998. Hallan Çemi, Pig Husbandry, and Post-Pleistocene Adaptations along the Taurus-Zagros Arc (Turkey). Paléorient 24(1): 25-41.

SANLAVILLE, P. 1996. Changements Climatiques dans la Région Levantine à la fin du Pléistocène Superieur et au Début de l'Holocène. Leurs Relations Avec l'Évolution des Sociétés Humaines. Paléorient 22(1): 7-30.

SANLAVILLE, P. 1997. Les Changements dans l'Environment au Moyen-Orient de 20,000 B.P. à 6,000 B.P. Paléorient 23(2): 249-262.

SAXON, E. 1974. The Mobile Herding Economy of Mt. Carmel: An Economic Analysis of the Faunal Remains. Journal of Archaeological Science 1: 27-45.

SCHAFFER, J. and BOESSNECK, J. 1988. Bericht über de Tierreste aus der Halafzeitlichen Siedlung Çavi Tarlasi (Nisibin/Ostturkei). Istanbuler Mitteilungen 38: 37-62.

SCHMID, E. 1972. Atlas of Animal Bones: for Prehistorians, Archaeologists and Quaternary Geologists. Elsevier Publishing Company, Amsterdam, London and New York.

SELLARS, J. 1989. A Study of the Wadi Judayid Site: A Natufian Occupation in Southern Jordan. Unpublished M.A. Thesis, University of Tulsa.

SELLARS, J. 1998. The Natufian of Jordan. In: HENRY, D. (ed). The Prehistoric Archaeology of Jordan. B.A.R. International Series 705, Oxford: 83-101.

SHERRATT, A. 1981. Plough and Pastoralism: Aspects of the Secondary Products Revolution. In: HODDER, I., ISAAC, G. and HAMMOND, N. (eds). Pattern of the Past: Studies in Honour of David Clarke. Cambridge University Press, Cambridge: 261-306.

SHIYAB, A. 1997. Animal Remains from 'Ain Rahub. In: GEBEL, H.-G., KAFAFI, Z. and ROLLEFSON, G. (eds). Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 593-599.

SILVER, I. 1969. The Ageing of Domestic Animals. In: BROTHWELL, D. and HIGGS, E. (eds). Science in Archaeology. Thames and Hudson, London: 283-302.

SIMMONS, A. and KAFAFI, Z. 1988. Preliminary Report on the 'Ain Ghazal Archaelogical Survey 1987. Annual of the Department of Antiquities of Jordan 32: 27-39.

SMITH, B. 1995. The Emergence of Agriculture. Scientific American Library, New York.

STAMPFLI, H. 1983. The Fauna of Jarmo, with Notes on Animal Bones from Matarrah, the 'Amuq and Karim Shahir. In: BRAIDWOOD, R., BRAIDWOOD, L., HOWE, B., REED, C. and WATSON, P. (eds). Prehistoric Archaeology along the Zagros Flanks. University of Chicago Oriental Institute Publications 105, Chicago: 431-484.

STEIN, G. 1988. Pastoral Production in Complex Societies: Mid-Late Third Millennium B.C. and Medieval Faunal Remains from Gritille Höyük in the Karababa Basin. University Microfilms International. Ph.D. Thesis, University of Pennsylvania.

STEIN, G. 1989. Strategies of Risk Reduction in Herding and Hunting Systems of Neolithic Southeast Anatolia. In: CRABTREE, P., CAMPANA, D. and RYAN, K. (eds). Early Animal Domestication and its Cultural Context. The University Museum of Archaeology and Anthropology University of Pennsylvania, Philadelphia: 87-97.

STEKELIS, M. 1951. A New Neolithic Industry: the Yarmukian of Palestine. Israel Exploration Journal 1: 1-19.

STEKELIS, M. and HAAS, G. 1952. The Abu Usba Cave (Mount Carmel). Israel Exploration Journal 2: 15-47.

STORDEUR, D. 1989. El Kowm 2 Caracol et le PPNB. Paléorient 15(1): 102-110.

STORDEUR, D. 1993. Sédentaires et Nomades du PPNB Final dans le Désert de Palmyre (Syrie). Paléorient 19/1(1): 187-204.

TCHERNOV, E. 1976. Some Late Quaternary Faunal Remains from the Avdat/Aqev Area. In: MARKS, A. (ed). Prehistory and Paleoenvironments in the Central Negev, Israel, Volume 1: The Avdat / Aqev Area Pt. 1. S.M.U. Press, Dallas: 69-73.

TCHERNOV, E. 1993. The Impact of Sedentism on Animal Exploitation in the Southern Levant. In: BUITENHUIS, H. and CLASON, A. (eds). Archaeozoology of the Near East. Universal Book Services, Leiden: 10-26.

TCHERNOV, E. 1994. An Early Neolithic Village in the Jordan Valley: Part II The Fauna of Netiv Hagdud. American School of Prehistoric Research Bulletin 44. Peabody Museum of Archaeology and Ethnology, Cambridge Mass..

TCHERNOV, E. and BAR-YOSEF, O. 1982. Animal Exploitation in the Pre-Pottery Neolithic B Period at Wadi Tbeik, Southern Sinai. Paléorient 8(2): 17-37.

TURNBULL, P. 1975. The Mammalian Fauna of Warwasi Rockshelter, West-Central Iran. Fieldiana Geology 33(8): 141-155.

TURNBULL, P. 1983. The Faunal Remains from M'lefaat. In: BRAIDWOOD, R., BRAIDWOOD, L., HOWE, B., REED, C. and WATSON, P. (eds). Prehistoric Archaeology along the Zagros Flanks. University of Chicago Oriental Institute Publications 105, Chicago: 693-695.

TURNBULL, P. and REED, C. 1974. The Fauna from the Terminal Pleistocene of Palegawra Cave, a Zarzian Occupation in North-Eastern Iraq. Fieldiana Anthropology 63(3): 81-146.

UERPMANN, H.-P. 1979. Probleme der Neolithisierung des Mittelmeerraums. Dr. Ludwig Reichert Verlag, Wiesbaden.

UERPMANN, H.-P. 1982. Faunal Remains from Shams ed -Din Tannira, a Halafian Site in Northern Syria. Berytus 30: 3-52.

UERPMANN, H.-P. 1987. The Ancient Distribution of Ungulate Mammals in the Middle East. Dr. Ludwig Reichert Verlag, Wiesbaden.

UERPMANN, H.-P. 1996. Animal Domestication - Accident or Intention? In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 227-237.

UERPMANN, M. and UERPMANN, H.-P. 1994. Animal Bones from Excavation 520 at Qala'at al-Bahrain. In: MORTENSEN, P. (ed). Qala'at al-Bahrain, Volume 1, The Northern City Wall and Islamic Fortress. Jutland Archaeological Society Publication, Aarhus: 417-454.

VALDEZ, R. 1982. The Wild Sheep of the World. Wild Sheep and Goat International, Mesilla New Mexico.

VALLA, F. 1995. The First Settled Societies: Natufian (12,500-10,200 BP). In: LEVY, T. (ed). The Archaeology of Society in the Holy Land. Leicester University Press, London: 169-187.

VAUX, R. DE 1970. Palestine during the Neolithic and Chalcolithic periods. In: The Cambridge Ancient History. EDWARDS, I., GADD, C. and HAMMOND, N. (eds). Cambridge University Press, Cambridge: 498-538.

VAVILOV, N. 1926. Studies on the Origin of Cultivated Plants. Institut Botanique Appliqué et d'Amélioration des Plantes, Leningrad.

WASSE, A. 1994. Pastoral Adaptations in the Central and Southern Levant during the Neolithic: the Sheep and Goat bones from Ain Ghazal, Jordan. Unpublished B.A. Dissertation, Institute of Archaeology, University College London.

WASSE, A. 1997. Preliminary Results of an Analysis of the Sheep and Goat Bones from 'Ain Ghazal, Jordan. In: GEBEL, H.-G., KAFAFI, Z and ROLLEFSON, G. (eds). The Prehistory of Jordan II: Perspectives from 1997. Ex Oriente, Berlin: 575-592.

WASSE, A. n.d. Goat - Sheep Distinctions. Unpublished Notes.

WATKINS, T. 1995. Qermez Dere, Tell Afar: Interim Report No.3. Department of Archaeology, University of Edinburgh.

WATSON, J. 1979. The Estimation of the Relative Frequencies of Mammalian Species: Khirokitia 1972. Journal of Archaelogical Science 6: 127-137.

WATSON, J. 1980. The Vertebrate Fauna from Arpachiyah. Iraq 42: 152-153.

WATTENMAKER, P. and STEIN, G. 1986. Early Pastoral Production in Southeast Anatolia: Faunal Remains from Kurban Höyük and Gritille Höyük. Anatolica 13: 90-96.

WEINSTEIN-EVRON, M. 1983. The Paleoecology of the Early Würm in the Hula Basin, Israel. Paléorient 9(1): 5-19.

WEINSTEIN-EVRON, M. 1987. Paleoclimatic Reconstructions of the Late Pleistocene in the Hula Basin. Israel Journal of Earth Sciences 36(1/2):59-64.

WRIGHT, H. 1977. Environmental Change and the Origins of Agriculture in the Old and New Worlds. In: REED, C. (ed). Origins of Agriculture. Mouton, The Hague: 281-318.

WRIGHT, K. 1991. The Origins and Development of Ground Stone Assemblages in Late Pleistocene Southwest Asia. Paléorient 17(1): 19-45.

YECHIELI, Y., MAGARITZ, M., LEVY, Y., WEBER, U., KAFRI, U., WOELFLI, W. and BONANI, G. 1993. Late Quaternary Geological History of the Dead Sea Area. Quaternary Research 39: 59-74.

ZEIST, W. VAN and BOTTEMA, S. 1982. Vegetational History of the Eastern Mediterranean and the Near East during the last 20,000 years. In: BINTLIFF, J. and ZEIST, W. VAN (eds). Paleoclimates, Paleoenvironments and Human Communities in the Eastern Mediterranean Region in Later Prehistory. B.A.R. International Series 133, Oxford: 277-321.

ZEIST, W. VAN and BOTTEMA, S. 1991. Late Quaternary Vegetation of the Middle East. Dr. Ludwig Reichert Verlag, Wiesbaden.

ZEIST, W. VAN, SMITH, P., PALFENIER-VEGTER, R. SUWIJN, M. and CASPARIE, W. 1984. An Archaeobotanical Study of Ganj Dareh Tepe, Iran. Palaeohistoria 26: 201-224.

ZEUNER, F. 1955. The Goats of Early Jericho. Palestine Exploration Quarterly: 17-54.

ZEUNER, F. 1963. A History of Domesticated Animals. Hutchinson, London.

ZOHARY, M. 1973. Geobotanical Foundations of the Middle East. Gustav Fischer Verlag, Stuttgart.

ZOHARY, D. 1989. Domestication of the Southwest Asian Crop Assemblage of Cereals, Pulses and Flax: The Evidence from the Living Plants. In: HARRIS, D. and HILLMAN, G. (eds). Foraging and Farming: the Evolution of Plant Domestication. Unwin and Hyman, London: 359-373.

ZOHARY, D. 1996. The Mode of Domestication of the Founder Crops of Southwest Asian Agriculture. In: HARRIS, D. (ed). The Origins and Spread of Agriculture and Pastoralism in Eurasia. U.C.L. Press, London: 142-158.

ZOHARY, D. and HOPF, M. 1988. Domestication of Plants in the Old World: The Origin and Spread of Cultivated Plants in West Asia, Europe and the Nile Valley. Oxford University Press, Oxford.

ZOHARY, D. and SPEIGEL-ROY, P. 1975. Beginning of Fruit Growing in the Old World. Science 187: 319-327.

APPENDIX A

Morphological Criteria Score Counts of 'Ain Ghazal Caprine POSACs Subjected to Principal Components Analysis

Phase	Fusion	Species	B23	B24	B25	B26	B27	B29	PF7	BU1	HR1
MPPNB	F	Goat	2		3	4	4	3	3	4	4
MPPNB	F	Goat	3	3	4	3	3	4	3	4	4
MPPNB	F	Goat	2	3	4	3	2	4	3	4	4
MPPNB	F	Goat	3	3	4		4	4	4	4	4
MPPNB	F	Goat	3	3	3	1	3	3	3	4	4
MPPNB	F	Goat	4		4	4	3	3	3	4	4
MPPNB	F	Goat				2	3		3	4	4
MPPNB	F	Goat	4	3	4	3	4	4	3	4	4
MPPNB	F	Goat	2		4	4	3	4	3		4
MPPNB	F	Goat		2	3		4		3	3	4
MPPNB	F	Goat		4	3	4	4	3	4	4	3
MPPNB	F	Goat				3	3		4		3
MPPNB	F	Goat		3	4	4	3	4	4	4	4
MPPNB	F	Goat		4	2	3	4	2	3	2	4
MPPNB	F	Goat			4		2		3	3	4
MPPNB	F	Goat		3	2	4	2	4	3		4
MPPNB	F	Goat		4	3	4	3	4	3	4	3
MPPNB	F	Goat/Sheep	3	4	4			3			
MPPNB	F	Goat/Sheep	3	2	3		3	1	3		
MPPNB	F	Goat/Sheep	3	2	4			1			
MPPNB	F	Goat/Sheep		3	4	2	3	4	2		3
MPPNB	F	Sheep	3		3	2	1		2	2	2
MPPNB	fg	Goat	3	3	4	3	3	4	2	3	4
MPPNB	uf	Goat/Sheep	4	3	4		4	3			4
MPPNB	uf	Goat/Sheep	4	3	4		3	4		4	4
MPPNB	uf	Goat/Sheep	4		4		2	4			
MPPNB	uf	Goat/Sheep	4		4			4			
LPPNB	F	Goat				4	3		3	4	4
LPPNB	F	Goat		4	3	4	3	3	3	4	4
LPPNB	F	Goat				3	4		4	3	3
LPPNB	F	Sheep	2	2		1			2	1	2
LPPNB	F	Sheep				2	1		2	2	2
LPPNB	uf	Goat/Sheep		2	4		2	1	1	1	
LPPNB/PPNC	F	Goat			4		3		3	4	4
LPPNB/PPNC	F	Goat				3	4		2		3
LPPNB/PPNC	F	Sheep			3	1	1		1	2	1
LPPNB/PPNC	F	Sheep				2	2		2		1
LPPNB/PPNC	uf	Goat		3	4		4	4			
PPNC	?	Goat/Sheep	4	2	3			3			
PPNC	?	Goat/Sheep	4	3	4			4			
PPNC	?	Goat/Sheep	3		3			4			
PPNC	?	Goat/Sheep	3		4			2			
PPNC	?	Goat/Sheep			3	3		3			
PPNC	F	Goat	3	2	3	3	4	3	2	4	3
PPNC	F	Goat				3	3		4		3
PPNC	F	Goat	4	4	4		2	4	3	3	4
PPNC	F	Goat	3		4	3	3	3	3	3	4
PPNC	F	Goat	4	3	4		4	3	3	3	4
PPNC	F	Goat		3	4	3	4	3	2		4
PPNC	F	Goat		4	4		4	2			
PPNC	F	Goat				3	4		3	4	3
PPNC	F	Goat			3	4	3		3	4	3
PPNC	F	Goat/Sheep			2	4	1		2	3	3
PPNC	F	Goat/Sheep				3	2		2	2	1
PPNC	F	Goat/Sheep	2	2	3	4	2	4	3	1	
PPNC	F	Goat/Sheep	4	2	2		3	1		1	
PPNC	F	Goat/Sheep	4	3	4	3	3	2	3	1	3
PPNC	F	Goat/Sheep		3			2	4	1		1
PPNC	F	Goat/Sheep				1	4		1		3

Table A.1: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Scapulae

Phase	Fusion	Species	B23	B24	B25	B26	B27	B29	PF7	BU1	HR1
PPNC	F	Goat/Sheep		3	3	2	2	1	3	1	3
PPNC	F	Goat/Sheep		2	4	3	2		1	2	
PPNC	F	Goat/Sheep		4	2	2	3		3	1	4
PPNC	F	Goat/Sheep		3	4	2	3		2	3	2
PPNC	F	Goat/Sheep		4	3	3	4		3		4
PPNC	F	Goat/Sheep			3		3	4	3	3	2
PPNC	F	Goat/Sheep		4	3	3	3	3	4	2	3
PPNC	F	Goat/Sheep		2	3	3	2	4	2	1	3
PPNC	F	Goat/Sheep				2	2		3	3	2
PPNC	F	Sheep		3	2	2	1	1	1		2
PPNC	F	Sheep		1		1	2		3	2	3
PPNC	F	Sheep			3	2	2		2	2	2
PPNC	F	Sheep			2	2	2		2		3
PPNC	F	Sheep			3	1	2			2	2
PPNC	F	Sheep	3	2	2	1	3	2	3	2	1
PPNC	F	Sheep	2	2	1	1	3	3	3	3	2
PPNC	F	Sheep	3		2	2	2		2	2	2
PPNC	F	Sheep	3	2	2	1	3	1	2	2	2
PPNC	F	Sheep	3	2		1	2	1	2	2	2
PPNC	F	Sheep	3			1	2		3	2	1
PPNC	F	Sheep	3	3	2	2	2	3	2	3	1
PPNC	F	Sheep	3	2	2	1	2		2	2	1
PPNC	F	Sheep	4	3	4	1	2		2	2	3
PPNC	F	Sheep	3			1	2		3	1	4
PPNC	F	Sheep				2	2		3	2	1
PPNC	F	Sheep	3	1	2	1	1	1	1	2	1
PPNC	F	Sheep				2	2		3	1	2
PPNC	F	Sheep				1	1		2		2
PPNC	F	Sheep			2	1	2		1	1	2
PPNC	F	Sheep				1	1		1	2	1
PPNC	F	Sheep		2	3	1	1	1	1	2	3
PPNC	uf	Goat			3		4	3			
PPNC	uf	Goat/Sheep	4		4		2	4			
Yarmoukian	?	Goat/Sheep	3		3		4	2			
Yarmoukian	?	Goat/Sheep	4		4						
Yarmoukian	?	Goat/Sheep	4	3	2			2			
Yarmoukian	?	Goat/Sheep	2		3		3	1			
Yarmoukian	?	Goat/Sheep	3	3	2			3			
Yarmoukian	?	Goat/Sheep	4	3	4		3	1			
Yarmoukian	F	Goat			3	4	4		3	3	4
Yarmoukian	F	Goat		3	4	3	3	3	4		4
Yarmoukian	F	Goat	3	3	4	3	3	3	3	4	4
Yarmoukian	F	Goat				3	3		4	3	3
Yarmoukian	F	Goat		4	3	3	3		4		3
Yarmoukian	F	Goat		4	3	4	3	2	4	3	4
Yarmoukian	F	Goat		4		3	4	4	3	3	2
Yarmoukian	F	Goat		3	2		4	4		4	
Yarmoukian	F	Goat		4	3		4	3	4		
Yarmoukian	F	Goat			4	3	4		4		4
Yarmoukian	F	Goat		2	4	4		3	2		3
Yarmoukian	F	Goat		4	4	4	3	4	4	3	4
Yarmoukian	F	Goat		4	4	3	4		4	4	3
Yarmoukian	F	Goat		3	4	4	3		3	4	4
Yarmoukian	F	Goat/Sheep	3	3	3		3	2	2	2	4
Yarmoukian	F	Goat/Sheep				3	3		3		2
Yarmoukian	F	Goat/Sheep		3	3	2		1	4	3	4
Yarmoukian	F	Goat/Sheep	3	2	2			1			
Yarmoukian	F	Goat/Sheep	3		4		3				4
Yarmoukian	F	Goat/Sheep				2	3		3	3	4

Table A.1: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Scapulae

Phase	Fusion	Species	B23	B24	B25	B26	B27	B29	PF7	BU1	HR1
Yarmoukian	F	Goat/Sheep		2	4	2	3	4	2		2
Yarmoukian	F	Goat/Sheep		2	4	2	2	3	3		4
Yarmoukian	F	Goat/Sheep		3		3	2		2		
Yarmoukian	F	Goat/Sheep		3	4	2	2	3	3		2
Yarmoukian	F	Goat/Sheep		4	2		2	4			
Yarmoukian	F	Goat/Sheep		2	2		3	2	3	1	4
Yarmoukian	F	Sheep		2	2	2	2	1	2	3	2
Yarmoukian	F	Sheep	2	2	2	1	2		3		3
Yarmoukian	F	Sheep	3	2	2	1	3	1	2		3
Yarmoukian	F	Sheep	4	2	3	2	2	1	1		
Yarmoukian	F	Sheep			3		2		1		2
Yarmoukian	F	Sheep		2	3	2	1		1	2	3
Yarmoukian	F	Sheep		2	2	2	2	4	1	2	2
Yarmoukian	F	Sheep		2	1				1		
Yarmoukian	F	Sheep					1		2		3
Yarmoukian	F	Sheep		2		1	2		3		3
Yarmoukian	F	Sheep		2	3		1	3	1		
Yarmoukian	F	Sheep		1	1	2	1	1	1		3
Yarmoukian	F	Sheep		1	1	1	3	1	3		1
Yarmoukian	F	Sheep				2	1		3	2	2
Yarmoukian	F	Sheep				1	2		2	2	2
Yarmoukian	F	Sheep	4	2	3	1	1	1	1		3
Yarmoukian	F	Sheep	3			1	3				1
Yarmoukian	fg	Sheep		1	3	2	2		2		
Yarmoukian	fg	Sheep		2	2	1	2	4	1	2	1
Yarmoukian	uf	Goat		4	4		4				
Yarmoukian	uf	Goat/Sheep	3		4						
Yarmoukian	uf	Goat/Sheep		2	4		2	1			
Yarmoukian	uf	Goat/Sheep	4	2	4			4			
Yarmoukian	uf	Goat/Sheep	4	2	4			1			
Yarmoukian	uf	Goat/Sheep		2	3		1	3			
Yarmoukian	uf	Goat/Sheep	4		4		2				

Table A.1: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Scapulae

Phase	Fusion	Species	B33	B34	B35	B36	U1	PF9	B15	PF10	AW1
MPPNB	F	Goat	2	2	3	4	1	3	2	4	2
MPPNB	F	Goat	3	2	4	3	3	4	3	4	4
MPPNB	F	Goat				3	3			4	
MPPNB	F	Goat	1			3	3	4	4	3	
MPPNB	F	Goat				3	2	3		4	
MPPNB	F	Goat	2		2	3	1	4	4	4	3
MPPNB	F	Goat	2	2	3			3	2		4
MPPNB	F	Goat	2	4	3	4	4	3	3	4	3
MPPNB	F	Goat	2	3	3	4	1			4	3
MPPNB	F	Goat	3	2	2	4	2	3	4	4	3
MPPNB	F	Goat	2	2	2	4	3	3			4
MPPNB	F	Goat	3	3	4	3	2	2	2	4	3
MPPNB	F	Goat	1	3							3
MPPNB	F	Goat	3	2	3	3	4	3	2	4	4
MPPNB	F	Goat/Sheep	2		3						
MPPNB	F	Goat/Sheep						2	3		
MPPNB	F	Goat/Sheep				3	4				
MPPNB	F	Sheep	2		4	2	3	2	2	1	
MPPNB	fg	Goat	4	4	4			3	3		4
MPPNB	fg	Goat			4	3	3	3	4	4	
MPPNB	fg	Goat	3	4	4	3	3			4	3
MPPNB	fg	Goat/Sheep	3	4	4						2
MPPNB	fg	Goat/Sheep	3	4	4			3	3		2
LPPNB	F	Goat	3		3			3	2		4
LPPNB	F	Goat	3	4	4			4	3		4
LPPNB	F	Goat				4	2			4	
LPPNB	F	Goat/Sheep	2	3	2		1	2	1	2	3
LPPNB	F	Goat/Sheep	2	4	4						3
LPPNB	F	Sheep	2	2	1	1	4	3	3	2	1
LPPNB	F	Sheep	3	1	2			2	2	2	2
LPPNB	fg	Goat/Sheep	3		3	2	4	2	3	3	
LPPNB	fg	Sheep	3	3	2	1	2	1	3	1	2
LPPNB/PPNC	F	Goat	3	2	2	3	4	3	3	3	3
LPPNB/PPNC	F	Goat	3		3	2	4	3	3	4	3
LPPNB/PPNC	F	Goat	3	3	4	4	2	3	3	4	3
LPPNB/PPNC	F	Sheep	1	3	2						1
LPPNB/PPNC	F	Sheep	2		3					1	2
LPPNB/PPNC	F	Sheep	2		2	2	3			2	1
LPPNB/PPNC	F	Sheep	2	3	2			2	2		1
LPPNB/PPNC	F	Sheep	3	3	2	2	3			1	2
LPPNB/PPNC	F	Sheep	2	3	2	1	2	3	3	1	1
LPPNB/PPNC	fg	Sheep	3		3	2	1	1	2	1	1
PPNC	?	Goat/Sheep	2		4						
PPNC	?	Goat/Sheep						2	2		
PPNC	F	Goat	2	4	3	4	3	3	3	4	3
PPNC	F	Goat	3	4	3			3	3		4
PPNC	F	Goat	1	3	3	4	4	3	2	4	4
PPNC	F	Goat	2	3	4	4	3	3	4	4	4
PPNC	F	Goat				4	3			4	
PPNC	F	Goat/Sheep	2		4	1	3	3	3	3	
PPNC	F	Goat/Sheep	3		2						
PPNC	F	Goat/Sheep	1		2				2		2
PPNC	F	Goat/Sheep	2		3	2	2	2			
PPNC	F	Goat/Sheep	3	4	4			2	3		2
PPNC	F	Goat/Sheep	1		2						
PPNC	F	Goat/Sheep	1		4			2	3		3
PPNC	F	Goat/Sheep	2								
PPNC	F	Goat/Sheep		2	2						2
PPNC	F	Goat/Sheep	2	4	2						

Table A.2: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Humeri

Phase	Fusion	Species	B33	B34	B35	B36	U1	PF9	B15	PF10	AW1
PPNC	F	Goat/Sheep	2	3	3	3	1	2	3	1	2
PPNC	F	Goat/Sheep	3	4	3			4	2		
PPNC	F	Goat/Sheep	2		3			2	1		2
PPNC	F	Sheep	2	2	3	2	3	1	2	2	1
PPNC	F	Sheep	3	1	2	2	2	3	2	1	3
PPNC	F	Sheep				2	3	2	1	2	
PPNC	F	Sheep	2	2	2	2	3	2	2	2	1
PPNC	F	Sheep	1	1	2	2	2			1	
PPNC	F	Sheep	2	3	1	1	4	2	2	1	1
PPNC	F	Sheep		3	3	3	2			1	2
PPNC	F	Sheep	2	2	1	3	1	1	2	2	3
PPNC	F	Sheep	2	3	2	2	2	2	3	1	1
PPNC	F	Sheep	3	3	3	2	1	2	2	2	1
PPNC	F	Sheep	3	3	2	1	1	2	2	2	
PPNC	F	Sheep			2			1	2		
PPNC	F	Sheep	1	1	2			2	2		3
PPNC	F	Sheep	3		2	2	2	3	2	2	1
PPNC	F	Sheep	2	2	3	2	2	2	2	2	1
PPNC	F	Sheep	3	2	4	1	1	1	2	1	1
PPNC	F	Sheep	2	3	3	1	2	1	2	2	2
PPNC	F	Sheep	3	2	2	2	1	3	2	3	2
PPNC	F	Sheep	1	2	4	2	4	2	2		2
PPNC	F	Sheep	2	4	3	3	2	2	2	2	1
PPNC	F	Sheep	2	2	3	1		2		1	2
PPNC	F	Sheep	3	2	2	2	3	1	2	1	2
PPNC	F	Sheep	1		1	1	3	2	1	1	
PPNC	F	Sheep	2	2	2	1	2	3	2	1	1
PPNC	F	Sheep	2	2	2	1	2	2	2	1	1
PPNC	F	Sheep	2	4	2			2	3		1
PPNC	F	Sheep	2	2	1	2	1	2	2	2	1
PPNC	F	Sheep	2	4	2	1	2	2	1	1	2
PPNC	F	Sheep	2	4	2	2	1	2	1	2	1
PPNC	F	Sheep	2	3	1	1	2	1	3	1	1
PPNC	F	Sheep	1	3	2	2	3	2	1	1	1
PPNC	F	Sheep	1		2			3	1		2
PPNC	F	Sheep	3	2	3			1	2		1
PPNC	F	Sheep	3	3	1	1	3	2	1		1
PPNC	F	Sheep	2		3	2	1	2	2	2	2
PPNC	F	Sheep	2	4	2	2	3	1	2		2
PPNC	F	Sheep	1	3	2	2	1	1	2	2	2
PPNC	F	Sheep	2	3	2	3	2	1	1	1	2
PPNC	fg	Goat				3	4	4	3	3	
PPNC	fg	Goat/Sheep	3	4	3	1	2	2	3	2	3
PPNC	fg	Goat/Sheep	3		3	2	2	1	3	1	
PPNC	fg	Goat/Sheep						2	2		
PPNC	fg	Goat/Sheep	4	4	4			2	3		2
PPNC	fg	Goat/Sheep	3	4	3	2	4	2	3	3	2
PPNC	fg	Sheep						1	1		
PPNC	fg	Sheep	3	4	4	1	2	4	2	2	2
PPNC	fg	Sheep	3		4	2	2	2	3	1	2
PPNC	fg	Sheep				1	3			1	
Yarmoukian	?	Goat/Sheep	2		3						
Yarmoukian	F	Goat	1		3	4	4	4	3	4	
Yarmoukian	F	Goat	2		4	2	3	3	3	3	3
Yarmoukian	F	Goat	3	3	3	4	3			4	4
Yarmoukian	F	Goat	3	4	2	3	3	4	3	4	4
Yarmoukian	F	Goat	1	3	4	4	2	4	2	4	3
Yarmoukian	F	Goat	2	3	3	4	3	2	2	4	4
Yarmoukian	F	Goat	2	4	4	3	3	4	3	4	3

Table A.2: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Humeri

Phase	Fusion	Species	B33	B34	B35	B36	U1	PF9	B15	PF10	AW1
Yarmoukian	F	Goat	3	3	4	3	2	3	2	4	2
Yarmoukian	F	Goat	2		4	4	2	4	3	2	3
Yarmoukian	F	Goat	2	2	3	3	2	3	2	3	4
Yarmoukian	F	Goat	2		4	4	2	4	3	3	3
Yarmoukian	F	Goat	2	4	3	2	3	3	2	4	4
Yarmoukian	F	Goat	2	2	4	3	4	4	4	4	3
Yarmoukian	F	Goat	3	4	2	4	3			4	4
Yarmoukian	F	Goat	2	4	4	2	3			3	4
Yarmoukian	F	Goat	3	4	3	3	4			4	4
Yarmoukian	F	Goat	2		4			3	4	4	3
Yarmoukian	F	Goat	1	2	2	4	2	4	4	4	3
Yarmoukian	F	Goat	3	4	3			4	4		4
Yarmoukian	F	Goat/Sheep	2		1	2	2	4	3	3	2
Yarmoukian	F	Goat/Sheep	1		1	3	3	4	2	3	
Yarmoukian	F	Goat/Sheep	1					1	1		
Yarmoukian	F	Goat/Sheep	1		3	1	3	4	3	3	3
Yarmoukian	F	Goat/Sheep	2					2	2		
Yarmoukian	F	Goat/Sheep	1		3			3	3		
Yarmoukian	F	Goat/Sheep	3	2	1						2
Yarmoukian	F	Goat/Sheep	1		4			2	3		
Yarmoukian	F	Goat/Sheep	2	4	2	3	3	4	3	4	
Yarmoukian	F	Goat/Sheep	2			3	3	2	2	2	
Yarmoukian	F	Goat/Sheep	2	3	1	2	4	1	3		2
Yarmoukian	F	Goat/Sheep	3	2	2	2	2	2	2	3	3
Yarmoukian	F	Goat/Sheep	3	4		3	2			3	
Yarmoukian	F	Goat/Sheep	2		2	3	1	2		3	
Yarmoukian	F	Goat/Sheep	3		2	3	3	2	3	3	
Yarmoukian	F	Goat/Sheep	2		3			4			2
Yarmoukian	F	Sheep	2	2	1	1	3	2	2	1	
Yarmoukian	F	Sheep	1		2			2			1
Yarmoukian	F	Sheep	2		2	3	2			1	
Yarmoukian	F	Sheep	3	3	1	1	3	1	2	1	3
Yarmoukian	F	Sheep	1			3	2	1	1	1	2
Yarmoukian	F	Sheep	2	1	1			2	1		1
Yarmoukian	F	Sheep	2		2	2	2	2	1	2	
Yarmoukian	F	Sheep	3		2	1	1	2	1	2	2
Yarmoukian	F	Sheep	2	3	2	1	2	3	3	1	2
Yarmoukian	F	Sheep	1	4	3	1	3	1	2	1	2
Yarmoukian	F	Sheep	2	3	2	2	2	2	2	2	1
Yarmoukian	F	Sheep	2	4	2			1	2		1
Yarmoukian	F	Sheep	3	2	3	1	3	2	2	1	1
Yarmoukian	F	Sheep	2			2	2			2	1
Yarmoukian	F	Sheep	2		2	1	2	2	3	1	2
Yarmoukian	F	Sheep	2	3	2	2	3	2	3	2	2
Yarmoukian	F	Sheep	1	3	3	2	3	2	1	1	2
Yarmoukian	F	Sheep	2	4	3	1	1	2	3	2	2
Yarmoukian	F	Sheep	3	3	2	2	2	2	1	1	
Yarmoukian	F	Sheep	2		2		3	2	3	2	1
Yarmoukian	F	Sheep	2	2	3	1	1	1	2	1	3
Yarmoukian	F	Sheep	2	3	2		2			1	1
Yarmoukian	F	Sheep	2	3	2						1
Yarmoukian	F	Sheep	3	3	2	1	1	2	2	1	2
Yarmoukian	F	Sheep	2	2	1	1	3	2	1	1	1
Yarmoukian	F	Sheep	1		1			2	2		1
Yarmoukian	F	Sheep	2	2	3	2	2	2	2	1	3
Yarmoukian	fg	Goat	3	4	4	3	4	2	2	4	3
Yarmoukian	fg	Goat/Sheep	3	3	4	3	3	2	3	2	1
Yarmoukian	fg	Goat/Sheep	3		4			2	2		2
Yarmoukian	fg	Goat/Sheep			4			2	2		

Table A.2: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Humeri

Phase	Fusion	Species	B33	B34	B35	B36	U1	PF9	B15	PF10	AW1
Yarmoukian	fg	Goat/Sheep	2	3	3			2	2		2
Yarmoukian	fg	Goat/Sheep	3		3			1	2		3
Yarmoukian	fg	Sheep	3	2	2	2	2	2	1	3	1

Table A.2: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Humeri

Phase	Fusion	Species	B904	B42	B905	B43	B906
MPPNB	F	Goat	4	3	3	3	3
MPPNB	F	Goat	4	3	4	3	2
MPPNB	fg	Goat	4	4	4	4	1
MPPNB	fg	Goat/Sheep	3	2	4	2	1
MPPNB	uf	Goat	3	3	3	4	1
MPPNB	uf	Goat	3	2	4	3	1
MPPNB	uf	Goat	4	4	4		
MPPNB	uf	Goat	3	3	4	3	1
MPPNB	uf	Goat	3	3	4	2	1
MPPNB	uf	Goat	4	3	3	4	1
MPPNB	uf	Goat	3	2	3	2	1
MPPNB	uf	Goat	4	2	3	2	1
MPPNB	uf	Goat	4	4	3	4	1
MPPNB	uf	Goat	3	3	4	3	1
MPPNB	uf	Goat	2	3	4	3	1
LPPNB	F	Sheep	2	2	2	3	1
LPPNB	uf	Goat	3	3	4	3	2
LPPNB	uf	Goat	4	4	3	4	2
LPPNB	uf	Sheep	1	2	1	2	1
LPPNB	uf	Sheep	1	1	1	2	1
LPPNB	uf	Sheep	1	1	1	2	2
LPPNB/PPNC	F	Sheep	1	1	2	1	1
LPPNB/PPNC	F	Sheep	2	2	2	2	1
LPPNB/PPNC	fg	Sheep	2	1	1	1	1
LPPNB/PPNC	uf	Goat	3	4	4	4	1
LPPNB/PPNC	uf	Goat	3	3	4		2
PPNC	F	Goat	4	3	3	3	2
PPNC	F	Goat	4	4	3	3	3
PPNC	F	Goat	4	3	4	3	1
PPNC	F	Goat	3	4	4	3	1
PPNC	F	Goat	4	4	3	4	1
PPNC	F	Sheep	1	2	1	2	1
PPNC	F	Sheep	2	1	1	3	1
PPNC	F	Sheep	2	1	2	2	1
PPNC	F	Sheep	3	2	2	2	1
PPNC	F	Sheep	2	1	1	1	1
PPNC	F	Sheep	1	2	1	1	1
PPNC	F	Sheep		2	2	3	1
PPNC	F	Sheep	2	1	1	1	1
PPNC	F	Sheep	1	2	1	2	1
PPNC	F	Sheep	1	1	1	2	1
PPNC	F	Sheep	2	1	1	1	1
PPNC	uf	Goat	3	3	3	4	1
PPNC	uf	Goat	4	3	4	3	1
PPNC	uf	Goat	4	4	4		
PPNC	uf	Sheep	1	1	1		1
PPNC	uf	Sheep	2	3	1	2	1
PPNC	uf	Sheep	1	1	1	1	1
PPNC	uf	Sheep	1	1	1	2	1
PPNC	uf	Sheep	1	2	1	2	1
PPNC	uf	Sheep	1	1	1	2	1
PPNC	uf	Sheep	1	1	1	2	1
PPNC	uf	Sheep	1	1	1	2	1
PPNC	uf	Sheep	1	2	1	2	1
PPNC	uf	Sheep	1	2	1	1	1
PPNC	uf	Sheep	2	1	2	2	1
Yarmoukian	F	Goat	3	3	3	3	3
Yarmoukian	F	Sheep	2	2	1	3	1
Yarmoukian	F	Sheep	1	1	1	2	1

Table A.3: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Radii

Phase	Fusion	Species	B904	B42	B905	B43	B906
Yarmoukian	F	Sheep	1	1	1	2	1
Yarmoukian	F	Sheep	2	1	2	1	
Yarmoukian	F	Sheep	2	1	2	3	1
Yarmoukian	F	Sheep	1	1	2	1	1
Yarmoukian	fg	Goat	3	3	3	3	1
Yarmoukian	fg	Goat/Sheep	1			3	
Yarmoukian	uf	Sheep	2	2	1	2	1
Yarmoukian	uf	Sheep	1	2	1	1	1
Yarmoukian	uf	Sheep	1	1	2	1	1

Table A.3: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Radii

Phase	Fusion	Species	B71	B207	B208	B209
MPPNB	F	Goat		3	4	
MPPNB	F	Goat	4	3	3	
MPPNB	F	Goat	4	4	4	
MPPNB	F	Goat		3	4	
MPPNB	F	Goat	3	3	3	3
MPPNB	F	Goat	3	4	3	3
MPPNB	F	Goat	2	3	4	
MPPNB	F	Goat	3	4	4	3
MPPNB	F	Goat	3	4	3	
MPPNB	F	Goat	2	3	2	3
MPPNB	fg	Goat	4	3	4	2
MPPNB	fg	Goat	3	3	2	3
MPPNB	uf	Goat	4	3	3	
MPPNB	uf	Goat	2	2	2	
MPPNB	uf	Goat	3	4	4	
MPPNB	uf	Goat	4	4	3	
MPPNB	uf	Goat	3	3	2	
MPPNB	uf	Goat	3	4	4	
MPPNB	uf	Goat	2	3	4	
MPPNB	uf	Goat	3	4	4	
LPPNB	?	Sheep	2	2	2	
LPPNB	F	Goat	4	3	4	
LPPNB	F	Goat	3		4	
LPPNB	F	Goat	4	3	3	
LPPNB	F	Goat	4	3	3	4
LPPNB	F	Goat	4	4	4	2
LPPNB	F	Sheep	2	2	2	
LPPNB	F	Sheep	3	2	2	
LPPNB	uf	Goat		4	4	
LPPNB	uf	Goat	3	2	2	
LPPNB	uf	Goat	3	2	2	
LPPNB	uf	Goat	3	4	4	
LPPNB	uf	Goat/Sheep	2	3	1	
LPPNB	uf	Sheep	3	1		
LPPNB	uf	Sheep	3	2		2
LPPNB/PPNC	F	Goat	4	4	3	4
LPPNB/PPNC	F	Goat	3	3	2	
LPPNB/PPNC	F	Goat	3	3	2	
LPPNB/PPNC	F	Goat		3	4	
LPPNB/PPNC	F	Sheep	3	2	2	2
LPPNB/PPNC	F	Sheep	1	2	1	
LPPNB/PPNC	F	Sheep	3	3	1	
LPPNB/PPNC	F	Sheep	2	2	1	
LPPNB/PPNC	F	Sheep	3	2	2	1
LPPNB/PPNC	uf	Goat	3	3		
LPPNB/PPNC	uf	Goat		2	3	
LPPNB/PPNC	uf	Sheep	2	2	2	
LPPNB/PPNC	uf	Sheep	2	2	3	2
LPPNB/PPNC	uf	Sheep	2	1		
LPPNB/PPNC	uf	Sheep	2	3	2	
PPNC	?	Sheep	3	2		
PPNC	F	Goat	3	3	4	
PPNC	F	Goat	3	3	3	
PPNC	F	Goat	3	4	3	2
PPNC	F	Goat	2	4	3	
PPNC	F	Goat	2	1	3	4
PPNC	F	Goat	4	2	4	4
PPNC	F	Goat	4	2		
PPNC	F	Goat	3	2	3	3

Table A.4: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metacarpals

Phase	Fusion	Species	B71	B207	B208	B209
PPNC	F	Goat	3	3	3	2
PPNC	F	Goat	3	3	3	2
PPNC	F	Goat		4	3	
PPNC	F	Goat	4	4	4	
PPNC	F	Goat	3	4	4	3
PPNC	F	Sheep	2	2	3	2
PPNC	F	Sheep	3	2	2	2
PPNC	F	Sheep	3	2	2	
PPNC	F	Sheep	2	1	2	1
PPNC	F	Sheep	2	1	2	1
PPNC	F	Sheep	3	3	1	2
PPNC	F	Sheep	1	1	1	2
PPNC	F	Sheep	1	2	2	2
PPNC	F	Sheep	2	3	2	2
PPNC	F	Sheep	3	1	3	
PPNC	F	Sheep	3	2	1	
PPNC	F	Sheep	3	2	2	2
PPNC	F	Sheep	2	1	1	2
PPNC	F	Sheep	3	2	1	2
PPNC	F	Sheep	3	2	3	1
PPNC	F	Sheep	3	2	2	1
PPNC	F	Sheep	3	2	2	
PPNC	F	Sheep	3	2	2	
PPNC	F	Sheep	2	2	1	
PPNC	F	Sheep	2	1	2	
PPNC	F	Sheep	2	2	1	
PPNC	F	Sheep	2	2	1	
PPNC	F	Sheep	3	2	1	
PPNC	fg	Goat	4	2	1	
PPNC	fg	Goat	3	4	4	
PPNC	uf	Goat	4	3	4	
PPNC	uf	Goat		2	1	
PPNC	uf	Sheep	3	2	1	
PPNC	uf	Sheep	3	2	2	
PPNC	uf	Sheep	3	1	2	
PPNC	uf	Sheep	2	1	1	
PPNC	uf	Sheep	3	2	3	
PPNC	uf	Sheep		1	2	2
PPNC	uf	Sheep	3	2	1	
Yarmoukian	F	Goat	3	3	3	
Yarmoukian	F	Goat	3	3	4	
Yarmoukian	F	Goat	3	4	4	4
Yarmoukian	F	Goat	4	2	2	3
Yarmoukian	F	Goat	3	2	4	
Yarmoukian	F	Sheep	3	2	1	2
Yarmoukian	F	Sheep	4	2	1	1
Yarmoukian	F	Sheep	3	2	1	2
Yarmoukian	F	Sheep	2	2	2	2
Yarmoukian	F	Sheep	3	3	2	2
Yarmoukian	F	Sheep	3	2	1	2
Yarmoukian	F	Sheep	3	1	1	2
Yarmoukian	F	Sheep	2	1	1	1
Yarmoukian	F	Sheep	2	3	2	2
Yarmoukian	F	Sheep	3	2	1	2
Yarmoukian	F	Sheep	2	2	1	1
Yarmoukian	F	Sheep	2	2	1	2
Yarmoukian	fg	Goat	4	3	2	3
Yarmoukian	fg	Goat	3	2	4	
Yarmoukian	uf	Goat	3	4	4	

Table A.4: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metacarpals

Phase	Fusion	Species	B71	B207	B208	B209
Yarmoukian	uf	Goat	2	3	4	
Yarmoukian	uf	Sheep	2	2	2	
Yarmoukian	uf	Sheep	2	2	1	
Yarmoukian	uf	Sheep	2	1	3	

Table A.4: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metacarpals

Phase	Fusion	Species	K1	K2	K3	K4	K5	K6	K7	K8	K9	K1	K11	K12	K13	K14
MPPNB	F	Goat		2	3	4	2	3	3	4	4	3	4	3	2	4
MPPNB	F	Goat	3	3	3	3	4	4	4	3	4	2	3	3		4
MPPNB	F	Goat	4	3	2	3	1	4	3	3	4	4	4	4	1	3
MPPNB	F	Goat	3	3	3	2		4	3	4		3		3		2
MPPNB	F	Goat	4	2	3	3		3	3	3	4	3	2	3	3	2
MPPNB	F	Goat		2	2	3	3	4	4	4		3		3	3	4
MPPNB	F	Goat	4	3	2	2	4	3	4	3	4	3	2	3	2	4
MPPNB	F	Goat	4	3	3	4	3	4	4	3	4	4	4	3	3	
MPPNB	F	Goat	3	3	3	3	4	4	3	4		4	4	4	3	3
MPPNB	F	Goat	3	2	3	3	4	4	3	3	4	3	2	2	3	
MPPNB	F	Goat	4	3	3	3	2	4	3	3	4	3	3	3	4	
MPPNB	F	Goat	3	3	4	4	3	4	3	4	4	3	3	3	2	
MPPNB	F	Goat/Sheep		3	4	2	1	3	3	3	1		2	3	2	
MPPNB	fg	Goat	3	4	3		4	4	4	2	3	3		3	3	
MPPNB	fg	Goat		2	3		2	4	4					4	2	
MPPNB	fg	Goat	3	3	2	2	2		4		3	3	2	4		
MPPNB	fg	Goat/Sheep	4	4	2	2	3	4	3	2	3	3	3	3	2	
MPPNB	uf	Goat		4	3		4	4		3		4	2	3	3	
MPPNB	uf	Goat	4	3	2		3	4		3	4	3	2	3	2	
MPPNB	uf	Goat	4	4	3		3	3		4	4	3		2	3	
MPPNB	uf	Goat	4	3	3		4	4			4	4		3	2	
MPPNB	uf	Goat	3	4	4		4	4				4		3	3	
MPPNB	uf	Goat	4	3	3		4	4			3	4		4	3	
MPPNB	uf	Goat	3	4	3		4	4		3	4	3		3	1	
MPPNB	uf	Goat	4	2	2		4	4		3	3	4		4	3	
MPPNB	uf	Goat	3	3	4		1	4	3	3	3	4	2	3	2	
LPPNB	?	Sheep	3	2	3	1	2	4	1	1	2	2	1	2	1	1
LPPNB	F	Goat	3	2	3	3	2	4	3			4	2	4	2	
LPPNB	F	Goat	4			3							3			
LPPNB	F	Goat	4	3	3	3	3	3	3	2	4	3	2	3	4	3
LPPNB	F	Goat	4	3	3	3	4	4	3	3		4	2	3	2	
LPPNB	F	Goat		3	3	4		4	4	4			3	3	3	3
LPPNB	F	Goat/Sheep	2			3		2	3	2			3	1	1	3
LPPNB	F	Goat/Sheep	2	1	1	2	3	4	3	3	3		3	3	2	
LPPNB	F	Goat/Sheep	2	2	2	1	3	3	2	2	1	2	2	2	1	
LPPNB	F	Sheep		3	3	2	2	4		2		1		1	2	
LPPNB	F	Sheep	2	1	2	1	3	2	1	2	3	1	2	1	1	1
LPPNB	F	Sheep		1	2	2	2	4	3	3	2	1	3	2	2	2
LPPNB	F	Sheep		2	3	1	2	1	2	2	3	1	3	1	2	1
LPPNB	uf	Goat/Sheep	2	2	3		2	4				3	2	3	2	
LPPNB	uf	Goat/Sheep		3	3		2	4			2	3	2	3		
LPPNB	uf	Goat/Sheep	4	2	3		2	4				4	1	2	3	
LPPNB/PPNC	F	Goat	3	3	4	2	1		3		4	4	2	3		
LPPNB/PPNC	F	Goat	4	3	4	3	2	4	3		4	2	3	3	3	3
LPPNB/PPNC	F	Goat		3	3	4	3	4		4	4	2	3	4	3	
LPPNB/PPNC	F	Goat	4	4	3	2	3	4	4	4	3	4	3	4	2	
LPPNB/PPNC	F	Goat/Sheep		2	2	2	2	4	3	2	4	1	3	3	2	
LPPNB/PPNC	F	Goat/Sheep	2	1	3	3		4	3	3	3	1	1	3	2	2
LPPNB/PPNC	F	Goat/Sheep	2	1	2	2	2	2	3	3	3	3	4	2	1	
LPPNB/PPNC	F	Goat/Sheep		2	1	1	2	4	1	1			3	2	3	
LPPNB/PPNC	F	Goat/Sheep	3	1	3	3	4	3	3	3	3	1	3	1	1	2
LPPNB/PPNC	F	Goat/Sheep	3	3	1	2	3	4	2	2	2	2	3	2	2	2
LPPNB/PPNC	F	Sheep	2	1	3	1	3	4	3	2		2	2	1		
LPPNB/PPNC	F	Sheep	1	1	2	2	2	4	2	1	3		2	2	2	
LPPNB/PPNC	F	Sheep		1	2	1	1	3	2	2	2	2	1	3	3	2
LPPNB/PPNC	F	Sheep	3	2	2	1		2	1	2		1	2	1	3	
LPPNB/PPNC	F	Sheep		1	3	1	2	1	2	1	2	1	2	1	1	2
PPNC	F	Goat	4	3	3	3	2	4	4	3	4	4	4	3	3	2
PPNC	F	Goat	4	4	2	4		3	3		3	2	4			3

Table A.5: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Tibiae

Phase	Fusion	Species	K1	K2	K3	K4	K5	K6	K7	K8	K9	K1	K11	K12	K13	K14
PPNC	F	Goat	3	4	3	3	2	4	4	3	4	4	2	4	2	2
PPNC	F	Goat	4	3	4	4		4	4	3	4	3	3	3	3	2
PPNC	F	Goat	4	4	2	3	2	4	4	3	2	2	4	3	3	3
PPNC	F	Goat		3	4	2	3	4	4	3	4		2	4	3	
PPNC	F	Goat	3	3	4	3		4	3	3	4	3	4	3	3	3
PPNC	F	Goat		3	3	3		4	3	3	4	4	2	3	4	
PPNC	F	Goat	4	4	3	3	2	4	4	4	3	4	3	3	4	3
PPNC	F	Goat	3	3	3	4	3	4	4	2	3	2	4	3	4	2
PPNC	F	Goat/Sheep	3	2	4	3	1	4	3	3	4	3	3	3		2
PPNC	F	Goat/Sheep		3	2	2	3	4	2	3	4		2	3	3	2
PPNC	F	Goat/Sheep	2	2	2		2	4		3	3	3		2	1	
PPNC	F	Goat/Sheep	3	2	2		1	4	1	3	2	3	3	3	3	
PPNC	F	Goat/Sheep		1	3	2	2	1	1	2			1	1	1	
PPNC	F	Goat/Sheep		2	2	2		3	2	3		2	3	2	2	2
PPNC	F	Goat/Sheep	3	2	3	2		3	3	4	4	1	2	1	2	
PPNC	F	Goat/Sheep	3	1	1	3		4	2	3	2	3	4	4		2
PPNC	F	Goat/Sheep		2	3	2		4	3	1		2	3	2	2	1
PPNC	F	Goat/Sheep		1	3	2		4	3	3	3		1	2	2	
PPNC	F	Goat/Sheep	3	1	2	3	3	4	4	3	4	2	4	3	2	
PPNC	F	Sheep	2	1	3	3		2	2	3	2	1	3	1	2	1
PPNC	F	Sheep	2	2	3	2	1	3				2	3	1		
PPNC	F	Sheep	1	2	4	2	2	3	1	4	3	3	2	2		1
PPNC	F	Sheep		2	2	1	2	3	1	2	1	3	1	1	1	
PPNC	F	Sheep			1		4			2	4		1	2	1	1
PPNC	F	Sheep	2	1	3	2		4	1	2	1	2	2		2	
PPNC	F	Sheep	2	1	4	2	1	4	1	2	3	2	1	3	2	1
PPNC	F	Sheep	2	1	3	1	1	4	2	3		2	4	3	2	2
PPNC	F	Sheep	2	1	3	1	2	3	2	3	3	1	3	2	2	1
PPNC	F	Sheep	1	2	1	1	2	3	3	2	2	2	1	2	1	
PPNC	F	Sheep		2	2	2	1	3	2	2				1	2	2
PPNC	F	Sheep		2	3	1	2	3	2	3	2	2	3	2	3	2
PPNC	F	Sheep		3	2	1	1	2	3	2	2		2	1	2	1
PPNC	F	Sheep	2	1	2	1	2	1	1	2	1	1	1	1	2	
PPNC	F	Sheep	2	1	2	2	2	3	2	3	1	1	3	2	2	2
PPNC	F	Sheep	2	1	2			4	3	2	2		1	2	2	2
PPNC	F	Sheep	2	2	3	1	2	2	1	1	2	2	1	1	1	1
PPNC	F	Sheep		1	1	1	2	4	3	3	1	1	1	2	2	
PPNC	F	Sheep	1	2	3	1	2	3	4	3	3	2	3	1	1	
PPNC	F	Sheep			2	2	2	2	1	2	2		1	2	1	
PPNC	fg	Goat	4	3	3	2	3	4	3	3	3	3	3	3	2	2
PPNC	fg	Goat/Sheep	3	1	2			4		1	3	3	1	2	1	
PPNC	fg	Goat/Sheep		3	3	2	3	3	3	3	4	2	2	3	3	2
PPNC	fg	Goat/Sheep	2	3	3	2	1	4	3	3	3	2	3	2	2	1
PPNC	uf	Goat/Sheep	3	1	1			3		2		1	3	2	1	
PPNC	uf	Goat/Sheep	1	2	2	1	4				4	1	1	3	1	
PPNC	uf	Sheep	2	2	2		1	4		1	2	2		2	1	
PPNC	uf	Sheep		1	1		3	3		2	2		2	2	2	
PPNC	uf	Sheep			3		2	4		3	2	2		2	2	
PPNC	uf	Sheep	2	1	2			4		2	4	2	2	2	2	
Yarmoukian	F	Goat		3	4	3	2	4	3	4	4		2	3	3	2
Yarmoukian	F	Goat	4	3	2	3	1	3	4	3	4	2	3	2	3	3
Yarmoukian	F	Goat	3	3	4	3		3	3	4	3	3	2	2	4	3
Yarmoukian	F	Goat			4	3		4		3	4	3	3	3	3	
Yarmoukian	F	Goat		4	4	3	1	4	3	3	4	4	2	4	2	2
Yarmoukian	F	Goat/Sheep		3		2	2	3	3			3	3	3		
Yarmoukian	F	Goat/Sheep		2	3	4	2	2	2	3			4	1	2	
Yarmoukian	F	Goat/Sheep	3	2	4	3		4	4	2		3	3	2		2
Yarmoukian	F	Goat/Sheep	4	4	2	2			2	4	4	3	3	2	2	3
Yarmoukian	F	Goat/Sheep	2		1	3		4			3	2	4	3	2	2

Table A.5: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Tibiae

Phase	Fusion	Species	K1	K2	K3	K4	K5	K6	K7	K8	K9	K1	K11	K12	K13	K14
Yarmoukian	F	Goat/Sheep	4	3	2	2		3	2			1	4	1	3	3
Yarmoukian	F	Goat/Sheep		3	4	2		2	3	4	3	3	2	3	3	
Yarmoukian	F	Goat/Sheep			3	3	1		3	3			4	3	2	
Yarmoukian	F	Goat/Sheep			2	1		4	4		3		3	3	2	
Yarmoukian	F	Goat/Sheep		2	4	2		4	2	1		3	4		2	
Yarmoukian	F	Goat/Sheep	3	3	2	2	2	3	3	2		2	1		3	
Yarmoukian	F	Sheep	3	2	1	2	2	2	2	3		1	2	2		1
Yarmoukian	F	Sheep	2	1	2	2	1	3	2	3	2	2	1	1	2	
Yarmoukian	F	Sheep		2	3	1	2	2	2	1		1	1	2		
Yarmoukian	F	Sheep	2	2	1	1	1	2	2	3		2	2	2	1	1
Yarmoukian	F	Sheep		2	1	1	2	3	2	2	3		3	3	2	2
Yarmoukian	F	Sheep		2	4	2	3	4	2	1	3	2	1	1	2	
Yarmoukian	F	Sheep		2	3	2		3	2	3	3		1	2	2	2
Yarmoukian	F	Sheep	2	1	3	2		2	2	2	4	2	1	2		1
Yarmoukian	F	Sheep		2	1	1		4	3	1	3	2	1	3	1	1
Yarmoukian	F	Sheep		2	2	1		4	2	1	1	1	1	3	1	
Yarmoukian	F	Sheep	2	1	2			2	3	2		2	2	1	3	
Yarmoukian	F	Sheep	1			2		3	1	2	2		2	2	2	1
Yarmoukian	F	Sheep		1	3	3		4	3	2		2	2	2	2	
Yarmoukian	F	Sheep	2	1	4	2	1	2	1	2	4	2	3	1	2	1
Yarmoukian	uf	Goat/Sheep	4	3	3		1	4	2	3			3	2	3	3
Yarmoukian	uf	Goat/Sheep	3	2	1		4	2	2	2	3	3	2	3		

Table A.5: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Tibiae

Phase	Species	B51	B62	B63	B64	PF26	PF27	PF28
MPPNB	Goat	4	3	4	3	2	2	4
MPPNB	Goat	4	3	2	2	3	3	4
MPPNB	Goat	4	3	3	2	3	3	
MPPNB	Goat	4	4	3	3	2	4	4
MPPNB	Goat	3	4	3	3	4	4	4
MPPNB	Goat	4	4	3	3	4	4	4
MPPNB	Goat	4	4	3	4	3	3	
MPPNB	Goat	3	3	1	3	3	2	4
MPPNB	Goat	4	3	2	4	4	3	4
MPPNB	Goat	4	3		4	4	2	
MPPNB	Goat	4	2	2	4	3	3	4
MPPNB	Goat	4	4	3	3	3	2	4
MPPNB	Goat	4	3	4	2	2	2	4
MPPNB	Goat	4	4	4	3	4	3	4
MPPNB	Goat	4	3	2	3	3	4	4
MPPNB	Goat	3	4	3	4	3	2	4
MPPNB	Goat	4	3	4	4	3	4	1
MPPNB	Goat	4	3	3	4	2	4	1
MPPNB	Goat	4	3		4	3	3	
MPPNB	Goat	3	4	4		3	3	4
MPPNB	Goat	4	4	3	3	3	3	4
MPPNB	Goat	3	4	3	4	3	3	4
MPPNB	Goat		3	3	3	2		4
MPPNB	Goat	3	3	3	4	2	2	4
MPPNB	Goat	3		4	4		2	4
MPPNB	Goat		3	4	4	2		4
MPPNB	Goat		3			2		
MPPNB	Goat	3	3	2	3	2	3	1
MPPNB	Goat	4	3		4	3	2	
MPPNB	Goat	4	3	3	4	2	3	4
MPPNB	Goat			3	4			4
MPPNB	Goat	3	3	3	3	3		
MPPNB	Goat	3			4			
MPPNB	Goat			2				4
MPPNB	Goat		3		4			
MPPNB	Goat	4						4
MPPNB	Goat	4	4	1	3	3	4	4
MPPNB	Goat	4	4	3	3	3	4	4
MPPNB	Goat		4	2	3			4
MPPNB	Goat		4	4	4	3		4
MPPNB	Goat	4	4	2	4	3	4	1
MPPNB	Goat	3			4			
MPPNB	Goat	3		3	4			4
MPPNB	Goat			3	3			
MPPNB	Goat	4	4	4	3	3	4	4
MPPNB	Goat	4	3	4	4	4		
MPPNB	Goat		3	2	3	4		4
MPPNB	Goat		4	3	3	2	4	4
MPPNB	Goat	4	4	4	3	3	4	4
MPPNB	Goat	3	3	2	3	2	3	4
MPPNB	Goat/Sheep		2			2		
MPPNB	Sheep	1	2	1	1	2	2	1
LPPNB	Goat	3	4	2	3	3	2	4
LPPNB	Goat	4	4	3	3	2	4	4
LPPNB	Goat		3	2	4	2		
LPPNB	Goat		3	4	4	2		4
LPPNB	Goat	4	4	3	2	4	3	4
LPPNB	Goat	3	4	4	3	2	3	4
LPPNB	Goat	3		3	4			4

Table A.6: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Astragali

Phase	Species	B51	B62	B63	B64	PF26	PF27	PF28
LPPNB	Goat	3	4	3	3	4		4
LPPNB	Goat	4		3	4		4	4
LPPNB	Goat	4	4	3	3	4	4	4
LPPNB	Goat	3	2	4	4		2	4
LPPNB	Goat	3	3	3	4	2	2	4
LPPNB	Goat/Sheep	2	3	3	3	2		4
LPPNB	Goat/Sheep	2	2	1	3	1	3	1
LPPNB	Sheep	1	1	2	2	1		1
LPPNB	Sheep	1	2	3	2	2	3	1
LPPNB	Sheep	2	1		1	1		
LPPNB	Sheep	1	2	2	1	3	1	1
LPPNB	Sheep	3	1	2	2	2	3	1
LPPNB	Sheep	2	1	2	2	1	2	3
LPPNB	Sheep	2	1	1	2	1	2	1
LPPNB/PPNC	Goat	4	4	2	3	3	3	4
LPPNB/PPNC	Goat	3	4	2	3	2	3	4
LPPNB/PPNC	Goat	4	3	3	3	2	4	4
LPPNB/PPNC	Goat	3	3	3	4	2	3	4
LPPNB/PPNC	Sheep	3	1	1		2	2	1
LPPNB/PPNC	Sheep	2	2	1	2	3	1	1
LPPNB/PPNC	Sheep	2	2	2	1	3	2	2
LPPNB/PPNC	Sheep	2	2	2	1	2		1
LPPNB/PPNC	Sheep	2	1	2	2	1	2	1
LPPNB/PPNC	Sheep	1	1	2	2	1	3	1
LPPNB/PPNC	Sheep	1	1	1	2	1	2	1
LPPNB/PPNC	Sheep	2	1	2	1	1	2	1
LPPNB/PPNC	Sheep	1	2	2	1	1	2	1
PPNC	Goat		3	3	2	2		4
PPNC	Goat	4	4	2	3	3	4	3
PPNC	Goat	4	3	3	3	4	4	4
PPNC	Goat	4	4	2	4	3	4	
PPNC	Goat	4	2	3	4	2	4	4
PPNC	Goat	4	2	3	3	2	4	
PPNC	Goat	4	3	3	4	4	4	4
PPNC	Goat	4	4		4	3	3	
PPNC	Goat			3	4			4
PPNC	Goat	4	4	2	3	3	4	4
PPNC	Goat	3	2	3	3	3	3	4
PPNC	Goat	3	3	2	3	2	3	
PPNC	Goat	4	3	2	4	2	4	4
PPNC	Goat	3	4	3	4	4	3	4
PPNC	Goat	4	3	3		3	4	4
PPNC	Goat	4	4	2	3	4	3	4
PPNC	Goat		4	4	3	3		
PPNC	Goat	4	3	3	3	4	4	3
PPNC	Goat	4	3	4	4	2	4	4
PPNC	Goat	4	4	4	4	4	4	3
PPNC	Goat	4	4	2	3	2	4	4
PPNC	Goat	3	3	3	4	4	3	4
PPNC	Goat	4	4	2	4	4	4	4
PPNC	Goat	3	4	2	3	3	4	4
PPNC	Goat	3	3	3	3	3	3	4
PPNC	Goat/Sheep	3	3		1	2	2	1
PPNC	Goat/Sheep				2			1
PPNC	Goat/Sheep	4	2		3		2	
PPNC	Goat/Sheep		1	1				
PPNC	Goat/Sheep		3			4		
PPNC	Goat/Sheep			2	4			4
PPNC	Goat/Sheep	2	2	3	3			4

Table A.6: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Astragali

Phase	Species	B51	B62	B63	B64	PF26	PF27	PF28
PPNC	Goat/Sheep			3				4
PPNC	Goat/Sheep	3	3	2	2	1	2	1
PPNC	Goat/Sheep	2	2	3	1		2	1
PPNC	Goat/Sheep	2	1	3		1	2	
PPNC	Goat/Sheep	1	3	1		3		1
PPNC	Goat/Sheep	2	3	1	2	2	3	4
PPNC	Sheep	1	1	2	2	1	2	1
PPNC	Sheep	2	1		2	1	3	
PPNC	Sheep	1	2	1	2	2	2	4
PPNC	Sheep	1	3	1	1	2	3	4
PPNC	Sheep	1	1	2	3	1	2	1
PPNC	Sheep	1	1	1	1	1	2	1
PPNC	Sheep	2		1	2		1	4
PPNC	Sheep	1	1	2		1		1
PPNC	Sheep	2	1	1	2	1	2	1
PPNC	Sheep	2	2	1		1		1
PPNC	Sheep	1	1	1	1	1		
PPNC	Sheep	2	1	2	2	1	1	
PPNC	Sheep	1	1	1	1	1	2	1
PPNC	Sheep	2	2	1	2	2	2	1
PPNC	Sheep	2	2		3	2	1	
PPNC	Sheep	1	1	1	2	1	2	1
PPNC	Sheep	2	1	1	1	1	2	1
PPNC	Sheep	1	1	2	1	1	2	1
PPNC	Sheep	3	1	2	2		3	1
PPNC	Sheep	2	2	1	2	1	2	1
PPNC	Sheep	2	2	1	2	2	2	1
PPNC	Sheep	3	1	1	1	1	3	1
PPNC	Sheep	1	1	1	1	1	2	1
PPNC	Sheep	2	1	1	1	1	2	1
PPNC	Sheep	1	1	2	1	1	2	1
PPNC	Sheep		1	1	1	1		1
PPNC	Sheep		1	1				1
PPNC	Sheep	2	2	1	2	2	2	1
PPNC	Sheep	1	2	2	1	2	1	1
PPNC	Sheep	1	2	1	2		2	1
PPNC	Sheep	2	2		1	1	1	
PPNC	Sheep	2	3	2	2	1	2	
PPNC	Sheep	2	1	1	1	1	2	1
PPNC	Sheep	2	2	1	3	2	2	1
PPNC	Sheep	2	2	2	1	1	2	1
PPNC	Sheep		1	3	2	1		
PPNC	Sheep	3	2	1	2	1	3	2
PPNC	Sheep	2	2	2	1	3	3	1
PPNC	Sheep		1	2	1	1		1
PPNC	Sheep	3	2	1	3	2	2	1
PPNC	Sheep	1	2	1	1	1	2	1
PPNC	Sheep	2	2	2	1	2	1	1
PPNC	Sheep	1		1	2			1
PPNC	Sheep	3	2	2	1	1	3	1
PPNC	Sheep	1	1	3	1	1	2	1
Yarmoukian	Goat	4	4	3	4	2	4	4
Yarmoukian	Goat	3	3	3	3		4	4
Yarmoukian	Goat	3	3	3	4	2	3	4
Yarmoukian	Goat	3		4	4		3	4
Yarmoukian	Goat	3	2	3	3	3	3	4
Yarmoukian	Goat		3	3	3	3		4
Yarmoukian	Goat	3	4	2	2	4	4	
Yarmoukian	Goat	3	3	3	4	3	4	4

Table A.6: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Astragali

Phase	Species	B51	B62	B63	B64	PF26	PF27	PF28
Yarmoukian	Goat	4	4	4	4	2	3	4
Yarmoukian	Goat	3	3	4	4	3	2	4
Yarmoukian	Goat	4	4	2	3	3	4	3
Yarmoukian	Goat	3	4	3	4	4	4	2
Yarmoukian	Goat/Sheep	4	2	4	3	3	3	1
Yarmoukian	Goat/Sheep		3	2		3		1
Yarmoukian	Goat/Sheep		2	3	3	2		4
Yarmoukian	Goat/Sheep	3	2	1	3	3	3	
Yarmoukian	Goat/Sheep	4		3	2		4	2
Yarmoukian	Sheep	1	1	2	1	1	2	1
Yarmoukian	Sheep	1	2	1	1	1	1	1
Yarmoukian	Sheep	2	3	2	1	2	2	1
Yarmoukian	Sheep	1	1	1	2	1	1	1
Yarmoukian	Sheep	2	2	1		1	2	1
Yarmoukian	Sheep	1	2	2	1	1	2	2
Yarmoukian	Sheep	2	1	2	2	1	3	1
Yarmoukian	Sheep	1	1	1	2	1	2	1
Yarmoukian	Sheep	2	2	1	2	1	1	1
Yarmoukian	Sheep	2	2	1	1	2	3	1
Yarmoukian	Sheep	1	1	2	1	1		1
Yarmoukian	Sheep	1	1	1	1	1	2	
Yarmoukian	Sheep	1	2	1	1	1		1
Yarmoukian	Sheep	3	1	3	1	1	3	1
Yarmoukian	Sheep	3	2	2	2		3	
Yarmoukian	Sheep	2	1	2	1	1	2	1
Yarmoukian	Sheep	1	2	2	2	1	2	1
Yarmoukian	Sheep	1	2	1	2	1	2	1
Yarmoukian	Sheep	3	2	1	1		2	1
Yarmoukian	Sheep	3	1	2	1	1	2	1
Yarmoukian	Sheep		1	1	2	2		1
Yarmoukian	Sheep		1	2	2			1
Yarmoukian	Sheep		2	1		1		4
Yarmoukian	Sheep	2	2	2	1	2	3	4
Yarmoukian	Sheep	1	1	2	1	1	3	1
Yarmoukian	Sheep	2	1	1	1	1		1
Yarmoukian	Sheep	2		1	2			1
Yarmoukian	Sheep	1	2	1	1	2	4	1

Table A.6: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Astragali

Phase	Fusion	Species	B65	B66	B68	B401	B402	B403	PF29	PF30
MPPNB	?	Goat		4	4					4
MPPNB	?	Goat			4					4
MPPNB	?	Goat			3				3	
MPPNB	F	Goat	4		3	3	3	3	4	4
MPPNB	F	Goat	4	3	4	4	3	4	4	4
MPPNB	F	Goat	2	4	4	4	3	4	4	3
MPPNB	F	Goat	3	4	4	4	2	4	4	4
MPPNB	F	Goat	3	3	4	3	4	2	3	4
MPPNB	F	Goat	4	3	4	4	3	3	3	4
MPPNB	F	Goat	4			3	3	3	4	
MPPNB	F	Goat	3	3	4	3	4	3	4	4
MPPNB	F	Goat/Sheep		3	1	3	1	2	3	1
MPPNB	uf	Goat		3	4	4	3	3	4	4
MPPNB	uf	Goat		3	3				3	4
MPPNB	uf	Goat		3	3	3	1	2	3	3
MPPNB	uf	Goat		4	4	3	2	3	3	3
MPPNB	uf	Goat		4	3		3	2	3	3
MPPNB	uf	Goat		3	4	3	1	2	3	4
MPPNB	uf	Goat		4	4	3	2	2	3	4
MPPNB	uf	Goat		4	4	4	2	4	4	4
MPPNB	uf	Goat			4	2	2	3	4	4
MPPNB	uf	Goat		4	4			3		4
MPPNB	uf	Goat/Sheep			3	3	2	1	2	3
MPPNB	uf	Goat/Sheep				2	1	2	3	
MPPNB	uf	Goat/Sheep				2	3	2	2	
MPPNB	uf	Goat/Sheep		4	2	2	2	2	3	3
LPPNB	?	Goat		4	4					4
LPPNB	?	Goat		4	4					4
LPPNB	?	Goat/Sheep		3						3
LPPNB	F	Goat	2			4	3	4	4	
LPPNB	F	Goat	3	4	4	4	3	4	4	4
LPPNB	F	Goat	4	3	4	3	3	4	4	3
LPPNB	fg	Goat	2	4	3	4	2	4	3	4
LPPNB	fg	Goat/Sheep	3			2			2	
LPPNB	uf	Goat		3	4	3	3	4	4	4
LPPNB	uf	Goat/Sheep					1		3	2
LPPNB	uf	Goat/Sheep		3	4	2	2	3	2	4
LPPNB	uf	Sheep			1	2	2	2	2	2
LPPNB	uf	Sheep		1	1	3	1	2	2	3
LPPNB/PPNC	?	Sheep		2	2					2
LPPNB/PPNC	F	Goat/Sheep	3	1		4	2	4	3	
LPPNB/PPNC	F	Sheep	2		1	3	1	3	2	2
LPPNB/PPNC	uf	Goat/Sheep		2				3	3	3
LPPNB/PPNC	uf	Sheep				1	1	2	3	
PPNC	?	Goat		4	3					4
PPNC	?	Goat		3	4					3
PPNC	?	Goat/Sheep		3	3					
PPNC	?	Sheep		1	1					3
PPNC	?	Sheep		2	1					1
PPNC	?	Sheep		2	1					
PPNC	?	Sheep		2	2		1	2		1
PPNC	F	Goat	3	4	4	4	2	3	3	3
PPNC	F	Goat	4	3	4	4	4	4	4	4
PPNC	F	Goat	3	4	4	3	2	4	4	4
PPNC	F	Goat	3	2	4	3	2	4	4	4
PPNC	F	Goat	3	4	3	3	2	3	3	4
PPNC	F	Goat	4	4	4	3	2	3	3	4
PPNC	F	Goat			4	3	2	3	4	4
PPNC	F	Goat/Sheep	3	3	1	4	2	3	3	1

Table A.7: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Calcanea

Phase	Fusion	Species	B65	B66	B68	B401	B402	B403	PF29	PF30
PPNC	F	Goat/Sheep	2			3	3	4	3	
PPNC	F	Sheep	1	3	4	2	2	1	1	
PPNC	F	Sheep	2	1	1	3	2	2	2	1
PPNC	F	Sheep	2	1	1	2	2	3	3	1
PPNC	F	Sheep	2	2	3	1	2	2	2	
PPNC	F	Sheep	2	1	1	3	1	3	2	1
PPNC	F	Sheep	2	1	2	3	1	3	2	3
PPNC	F	Sheep	3	2	2	2	2	3	2	2
PPNC	F	Sheep		2	3		2	3	2	2
PPNC	F	Sheep	2	2	2	3	1	3	2	1
PPNC	F	Sheep	3	1	3	3	2	3	1	2
PPNC	F	Sheep	2	2	1	3	1	2	2	2
PPNC	F	Sheep	2	2	1	2	1	3	4	1
PPNC	uf	Goat		4	4	3	2	3	3	3
PPNC	uf	Goat		3	4		3	2	2	4
PPNC	uf	Goat		4	3	2	2	2	3	4
PPNC	uf	Goat/Sheep				2	2	2	3	
PPNC	uf	Goat/Sheep				2	1	2	2	
PPNC	uf	Goat/Sheep		1	1					1
PPNC	uf	Goat/Sheep		2	3		3	2	1	3
PPNC	uf	Sheep		3	2	2	1	2	1	1
PPNC	uf	Sheep		3	1	2	2	1	1	1
PPNC	uf	Sheep			1	1	1	1	1	1
PPNC	uf	Sheep			2	2	2	1	2	2
PPNC	uf	Sheep			2	1	1	1	2	2
PPNC	uf	Sheep		2	3	1	1	2	3	3
PPNC	uf	Sheep		1	2	2	2	1	1	3
PPNC	uf	Sheep				2	2		2	3
Yarmoukian	?	Goat		3	4					3
Yarmoukian	?	Goat/Sheep		2	2					3
Yarmoukian	?	Sheep		3	1					1
Yarmoukian	F	Goat			4	3	2	3	3	4
Yarmoukian	F	Goat	3	3	4	4	4	4	3	3
Yarmoukian	F	Goat	2	3	4	2	1	3	3	4
Yarmoukian	F	Goat	4	4	3	4	2	4	3	3
Yarmoukian	F	Goat	3			4	3	4	4	3
Yarmoukian	F	Goat/Sheep	2	3		3	2	2	2	2
Yarmoukian	F	Goat/Sheep	3	4		3	2	4	3	3
Yarmoukian	F	Sheep	3	1	1	4	1	3	2	1
Yarmoukian	F	Sheep	2	2	1	2	3	1	3	1
Yarmoukian	F	Sheep	2		2	2	2	2	2	1
Yarmoukian	F	Sheep	2	1	1	3	2	2	2	1
Yarmoukian	F	Sheep	2	1	1	2		3	3	2
Yarmoukian	F	Sheep	2	1	3	3	1	3	2	3
Yarmoukian	F	Sheep	1			3	2	2	2	
Yarmoukian	F	Sheep	3	2	1	4	2	3	1	1
Yarmoukian	F	Sheep	3	2	1	3	1	3	2	1
Yarmoukian	F	Sheep	3	2	2	3	1	2	2	1
Yarmoukian	uf	Goat/Sheep		4		2	1	2	3	3
Yarmoukian	uf	Goat/Sheep			2	2	1	1	2	2
Yarmoukian	uf	Goat/Sheep		3	4	2	3	2	2	4
Yarmoukian	uf	Goat/Sheep		3	3	3	1	2	3	3
Yarmoukian	uf	Goat/Sheep		3	2		2	2	2	3
Yarmoukian	uf	Sheep		2	1	2	1	2	2	1
Yarmoukian	uf	Sheep		3	1		1	2	1	1
Yarmoukian	uf	Sheep		3	1		2	1	1	1

Table A.7: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Calcanea

Phase	Fusion	Species	B305	B306	B307	B308	B309
MPPNB	?	Goat	3	3			
MPPNB	F	Goat	3	2	3	2	3
MPPNB	F	Goat	3	4	2	2	3
MPPNB	F	Goat	4	4	2	3	3
MPPNB	F	Goat	4	3	3	2	3
MPPNB	F	Goat	4	4	2	2	3
MPPNB	F	Goat	3	4	3	3	3
MPPNB	F	Goat	3	4	3	2	2
MPPNB	F	Goat	3	4	3	2	4
MPPNB	F	Goat	4	4	3	2	3
MPPNB	F	Goat	4	3	3	2	3
MPPNB	F	Goat	3	3		2	
MPPNB	F	Goat	4	4	3	2	4
MPPNB	F	Goat	3	2		2	
MPPNB	F	Goat	2	4			
MPPNB	F	Goat	3	2	3	3	3
MPPNB	F	Goat	3	3	3	2	4
MPPNB	fg	Goat	3	3	4	2	3
MPPNB	fg	Goat	2	3	4		4
MPPNB	fg	Goat	3	2	3	3	2
MPPNB	uf	Goat	3	3			
MPPNB	uf	Goat	4	3			
MPPNB	uf	Goat	3	4			
MPPNB	uf	Goat	4	2			
MPPNB	uf	Goat	3	3	2		
MPPNB	uf	Goat	2	2	3	2	
LPPNB	F	Goat	3	3	3		2
LPPNB	F	Goat	4	2	3	2	3
LPPNB	F	Goat	3	2	4	3	3
LPPNB	F	Goat	3	2	4	3	
LPPNB	F	Goat	3	2	3	3	4
LPPNB	F	Goat	4	3	3	4	3
LPPNB	fg	Goat	3	2	2		
LPPNB	uf	Goat	4	3			
LPPNB	uf	Goat	4	2			
LPPNB	uf	Goat	2	4			
LPPNB	uf	Goat	4	2	3		
LPPNB	uf	Goat	3	2	2		
LPPNB/PPNC	?	Sheep	2	1	2		
LPPNB/PPNC	F	Goat	3		3		2
LPPNB/PPNC	F	Goat	3	2	4	2	3
LPPNB/PPNC	F	Goat	4	3	3		
LPPNB/PPNC	F	Goat	3	2	3		3
LPPNB/PPNC	F	Sheep	2	2	1	1	1
LPPNB/PPNC	F	Sheep	2	2	2	1	1
LPPNB/PPNC	F	Sheep	3	1	2	1	
LPPNB/PPNC	F	Sheep	2	2	1		
LPPNB/PPNC	uf	Goat	3	2	3		
LPPNB/PPNC	uf	Sheep	2	1	2		
LPPNB/PPNC	uf	Sheep	3	2			
PPNC	F	Goat	2	4	3	3	4
PPNC	F	Goat	4	3	3	2	3
PPNC	F	Goat	3	3	3		4
PPNC	F	Goat	4	3	4		3
PPNC	F	Goat	4	3	4		3
PPNC	F	Goat	2	4			
PPNC	F	Goat	4	2	3	2	
PPNC	F	Goat	4	2	3	3	
PPNC	F	Goat	4	4	3	2	2

Table A.8: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metatarsals

Phase	Fusion	Species	B305	B306	B307	B308	B309
PPNC	F	Sheep	3	1	2	1	2
PPNC	F	Sheep	2	1			
PPNC	F	Sheep	3	1	2	1	1
PPNC	F	Sheep	3	3	1	2	1
PPNC	F	Sheep	3	2	2	2	1
PPNC	F	Sheep	2	2	1	1	1
PPNC	F	Sheep	2	1	1		1
PPNC	F	Sheep	2	1	3		
PPNC	F	Sheep	3	1	2		
PPNC	F	Sheep	2	2	1		
PPNC	F	Sheep	3	1	2		1
PPNC	F	Sheep	3	1	2	2	2
PPNC	F	Sheep	2	1	2		1
PPNC	F	Sheep	3	1	1	2	1
PPNC	F	Sheep	3	2	2	2	2
PPNC	F	Sheep	2	1	2	2	2
PPNC	F	Sheep	2	1	2	1	1
PPNC	fg	Goat	3	3	2	3	4
PPNC	uf	Goat	3	3	3		
PPNC	uf	Goat	3	2	4		
PPNC	uf	Goat	4	3	4		
PPNC	uf	Sheep	2	2	2		
PPNC	uf	Sheep	2	2			
PPNC	uf	Sheep	2	1	2		
PPNC	uf	Sheep	2	2	1		
PPNC	uf	Sheep	3	1	2		
PPNC	uf	Sheep	3	1	1	2	
PPNC	uf	Sheep	2	2			
PPNC	uf	Sheep	3	1	1		
Yarmoukian	F	Goat	3	3	2	2	4
Yarmoukian	F	Goat	3	4	3	2	4
Yarmoukian	F	Goat	3	4	3	2	2
Yarmoukian	F	Goat	4	3	4	3	4
Yarmoukian	F	Goat	3	3	2	3	3
Yarmoukian	F	Goat	3	3	3	2	4
Yarmoukian	F	Goat	2	1	3	3	3
Yarmoukian	F	Goat	4	3	3	4	3
Yarmoukian	F	Goat	4	4	4		
Yarmoukian	F	Sheep	3	3	2	2	1
Yarmoukian	F	Sheep	2	2	2	2	1
Yarmoukian	F	Sheep	2	1	3		
Yarmoukian	F	Sheep	3	2	2		1
Yarmoukian	F	Sheep	1	2	2	1	1
Yarmoukian	F	Sheep	2	1	1		
Yarmoukian	F	Sheep	2	2	1	3	1
Yarmoukian	F	Sheep	2	1	2		
Yarmoukian	F	Sheep	2	1	2	2	1
Yarmoukian	F	Sheep	3	2	2	1	2
Yarmoukian	F	Sheep	3	2	1	1	2
Yarmoukian	F	Sheep	3	2	2	2	1
Yarmoukian	F	Sheep	2	2	1	2	1
Yarmoukian	F	Sheep	1	1	1	1	1
Yarmoukian	uf	Goat	3	2	4		
Yarmoukian	uf	Goat	2	3	2		
Yarmoukian	uf	Goat	4	3	2		
Yarmoukian	uf	Goat	4	2			
Yarmoukian	uf	Goat/Sheep	2	2	3		
Yarmoukian	uf	Sheep	2	3			
Yarmoukian	uf	Sheep	2	1			

Table A.8: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metatarsals

Phase	Fusion	Species	B305	B306	B307	B308	B309
Yarmoukian	uf	Sheep	3	2			
Yarmoukian	uf	Sheep	3	3	1	2	

Table A.8: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Metatarsals

Phase	Fusion	Species	B500	B73	B501	B502	B75	B74	B76
MPPNB	?	Goat/Sheep	2	2	2				
MPPNB	F	Goat	3	3	4	3	4	1	2
MPPNB	F	Goat	3	3	3	3	4	2	2
MPPNB	F	Goat	3	3	4	4	4	2	2
MPPNB	F	Goat	4	3	4	2	3	1	2
MPPNB	F	Goat	3	4	3	3	2	3	2
MPPNB	F	Goat	2			4	4	3	2
MPPNB	F	Goat	4	4	4	4	3	1	3
MPPNB	F	Goat	2	2		3	3	2	2
MPPNB	F	Goat	3	3		3	4	3	2
MPPNB	F	Goat	3	3	4	4	3	3	2
MPPNB	F	Goat	4	4	4	3	4	1	4
MPPNB	F	Goat	4	3	2	4	4	1	3
MPPNB	F	Goat	3	4	4	4	4	2	2
MPPNB	F	Goat				4	4	2	3
MPPNB	F	Goat	4	3	4	3	4	2	
MPPNB	F	Goat	3			2	4	3	4
MPPNB	F	Goat	3	3	4	3	4	2	3
MPPNB	F	Goat	3	4	3	2	3	2	2
MPPNB	F	Goat	3	4	4	4	2	3	2
MPPNB	F	Goat	3	4	2	2	4	2	2
MPPNB	F	Goat	3	3	4	4	4	2	2
MPPNB	F	Goat	4	3	4	3	2	2	3
MPPNB	F	Goat				3	4	3	3
MPPNB	F	Goat	3			2	4	2	4
MPPNB	F	Goat	2	3	2	4	2	2	3
MPPNB	F	Goat	4	4	3	3	4	2	2
MPPNB	F	Goat	3	3	3	2	4	3	2
MPPNB	F	Goat	3	3	2	2	3	1	2
MPPNB	F	Goat	3	3	2	3			
MPPNB	F	Goat	3	4	4	2	4	2	3
MPPNB	F	Goat				3	3	2	2
MPPNB	F	Goat	3	3	3	2	3	3	3
MPPNB	F	Goat	4	3	4	3	3	2	
MPPNB	F	Goat	4	3	4	3	4	2	2
MPPNB	F	Goat	3	3	2	3	4	3	3
MPPNB	F	Goat	4	4	4	2	3	1	2
MPPNB	F	Goat	2	3	4	2	2	3	1
MPPNB	F	Goat	3	4	4	4	3	3	
MPPNB	F	Goat	4	4	3	2	4	3	3
MPPNB	F	Goat	4	3			4	1	3
MPPNB	F	Goat	2	3		4	4	2	3
MPPNB	F	Goat	3	4	3	3	4	2	3
MPPNB	F	Goat	4	3	3				
MPPNB	F	Goat	3	4	4	4		3	
MPPNB	F	Goat	3	3	3	4	4	4	3
MPPNB	F	Goat	3	3	3	4	4	3	4
MPPNB	F	Goat	4	3	3	3	4	3	3
MPPNB	F	Goat	3	2		3	4	2	2
MPPNB	F	Goat	2	3	2	3	3	3	3
MPPNB	F	Goat	3	3	3	2	3	2	4
MPPNB	F	Goat	2	2	3	3	4	3	3
MPPNB	F	Goat	2	3	3	4	3	3	3
MPPNB	F	Goat	3	4	3	3	4	2	
MPPNB	F	Goat	3	3	4	4	4	3	2
MPPNB	F	Goat	3	4	3	3	4	2	3
MPPNB	F	Goat	3	3	4	3	4	2	4
MPPNB	F	Goat	2	4	3	2	3	3	3
MPPNB	F	Goat	2	3	3	3	3	3	2

Table A.9: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine First Phalanges

Phase	Fusion	Species	B500	B73	B501	B502	B75	B74	B76
MPPNB	F	Goat	3	3	3	2	4	2	4
MPPNB	F	Goat				3	4	3	4
MPPNB	F	Goat	3	2	2	3	4	2	2
MPPNB	F	Goat	3	4	4	2	3	3	2
MPPNB	F	Goat	3	3		3	4	3	3
MPPNB	F	Goat	2	4	2	3	3	3	2
MPPNB	F	Goat	3	3	4	3	4	2	4
MPPNB	F	Goat/Sheep	3	3		1	2	2	3
MPPNB	F	Goat/Sheep	2	3		2	2	2	2
MPPNB	F	Goat/Sheep	3	3					
MPPNB	F	Goat/Sheep	3	3	3	2	2		
MPPNB	F	Goat/Sheep	2	2					
MPPNB	F	Goat/Sheep	3	3	4				
MPPNB	F	Goat/Sheep	4	3	2	2	3	1	
MPPNB	F	Goat/Sheep	3	3		2			
MPPNB	F	Goat/Sheep	2	3	2	2	3	3	2
MPPNB	F	Goat/Sheep	2	3		1			
MPPNB	F	Goat/Sheep	2	2	3	3			
MPPNB	F	Goat/Sheep	3	2		3	2	3	3
MPPNB	F	Goat/Sheep	2	3	3	3	3	2	1
MPPNB	F	Goat/Sheep	2	3	3	2	2	2	2
MPPNB	F	Goat/Sheep				3	3	3	1
MPPNB	F	Goat/Sheep	3	3	2	2			
MPPNB	F	Goat/Sheep				1	2	2	3
MPPNB	F	Goat/Sheep	3	3	2				
MPPNB	F	Goat/Sheep	3	3	2	2	4	2	3
MPPNB	F	Goat/Sheep	3	3	2				
MPPNB	F	Goat/Sheep	3	3	3	2		3	
MPPNB	F	Goat/Sheep	3	4	3				
MPPNB	F	Goat/Sheep	3	4	2			2	
MPPNB	fg	Goat	2	3	3	2	3	2	1
MPPNB	fg	Goat	3	3	2	1	3	2	4
MPPNB	fg	Goat/Sheep	2	3	2	1	1	2	
MPPNB	fg	Goat/Sheep	3	3	2	1	2	1	2
MPPNB	uf	Goat/Sheep	3	3					
MPPNB	uf	Goat/Sheep	2	2					
MPPNB	uf	Goat/Sheep	2	2	2				
MPPNB	uf	Goat/Sheep	3	3	2				
MPPNB	uf	Goat/Sheep	2	2					
MPPNB	uf	Goat/Sheep	2	2					
MPPNB	uf	Goat/Sheep	4	3					
LPPNB	F	Goat	3	3		2	3	1	3
LPPNB	F	Goat	2	3	3	3	4	3	3
LPPNB	F	Goat		3	3	4	2	3	2
LPPNB	F	Goat	2	3	3	2	4	3	4
LPPNB	F	Goat/Sheep	3	3	3				
LPPNB	F	Goat/Sheep	3	3	2	3	2	3	
LPPNB	F	Sheep	1	2	2	2	2	1	1
LPPNB	F	Sheep	1	1	2	2	1	2	1
LPPNB	uf	Goat	1	3	4				
LPPNB/PPNC	F	Goat	4	3	4	2	4	1	3
LPPNB/PPNC	F	Goat	2	2	3	3	4	3	4
LPPNB/PPNC	F	Goat		4	3	3	4	3	3
LPPNB/PPNC	F	Goat	4	4	3	2	4	2	3
LPPNB/PPNC	F	Goat	3	4	2	4	4	3	4
LPPNB/PPNC	F	Goat	2	4	4	3			
LPPNB PPNC	F	Goat	1	4	2	3	4	3	2
LPPNB/PPNC	F	Goat/Sheep	1	3		2	3	2	4
LPPNB/PPNC	F	Goat/Sheep	3	3		2	3	3	2

Table A.9: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine First Phalanges

Phase	Fusion	Species	B500	B73	B501	B502	B75	B74	B76
LPPNB/PPNC	F	Goat/Sheep	3	3	3	2	2	2	2
LPPNB/PPNC	F	Goat/Sheep	3	3	3	2			
LPPNB/PPNC	F	Goat/Sheep	1	2	2	2	3	2	3
LPPNB/PPNC	F	Sheep	2	3		2	1	2	2
LPPNB/PPNC	F	Sheep	1	2	2	1	2	2	1
LPPNB/PPNC	F	Sheep	2	1	2	2	1	2	2
LPPNB/PPNC	F	Sheep	1	3	2	2	2	2	1
LPPNB/PPNC	F	Sheep	2	1	2	1	1	3	1
PPNC	F	Goat	4	4	2	3	4	2	3
PPNC	F	Goat	3	3		3	4	3	3
PPNC	F	Goat	3	2	4	4	4	3	4
PPNC	F	Goat	3	3	2	4	4	3	2
PPNC	F	Goat	4	3	3	3	4	3	3
PPNC	F	Goat	4	2		3	3	1	4
PPNC	F	Goat	3	3	3	2	3	2	3
PPNC	F	Goat	4	4	4	3	3	2	2
PPNC	F	Goat	2	3	4	3	2	2	3
PPNC	F	Goat	2	3		3	4	2	4
PPNC	F	Goat	3	3	2	3	3	3	4
PPNC	F	Goat	4	2	4	3	2	2	3
PPNC	F	Goat	2	4	3	2	4	4	3
PPNC	F	Goat	3	3	4				
PPNC	F	Goat	3	2	4	4	3	3	4
PPNC	F	Goat	2	4	4				
PPNC	F	Goat	1	4	4	2			
PPNC	F	Goat	3	3	3	2	3	3	
PPNC	F	Goat	3	3	4	3	4	2	3
PPNC	F	Goat/Sheep				4	3	3	1
PPNC	F	Goat/Sheep	2	3	3	3	3	2	3
PPNC	F	Goat/Sheep	2	2		2			
PPNC	F	Goat/Sheep	2	2	1	1			
PPNC	F	Goat/Sheep	2	2	1	1			
PPNC	F	Goat/Sheep	2	3	4				
PPNC	F	Goat/Sheep	2	3	2				
PPNC	F	Goat/Sheep	2			2			
PPNC	F	Goat/Sheep	2	2	2				
PPNC	F	Goat/Sheep	2	3	2	2	2	4	3
PPNC	F	Goat/Sheep	3	2	2	3	2	2	2
PPNC	F	Goat/Sheep	2		3	2	3	1	1
PPNC	F	Goat/Sheep	3				3	2	3
PPNC	F	Goat/Sheep	1	2			2	2	2
PPNC	F	Goat/Sheep	2	3	2	2	3	2	2
PPNC	F	Goat/Sheep	3	4	3	2	2	3	
PPNC	F	Goat/Sheep	3	2	3	3	2	3	1
PPNC	F	Goat/Sheep	3	4	2	2			
PPNC	F	Goat/Sheep	1	2					
PPNC	F	Goat/Sheep	3	4					
PPNC	F	Goat/Sheep	1	3	3	2	3	3	3
PPNC	F	Goat/Sheep	2	2	4	2	3	2	4
PPNC	F	Goat/Sheep	1	2	2				
PPNC	F	Goat/Sheep	2	2	2	3			
PPNC	F	Goat/Sheep	3	3	2	3	2	3	
PPNC	F	Sheep	1	1	2	3	2	3	2
PPNC	F	Sheep	1	2		2	2	2	2
PPNC	F	Sheep	1	1	2	2			
PPNC	F	Sheep	2	1	2	1	2	2	2
PPNC	F	Sheep	2	1		2	2	2	1
PPNC	F	Sheep	2	2	2	1	2	1	1
PPNC	F	Sheep	1	1	1	1	2	2	1

Table A.9: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine First Phalanges

Phase	Fusion	Species	B500	B73	B501	B502	B75	B74	B76
PPNC	F	Sheep	2	3	2	2	2	2	2
PPNC	F	Sheep	2	2	3	2			
PPNC	F	Sheep	1	2	2	2	1		
PPNC	F	Sheep	1	2	2	2	3	2	
PPNC	F	Sheep	3	3		4	3	1	3
PPNC	F	Sheep	1	2		2	1	2	2
PPNC	F	Sheep	2	2	1	3	1	2	1
PPNC	F	Sheep	2	1	3	1	2	1	2
PPNC	F	Sheep	1	2	2	4	1	2	2
PPNC	F	Sheep	1	2	1	2			
PPNC	F	Sheep	1	2	1	1			
PPNC	F	Sheep	1	2	2	2			
PPNC	F	Sheep	1	2	2	1	1		
PPNC	F	Sheep	2	2	2	2	1	2	2
PPNC	F	Sheep	1	3		1	2	2	1
PPNC	F	Sheep	2	3	2	1	2	2	2
PPNC	F	Sheep	1	3		2	2	1	1
PPNC	F	Sheep	1	2	2	1	1	2	2
PPNC	F	Sheep	2	3	2	2	1	2	2
PPNC	F	Sheep	1	2	3	2	3	1	2
PPNC	F	Sheep	2	2	2	2	1	2	1
PPNC	F	Sheep	1	2	2	2	1	2	2
PPNC	F	Sheep	2	2	2	2			
PPNC	F	Sheep	2	3	1	1	2	2	2
PPNC	fg	Sheep	2	2	1	2	2	2	1
PPNC	fg	Sheep	1	2	2	1	1		
PPNC	uf	Goat/Sheep	1	1					
PPNC	uf	Goat/Sheep	1	1	1				
PPNC	uf	Sheep	2	2	1				
Yarmoukian	F	Goat	3	2		3	3	3	3
Yarmoukian	F	Goat	3	3	4	4	2	2	2
Yarmoukian	F	Goat	3	3		4	4	3	4
Yarmoukian	F	Goat	2	3		3	3	3	2
Yarmoukian	F	Goat	3	4				3	
Yarmoukian	F	Goat	3	4	3	3	3	3	3
Yarmoukian	F	Goat	3	4	3	1	4	2	4
Yarmoukian	F	Goat	4	4		4	3	3	3
Yarmoukian	F	Goat	2	4	3			3	
Yarmoukian	F	Goat			4	3	3	3	2
Yarmoukian	F	Goat	3	3	2	3	3	3	3
Yarmoukian	F	Goat	3	4	3	3	4	3	4
Yarmoukian	F	Goat	3	3	3	2	3	3	2
Yarmoukian	F	Goat	2	3		3	4	3	3
Yarmoukian	F	Goat	2	4	3	4	3	3	4
Yarmoukian	F	Goat	2	3	3	3	3	4	4
Yarmoukian	F	Goat	2	2	2	3	4	4	3
Yarmoukian	F	Goat	4	3	3	3	4	3	3
Yarmoukian	F	Goat	3	4	3		4	3	3
Yarmoukian	F	Goat	3	4	3	4	3	3	3
Yarmoukian	F	Goat/Sheep	3	3		2	2	3	1
Yarmoukian	F	Goat/Sheep	2	2	1	4	4	3	2
Yarmoukian	F	Goat/Sheep	2	2	3	1	2	1	3
Yarmoukian	F	Goat/Sheep	1	2	1	3	3	2	2
Yarmoukian	F	Goat/Sheep	3	3	3	2	2		
Yarmoukian	F	Goat/Sheep	3	2	3	2	3	3	3
Yarmoukian	F	Goat/Sheep	2	3	3	2			
Yarmoukian	F	Goat/Sheep	2				2	3	
Yarmoukian	F	Goat/Sheep	1	2	3	2	2	3	2
Yarmoukian	F	Goat/Sheep	1	3	3	2	2	3	

Table A.9: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine First Phalanges

Phase	Fusion	Species	B500	B73	B501	B502	B75	B74	B76
Yarmoukian	F	Goat/Sheep	2	3	3	3	2	2	2
Yarmoukian	F	Goat/Sheep	2	3	2		2	3	2
Yarmoukian	F	Goat/Sheep	3	3	2	3	2	2	3
Yarmoukian	F	Goat/Sheep	3	2	3	3	4	3	2
Yarmoukian	F	Goat/Sheep	2	3	2	2	2	3	2
Yarmoukian	F	Goat/Sheep	2	3	3	2	3	2	2
Yarmoukian	F	Goat/Sheep	1	3	3	2	2	3	2
Yarmoukian	F	Goat/Sheep	2	3	3	2			
Yarmoukian	F	Goat/Sheep	2	2	2				
Yarmoukian	F	Goat/Sheep	1	2					
Yarmoukian	F	Sheep	2	2	2	2	2	2	2
Yarmoukian	F	Sheep	1	2	2	2	3	2	2
Yarmoukian	F	Sheep	1	1	1	2	1	2	1
Yarmoukian	F	Sheep	2	2	1	2	1	2	1
Yarmoukian	F	Sheep	1	3	1	3	2	1	1
Yarmoukian	F	Sheep	1		1	2	3	1	1
Yarmoukian	F	Sheep	2						1
Yarmoukian	F	Sheep	2	2	1	2	2	2	1
Yarmoukian	F	Sheep	2	3	1	2	2	2	2
Yarmoukian	F	Sheep	2	2	2	1	1	2	2
Yarmoukian	F	Sheep		2			1	3	2
Yarmoukian	F	Sheep	2	3	2	1	2	2	2
Yarmoukian	F	Sheep	2	1	2	1	2	2	2
Yarmoukian	F	Sheep	3	2	2	2	2	2	2
Yarmoukian	F	Sheep	1	1		2	1	1	2
Yarmoukian	F	Sheep	2	1	2	1	2	2	2
Yarmoukian	F	Sheep	2	2	2	2	2	3	2
Yarmoukian	F	Sheep	2	2	3	1	2	2	1
Yarmoukian	F	Sheep	1	3	2	1	2	2	2
Yarmoukian	F	Sheep	1	2	1	2	3	2	2
Yarmoukian	F	Sheep	2	2	2	1	2	1	1
Yarmoukian	F	Sheep	2	2	2	3	1	2	1
Yarmoukian	F	Sheep	2	3	3	1	1	2	2
Yarmoukian	F	Sheep	1	2	2	1			
Yarmoukian	F	Sheep	2	2	1	1			
Yarmoukian	fg	Goat/Sheep	3	2	3	2	1	2	2
Yarmoukian	fg	Sheep	1	2	1	1			
Yarmoukian	fg	Sheep	2	1	1	2	2	2	1

Table A.9: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine First Phalanges

Phase	Species	B80	B701	B81	B702	B703
MPPNB	Goat		3	4	4	3
MPPNB	Goat		2	4	3	2
MPPNB	Goat	3	3	4	4	4
MPPNB	Goat	3	3	4	4	3
MPPNB	Goat			4	4	4
MPPNB	Goat			3	3	4
MPPNB	Goat	3	3	4	3	3
MPPNB	Goat	3	3	4	4	4
MPPNB	Goat	3	3	3	4	3
MPPNB	Goat		4	4	4	4
MPPNB	Goat		4	4	4	4
MPPNB	Goat		4	3	3	4
MPPNB	Goat	3	4	3	4	3
MPPNB	Goat	3	4		4	4
MPPNB	Goat				4	4
MPPNB	Goat	3	4	3	4	3
MPPNB	Goat		4	4	4	4
MPPNB	Goat		2	3	3	3
MPPNB	Goat	4	4	3	3	3
MPPNB	Goat			4	3	3
MPPNB	Goat			3	4	4
MPPNB	Goat	3	4	3	3	4
MPPNB	Goat		3	4	4	4
MPPNB	Goat	3	4	4	4	3
MPPNB	Goat/Sheep				3	3
MPPNB	Goat/Sheep			3		3
MPPNB	Goat/Sheep		3	2	4	2
MPPNB	Goat/Sheep			3		2
MPPNB	Goat/Sheep			3		3
MPPNB	Goat/Sheep			3		3
MPPNB	Goat/Sheep	3	4	3	3	
LPPNB	Goat	3	4	4	3	4
LPPNB	Goat	3	3	3	4	3
LPPNB	Goat		3	3	3	3
LPPNB	Goat			3	4	4
LPPNB	Goat/Sheep	2	2		3	3
LPPNB	Sheep	2	1	2	2	2
LPPNB	Sheep	2	2	3	1	2
LPPNB	Sheep	3	2	3	1	2
LPPNB	Sheep	3	2		2	2
LPPNB/PPNC	Goat	2	2		4	3
LPPNB/PPNC	Goat/Sheep				3	4
LPPNB/PPNC	Goat/Sheep	3	3	4	3	3
LPPNB/PPNC	Goat/Sheep	3	2	2	2	
LPPNB/PPNC	Goat/Sheep	4	3	3	3	2
LPPNB/PPNC	Sheep	3	2	2	1	2
PPNC	Goat	3	4	3	3	4
PPNC	Goat	3	4	4	4	4
PPNC	Goat	3	3		3	3
PPNC	Goat		3	3	3	4
PPNC	Goat	3	4	4	3	4
PPNC	Goat	4	3	3	3	
PPNC	Goat	2	3	3	3	2
PPNC	Goat	4	3	3	3	3
PPNC	Goat		3	3	4	3
PPNC	Goat	3	4	3	3	3
PPNC	Goat	3	3	4	3	3
PPNC	Goat			4	4	4
PPNC	Goat/Sheep	4	2	3	3	2

Table A.10: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Third Phalanges

Phase	Species	B80	B701	B81	B702	B703
PPNC	Goat/Sheep			4		2
PPNC	Goat/Sheep		2		2	3
PPNC	Goat/Sheep	3	3		3	3
PPNC	Goat/Sheep		3		2	2
PPNC	Goat/Sheep			3	3	2
PPNC	Goat/Sheep	2	2	2	3	3
PPNC	Goat/Sheep			3	3	3
PPNC	Goat/Sheep	2	2		2	2
PPNC	Sheep	3	2	1	2	2
PPNC	Sheep	2	1		1	1
PPNC	Sheep				1	2
PPNC	Sheep	2	2	3	2	2
PPNC	Sheep	3	2	2	2	2
PPNC	Sheep	2	1	3	2	2
PPNC	Sheep		2		2	1
PPNC	Sheep	3	2		1	1
PPNC	Sheep	3	2	3	1	1
PPNC	Sheep	4	2	2	2	2
PPNC	Sheep				1	1
PPNC	Sheep				2	1
PPNC	Sheep		2	2	2	
PPNC	Sheep	2	1	1	3	1
Yarmoukian	Goat	4	3	3	3	3
Yarmoukian	Goat	2	3	3	4	3
Yarmoukian	Goat/Sheep			4		1
Yarmoukian	Goat/Sheep	2	3	4	3	3
Yarmoukian	Goat/Sheep	3	2	4	2	3
Yarmoukian	Goat/Sheep				2	2
Yarmoukian	Sheep	2	1		2	1
Yarmoukian	Sheep	3	2		2	1
Yarmoukian	Sheep	2	2	2	2	1
Yarmoukian	Sheep	2	2	1	2	1

Table A.10: Principal Components Analysis Score Counts for 'Ain Ghazal Caprine Third Phalanges

APPENDIX B

'Ain Ghazal Goat and Sheep Bone Measurements (Burnt Specimens not Included)

Phase	Fusion	SLC	BG	LG	GLP
MPPNB	F		27.3	33.7	40.9
MPPNB	F	21.2	22.5	27.1	34.3
MPPNB	F	20.0	27.1	33.0	40.2
MPPNB	F	20.6	22.3	26.0	
MPPNB	F	23.1	25.9	31.3	39.8
MPPNB	F	19.4	21.4	26.1	31.8
MPPNB	F		22.0	25.1	32.3
MPPNB	F	18.0	20.4	25.2	29.9
MPPNB	F	23.9	24.6	30.3	37.5
MPPNB	F		23.1	27.1	
MPPNB	F		27.2	32.6	40.3
MPPNB	F		21.8	25.8	31.1
MPPNB	F		26.8	30.5	
MPPNB	F		23.9		
MPPNB	F		22.2	28.0	34.7
MPPNB	F				40.1
MPPNB	F		24.9	31.5	38.9
MPPNB	fg	19.2	23.7	28.3	33.0
LPPNB	F		22.4	28.9	34.2
LPPNB	F		25.4	28.2	36.8
LPPNB	F		22.4	24.7	33.8
LPPNB/PPNC	F		22.7		
LPPNB/PPNC	F		25.8	28.4	37.3
LPPNB/PPNC	uf		21.5		
PPNC	F	21.1	24.5	30.0	35.9
PPNC	F		24.3	30.9	38.2
PPNC	F	17.9	21.4	26.0	31.4
PPNC	F	23.2	24.1	28.2	36.1
PPNC	F	18.1	21.3	25.9	
PPNC	F		19.9	24.3	29.7
PPNC	F		21.8	25.2	
PPNC	F		26.1	29.6	37.2
PPNC	F		22.2	28.9	36.7
PPNC	uf		25.4	27.1	
Yarmoukian	?		23.0		
Yarmoukian	F		20.3	24.4	30.2
Yarmoukian	F		26.3	29.0	37.5
Yarmoukian	F	21.7	24.1	29.3	36.4
Yarmoukian	F		24.5	29.3	36.0
Yarmoukian	F				37.1
Yarmoukian	F		22.0	25.9	30.7
Yarmoukian	F		22.6	26.6	32.7
Yarmoukian	F		20.5	22.7	
Yarmoukian	F		21.1		29.4
Yarmoukian	F		21.1	24.8	31.2
Yarmoukian	F			24.6	31.6
Yarmoukian	F		24.9	29.6	38.0
Yarmoukian	F		19.4	21.4	27.8
Yarmoukian	F		19.1	23.0	28.0
Yarmoukian	uf		24.3		

Table B.1: 'Ain Ghazal Goat Scapula Measurements (mm)

Phase	Fusion	Bd
MPPNB	F	33.3
MPPNB	F	30.2
MPPNB	F	31.3
MPPNB	F	31.9
MPPNB	F	42.9
MPPNB	F	33.1
MPPNB	F	30.1
MPPNB	F	34.2
MPPNB	F	34.9
MPPNB	F	32.6
MPPNB	F	32.0
MPPNB	F	34.1
MPPNB	F	42.3
MPPNB	fg	29.6
MPPNB	fg	29.2
LPPNB	F	35.6
LPPNB	F	33.3
LPPNB/PPNC	F	30.7
LPPNB/PPNC	F	32.0
LPPNB/PPNC	F	32.4
PPNC	F	30.6
PPNC	F	32.6
PPNC	F	29.9
PPNC	F	32.6
PPNC	F	35.7
Yarmoukian	F	29.1
Yarmoukian	F	29.1
Yarmoukian	F	33.0
Yarmoukian	F	31.1
Yarmoukian	F	30.2
Yarmoukian	F	33.3
Yarmoukian	F	32.3
Yarmoukian	F	30.6
Yarmoukian	F	31.3
Yarmoukian	F	28.1
Yarmoukian	F	33.2
Yarmoukian	F	27.9
Yarmoukian	F	31.8
Yarmoukian	F	30.0
Yarmoukian	F	33.2
Yarmoukian	F	32.3
Yarmoukian	F	30.0
Yarmoukian	F	36.8
Yarmoukian	F	34.8
Yarmoukian	F	26.2
Yarmoukian	F	36.6
Yarmoukian	fg	27.4

Table B.2: ‘Ain Ghazal Goat Humerus Measurements (mm)

Phase	Fusion	Bd	BFd
MPPNB	F	31.8	27.2
MPPNB	F	32.4	29.0
MPPNB	fg	40.9	36.4
MPPNB	uf	39.6	33.7
MPPNB	uf	36.5	32.7
MPPNB	uf	29.9	27.3
MPPNB	uf	31.1	29.4
MPPNB	uf	39.7	37.0
MPPNB	uf	29.9	28.3
MPPNB	uf	28.8	27.3
MPPNB	uf	34.8	33.2
MPPNB	uf	31.2	29.6
MPPNB	uf	26.4	25.3
MPPNB	uf	35.3	30.5
LPPNB	uf	29.2	25.8
LPPNB	uf	33.4	31.2
LPPNB/PPNC	uf	39.5	34.9
PPNC	F	31.5	26.5
PPNC	F		27.2
PPNC	F	30.8	26.5
PPNC	F	30.3	27.5
PPNC	F	31.5	27.9
PPNC	uf	33.6	32.7
PPNC	uf		32.5
PPNC	uf	32.1	29.7
Yarmoukian	F		25.9
Yarmoukian	fg	26.7	24.2

Table B.3: 'Ain Ghazal Goat Radius Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
MPPNB	?						11.4	14.4
MPPNB	F						13.3	
MPPNB	F						11.3	14.2
MPPNB	F						10.7	13.1
MPPNB	F						10.5	12.7
MPPNB	F	29.6	10.8	13.7	10.4	13.3		
MPPNB	F	29.3	10.6	13.9	10.3	13.5		
MPPNB	F						12.5	15.4
MPPNB	F						11.1	13.6
MPPNB	F						11.4	16.0
MPPNB	F						9.9	12.8
MPPNB	F						10.4	14.4
MPPNB	F						10.3	13.1
MPPNB	F						10.4	12.3
MPPNB	F	29.9	11.0	13.7	10.8	13.5		
MPPNB	fg	30.4	11.7	13.3	11.3	13.4		
MPPNB	fg	29.3	10.3	13.1	10.1	12.7		
MPPNB	uf						10.6	12.8
MPPNB	uf						9.9	12.1
MPPNB	uf						10.8	13.1
MPPNB	uf						10.1	12.0
MPPNB	uf						10.4	12.6
MPPNB	uf						11.6	15.1
MPPNB	uf						11.9	15.8
MPPNB	uf						12.4	16.3
MPPNB	uf	30.5	9.9	13.1	9.3	12.8		
MPPNB	uf						11.9	14.7
MPPNB	uf						11.7	12.5
MPPNB	uf						12.1	15.1
MPPNB	uf						9.6	12.7
MPPNB	uf						10.0	13.4
MPPNB	uf						9.5	12.7
MPPNB	uf						11.0	13.4
MPPNB	uf						12.2	14.0
LPPNB	?						12.3	15.7
LPPNB	F		10.0	13.3				
LPPNB	F						9 8	12.8
LPPNB	F						10.1	13.8
LPPNB	F				11.7	13.1		
LPPNB	F	34.5	11.9	15.6	11.3			
LPPNB	uf						12.2	15.4
LPPNB	uf		7.8	10.1				
LPPNB	uf				7.3	9.8		
LPPNB	uf						11.6	15.9
LPPNB	uf						10.5	11.2
LPPNB	uf		9.0	11.7	8.2	10.9		
LPPNB	uf						9.9	13.4
LPPNB	uf						11.5	14.9
LPPNB/PPNC	?						10.2	12.7
LPPNB/PPNC	F						11.7	15.6

Table B.4: 'Ain Ghazal Goat Metacarpal Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
LPPNB/PPNC	F						10.2	12.6
LPPNB/PPNC	F						9.3	12.2
LPPNB/PPNC	F						10.2	13.0
LPPNB/PPNC	F		12.6	15.5	10.9	14.4		
LPPNB/PPNC	uf						10.4	13.2
LPPNB/PPNC	uf						10.2	13.2
PPNC	F						9.5	13.1
PPNC	F						10.3	13.2
PPNC	F	27.2	9.5	12.0	8.9	11.8		
PPNC	F						11.5	15.7
PPNC	F	28.2	10.4	13.4	9.5	12.5		
PPNC	F	28.9	10.1	12.8	9.9	12.6		
PPNC	F						11.6	13.4
PPNC	F						12.3	12.9
PPNC	F	27.5	9.3	11.9	9.2	12.0		
PPNC	F	27.9	10.2	13.1	9.8	12.5		
PPNC	F	35.3	10.8	15.8	10.6	15.8		
PPNC	F		10.0	13.0	9.9	12.5		
PPNC	F						9.6	13.1
PPNC	F						11.0	15.4
PPNC	F	35.4	11.5	16.5	11.3	14.6		
PPNC	fg						10.3	13.0
PPNC	fg						9.1	11.0
PPNC	fg						11.6	11.5
PPNC	uf						9.6	13.9
PPNC	uf						12.0	17.0
PPNC	uf						11.0	15.4
PPNC	uf						10.9	13.4
Yarmoukian	F						8.6	10.9
Yarmoukian	F						9.5	11.8
Yarmoukian	F	27.5	10.5	13.1	9.6	13.2		
Yarmoukian	F	26.0	9.7	11.6	9.8	11.5		
Yarmoukian	F						11.6	12.6
Yarmoukian	F						9.7	12.5
Yarmoukian	F	35.3	11.7	16.4	11.4	15.3		
Yarmoukian	fg	26.9			12.4	12.3		
Yarmoukian	fg						8.6	11.9
Yarmoukian	fg						12.6	15.1
Yarmoukian	uf						11.6	14.3
Yarmoukian	uf		9.6	11.7	8.7	11.3		
Yarmoukian	uf						9.6	12.9
Yarmoukian	uf						10.4	13.3

Table B.4 (cont.): 'Ain Ghazal Goat Metacarpal Measurements (mm)

Phase	Fusion	Bd
MPPNB	fg	46.2
MPPNB	fg	44.9
PPNC	uf	40.1

Table B.5: 'Ain Ghazal Goat Femur Measurements (mm)

Phase	Fusion	Bd
MPPNB	F	27.7
MPPNB	F	28.4
MPPNB	F	34.2
MPPNB	F	28.4
MPPNB	F	26.5
MPPNB	F	26.8
MPPNB	F	29.0
MPPNB	F	29.7
MPPNB	F	29.0
MPPNB	F	29.2
MPPNB	F	27.8
MPPNB	F	28.5
MPPNB	fg	28.1
MPPNB	uf	31.2
MPPNB	uf	27.5
MPPNB	uf	27.3
MPPNB	uf	24.7
MPPNB	uf	29.7
MPPNB	uf	28.1
MPPNB	uf	30.7
MPPNB	uf	31.4
MPPNB	uf	27.9
LPPNB	F	26.1
LPPNB	F	26.5
LPPNB	F	29.9
LPPNB	F	27.1
LPPNB/PPNC	F	29.5
LPPNB/PPNC	F	31.4
PPNC	F	27.5
PPNC	F	27.0
PPNC	F	27.1
PPNC	F	26.5
PPNC	F	32.1
PPNC	F	30.7
PPNC	F	31.2
PPNC	F	26.5
PPNC	F	29.7
PPNC	fg	30.4
PPNC	uf	32.1
Yarmoukian	F	23.7
Yarmoukian	F	25.3
Yarmoukian	F	27.8
Yarmoukian	F	26.8
Yarmoukian	F	31.1
Yarmoukian	F	25.8

Table B.6: 'Ain Ghazal Goat Tibia Measurements (mm)

Phase	GLl	GLm	Dl	Bd
MPPNB	33.1	30.6	18.7	22.6
MPPNB	32.7	30.3	17.8	22.5
MPPNB		30.8		
MPPNB	33.9	30.1	18.3	21.8
MPPNB	35.4	32.6	19.1	23.7
MPPNB	30.9	28.8	16.6	19.6
MPPNB		28.0		
MPPNB	31.1		17.2	19.4
MPPNB	34.9	32.2	18.8	21.8
MPPNB	30.6	28.6	16.3	18.9
MPPNB	31.5	29.3	16.6	19.2
MPPNB	33.2	31.0	18.6	20.7
MPPNB	31.5		17.1	18.9
MPPNB	29.3	27.7	16.3	18.8
MPPNB	30.1	27.6	16.6	20.2
MPPNB	32.2	28.0	17.2	20.5
MPPNB	33.2	30.2	17.9	20.4
MPPNB		28.5		18.8
MPPNB	34.6		18.8	
MPPNB	33.2	30.7	19.1	23.5
MPPNB	30.2	27.3	16.0	19.3
MPPNB		30.7	18.3	
MPPNB	32.1	29.6	16.8	21.6
MPPNB	31.6	29.2	17.8	20.2
MPPNB	29.0	26.1	15.4	18.9
MPPNB		32.2	19.4	
MPPNB	30.6	29.3	15.9	19.1
MPPNB		30.7		20.3
MPPNB	31.8	28.6	16.9	19.7
MPPNB	31.6	29.2	17.8	19.9
MPPNB		32.6	19.7	
MPPNB		30.9		
MPPNB	34.9	31.3	18.6	23.3
MPPNB	35.9		19.7	
MPPNB	37.3	34.9	20.6	25.1
MPPNB	34.5	31.0	19.1	23.7
MPPNB			19.4	22.6
MPPNB	31.3	28.2	17.1	20.5
MPPNB	33.1	30.3	18.4	23.2
MPPNB		28.5		
MPPNB		30.3		20.2
MPPNB			18.5	
MPPNB	34.9	30.9	18.8	23.0
MPPNB				22.0
MPPNB	31.8	29.9	17.0	20.9
MPPNB	34.5		18.7	22.4
MPPNB	31.6	29.2	17.0	19.3
MPPNB	32.8	30.0	17.4	21.3
MPPNB	34.4	31.8	18.1	
MPPNB	27.9	26.8	16.0	17.5

Table B.7: 'Ain Ghazal Goat Astragalus Measurements (mm)

Phase	GLl	GLm	Dl	Bd
LPPNB	34.0	31.6	19.2	22.1
LPPNB	28.8	27.1	15.8	19.5
LPPNB	30.1	27.0	16.0	18.1
LPPNB	30.3	27.6	16.6	18.8
LPPNB	31.2	28.7	16.5	19.7
LPPNB	36.3	33.8	19.4	23.3
LPPNB	32.7	29.2	18.3	22.7
LPPNB	30.6		16.6	
LPPNB	33.3	31.2	18.6	22.2
LPPNB	30.2	27.2	16.8	19.8
LPPNB	29.4	25.8		18.0
LPPNB/PPNC	34.9	32.1	18.8	23.5
LPPNB/PPNC	30.2	27.5	16.4	20.1
LPPNB/PPNC	28.5	25.7	15.1	19.1
LPPNB/PPNC	28.7	26.4	16.5	18.4
LPPNB/PPNC	31.8	29.2	16.4	19.1
PPNC	30.5	28.5	17.1	21.3
PPNC	31.4	28.5	16.8	19.4
PPNC	32.9	31.5	18.0	22.2
PPNC	29.3	27.1	15.2	17.9
PPNC		27.0		18.4
PPNC	35.5	32.4	19.2	23.2
PPNC		31.2		
PPNC	28.7	25.9	15.2	18.2
PPNC	32.8	30.5	17.6	21.7
PPNC	30.1	28.3	16.9	19.8
PPNC	32.3	30.4	18.2	21.3
PPNC	29.1	25.9	15.9	18.3
PPNC	32.1	30.0	17.3	22.0
PPNC	29.7	26.7	15.2	17.9
PPNC	29.0	28.0	15.7	18.0
PPNC	32.3	30.2	18.2	20.0
PPNC	29.6	27.6	15.7	18.9
PPNC	32.1		17.6	
PPNC	28.7	26.8	15.1	18.2
PPNC	34.8	31.0	18.9	23.0
PPNC	32.0	29.0	17.6	21.3
PPNC	30.3	27.8	16.8	19.6
PPNC	34.2	32.2	19.3	22.4
PPNC	30.5	28.7	16.7	20.4
PPNC	31.1	29.1	16.9	18.9
PPNC	32.2		17.6	
Yarmoukian	30.9	28.2	17.2	22.2
Yarmoukian	29.5	26.8	16.6	20.2
Yarmoukian	30.0	27.4	16.3	19.0
Yarmoukian	32.7		17.7	21.8
Yarmoukian	27.1	25.8	14.6	17.2
Yarmoukian	32.8	31.0	18.2	22.5
Yarmoukian	28.6	26.3		18.1
Yarmoukian	29.4	27.0	16.0	
Yarmoukian	28.3	26.4	15.3	18.1
Yarmoukian	28.8	26.3	15.0	16.9

Table B.7 (cont.): 'Ain Ghazal Goat Astragalus Measurements (mm)

Phase	Fusion	GL	GB
MPPNB	?		19.9
MPPNB	?		21.2
MPPNB	F		17.8
MPPNB	F	62.4	21.6
MPPNB	F	66.8	23.5
MPPNB	F	64.9	
MPPNB	F		20.7
MPPNB	F	60.9	19.5
MPPNB	F	62.7	22.1
MPPNB	uf		20.5
MPPNB	uf		24.1
MPPNB	uf		22.7
MPPNB	uf		20.1
MPPNB	uf		24.1
MPPNB	uf		23.5
MPPNB	uf		22.6
LPPNB	F	59.7	21.3
LPPNB	F	58.9	21.0
LPPNB	fg	63.3	21.2
LPPNB	uf		17.5
PPNC	?		23.8
PPNC	?		24.8
PPNC	F	57.3	20.5
PPNC	F	53.6	18.2
PPNC	F	60.4	
PPNC	F	68.2	
PPNC	F	64.7	23.5
PPNC	F	56.6	20.4
PPNC	F		22.0
PPNC	uf		18.0
PPNC	uf		17.4
PPNC	uf		22.0
PPNC	uf		21.2
Yarmoukian	?		23.6
Yarmoukian	F		19.5
Yarmoukian	F	55.8	19.4
Yarmoukian	F	61.1	22.2
Yarmoukian	F	52.3	18.3
Yarmoukian	uf		16.2

Table B.8: Goat Calcaneum Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
MPPNB	?						11.8	14.4
MPPNB	F	27.1	10.7	12.7	10.4	12.5		
MPPNB	F	31.8	11.4	14.5	12.0	13.4		
MPPNB	F	26.7	10.1	12.2	10.0	11.4		
MPPNB	F	26.7	9.7	12.0	10.1	11.5		
MPPNB	F	26.4	10.0	11.7	10.3	11.4		
MPPNB	F	33.3	12.1	15.6	12.6	14.2		
MPPNB	F	32.4	11.4	14.8	12.0	14.4		
MPPNB	F	27.2	10.4	12.7	10.7	12.1		
MPPNB	F	32.8	12.2	15.3	12.7	14.5		
MPPNB	F	32.9	12.0	14.8	12.6	14.4		
MPPNB	F		10.1	12.3	10.6	11.6		
MPPNB	F	28.1	10.3	12.7	10.5	11.9		
MPPNB	F		11.7	15.2	11.7	14.5		
MPPNB	F						10.1	12.6
MPPNB	F	25.8	9.3	11.9	9.5	11.2		
MPPNB	F	26.1	9.3	11.6	9.8	11.4		
MPPNB	fg	27.8	10.3	12.4	10.8	12.3		
MPPNB	fg				12.1			
MPPNB	fg	26.2	10.1	12.1	9.7	11.5		
MPPNB	uf						11.7	14.0
MPPNB	uf						12.6	14.0
MPPNB	uf						12.0	15.1
MPPNB	uf						10.9	13.1
MPPNB	uf						11.1	13.0
MPPNB	uf						10.0	11.4
MPPNB	uf						11.4	13.1
MPPNB	uf		10.2	11.9	10.0	11.3		
MPPNB	uf	25.2	10.2	11.3	10.5			
MPPNB	uf						9.2	11.0
MPPNB	uf						10.3	10.8
MPPNB	uf						11.0	12.9
MPPNB	uf						9.9	12.3
LPPNB	F						9.7	11.7
LPPNB	F	27.1	10.5	11.8	9.8	12.4		
LPPNB	F	28.1	11.5		11.1	13.1		
LPPNB	F						12.2	13.8
LPPNB	F	31.1	12.6	14.1	12.3	14.5		
LPPNB	F	32.4	12.0	14.1	11.7	13.9		
LPPNB	F				8.8	10.5		
LPPNB	F						11.6	14.2
LPPNB	fg						10.5	12.8
LPPNB	uf		8.9	10.0	8.4	10.1		
LPPNB	uf						9.8	11.5
LPPNB	uf						10.9	13.8
LPPNB	uf						9.8	11.4
LPPNB	uf						10.8	12.3
LPPNB	uf		10.7	12.2	9.9	11.0		
LPPNB/PPNC	F						8.6	11.0
LPPNB/PPNC	F		11.9	13.8	11.7	13.8		

Table B.9: 'Ain Ghazal Goat Metatarsal Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
LPPNB/PPNC	F	29.6	11.7	16.6	9 3	11.4		
LPPNB/PPNC	F						9.6	11.4
LPPNB/PPNC	uf						9.2	11.2
LPPNB/PPNC	uf						11.5	13.4
PPNC	F	30.1	11.4	14.1	11.2	13.5		
PPNC	F	25.1	10.1	11.5	10.3	11.2		
PPNC	F	29.8	11.7	13.7	12.3	13.4		
PPNC	F				9 8	11.4		
PPNC	F						12.2	14.7
PPNC	F	25.8	9.7	11.6	9.7			
PPNC	F						12.2	16.0
PPNC	F	31.4	11.5	13.9	11.5	14.2		
PPNC	F	26.1	11.3	12.1	10.3	11.2		
PPNC	F	32.2	11.4	14.2	11.3	13.4		
PPNC	F						11.0	11.7
PPNC	F						9.5	10.2
PPNC	F	25.4	10.5	12.1				
PPNC	fg	25.7	9.5	11.3	9.5	10.8		
PPNC	uf		12.3	13.6	11.7	13.6		
PPNC	uf						11.9	13.4
PPNC	uf						10.3	14.3
PPNC	uf						12.1	13.3
PPNC	uf						10.4	10.7
PPNC	uf		9.7	11.8	9.9	11.0		
Yarmoukian	F	23.7	9.0	10.9	9.1	10.9		
Yarmoukian	F	24.6	8.9		8.7			
Yarmoukian	F						10.3	11.4
Yarmoukian	F	27.8						
Yarmoukian	F	27.8	9.2	12.7	10.1	11.8		
Yarmoukian	F	22.8	8.2	10.3	8.1	9.7		
Yarmoukian	F	26.1	10.1	12.3	10.0	11.7		
Yarmoukian	F	24.4	9.9	11.1	10.1	10.1		
Yarmoukian	F	25.8	9.8		10.1	11.7		
Yarmoukian	F	27.7	12.3	13.3	11.4	11.7		
Yarmoukian	F	25.7	10.3	11.8	10.2	11.1		
Yarmoukian	F						11.3	13.3
Yarmoukian	F						10.2	12.8
Yarmoukian	uf						10.5	11.6
Yarmoukian	uf		10.0	11.5	10.1	10.5		
Yarmoukian	uf						8.6	10.7
Yarmoukian	uf						9.9	11.5

Table B.9 (cont): 'Ain Ghazal Goat Metatarsal Measurements (mm)

Phase	Fusion	GLpe	Bp	SD	Bd
MPPNB	F	38.7	13.1	9.9	11.7
MPPNB	F	40.8	13.3	10.1	12.2
MPPNB	F	41.1	13.2	10.2	12.4
MPPNB	F	39.9	13.6	10.5	12.9
MPPNB	F	42.9	13.6	11.3	14.0
MPPNB	F		14.4	11.4	13.8
MPPNB	F	40.4	13.4	10.8	12.2
MPPNB	F		14.0	10.2	13.5
MPPNB	F		16.7	15.1	16.8
MPPNB	F	45.0	16.5	14.3	16.8
MPPNB	F	40.9	14.1	11.7	13.2
MPPNB	F	41.2	13.8	10.5	12.1
MPPNB	F	42.5	14.8	11.3	14.1
MPPNB	F		14.4	11.7	15.2
MPPNB	F		15.7		
MPPNB	F		11.8	9.5	12.2
MPPNB	F	46.9	15.0	11.4	13.9
MPPNB	F	39.6	13.8	11.3	13.2
MPPNB	F	50.1	18.1	14.8	16.7
MPPNB	F	39.4	12.9	10.9	12.1
MPPNB	F	48.4	17.9	14.0	16.7
MPPNB	F	47.9	16.6	13.2	16.2
MPPNB	F		15.7	12.5	14.3
MPPNB	F			10.3	11.4
MPPNB	F	41.1	14.1	11.8	13.9
MPPNB	F	38.8	12.7	11.1	11.9
MPPNB	F	44.5	16.0	13.7	16.6
MPPNB	F	44.5	15.6	11.6	14.3
MPPNB	F		16.7		
MPPNB	F	41.0	13.9	10.5	13.2
MPPNB	F	39.9	13.3	10.5	13.0
MPPNB	F	40.1	13.6	11.9	14.2
MPPNB	F	40.0	14.2	10.4	13.1
MPPNB	F	41.7	13.7	11.3	13.1
MPPNB	F	38.7	12.5	10.3	11.7
MPPNB	F	41.0	12.7	9.7	12.3
MPPNB	F	47.6	16.4	14.0	16.1
MPPNB	F		14.8		
MPPNB	F	41.9	13.7	11.4	13.1
MPPNB	F		12.2	10.7	12.2
MPPNB	F	46.8	16.5	12.9	15.8
MPPNB	F			10.7	12.2
MPPNB	F		12.7		
MPPNB	F		16.4		
MPPNB	F	47.0	16.8	15.3	16.0
MPPNB	F		13.7		
MPPNB	F	40.4	13.6		15.0
MPPNB	F	48.2	14.0		
MPPNB	F	50.5	15.3	13.4	14.9
MPPNB	F	50.5		14.5	15.2

Table B.10: 'Ain Ghazal Goat First Phalanx Measurements (mm)

Phase	Fusion	GLpe	Bp	SD	Bd
MPPNB	F		13.0	10.9	12.2
MPPNB	F	51.0	18.0	16.4	17.6
MPPNB	F	39.1	11.7	9.0	11.5
MPPNB	F	38.1	12.3	10.3	12.2
MPPNB	F	49.3	18.2	16.3	17.3
MPPNB	F	38.5	12.7	10.1	
MPPNB	F		13.8		14.4
MPPNB	F			14.1	
MPPNB	F	40.4	14.5	11.9	14.4
MPPNB	F	48.6	16.4	13.3	15.4
MPPNB	F	40.5	13.6	10.8	12.9
MPPNB	F	38.8	13.3	12.9	14.0
MPPNB	F	50.0	16.1	14.1	17.6
MPPNB	F	39.5	12.1	9.7	11.5
MPPNB	F		15.1	12.7	14.7
MPPNB	F		13.6		
MPPNB	F	49.0	15.4	12.5	14.9
MPPNB	F	45.8	14.9	12.7	15.2
MPPNB	F	41.3	14.2	12.4	14.4
MPPNB	F	44.4	15.2	12.2	14.3
MPPNB	F		15.0		
MPPNB	F	53.3	18.3	15.7	18.3
MPPNB	F		12.6	10.9	13.3
MPPNB	F		15.5		
MPPNB	F	46.8	15.4	12.3	15.1
MPPNB	fg	48.4	14.8	11.4	14.7
MPPNB	fg	40.9	12.7	10.4	11.6
MPPNB	uf		14.1		
LPPNB	F	45.3	15.8	12.6	15.2
LPPNB	F	36.8	13.3	11.8	13.6
LPPNB	F		15.9		
LPPNB	F	40.9	12.8	10.4	12.7
LPPNB	F	36.8	12.4	9.7	11.6
LPPNB	uf		14.4		
LPPNB/PPNC	F	41.7	14.2	11.1	13.8
LPPNB/PPNC	F	44.9	14.5	11.7	14.3
LPPNB/PPNC	F	40.1	12.6	10.4	12.6
LPPNB/PPNC	F	36.4	12.5	10.3	13.0
LPPNB/PPNC	F		15.1		
LPPNB/PPNC	F	41.4	15.2	11.7	14.5
PPNC	F	38.9	12.2	10.1	10.7
PPNC	F	41.9	14.3	11.6	14.1
PPNC	F	45.3	16.7	12.5	14.9
PPNC	F	39.6	13.5	11.9	13.6
PPNC	F	44.9	14.7	11.7	13.7
PPNC	F	42.6	14.7	11.1	11.7
PPNC	F	45.8	15.9	13.3	16.0
PPNC	F	39.9	13.2	9 6	11.7
PPNC	F	42.8	14.3	11.0	13.3
PPNC	F	38.2	11.9	9.5	11.2
PPNC	F	42.2	12.2	8.9	11.1

Table B.10 (cont): 'Ain Ghazal Goat First Phalanx Measurements (mm)

Phase	Fusion	GLpe	Bp	SD	Bd
PPNC	F	37.7	13.8	11.9	14.0
PPNC	F		15.6		
PPNC	F		15.0		
PPNC	F	47.1	16.1	13.3	
PPNC	F		15.6		
PPNC	F		16.0		
PPNC	F		15.1		
PPNC	F	44.5	15.5	11.8	14.2
Yarmoukian	F	43.4	15.4	13.0	16.1
Yarmoukian	F	35.5	12.3	9.2	11.8
Yarmoukian	F		12.9		12.4
Yarmoukian	F		13.7	11.3	14.2
Yarmoukian	F	39.1	13.1	10.2	12.9
Yarmoukian	F	36.5	13.6	12.5	12.3
Yarmoukian	F	37.4	12.8	10.6	12.6
Yarmoukian	F	40.8	15.7	12.4	15.3
Yarmoukian	F		14.1		
Yarmoukian	F		12.7	10.9	12.6
Yarmoukian	F	35.4	13.1	11.9	13.1
Yarmoukian	F	34.7	12.3	9.8	11.2
Yarmoukian	F	36.6	13.5	10.9	13.9
Yarmoukian	F	42.8	13.5	10.9	12.7
Yarmoukian	F	36.1	13.1	11.7	12.9
Yarmoukian	F	34.0	11.1	9.0	9.9
Yarmoukian	F	36.0	12.4	10.6	12.2
Yarmoukian	F	35.1	12.1	10.3	11.7
Yarmoukian	F	40.2	14.4	11.1	13.7
Yarmoukian	F	36.4	13.6	11.8	13.3

Table B.10 (cont): 'Ain Ghazal Goat First Phalanx Measurements (mm)

Phase	DLS	Ld	MBS
MPPNB			5.7
MPPNB	37.1	29.0	5.9
MPPNB		29.3	5.6
MPPNB	35.5	27.8	5.2
MPPNB			6.3
MPPNB			5.0
MPPNB			4.8
MPPNB	42.3	35.2	7.4
MPPNB	34.8	27.3	4.1
MPPNB			5.3
MPPNB			5.3
MPPNB	39.3	32.2	5.6
MPPNB			4.2
MPPNB			4.5
MPPNB			5.5
MPPNB	24.1	16.8	3.3
MPPNB			5.1
MPPNB			6.9
MPPNB	39.2	31.2	7.2
MPPNB			7.1
MPPNB			5.2
MPPNB	40.6	33.9	7.1
MPPNB	38.0	29.4	5.8
LPPNB	36.6	29.9	5.8
LPPNB	36.3	30.2	5.9
LPPNB/PPNC	30.8	23.9	5.8
PPNC	33.8	28.8	5.7
PPNC	44.2	36.5	7.6
PPNC			3.6
PPNC	36.1	30.4	5.9
PPNC	40.8	34.0	7.0
PPNC	28.9	23.6	
PPNC	29.6	23.8	5.1
PPNC	29.9	25.1	4.9
PPNC			4.5
PPNC	32.0	25.4	
PPNC	36.3	30.5	7.0
Yarmoukian	34.5	29.0	6.1
Yarmoukian	31.9	25.5	5.4

Table B.11: 'Ain Ghazal Goat Distal Phalanx Measurements (mm)

Phase	Max BD	Min BD
MPPNB	31.8	23.8
MPPNB	35.0	24.0
LPPNB	33.3	24.9
PPNC	30.4	21.5
PPNC	30.7	20.9
Yarmoukian	38.5	23.0
Yarmoukian	36.8	20.9
Yarmoukian	38.4	22.8
Yarmoukian	30.1	18.0
Yarmoukian	35.6	23.3
Yarmoukian	32.1	20.4
Yarmoukian	33.9	21.2
Yarmoukian	27.6	18.0
Yarmoukian	31.4	19.4
Yarmoukian	29.8	17.6
Yarmoukian	31.7	20.1
Yarmoukian	34.6	19.5

Table B.12: 'Ain Ghazal Goat Basal Horncore Measurements (mm)

Phase	Fusion	SLC	BG	LG	GLP
MPPNB	F	19.8	20.1	27.2	34.4
LPPNB	F		21.7	28.1	35.7
LPPNB/PPNC	F		19.5	24.7	32.8
LPPNB/PPNC	F		20.5	24.4	
PPNC	F		21.1	28.0	33.9
PPNC	F			27.7	34.4
PPNC	F		20.3	25.6	31.1
PPNC	F		21.1	24.8	32.0
PPNC	F	21.6	21.4	26.2	33.1
PPNC	F	23.4	24.7	28.2	36.5
PPNC	F	21.6	21.4	29.2	33.9
PPNC	F	21.3	22.2	26.6	34.6
PPNC	F	21.7	23.4	29.3	38.2
PPNC	F	21.4	22.6	27.6	37.2
PPNC	F	20.0	21.4	26.4	34.4
PPNC	F	18.1	19.0	24.1	31.5
PPNC	F	17.8	20.3	24.4	32.8
PPNC	F	18.2	19.6	26.8	32.9
PPNC	F		22.5	28.2	38.0
PPNC	F	20.8		29.2	
PPNC	F		23.9	28.1	36.9
PPNC	F				35.0
PPNC	F		19.3	24.6	30.5
PPNC	F			28.7	
PPNC	F		20.4	27.0	35.0
Yarmoukian	F		21.4	26.6	34.6
Yarmoukian	F	21.6	19.9	25.7	33.4
Yarmoukian	F	20.0	20.5	25.4	31.3
Yarmoukian	F	17.3	19.9	24.6	30.9
Yarmoukian	F		19.5	26.2	32.6
Yarmoukian	F		20.4	27.2	32.6
Yarmoukian	F		23.7		
Yarmoukian	F			30.7	38.9
Yarmoukian	F		19.7	25.1	30.6
Yarmoukian	F		23.0	30.4	
Yarmoukian	F		17.9	22.8	29.8
Yarmoukian	F		22.5	27.1	33.7
Yarmoukian	F		21.8	28.2	36.9
Yarmoukian	F		21.2	26.5	34.0
Yarmoukian	F	18.2	20.4	26.2	33.6
Yarmoukian	F	20.7	22.3	25.8	
Yarmoukian	fg		20.0	25.9	32.3
Yarmoukian	fg			26.1	32.7

Table B13: 'Ain Ghazal Sheep Scapula Measurements (mm)

Phase	Fusion	Bd
MPPNB	F	32.4
LPPNB	F	37.1
LPPNB	F	29.8
LPPNB	fg	28.9
LPPNB/PPNC	F	33.5
LPPNB/PPNC	F	31.9
LPPNB/PPNC	F	31.9
LPPNB/PPNC	F	31.2
LPPNB/PPNC	F	32.1
LPPNB/PPNC	F	28.5
LPPNB/PPNC	fg	30.9
PPNC	F	35.2
PPNC	F	35.6
PPNC	F	31.8
PPNC	F	37.7
PPNC	F	31.1
PPNC	F	31.5
PPNC	F	32.6
PPNC	F	29.1
PPNC	F	30.5
PPNC	F	29.2
PPNC	F	33.4
PPNC	F	29.6
PPNC	F	32.8
PPNC	F	32.9
PPNC	F	31.2
PPNC	F	33.7
PPNC	F	34.6
PPNC	F	30.5
PPNC	F	34.2
PPNC	F	29.9
PPNC	F	31.8
PPNC	F	30.6
PPNC	F	31.2
PPNC	F	33.1
PPNC	F	31.6
PPNC	F	32.3
PPNC	F	32.4
PPNC	F	31.5
PPNC	F	34.6
PPNC	F	33.1
PPNC	F	33.5
PPNC	F	33.3
PPNC	F	31.7
PPNC	F	34.8
PPNC	F	29.7
PPNC	F	35.7
PPNC	F	30.0
PPNC	F	34.5

Table B.14: 'Ain Ghazal Sheep Humerus Measurements (mm)

Phase	Fusion	Bd
PPNC	fg	26.7
PPNC	fg	30.0
Yarmoukian	F	32.4
Yarmoukian	F	31.3
Yarmoukian	F	32.7
Yarmoukian	F	29.2
Yarmoukian	F	32.5
Yarmoukian	F	29.4
Yarmoukian	F	32.0
Yarmoukian	F	33.3
Yarmoukian	F	30.1
Yarmoukian	F	29.1
Yarmoukian	F	32.4
Yarmoukian	F	30.2
Yarmoukian	F	32.7
Yarmoukian	F	30.4
Yarmoukian	F	31.6
Yarmoukian	F	30.9
Yarmoukian	F	29.3
Yarmoukian	F	31.6
Yarmoukian	F	29.1
Yarmoukian	F	29.2
Yarmoukian	F	28.1
Yarmoukian	F	31.7
Yarmoukian	F	34.9
Yarmoukian	F	30.3
Yarmoukian	F	30.8
Yarmoukian	F	34.1
Yarmoukian	F	31.2
Yarmoukian	F	29.5
Yarmoukian	F	32.0
Yarmoukian	F	33.0
Yarmoukian	fg	28.2

Table B.14 (cont): 'Ain Ghazal Sheep Humerus Measurements (mm)

Phase	Fusion	Bd	BFd
LPPNB	F	28.4	26.0
LPPNB	uf	31.9	26.2
LPPNB	uf	29.8	25.5
LPPNB	uf		26.9
LPPNB/PPNC	F	28.7	24.3
LPPNB/PPNC	F	30.8	25.0
LPPNB PPNC	fg	30.9	25.8
PPNC	F	31.8	26.4
PPNC	F	28.8	24.6
PPNC	F	29.5	24.5
PPNC	F		24.9
PPNC	F	29.3	23.0
PPNC	F	29.8	24.3
PPNC	F	31.7	28.4
PPNC	F	31.1	26.2
PPNC	F	29.6	25.9
PPNC	F	26.5	22.5
PPNC	F	29.4	24.5
PPNC	uf	27.6	24.1
PPNC	uf	28.5	23.4
PPNC	uf	25.9	22.4
PPNC	uf		26.8
PPNC	uf	30.1	23.3
PPNC	uf	28.7	
PPNC	uf	29.8	26.4
PPNC	uf	27.4	25.2
PPNC	uf	29.7	25.6
PPNC	uf	27.1	24.8
PPNC	uf		26.2
PPNC	uf	34.1	27.0
Yarmoukian	F	30.0	25.6
Yarmoukian	F	27.9	23.2
Yarmoukian	F	27.8	24.1
Yarmoukian	F	29.2	24.6
Yarmoukian	F	28.9	24.1
Yarmoukian	F	27.6	25.8
Yarmoukian	uf	26.7	22.2
Yarmoukian	uf	24.9	23.2
Yarmoukian	uf	30.3	26.0

Table B.15: 'Ain Ghazal Sheep Radius Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
LPPNB	?						10.7	11.7
LPPNB	F						12.3	12.1
LPPNB	F						10 8	10.9
LPPNB	uf						12.1	11.6
LPPNB	uf	27.6	12.1	12.0	11.5	11.4		
LPPNB/PPNC	F	26.6	11.5	11.9	10.9	11.5		
LPPNB/PPNC	F						12.1	12.1
LPPNB/PPNC	F	24.6	11.1	10.5	10.4	9.9		
LPPNB/PPNC	F						11.9	12.3
LPPNB/PPNC	F						12.1	12.0
LPPNB/PPNC	F		12.0	12.1				
LPPNB/PPNC	uf						11.3	11.5
LPPNB/PPNC	uf	29.7	12.4	13.0	11.9	12.8		
LPPNB/PPNC	uf		12.6	11.9	12.0	11.6		
LPPNB/PPNC	uf						12.7	12.2
PPNC	?						12.6	12.7
PPNC	F	28.8	11.4	12.4	11.3	12.1		
PPNC	F	25.6	11.3	11.3	11.4			
PPNC	F						12.4	12.4
PPNC	F	24.4	11.2	11.5	10.5	10.5		
PPNC	F				10.4	10.3		
PPNC	F	28.4	12.6	12.8	11.7	12.4		
PPNC	F	30.0	13.1	13.3				
PPNC	F	24.9	11.4	10.8	10.9	10.8		
PPNC	F	24.5	11.2	11.1	10.6	10.6		
PPNC	F						11.9	11.3
PPNC	F				10.6	11.3		
PPNC	F	24.3	12.0	11.3	11.0	10.6		
PPNC	F	27.4	13.2	12.9	12.6	12.9		
PPNC	F		10.9	10.5	10.6	10.4		
PPNC	F	28.8	12.1	12.8	12.2	12.9		
PPNC	F	28.6	12.2	12.9	11.9	12.9		
PPNC	F						10.8	11.2
PPNC	F						12.4	12.1
PPNC	F						11.2	11.9
PPNC	F						11.9	12.0
PPNC	F						10.7	10.9
PPNC	F						10.8	11.1
PPNC	F						12.3	12.5
PPNC	F	29.4	13.0	13.0	12.2	12.5		
PPNC	F						12.1	11.8
PPNC	uf						10.7	11.4
PPNC	uf						12.0	12.6
PPNC	uf						11.1	10.8
PPNC	uf						10.8	11.9
PPNC	uf						11.7	11.7
PPNC	uf	27 3	11.8	11.5	11.0	10.8		
PPNC	uf						12.3	12.5

Table B.16: 'Ain Ghazal Sheep Metacarpal Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
PPNC	uf						12.1	12.3
PPNC	uf						11.9	12.5
PPNC	uf						12.2	11.3
PPNC	uf						11.7	11.3
PPNC	uf						10.7	10.3
Yarmoukian	?						13.1	13.3
Yarmoukian	F	24.6	11.0	11.5	10.0	11.1		
Yarmoukian	F	24.8	10.7	11.3	10.2	11.4		
Yarmoukian	F	29.1	13.3	13.2	12.8	13.1		
Yarmoukian	F	25.0						
Yarmoukian	F	24.8	11.1	11.1	10.5	11.2		
Yarmoukian	F	25.6	11.9	12.0	11.4	11.3		
Yarmoukian	F	25.5	11.8	11.6	10.8	11.4		
Yarmoukian	F	26.8	12.7	12.5	12.0	12.2		
Yarmoukian	F	24.3	11.9	11.5	11.6	11.2		
Yarmoukian	F	26.1	11.0	11.6	10.3	10.9		
Yarmoukian	F						11.2	11.5
Yarmoukian	F						10.6	10.8
Yarmoukian	F	28.9	12.3	12.5	11.7	12.6		
Yarmoukian	F						11.5	11.3
Yarmoukian	F	25.1	11.9	11.3	11.3	11.1		
Yarmoukian	F	25.9	11.7	11.5	11.0	11.8		
Yarmoukian	F	25.0	11.5	11.4	10.8	10.9		
Yarmoukian	F						11.6	11.7
Yarmoukian	F	23.6	10.2	11.3	9.7	10.8		
Yarmoukian	uf						12.2	12.3
Yarmoukian	uf						11.9	11.3
Yarmoukian	uf						11.4	10.8
Yarmoukian	uf						11.3	11.6

Table B.16 (cont): 'Ain Ghazal Sheep Metacarpal Measurements (mm)

Phase	Fusion	Bd
PPNC	F	42.1
Yarmoukian	F	37.2

Table B.17: 'Ain Ghazal Sheep Femur Measurements (mm)

Phase	Fusion	Bd
LPPNB	?	25.9
LPPNB	F	25.6
LPPNB	F	25.3
LPPNB	F	27.5
LPPNB	F	27.6
LPPNB/PPNC	F	28.6
LPPNB/PPNC	F	25.4
LPPNB/PPNC	F	29.0
LPPNB/PPNC	F	24.9
LPPNB/PPNC	F	25.2
PPNC	F	26.8
PPNC	F	27.5
PPNC	F	26.6
PPNC	F	27.1
PPNC	F	26.1
PPNC	F	27.0
PPNC	F	27.9
PPNC	F	28.4
PPNC	F	27.3
PPNC	F	25.4
PPNC	F	27.1
PPNC	F	25.7
PPNC	F	26.4
PPNC	F	27.2
PPNC	F	28.5
PPNC	F	27.5
PPNC	F	26.3
PPNC	F	29.3
PPNC	uf	25.7
PPNC	uf	28.0
PPNC	uf	23.1
Yarmoukian	F	28.5
Yarmoukian	F	27.2
Yarmoukian	F	26.8
Yarmoukian	F	24.3
Yarmoukian	F	27.4
Yarmoukian	F	27.2
Yarmoukian	F	25.1
Yarmoukian	F	29.1
Yarmoukian	F	25.8
Yarmoukian	F	25.9
Yarmoukian	F	24.5
Yarmoukian	F	26.2
Yarmoukian	F	25.6
Yarmoukian	F	27.2

Table B.18: 'Ain Ghazal Sheep Tibia Measurements (mm)

Phase	GLl	GLm	Dl	Bd
MPPNB	28.2	26.8	16.1	18.5
LPPNB	31.6	29.9	17.9	19.7
LPPNB	30.8	29.4	17.2	19.0
LPPNB	27.8	26.9	15.9	17.1
LPPNB	30.2	28.9	17.6	19.4
LPPNB	29.3	28.1	16.4	18.7
LPPNB	27.7	26.3	16.4	17.3
LPPNB	31.9	29.5	17.5	19.1
LPPNB/PPNC	29.1		16.4	18.3
LPPNB/PPNC	29.6	28.8	17.2	18.8
LPPNB PPNC	30.5	29.1	17.3	19.5
LPPNB/PPNC	31.8	29.7	18.5	20.3
LPPNB/PPNC	31.1	28.9	17.4	20.4
LPPNB/PPNC	28.9	28.3	17.4	19.9
LPPNB/PPNC	28.1	27.4	16.3	17.3
LPPNB PPNC	31.8	29.8	17.8	20.0
LPPNB/PPNC	20.4	19.3	18.7	19.8
LPPNB/PPNC	29.9		15.3	
PPNC	28.0	26.7	15.9	18.4
PPNC		28.6		19.8
PPNC	31.2	29.1	18.3	21.0
PPNC	29.1	27.7	16.6	18.5
PPNC	26.6	25.1	15.9	18.4
PPNC	28.1	26.6	16.2	18.5
PPNC	31.3		18.4	
PPNC	29.5	28.4	17.2	
PPNC		26.8		
PPNC	30.2	28.9	17.6	19.4
PPNC	29.9	29.1	17.0	
PPNC	29.1	27.6	17.8	18.7
PPNC	32.1	29.9	18.5	19.8
PPNC	33.4	32.1	18.5	20.4
PPNC		28.6		18.9
PPNC	31.8	29.8	17.9	19.8
PPNC	29.2	28.7	16.9	18.9
PPNC	30.5	29.2	17.4	20.0
PPNC	29.0	26.8	17.1	18.5
PPNC	29.6	28.2	16.8	18.8
PPNC			17.0	
PPNC	27.3	27.1	15 5	17.4
PPNC	28.3	27.2	16.2	19.9
PPNC	30.7	29.0	17.2	19.2
PPNC	29.3	28.1	17.0	19.8
PPNC	30.0	28.7	16.8	18.3
PPNC	27.9	26.5	15.7	17.9
PPNC	29.1	28.0	17.3	19.5
PPNC	30.1	29.2	17.3	19.5
PPNC		28.5		19.8
PPNC	30.9	29.7		19.5

Table B.19: 'Ain Ghazal Sheep Astragalus Measurements (mm)

Phase	GLl	GLm	Dl	Bd
PPNC	29.4	28.7	16.9	19.4
PPNC	31.7	30.2	18.7	21.2
PPNC	29.7	28.7	16.9	18.7
PPNC	29.9	28.0	16.0	18.4
PPNC	27.2	26.7	15.9	18.5
PPNC	25.7	24.8	14.6	15.4
PPNC	32.8	31.0	18.1	20.0
PPNC	33.2		19.6	21.0
PPNC	29.0	28.3	16.9	18.6
PPNC	29.0	27.6	16.9	19.3
PPNC	30.1	29.3	18.0	19.5
PPNC	31.1	30.0	17.3	19.2
PPNC	29.9	29.0	17.3	18.9
PPNC	29.2	28.7	17.5	20.3
PPNC	32.5	30.6	17.9	19.3
PPNC	32.9	31.7	19.2	21.1
Yarmoukian	29.9	27.8	16.7	18.1
Yarmoukian	29.4	27.9	17.1	20.6
Yarmoukian	30.7	29.9	17.0	18.9
Yarmoukian	29.5	27.6	16.9	19.6
Yarmoukian		29.6	17.7	21.1
Yarmoukian	30.7	28.9	18.0	20.1
Yarmoukian	32.4	30.2	19.2	21.4
Yarmoukian	28.2	27.2	16.9	18.5
Yarmoukian	32.0	30.4	18.6	21.1
Yarmoukian	28.5	27.4	16.6	17.8
Yarmoukian		28.4		19.0
Yarmoukian		26.4	16.5	18.6
Yarmoukian	31.9	30.3	18.3	20.0
Yarmoukian	30.3	28.6	17.7	20.4
Yarmoukian	28.9	26.5		
Yarmoukian	28.4	27.2	16.2	18.1
Yarmoukian	28.2	26.5	16.2	18.5
Yarmoukian	27.8	26.0	15.6	18.8
Yarmoukian		27.7		18.5
Yarmoukian		28.7	17.3	
Yarmoukian	29.3	28.1	16.1	18.5
Yarmoukian	30.7		16.5	
Yarmoukian	19.3	17.8	16.6	18.5
Yarmoukian	30.0	28.5	16.4	19.4
Yarmoukian	29.9	28.6	16.8	
Yarmoukian	34.4	32.8	19.4	22.6
Yarmoukian	31.5	30.9	18.8	21.3
Yarmoukian	30.8	29.3	18.3	20.6
Yarmoukian			17.6	
Yarmoukian	29.4	27.9	16.8	17.6

Table B.19 (cont): 'Ain Ghazal Sheep Astragalus Measurements (mm)

Phase	Fusion	GL	GB
LPPNB	uf		20.5
LPPNB	uf		21.2
LPPNB PPNC	F		19.2
LPPNB/PPNC	?		20.3
PPNC	F	65.2	21.0
PPNC	F	57.5	20.9
PPNC	uf		18.8
PPNC	F		19.8
PPNC	uf		19.8
PPNC	F		22.2
PPNC	F	58.8	20.8
PPNC	uf		20.7
PPNC	F		19.7
PPNC	?		21.2
PPNC	F	64.2	22.1
PPNC	F	62.9	21.7
PPNC	?		18.8
PPNC	F	61.5	21.7
PPNC	uf		19.8
PPNC	?		20.7
PPNC	F	65.1	22.4
PPNC	F	61.2	
PPNC	F	63.7	20.3
Yarmoukian	F	57.8	21.1
Yarmoukian	F	58.1	21.8
Yarmoukian	F		21.5
Yarmoukian	F	54.4	19.6
Yarmoukian	F	57.4	19.2
Yarmoukian	F	54.5	18.8
Yarmoukian	F	57.5	
Yarmoukian	F	58.7	19.2
Yarmoukian	F	54.5	20.3
Yarmoukian	F	70.5	24.3
Yarmoukian	uf		20.2
Yarmoukian	uf		19.1
Yarmoukian	?		20.9

Table B.20: 'Ain Ghazal Sheep Calcaneum Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
LPPNB	F						10.1	10.4
LPPNB	F						10.4	9.6
LPPNB/PPNC	F	26.7	12.2	12.6	11.7	11.5		
LPPNB/PPNC	F	23.1	11.1	10.8	10.5	9.9		
LPPNB/PPNC	F	23.9	10.5	11.4	10.1	10.5		
LPPNB/PPNC	F						11.7	12.1
LPPNB/PPNC	F						11.1	11.0
LPPNB/PPNC	F						10.6	10.6
LPPNB/PPNC	uf						10.8	10.5
LPPNB/PPNC	uf						10.5	10.2
LPPNB/PPNC	uf						10.8	10.2
LPPNB/PPNC	uf						9.1	10.4
PPNC	F				9.9	10.1		
PPNC	F				11.1	11.3		
PPNC	F	23.9						
PPNC	F	25.4	11.5	11.5	10.9	10.6		
PPNC	F	26.3	11.5	12.2	10.9	11.1		
PPNC	F	25.7	11.8	11.9	11.4	10.6		
PPNC	F	26.3	11.5	12.1	10.7	11.4		
PPNC	F	25.4	10.9	11.5	10.9	10.7		
PPNC	F				10.4	9.5		
PPNC	F						11.0	10.0
PPNC	F						11.1	10.9
PPNC	F						12.0	12.6
PPNC	F	25.3	10.6		10.1	10.1		
PPNC	F	24.7	11.3	11.4	10.5	10.2		
PPNC	F						11.5	11.0
PPNC	F						10.8	10.7
PPNC	F	25.7	11.5	11.5	10.8	10.7		
PPNC	F	27.0	11.3	12.0	10.9	11.3		
PPNC	F	27.4	11.9	12.4	11.5	11.7		
PPNC	F	25.4	11.5	11.7	11.1	10.8		
PPNC	F		11.2	11.1	10.5	10.0		
PPNC	uf						12.2	12.0
PPNC	uf		11.0	11.3	10.8	10.3		
PPNC	uf						10.4	10.2
PPNC	uf						11.5	11.7
PPNC	uf		12.2	12.3	11.5	11.2		
PPNC	uf						10.3	10.4
PPNC	uf		12.2	11.9	11.5	11.6		
PPNC	uf						11.2	12.1
PPNC	uf						11.0	11.0
PPNC	uf	25.3	11.3	11.2	10.4	10.5		
PPNC	uf						10.7	10.6
Yarmoukian	F	25.2	11.3	11.6	10.6	10.4		
Yarmoukian	F	23.6	10.3	11.0	9.9	10.5		
Yarmoukian	F	24.5	10.8	11.0	10.6	9.9		
Yarmoukian	F						12.4	12.1
Yarmoukian	F						10.0	11.0
Yarmoukian	F	28.0	12.8	13.1	12.7	12.5		

Table B.21: 'Ain Ghazal Sheep Metatarsal Measurements (mm)

Phase	Fusion	Bd	W.troch (Med)	W.cond (Med)	W.troch (Lat)	W.cond (Lat)	W.troch (?)	W.cond (?)
Yarmoukian	F				11.5	11.1		
Yarmoukian	F						12.6	12.5
Yarmoukian	F	24.1	12.2	11.1	11.5	10.0		
Yarmoukian	F						10.6	10.9
Yarmoukian	F	24.4	10.6	10.7	10.3	9.7		
Yarmoukian	F						11.7	12.2
Yarmoukian	F	29.8						
Yarmoukian	F	25.1	10.3	10.9				
Yarmoukian	F						11.2	11.5
Yarmoukian	F	22.7	10.1	10.1	9.7	9.3		
Yarmoukian	F	23.5	11.0	11.1				
Yarmoukian	F	24.1	10.2	10.9	10.2	10.2		
Yarmoukian	F	22.7	9.9	10.3	9.3	9.9		
Yarmoukian	F	25.0	10.6	11.1	10 3	10.5		
Yarmoukian	F	24.8	11.6	11.0	10.5	10.7		
Yarmoukian	uf						12.0	11.8
Yarmoukian	uf						11.3	10.9
Yarmoukian	uf						10.6	10.8
Yarmoukian	uf						9.2	9.2
Yarmoukian	uf	25.3	11.1	11.1	10.5	10.5		

Table B.21 (cont): 'Ain Ghazal Sheep Metatarsal Measurements (mm)

Phase	Fusion	GLpe	Bp	SD	Bd
LPPNB	F	38.6	11.2	8.0	10.3
LPPNB	F	41.6	13.2	11.0	13.7
LPPNB/PPNC	F	44.1	12.8	10.3	
LPPNB/PPNC	F		11.7		
LPPNB/PPNC	F	38.4	11.5	8.3	10.9
LPPNB/PPNC	F	38.1	12.1	8.4	10.7
LPPNB/PPNC	F	36.8	11.7		12.2
LPPNB/PPNC	F	34.9	11.1	8.9	10.1
PPNC	F	40.6	13.4	10.5	12.7
PPNC	F	42.7	12.7	9.7	12.0
PPNC	F		12.4		
PPNC	F	41.4	12.8	9.8	12.0
PPNC	F	41.2	12.9	10.2	12.3
PPNC	F	39.1	11.8	8.7	10.7
PPNC	F	36.8	10.9	8.5	10.7
PPNC	F	39.2	12.8	10.4	11.3
PPNC	F		14.2		
PPNC	F		12.0		
PPNC	F		12.7		
PPNC	F	46.8	14.3	12.2	14.7
PPNC	F	43.3	13.0	11.1	13.3
PPNC	F	41.1	13.9	11.2	13.3
PPNC	F	40.0	12.0	9.3	11.4
PPNC	F	41.2	12.7	11.0	13.1
PPNC	F		13.6		
PPNC	F				12.8
PPNC	F		13.9		
PPNC	F		13.7		
PPNC	F	37.6	12.1	9.7	12.0
PPNC	F	40.7	13.7	10.3	12.7
PPNC	F	37.6	11.4	9.3	11.9
PPNC	F	38.2	12.1	8.9	11.1
PPNC	F	39.4	11.3	8.9	10.9
PPNC	F	37.6	11.5	8.4	10.5
PPNC	F	38.4	12.1	9.1	10.6
PPNC	F	36.0	11.4	8.6	10.8
PPNC	F	36.3	10.9	8.2	10.3
PPNC	F		13.0		
PPNC	F		12.6		
PPNC	F	39.0	12.3	8.9	11.2
PPNC	fg	37.9	11.6	9.8	11.9
PPNC	fg		12.5	9.5	
PPNC	uf				12.2
PPNC	uf		11.7		
Yarmoukian	F	37.2	12.6	8.9	11.0
Yarmoukian	F	34.9	13.1	10.2	11.8
Yarmoukian	F	36.9	11.5	8.9	11.0
Yarmoukian	F	40.9	12.5	10.4	12.3
Yarmoukian	F	43.1	13.9	11.1	13.4
Yarmoukian	F	33.2	10.5	8.2	10.3

Table B.22: 'Ain Ghazal Sheep First Phalanx Measurements (mm)

Phase	Fusion	GLpe	Bp	SD	Bd
Yarmoukian	F				11.6
Yarmoukian	F	40.1	12.0	8.9	11.6
Yarmoukian	F	37.9	13.2	11.4	13.5
Yarmoukian	F	37.3	13.1		
Yarmoukian	F	35.8	11.2	8.2	
Yarmoukian	F	37.7	11.8	8.9	10.9
Yarmoukian	F	35.2	10.7	8.5	10.6
Yarmoukian	F	34.8	11.2	8.6	10.5
Yarmoukian	F	39.8	11.4	9.7	11.0
Yarmoukian	F	35.7	10.8	8.1	10.0
Yarmoukian	F	40.5	13.5	11.1	12.4
Yarmoukian	F		12.1		11.2
Yarmoukian	F	35.2	11.5	9.8	11.8
Yarmoukian	F	37.4	11.6	8.4	10.8
Yarmoukian	F	38.4	12.3	9.2	11.4
Yarmoukian	F	40.8	13.4	10.4	12.4
Yarmoukian	F	39.7	12.0	9.2	11.6
Yarmoukian	F		13.0		
Yarmoukian	F		11.9		
Yarmoukian	fg		12.2		
Yarmoukian	fg		12.5	9.8	12.4

Table B.22 (cont): 'Ain Ghazal Sheep First Phalanx Measurements (mm)

Phase	DLS	Ld	MBS
LPPNB	28.1	23.6	5.2
LPPNB	32.7	25.7	6.4
LPPNB			6.1
LPPNB			6.1
LPPNB/PPNC	27.8	22.9	5.7
PPNC	32.1	25.8	7.1
PPNC			6.4
PPNC	31.9	25.7	6.6
PPNC	27.8	23.2	5.1
PPNC	27.2	21.7	5.2
PPNC	29.5	23.4	5.3
PPNC			5.4
PPNC	37.0	29.7	6.9
PPNC	37.6	30.7	6.8
PPNC	33.1	28.1	5.9
PPNC			6.5
PPNC			5.5
PPNC	33.8	27.8	6.4
PPNC	30.0	24.6	6.3
Yarmoukian			7.4
Yarmoukian	40.9	33.4	7.9
Yarmoukian	34.1	26.3	6.6
Yarmoukian	25.2	20.0	5.3

Table B.23: 'Ain Ghazal Sheep Third Phalanx Measurements (mm)

APPENDIX C

Bone Counts Obtained in this Analysis of the 'Ain Ghazal Faunal Assemblage by Phase (NISP and adjusted NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total
Scap a	Left		1	21	2	24					0	10		14	4	28	3	1	34	1	39
Sca ula	R ght			13	1	14			1		1	10		9	5	24	3		20	2	25
Scapula	Unknown				1	1					0					0					0
Humerus	I ft		1	50		51			1		1	4	8	27	1	40	1	6	36		43
Humerus	R ght		7	35		42					0	5	4	23		32	1	8	47	1	57
I umerus	Unknown					0					0					0					0
R d us	Left	27	4	6		37					0	5	1	3		9	4		9		13
R d'us	R ght	23	2	4		29					0	5		1	1	7	2		8	1	11
Ra us	Unknown					0					0					0					0
Pub	I ft	2		15	9	26					0			4	1	5	10		15	3	28
Pubis	Right	2		6	5	13					0	2		3	3	8	5		13	9	27
Pubis	Unknown					0					0					0					0
Femur	Left		1			1					0	11	2	6		19	4	1	4		9
Femur	R ght	3	1			4					0	11	1	6		18	12		6		18
Femur	Unknown					0					0					0					0
T ia	Left	7	4	22		33			1		1	15	1	19		35	4	1	15		20
T bia	R ght	11	5	22	1	39					0	9	1	10		20	5	1	18		24
T ia	Unkno vn					0					0					0	1				1
M tac rpal	Left	8	2	15		25					0					0	1		4		5
M ta rp	R ght	9	1	17		27					0				1	1			6		6
Metacarpal	Unkno n	1		1		2					0	1				1	2	1	14	1	18
M ta arpal /2	L Med/R La	39		12	6	57					0					0	6		3	2	11
M tacarpa	R Med/L Lat	35		18		53					0	2				2	8		11	2	21
Meta 1/2	Unknown		3	5		8					0					0			2		2
M tata a	Left	8	3	20	1	32					0			1		1			6		6
Me tarsal	R ght	12	3	19		34					0	1		1		2			8		8
M tatarsal	Unknown	2				2					0					0	1		8		9
Metatarsal 1/2	L Med/R Lat	14		3	3	20	1				1					0	2		8		10
M tatarsa 1/2	R M d/L Lat	30		3	2	35			1		1	4		2	1	7	4		7		11
Metatarsal 1/2	Unknow					0					0					0			1		1
M tapodial	Left	1		1		2					0					0					0
M tapodial	R ght					0					0					0			2		2
M podial	Unknov					0					0					0	1				1
M t po al 1/2	L Med/R Lat	9		6	2	17					0	11		1		12	3		6	1	10
M tapod 1/2	R M d/L Lat	11	1	6	1	19					0	6		1	1	8	3		9	2	14
M tapodia /2	Unkno			1	2	3					0			1	1	2					0
F Phalanx	L M d/R Lat	4	3	94		101					0	23	5	78		106	5	2	65		72
F rs Phalanx	R Med/L Lat	2	2	122		126					0	21	8	58	1	88	1	2	76		79
F rst Phalanx	Unknow					0					0					0				1	1
Third Pha anx	L Med/R Lat				65	65					0				100	100				60	60
Third Phalanx	R M d/L Lat				60	60					0				90	90				60	60
Th d Phalanx	Unknown					0					0					0					0
A trag lus	Left				67	67				1	1				31	31				22	22
A ga us	R ght				92	92					0				25	25				23	23
Astr ga us	Unknown					0					0					0					0
Ca neum	Left	23		13	5	41					0	10		2	10	22	9		17	6	32
Ca caneum	R ght	18	1	13	4	36	2				2	17		2	7	26	3		11	6	20
Calcaneum	Unknown					0					0					0					0
Ma d'ble vith teeth	I ft				1	1					0				20	20				5	5
M dible w h teeth	R gh				1	1					0				30	30				6	6
Mandible with teeth	Unknown					0					0					0					0
	TOTAL					1240					8					819					830

POSAC	Side	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scap a	Left	5		3	4	12					0	2		1	1	4					0
Sca ula	R ght	8		3	1	12	1		1	1	3	5		4	1	10					0
Scapula	Unknown					0					0					0					0
Humerus	I ft	2	3	9		14	1		7		8	1	1			2					0
Humerus	R ght	3	1	7	1	12			5		5	2		3		5					0
I umerus	Unknown	1				1	1				1	2				2					0
R d us	Left			1	1	2	1				1			1		1					0
R d'us	R ght	1				1			4		4	2				2					0
Ra us	Unknown					0					0					0					0
Pub	I ft	5		3	1	9	2		3		5	1		4	2	7					0
Pubis	Right	1		3	9	13			1		1	2			2	4					0
Pubis	Unknown					0					0					0					0
Femur	Left	6		2		8				1	1	2				2				1	1
Femur	R ght	9		4	1	14					0		1			1					0
Femur	Unknown					0					0					0					0
T ia	Left	1		2		3	1				1	4	1	2		7					0
T bia	R ght			4		4			1		1			2		2					0
T ia	Unkno vn					0					0					0					0
M tac rpal	Left					0	1				1					0					0
M ta rp	R ght					0			2		2					0					0
Metacarpal	Unkno n					0	1		2		3					0					0
M ta arpal /2	L Med/R La					0			1		1					0					0
M tacarpa	R Med/L Lat					0			1		1			1		1					0
Meta 1/2	Unknown					0					0					0					0
M tata a	Left					0	2				2					0					0
Me tarsal	R ght					0	1		1		2					0					0
M tatarsal	Unknown					0					0					0					0
Metatarsal 1/2	L Med/R Lat					0					0	2		3		5					0
M tatarsa 1/2	R M d/L Lat	2				2					0	2		1		3					0
Metatarsal 1/2	Unknow					0					0					0					0
M tapodial	Left					0			1		1					0					0
M tapodial	R ght					0					0					0					0
M podial	Unknov					0					0					0					0
M t po al 1/2	L Med/R Lat	4				4	3		1		4	3		2		5					0
M tapod 1/2	R M d/L Lat	4		2	2	8			2		2	1		6		7					0
M tapodia /2	Unkno					0			2	2	4	1				1					0
F Phalanx	L M d/R Lat	2		3		5	3	1	12		16	4	2	5		11					0
F rs Phalanx	R Med/L Lat	3		5		8	2		20		22	3	1	4		8					0
F rst Phalanx	Unknow					0					0	1		2		3			1		1
Third Pha anx	L Med/R Lat				7	7				22	22				3	3					0
Third Phalanx	R M d/L Lat				6	6				16	16				3	3					0
Th d Phalanx	Unknown					0					0					0					0
A trag lus	Left				7	7				6	6				3	3				1	1
A ga us	R ght				4	4				3	3				3	3					0
Astr ga us	Unknown					0					0					0					0
Ca neum	Left	6		2	6	14				4	4	1		1	2	4			1		1
Ca caneum	R ght	12				12				4	4			4	4	8					0
Calcaneum	Unknown					0					0					0					0
Ma d'ble vith teeth	I ft					0					0				1	1					0
M dible w h teeth	R gh				1	1					0					0					0
Mandible with teeth	Unknown					0					0				2	2					0
	TOTAL					183					147					120					4

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	OC uf	OC fg	OC F	OC ?	OC Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total
Ma dib tooth	Left					0					0				27	27				7	7
Ma idibu ar tooth	R ght				2	2					0				26	26				2	2
Mandibular tooth	Unknown					0					0					0					0
I m re	Left				15	15					0				1	1				10	10
Horncore	R ght				8	8					0				1	1				10	10
Horncore	Unknown				1	1					0				9	9				12	12
	TOTAL					26					0					64					41

Non POSAC	Side	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Ma dib tooth	Left				3	3				2	2					0					0
Ma idibu ar tooth	R ght				3	3				5	5					0					0
Mandibular tooth	Unknown					0					0				14	14				1	1
I m re	Left					0					0					0					0
Horncore	R ght					0					0					0					0
Horncore	Unknown				10	10				2	2					0					0
	TOTAL					16					9					14					1

Species	NISP	%
Goat	124	37 0
Sheep	8	0 2
Goat/Sheep	819	24 4
Ga e	830	24 8
Sma l Ruminant	183	5 5
Cattle	147	4 4
P g	120	3 6
Eq id	4	0 1
TOTAL	3351	100 0

Table C.1: 'Ain Ghazal Middle PPNB Bone Counts (NISP)

		Gt	Gt	Gt	Gt	Gt	Sp	Sp	Sp	Sp	Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gz	Gz	Gz	Gz	Gz	SR	SR	SR	SR	SR	Ct	Ct	Ct	Ct	Ct	Pg	Pg	Pg	Pg	Pg	Eq	Eq	Eq	Eq	Eq
POSAC	Side	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total
Scapula	Left		1	21	2	24					0	10		14	4	28	3	1	34	1	39	5		3	4	12					0	2		1	1	4					0
Scapula	Right			13	1	14			1		1	10		9	5	24	3		20	2	25	8		3	1	12	1		1	1	3	5		4	1	10					0
Scapula	Unknown				1	1					0					0					0					0					0					0					0
Humerus	Left		1	50		51			1		1	4	8	27	1	40	1	6	36		43	2	3	9		14	1		7		8	1	1			2					0
Humerus	Right		7	35		42					0	5	4	23		32	1	8	47	1	57	3	1	7	1	12			5		5	2		3		5					0
Humerus	Unknown					0					0					0					0	1				1	1				1	2				2					0
Radius	Left	27	4	6		37					0	5	1	3		9	4		9		13			1	1	2	1				1			1		1					0
Radius	Right	23	2	4		29					0	5		1	1	7	2		8	1	11	1				1			4		4	2				2					0
Radius	Unknown					0					0					0					0					0					0					0					0
Pubis	Left	2		15	9	26					0			4	1	5	10		15	3	28	5		3	1	9	2		3		5	1		4	2	7					0
Pubis	Right	2		6	5	13					0	2		3	3	8	5		13	9	27	1		3	9	13			1		1	2			2	4					0
Pubis	Unknown					0					0					0					0					0					0					0					0
Femur	Left		1			1					0	11	2	6		19	4	1	4		9	6		2		8				1	1	2				2				1	1
Femur	Right	3	1			4					0	11	1	6		18	12		6		18	9		4	1	14					0		1			1					0
Femur	Unknown					0					0					0					0					0					0					0					0
Tibia	Left	7	4	22		33			1		1	15	1	19		35	4	1	15		20	1		2		3	1				1	4	1	2		7					0
Tibia	Right	11	5	22	1	39					0	9	1	10		20	5	1	18		24			4		4			1		1			2		2					0
Tibia	Unknown					0					0					0	1				1					0					0					0					0
Metacarpal	Left	8	2	15		25					0					0	1		4		5					0	1				1					0					0
Metacarpal	Right	9	1	17		27					0				1	1			6		6					0			2		2					0					0
Metacarpal	Unknown	1		1		2					0	1				1	2	1	14	1	18					0	1		2		3					0					0
Metacarpal 1/2	L Med/R Lat	39		12	6	28.5					0					0	6		3	2	5.5					0			1		0.5					0					0
Metacarpal 1/2	R Med/L Lat	35		18		26.5					0	2				1	8		11	2	10.5					0			1		0.5			1		0.5					0
Metacarpal 1/2	Unknown		3	3		4					0					0			2		1					0					0					0					0
Metatarsal	Left	8	3	20	1	32					0			1		1			6		6					0	2				2					0					0
Metatarsal	Right	12	3	19		34					0	1		1		2			8		8					0	1		1		2					0					0
Metatarsal	Unknown	2				2					0					0	1		8		9					0					0					0					0
Metatarsal 1/2	L Med/R Lat	14		3	3	10	1				0.5					0	2		8		5					0					0	2		3		2.5					0
Metatarsal 1/2	R Med/L Lat	30		3	2	17.5			1		0.5	4		2	1	3.5	4		7		5.5	2				1					0	2		1		1.5					0
Metatarsal 1/2	Unknown					0					0					0			1		0.5					0					0					0					0
Metapodial	Left	1		1		2					0					0					0					0			1		1					0					0
Metapodial	Right					0					0					0			2		2					0					0					0					0
Metapodial	Unknown					0					0					0	1				1					0					0					0					0
Metapodial 1/2	L Med/R Lat	9		6	2	8.5					0	11		1		6	3		6	1	5	4				2	3		1		2	3		2		2.5					0
Metapodial 1/2	R Med/L Lat	11	1	6	1	9.5					0	6		1	1	4	3		9	2	7	4		2	2	4			2		1	1		6		3.5					0
Metapodial 1/2	Unknown			1	2	1.5					0			1	1	1					0					0			2	2	2	1				0.5					0
First Phalanx	L Med/R Lat	4	3	94		101					0	23	5	78		106	5	2	65		72	2		3		5	3	1	12		16	4	2	5		11					0
First Phalanx	R Med/L Lat	2	2	122		126					0	21	8	58	1	88	1	2	76		79	3		5		8	2		20		22	3	1	4		8					0
First Phalanx	Unknown					0					0					0				1	1					0					0	1		2		3			1		2
Third Phalanx	L Med/R Lat				65	65					0				100	100				60	60				7	7				22	22				3	3					0
Third Phalanx	R Med/L Lat				60	60					0				90	90				60	60				6	6				16	16				3	3					0
Third Phalanx	Unknown					0					0					0					0					0					0					0					0
Astragalus	Left				67	67				1	1				31	31				22	22				7	7				6	6				3	3				1	1
Astragalus	Right				92	92					0				25	25				23	23				4	4				3	3				3	3					0
Astragalus	Unknown					0					0					0					0					0					0					0					0
Calcaneum	Left	23		13	5	41					0	10		2	10	22	9		17	6	32	6		2	6	14				4	4	1		1	2	4			1		1
Calcaneum	Right	18	1	13	4	36	2				2	17		2	7	26	3		11	6	20	12				12				4	4			4	4	8					0
Calcaneum	Unknown					0					0					0					0					0					0					0					0
Mandible with teeth	Left				1	1					0				20	20				5	5					0					0				1	1					0
Mandible with teeth	Right				1	1					0				30	30				6	6				1	1					0					0					0
Mandible with teeth	Unknown					0					0					0					0					0					0				2	2					0
	TOTAL					1134					7					803.5					790					176					141					109					5

		Gt	Gt	Gt	Gt	Gt	Sp	Sp	Sp	Sp	Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gt/Sp	Gz	Gz	Gz	Gz	Gz	SR	SR	SR	SR	SR	Ct	Ct	Ct	Ct	Ct	Pg	Pg	Pg	Pg	Pg	Eq	Eq	Eq	Eq	Eq
Non POSAC	Side	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total	uf	fg	F	?	Total
Mandibular tooth	Left					0					0				27	27				7	7				3	3				2	2					0					0
Mandibular tooth	Right				2	2					0				26	26				2	2				3	3				5	5					0					0
Mandibular tooth	Unknown					0					0					0					0					0					0				14	14				1	1
Horncore	Left				15	15					0				1	1				10	10					0					0					0					0
Horncore	Right				8	8					0				1	1				10	10					0					0					0					0
Horncore	Unknown				1	1					0				9	9				12	12				10	10				2	2					0					0
	TOTAL					26					0					64					41					16					9					14					1

Species	adj NISP	%
Goat	1134	35.8
Sheep	7	0.2
Goat/Sheep	803.5	25.4
Gazelle	790	25.0
Small Ruminant	176	5.6
Cattle	141	4.5
Pig	109	3.4
Equid	5	0.2
TOTAL	3165.5	100.0

Table C.2: 'Ain Ghazal Middle PPNB Bone Counts (adjusted NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Scapula	Left			7		7			4		4	2		8	3	13
Scapula	Right			1		1			8		8	5		9	7	21
Scapula	Unknown					0					0					0
Humerus	I ft			5		5			7		7	1	3	9		13
Humerus	R ght			6		6		2	5		7		3	10		13
Humerus	Unknown					0					0	1				1
Radius	Left	1				1			3		3	1		3		4
R dius	R ght	3				3	4		2		6	1				1
Radius	Unknown					0					0					0
Pubis	Left			1		1				1	1	2		3		5
Pubis	R ght			2		2	1			1	2			1	1	2
Pubi	Unknown					0					0					0
Femur	Left	1				1					0	1		1		2
F mur	R ght					0					0	1				1
Femur	Unknown					0					0					0
T bia	Left			5		5			6		6	5		7		12
T bia	R ght			8		8			5	1	6	4	1	2		7
T bia	Unknown					0					0					0
M tacarpal	I ft	1		4		5			3		3					0
M tacarp l	R gh	2		5		7	1		5		6					0
M ta arpal	Unknov			1		1					0					0
Metacarpal 1/2	L M d/R Lat	6	1	4		11			1	1	2	1				1
M tacarpa 1/2	R M d/L Lat	3		3	1	7	2		2		4					0
Meta arpal 1/2	Unknown	1				1					0					0
Metatarsal	I eft	1		11		12			2		2			1		1
M tatarsal	R ght	2		1		3			2		2					0
Metatarsal	Unknown					0					0					0
Metatarsal 1/2	L M d/R Lat	3		3		6	1		3		4	1		1		2
Metatarsal 1/2	R Med/L Lat	1	1	1		3			2		2	1				1
M tatarsal 1/2	Unknown					0					0					0
Metapod'al	Left					0					0	1				1
Metapod al	R'ght	1				1					0					0
Metapodial	U known					0					0					0
Metapodial 1/2	L Med/R Lat					0				1	1					0
Metapodial 1/2	R Med/l Lat	1		1	1	3					0					0
M tapodial /2	Unkno vn					0					0					0
F rs Phalanx	L Med/R Lat	1		5		6			1		1	2	1	7		10
First Phalanx	R Med/L Lat			7		7			3		3	2		10		12
F rst Phalanx	Unknown					0					0					0
Third Phalanx	L Med/R Lat				4	4				4	4				7	7
Third Pha anx	R Med/L Lat				4	4				4	4				6	6
Third Phalanx	Unknown					0					0					0
A tragalus	Left				9	9				14	14				4	4
Astraga us	Right				10	10				8	8				5	5
Astraga us	Unknown					0					0					0
C aneum	I ft	2	1	3	2	8	2		1	2	5	1	1	2	2	6
Calcaneum	Right			1	5	6	2		1	1	4		5	1	5	11
Calcaneum	Unknown					0					0					0
Mandi with teet	Left					0				1	1				15	15
Mand e w th teet	R ght					0					0				7	7
Mandible w th teet	Unknown					0					0					0
	TOTAL					154					120					184

POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left	1		1		2	1		1	2	4			1		1			3		3			1		1
Scapula	Right			3		3	1		1	1	3				1	1			4	1	5					0
Scapula	Unknown					0					0					0					0					0
Humerus	I ft		1	2		3			1	1	2	1		1		2	2		5		7	1				1
Humerus	R ght			2		2	1		2		3					0	1		2		3			1		1
Humerus	Unknown					0					0					0					0					0
Radius	Left			1		1					0			1		1					0					0
R dius	R ght			1		1					0					0					0					0
Radius	Unknown					0					0					0					0					0
Pubis	Left			2		2	1			1	2			1		1	1			2	3					0
Pubis	R ght			1	1	2			1	2	3				2	2	1		2	1	4					0
Pubi	Unknown					0					0					0					0					0
Femur	Left			1		1	5				5			1		1	2				2					0
F mur	R ght					0	2				2			2		2					0					0
Femur	Unknown					0					0					0					0					0
T bia	Left			2		2	1				1					0			3		3					0
T bia	R ght			2		2					0	1		1		2					0					0
T bia	Unknown					0					0					0					0					0
M tacarpal	I ft	1		1		2					0					0					0			1		1
M tacarp l	R gh	1		1		2					0					0					0					0
M ta arpal	Unknov					0					0					0					0					0
Metacarpal 1/2	L M d/R Lat			1		1					0			1		1	1		1		2					0
M tacarpa 1/2	R M d/L Lat	1		1		2			1		1					0			1		1					0
Meta arpal 1/2	Unknown					0					0					0					0					0
Metatarsal	I eft			1		1					0					0					0					0
M tatarsal	R ght			4		4					0					0					0					0
Metatarsal	Unknown					0					0					0					0					0
Metatarsal 1/2	L M d/R Lat	1		3		4					0					0	1				1					0
Metatarsal 1/2	R Med/L Lat	1		8		9					0					0					0					0
M tatarsal 1/2	Unknown					0					0					0					0					0
Metapod'al	Left					0					0					0					0					0
Metapod al	R'ght					0					0					0					0					0
Metapodial	U known					0					0					0					0			3		3
Metapodial 1/2	L Med/R Lat			2		2			1		1					0	3		1		4					0
Metapodial 1/2	R Med/l Lat	1		1		2					0	2				2	3	1	4		8					0
M tapodial /2	Unkno vn					0					0					0					0					0
F rs Phalanx	L Med/R Lat			7		7					0					0	2		3		5					0
First Phalanx	R Med/L Lat	2		8		10					0			3		3			3		3					0
F rst Phalanx	Unknown					0					0					0					0			1		1
Third Phalanx	L Med/R Lat				4	4				1	1				1	1				1	1					0
Third Pha anx	R Med/L Lat				2	2				2	2				3	3				8	8					0
Third Phalanx	Unknown					0					0					0					0				2	2
A tragalus	Left				3	3				5	5				1	1				1	1					0
Astraga us	Right				3	3				3	3				1	1				7	7				2	2
Astraga us	Unknown					0					0					0					0					0
C aneum	I ft			1	2	3	1				1					0	2			1	3			1		1
Calcaneum	Right			4	1	5			1		1				1	1	1				1					0
Calcaneum	Unknown					0					0					0					0					0
Mandi with teet	Left				1	1					0					0					0					0
Mand e w th teet	R ght					0					0					0				1	1					0
Mandible w th teet	Unknown					0					0					0				3	3					0
	TOTAL					88					40					26					79					13

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Ma dibular tooth	Left					0					0				11	11
Mand'bular tooth	R'ght					0					0				20	20
Mandibular tooth	Unknown					0					0					0
Horncore	Left				5	5					0					0
H rncore	R ght				5	5					0				1	1
Horncore	Unknown				1	1					0				2	2
	TOTAL					11					0					34

Non POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Ma dibular tooth	Left				3	3					0					0					0					0
Mand'bular tooth	R'ght				1	1					0					0				3	3				1	1
Mandibular tooth	Unknown				1	1					0				1	1				1	1				1	1
Horncore	Left				4	4					0					0					0					0
H rncore	R ght				9	9					0					0					0					0
Horncore	Unknown				3	3				11	11				2	2					0					0
	TOTAL					21					11					3					4					2

Species	NISP	%
Goat	154	21 8
Sheep	120	17 0
Goat/Sheep	184	26 1
Gazelle	88	12 5
mall Ruminant	40	5
attle	26	3 7
Pig	79	11.2
Equid	13	1 8
TOTAL	704	100.0

Table C.3: 'Ain Ghazal Late PPNB Bone Counts (NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left			7		7			4		4	2		8	3	13	1		1		2	1		1	2	4			1		1			3		3			1		1
Scapula	Right			1		1			8		8	5		9	7	21			3		3	1		1	1	3				1	1			4	1	5					0
Scapula	Unknown					0					0					0					0					0					0					0					0
Humerus	Left			5		5			7		7	1	3	9		13		1	2		3			1	1	2	1		1		2	2		5		7	1				1
Humerus	Right			6		6		2	5		7		3	10		13			2		2	1		2		3					0	1		2		3			1		1
Humerus	Unknown					0					0	1				1					0					0					0					0					0
Radius	Left	1				1			3		3	1		3		4			1		1					0			1		1					0					0
Radius	Right	3				3	4		2		6	1				1			1		1					0					0					0					0
Radius	Unknown					0					0					0					0					0					0					0					0
Pubis	Left			1		1				1	1	2		3		5			2		2	1			1	2			1		1	1			2	3					0
Pubis	Right			2		2	1			1	2			1	1	2			1	1	2			1	2	3				2	2	1		2	1	4					0
Pubis	Unknown					0					0					0					0					0					0					0					0
Femur	Left	1				1					0	1		1		2			1		1	5				5			1		1	2				2					0
Femur	Right					0					0	1				1					0	2				2			2		2					0					0
Femur	Unknown					0					0					0					0					0					0					0					0
Tibia	Left			5		5			6		6	5		7		12			2		2	1				1					0			3		3					0
Tibia	Right			8		8			5	1	6	4	1	2		7			2		2					0	1		1		2					0					0
Tibia	Unknown					0					0					0					0					0					0					0					0
Metacarpal	Left	1		4		5			3		3					0	1		1		2					0					0					0			1		1
Metacarpal	Right	2		5		7	1		5		6					0	1		1		2					0					0					0					0
Metacarpal	Unknown			1		1					0					0					0					0					0					0					0
Metacarpal 1/2	L Med/R Lat	6	1	4		5.5			1	1	1	1				0.5			1		0.5					0			1		1	1		1		1					0
Metacarpal 1/2	R Med/L Lat	3		3	1	3.5	2		2		2					0	1		1		1			1		0.5					0			1		0.5					0
Metacarpal 1/2	Unknown	1				0.5					0					0					0					0					0					0					0
Metatarsal	Left	1		11		12			2		2			1		1			1		1					0					0					0					0
Metatarsal	Right	2		1		3			2		2					0			4		4					0					0					0					0
Metatarsal	Unknown					0					0					0					0					0					0					0					0
Metatarsal 1/2	L Med/R Lat	3		3		3	1		3		2	1		1		1	1		3		2					0					0	1				0.5					0
Metatarsal 1/2	R Med/L Lat	1	1	1		1.5			2		1	1				0.5	1		8		4.5					0					0					0					0
Metatarsal 1/2	Unknown					0					0					0					0					0					0					0					0
Metapodial	Left					0					0	1				1					0					0					0					0					0
Metapodial	Right	1				1					0					0					0					0					0					0					0
Metapodial	Unknown					0					0					0					0					0					0					0			3		3
Metapodial 1/2	L Med/R Lat					0				1	0.5					0			2		1			1		0.5					0	3		1		2					0
Metapodial 1/2	R Med/L Lat	1		1	1	1.5					0					0	1		1		1					0	2				1	3	1	4		4					0
Metapodial 1/2	Unknown					0					0					0					0					0					0					0					0
First Phalanx	L Med/R Lat	1		5		6			1		1	2	1	7		10			7		7					0					0	2		3		5					0
First Phalanx	R Med/L Lat			7		7			3		3	2		10		12	2		8		10					0			3		3			3		3					0
First Phalanx	Unknown					0					0					0					0					0					0					0			1		2
Third Phalanx	L Med/R Lat				4	4				4	4				7	7				4	4				1	1				1	1				1	1					0
Third Phalanx	R Med/L Lat				4	4				4	4				6	6				2	2				2	2				3	3				8	8					0
Third Phalanx	Unknown					0					0					0					0					0					0					0				2	4
Astragalus	Left				9	9				14	14				4	4				3	3				5	5				1	1				1	1					0
Astragalus	Right				10	10				8	8				5	5				3	3				3	3				1	1				7	7				2	2
Astragalus	Unknown					0					0					0					0					0					0					0					0
Calcaneum	Left	2	1	3	2	8	2		1	2	5	1	1	2	2	6			1	2	3	1				1					0	2			1	3			1		1
Calcaneum	Right			1	3	6	2		1	1	4		5	1	5	11			4	1	5			1		1				1	1	1				1					0
Calcaneum	Unknown					0					0					0					0					0					0					0					0
Mandible with teeth	Left					0				1	1				15	15				1	1					0					0					0					0
Mandible with teeth	Right					0					0				7	7					0					0					0				1	1					0
Mandible with teeth	Unknown					0					0					0					0					0					0				3	3					0
	TOTAL					138.5					113.5					182					78					39					25					71					16

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Mandibular tooth	Left					0					0				11	11				3	3					0					0					0					0
Mandibular tooth	Right					0					0				20	20				1	1					0					0				3	3				1	1
Mandibular tooth	Unknown					0					0					0				1	1					0				1	1				1	1				1	1
Horncore	Left				5	5					0					0				4	4					0					0					0					0
Horncore	Right				5	5					0				1	1				9	9					0					0					0					0
Horncore	Unknown				1	1					0				2	2				3	3				11	11				2	2					0					0
	TOTAL					11					0					34					21					11					3					4					2

Species	adj NISP	%
Goat	138.5	20.9
Sheep	113.5	17.1
Goat/Sheep	182	27.5
Gazelle	78	11.8
Small Ruminant	39	5.9
Cattle	25	3.8
Pig	71	10.7
Equid	16	2.4
TOTAL	663	100.0

Table C.4: 'Ain Ghazal Late PPNB Bone Counts (adjusted NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left	1		2		3			1		1	1			1	2			2		2				1	1				2	2			1	1	2					0
Scapula	Right			1		1			1		1	2		1		3				1	1					0					0				1	1					0
Scapula	Unknown					0					0					0					0					0					0					0					0
Humerus	Left			3		3		1	6		7			4		4			2		2			1		1			1		1			2		2			1		1
Humerus	Right			3		3		1	1		2	1	1	3		5					0			2		2	1		2		3					0			1		1
Humerus	Unknown					0					0					0					0					0					0					0					0
R dius	Left	1				1			1		1		1			1					0					0					0					0					0
Radius	Right	1				1		1	1		2					0	1				1					0			1		1					0					0
Rad us	Unknown					0					0					0					0					0					0					0					0
Pubis	Left	1		2		3			1	3	4					0					0	1			1	2				1	1	1		1	1	3					0
Pubis	R ght					0				1	1				1	1				1	1	2			4	6					0					0					0
Pub s	Unknown					0					0					0					0					0					0					0					0
Femur	Left					0					0	3		2		5					0					0			2		2	1				1					0
Femur	Right					0					0			1		1					0	1				1					0	1				1					0
Femur	Unknown					0					0					0					0					0					0					0					0
T bia	Left			1		1			2		2	2		4		6					0	1				1	2		2		4					0					0
T ia	Right			5		5			3		3	1		6		7		1			1					0					0					0			1		1
T ia	Unknown					0					0					0					0					0					0					0					0
M tacarpal	Left			1		1	2		3		5					0					0					0					0					0					0
M tacarp l	R ght					0			1		1					0					0					0					0					0					0
M tacarpal	Unknown					0					0					0					0					0					0					0					0
Metacarp l 1/2	L M d/R Lat	1		3		4	1		1		2					0	1				1					0					0					0					0
M tacarpal 1/2	R M d/L Lat	1		3	1	5	1		2		3					0			2		2					0			2		2					0					0
M ta rp l 1/2	Unknown					0					0					0					0					0					0					0					0
4 r	Left			1		1			1		1					0			1		1					0					0					0					0
Metatarsa	Right			1		1			2		2					0					0					0					0					0					0
Metatarsal	Unknown					0					0					0					0					0					0					0					0
Metatarsa 1/2	L Med/R Lat					0	1		2		3					0				1	1					0					0					0					0
Metatarsa 1/2	R Med/L Lat	3		3		6	3		2		5					0			2		2					0					0					0					0
M tatarsa 1/2	Unknown					0					0					0					0					0					0					0					0
M tapodial	Left					0					0					0					0					0					0					0					0
Metapod al	Right					0					0					0					0					0					0					0					0
Metapod al	Unknown					0					0					0					0					0					0	1				1					0
Metapodial 1/2	L M d/R Lat					0					0					0	1		1		2					0					0	1		1		2					0
M tapodial 1/2	R Med/L Lat				1	1	2				2					0			1		1					0					0	1				1					0
M tapod al 1/2	Unknown					0					0	1			1	2					0	1				1			1	2	3					0					0
F rs Phal nx	L Med/R Lat			4		4			4		4	2		1		3			1		1	2				2			1		1	1		1		2					0
F rs Pha anx	R Med/L Lat	1		3		4			2		2	1		5		6					0					0	1		2		3			1		1					0
First Phalanx	Unknown					0					0					0					0					0					0			1		1					0
Third Phalanx	L Med/R Lat					0				1	1				3	3				2	2				2	2				2	2				2	2					0
Third Pha anx	R Med/L Lat				2	2					0				6	6				2	2					0				1	1				3	3					0
Third Phalanx	Unknown					0					0					0					0					0					0					0				1	1
A tragalus	Left				2	2				7	7				1	1				2	2				3	3					0					0					0
Astragalus	R ght				4	4				5	5				2	2				1	1				4	4					0				1	1					0
Astraga us	Unknown					0					0					0					0					0					0					0					0
Ca caneum	Left					0			1		1	1				1			1		1	3			1	4				1	1			1	1	2					0
Calcaneum	Right					0	2			1	3	2		1	3	6			1		1	1				1					0				1	1					0
Cal neum	Unknown					0					0					0					0					0					0					0					0
Mand b e with teet	Left					0				1	1				7	7				1	1					0					0					0					0
Mandib e with teet	R ght					0					0				7	7				1	1					0					0					0					0
Mandible with teet	Unknown					0					0					0					0					0					0					0					0
	TOTAL					56					72					79					30					31					27					27					4
Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Ma dib lar tooth	Left					0					0				22	22				2	2					0				2	2					0					0
Ma dibular t th	Right					0					0				17	17				3	3					0					0				1	1				1	1
Mandibular tooth	Unknown					0					0					0					0					0					0				2	2					0
Horncore	Left					0				1	1					0					0					0					0					0					0
H rncore	Right					0					0					0					0					0					0					0					0
Horncore	Unknown					0					0					0					0				2	2					0					0					0
	TOTAL					0					1					39					5					2					2					3					1

Species	NISP	%
Goat	56	17 2
Sheep	72	22 1
Goat/Sheep	79	24 2
Gaze le	30	9 2
Small Ruminant	31	9 5
Cattle	27	8 3
P g	27	8 3
Eq id	4	1 2
TOTAL	326	100 0

Tbale C.5: 'Ain Ghazal Transitional Late PPNB/PPNC Bone Counts (NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left	1		2		3			1		1	1			1	2			2		2				1	1				2	2			1	1	2					0
Scapula	Right			1		1			1		1	2		1		3				1	1					0					0				1	1					0
Scapula	Unknown					0					0					0					0					0					0					0					0
Humerus	Left			3		3		1	6		7			4		4			2		2			1		1			1		1			2		2			1		1
Humerus	Right			3		3		1	1		2	1	1	3		5					0			2		2	1		2		3					0			1		1
Humerus	Unknown					0					0					0					0					0					0					0					0
Radius	Left	1				1			1		1		1			1					0					0					0					0					0
Radius	Right	1				1		1	1		2					0	1				1					0			1		1					0					0
Radius	Unknown					0					0					0					0					0					0					0					0
Pubis	Left	1		2		3			1	3	4					0					0	1			1	2				1	1	1		1	1	3					0
Pubis	Right					0				1	1				1	1				1	1	2			4	6					0					0					0
Pubis	Unknown					0					0					0					0					0					0					0					0
Femur	Left					0					0	3		2		5					0					0			2		2	1				1					0
Femur	Right					0					0			1		1					0	1				1					0	1				1					0
Femur	Unknown					0					0					0					0					0					0					0					0
Tibia	Left			1		1			2		2	2		4		6					0	1				1	2		2		4					0					0
Tibia	Right			5		5			3		3	1		6		7		1			1					0					0					0			1		1
Tibia	Unknown					0					0					0					0					0					0					0					0
Metacarpal	Left			1		1	2		3		5					0					0					0					0					0					0
Metacarpal	Right					0			1		1					0					0					0					0					0					0
Metacarpal	Unknown					0					0					0					0					0					0					0					0
Metacarpal 1/2	L Med/R Lat	1		3		2	1		1		1					0	1				0.5					0					0					0					0
Metacarpal 1/2	R Med/L Lat	1		3	1	2.5	1		2		1.5					0			2		1					0			2		1					0					0
Metacarpal 1/2	Unknown					0					0					0					0					0					0					0					0
Metatarsal	Left			1		1			1		1					0			1		1					0					0					0					0
Metatarsal	Right			1		1			2		2					0					0					0					0					0					0
Metatarsal	Unknown					0					0					0					0					0					0					0					0
Metatarsal 1/2	L Med/R Lat					0	1		2		1.5					0				1	0.5					0					0					0					0
Metatarsal 1/2	R Med/L Lat	3		3		3	3		2		2.5					0			2		1					0					0					0					0
Metatarsal 1/2	Unknown					0					0					0					0					0					0					0					0
Metapodial	Left					0					0					0					0					0					0					0					0
Metapodial	Right					0					0					0					0					0					0					0					0
Metapodial	Unknown					0					0					0					0					0					0					0					0
Metapodial 1/2	L Med/R Lat					0					0					0	1		1		1					0					0	2		1		1.5					0
Metapodial 1/2	R Med/L Lat				1	0.5	2				1					0			1		0.5					0					0	1				0.5					0
Metapodial 1/2	Unknown					0					0	1			1	1					0	1				0.5			1	2	1.5					0					0
Phalanx I	L Med/R Lat			4		4			4		4	2		1		3			1		1	2				2			1		1	1		1		2					0
Phalanx I	R Med/L Lat	1		3		4			2		2	1		5		6					0					0	1		2		3			1		1					0
Phalanx I	Unknown					0					0					0					0					0					0			1		1					0
Phalanx III	L Med/R Lat					0				1	1				3	3				2	2				2	2				2	2				2	2					0
Phalanx III	R Med/L Lat				2	2					0				6	6				2	2					0				1	1				3	3					0
Phalanx III	Unknown					0					0					0					0					0					0					0				1	2
Astragalus	Left				2	2				7	7				1	1				2	2				3	3					0					0					0
Astragalus	Right				4	4				5	5				2	2				1	1				4	4					0				1	1					0
Astragalus	Unknown					0					0					0					0					0					0					0					0
Calcaneum	Left					0			1		1	1				1			1		1	3			1	4				1	1			1	1	2					0
Calcaneum	Right					0	2			1	3	2		1	3	6			1		1	1				1					0				1	1					0
Calcaneum	Unknown					0					0					0					0					0					0					0					0
Mandible with teeth	Left					0				1	1				7	7				1	1					0					0					0					0
Mandible with teeth	Right					0					0				7	7				1	1					0					0					0					0
Mandible with teeth	Unknown					0					0					0					0					0					0					0					0
	TOTAL					48					64.5					78					25.5					30.5					24.5					25					5

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp *	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq *	Eq Total
Mandibular tooth	Left					0					0				22	22				2	2					0				2	2					0					0
Mandibular tooth	Right					0					0				17	17				3	3					0					0				1	1				1	1
Mandibular tooth	Unknown					0					0					0					0					0					0				2	2					0
Horncore	Left					0				1	1					0					0					0					0					0					0
Horncore	Right					0					0					0					0					0					0					0					0
Horncore	Unknown					0					0					0					0				2	2					0					0					0
	TOTAL					0					1					39					5					2					2					3					1

Species	adj NISP	%
Goat	48	15.9
Sheep	64.5	21.4
Goat/Sheep	78	25.9
Gazelle	25.5	8.5
Small Ruminant	30.5	10.1
Cattle	24.5	8.1
Pig	25	8.3
Equid	5	1.7
TOTAL	301	100.0

Table C.6: 'Ain Ghazal Transitional Late PPNB/PPNC Bone Counts (adjusted NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left	1		7		8		2	22	1	25	8		17	13	38			8		8	4	1		2	7			1		1	4	1	6		11					0
Scapula	Right			5	1	6	2		19	1	22	9		19	12	40			6	3	9	1		1	1	3					0	2		6	7	15	1		1		2
Scapula	Unknown					0					0					0					0					0					0					0					0
Humerus	Left		1	8		9		1	35		36	1	8	26		35			11		11	1	4	15		20			2		2	1	2	8		11			2		2
Humerus	Right			9		9		11	29		40	1	8	38	2	49			14		14		2	8		10			1		1			6		6			4		4
Humerus	Unknown					0					0					0					0					0	2				2				1	1					0
Radius	Left	1		3		4	6		8		14	3		1		4			3		3	1				1					0	1				1	1		1		2
Radius	Right	3	1	5		9	9		7		16					0			1		1					0	1				1	1				1	2		2		4
Radius	Unknown					0					0					0					0					0					0					0					0
Pubis	Left			2	6	8	1		2	2	5	4		1	4	9			4	5	9	3		4	3	10	1			1	2	1		2	7	10			1		1
Pubis	Right	1		2	6	9	2		5	6	13			2	2	4			5	2	7			5	4	9	1			2	3	2		4	10	16			1	1	2
Pubis	Unknown					0					0					0					0					0					0					0					0
Femur	Left	1				1					0	5		6		11		1	1		2	4		2		6	1				1				1	1	1		1		2
Femur	Right					0			1		1	7	1	4		12	2		1		3	2		1		3			2		2	1				1			1	1	2
Femur	Unknown					0					0					0					0					0	1				1	1				1					0
Tibia	Left			7		7	3		19		22	5	2	12	1	20			7		7			2		2					0	4		3		7			2		2
Tibia	Right	1	1	4		6	4		15		19	4	2	24		30			3		3	1	1	3		5			1		1	2	2	3		7			2		2
Tibia	Unknown					0					0					0					0					0					0					0					0
Metacarpal	Left			9		9	1		12		13					0			3		3					0					0					0					0
Metacarpal	Right			3		3	1		13		14					0			1		1					0	1			1	2					0					0
Metacarpal	Unknown					0					0					0			1		1					0					0					0				1	1
Metacarpal 1/2	L Med/R Lat	5		2		7	13		11	1	25					0		1	4	1	6				1	1					0			1		1					0
Metacarpal 1/2	R Med/L Lat	5	2	6		13	9	1	9		19					0		2	6		8			1		1					0					0					0
Metacarpal 1/2	Unknown					0					0					0					0					0					0					0					0
Metatarsal	Left			7		7	3		8		11					0			1		1			1		1	1				1					0			1		1
Metatarsal	Right	2	1	6		9	3		13		16					0			2		2					0			1		1					0					0
Metatarsal	Unknown					0					0			1		1			1		1					0					0					0					0
Metatarsal 1/2	L Med/R Lat		1	1		2	12		3		15	1				1			2	1	3					0					0					0					0
Metatarsal 1/2	R Med/L Lat	4	1	4		9	7		5		12					0	2		2	2	6					0					0					0					0
Metatarsal 1/2	Unknown					0					0					0					0					0					0					0					0
Metapodial	Left					0					0					0					0					0					0					0					0
Metapodial	Right					0					0					0					0					0					0					0					0
Metapodial	Unknown					0					0					0					0					0	1		1	1	3					0			4	3	7
Metapodial 1/2	L Med/R Lat	1				1	3				3					0	1				1	2				2	2		3	1	6	5	1	4		10					0
Metapodial 1/2	R Med/L Lat					0	4		5	1	10	2				2	1		2	1	4					0	1		6		7	2		5		7					0
Metapodial 1/2	Unknown					0				1	1				1	1					0					0				3	3		1		1	2					0
First Phalanx	L Med/R Lat			12		12	2	2	19		23	3		21		24			16		16			1		1	2		8		10	2	1	10		13					0
First Phalanx	R Med/L Lat			12		12	1	1	21		23	1	2	33		36			24		24	1		4		5			9		9	3		12		15					0
First Phalanx	Unknown					0					0					0					0					0					0			2		2			3		3
Third Phalanx	L Med/R Lat				13	13				10	10				24	24				9	9				5	5				4	4				10	10					0
Third Phalanx	R Med/L Lat				5	5				12	12				16	16				7	7				1	1				4	4				8	8					0
Third Phalanx	Unknown					0					0					0					0					0					0					0				4	4
Astragalus	Left				15	15				33	33				28	28				12	12				7	7				4	4				8	8					0
Astragalus	Right				18	18				41	41				19	19				8	8				7	7				5	5				9	9				6	6
Astragalus	Unknown					0					0					0					0					0					0					0					0
Calcaneum	Left	2		4	3	11	7		5	2	14	10		3	9	22	3		3	1	7	2				2				1	1	5			4	9	1				1
Calcaneum	Right	4		4	2	10	4		8	6	18	9		4	5	18	3		6		9	8			1	9				1	1	7		1	7	15			2		2
Calcaneum	Unknown					0					0					0					0					0					0					0					0
Mandible with teeth	Left				1	1					0				29	29				2	2				2	2				1	1				7	7					0
Mandible with teeth	Right				3	3					0				42	42					0				1	1				1	1				3	3					0
Mandible with teeth	Unknown					0					0					0					0					0					0				7	7					0
	TOTAL					236					526					515					208					121					80					215					50
Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Mandibular tooth	Left				2	2					0				59	59					0					0				3	3				1	1				1	1
Mandibular tooth	Right				1	1				1	1				65	65				1	1					0				7	7				28	28				1	1
Mandibular tooth	Unknown					0					0					0					0					0				1	1					0				8	8
Horncore	Left				6	6				1	1				1	1				4	4					0				1	1					0					0
Horncore	Right				5	5				3	3				1	1				3	3					0				1	1					0					0
Horncore	Unknown				3	3					0				2	2				5	5					0				1	1					0					0
	TOTAL					17					5					128					13					0					14					29					10

Species	NISP	%
Goat	236	12.1
Sheep	526	27.0
Goat/Sheep	515	26.4
Gazelle	208	10.7
Small Ruminant	121	6.2
Cattle	80	4.1
Pig	215	11.0
Equid	50	2.6
TOTAL	1951	100.0

Table C.7: 'Ain Ghazal PPNC Bone Counts (NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left	1		7		8		2	22	1	25	8		17	13	38			8		8	4	1		2	7			1		1	4	1	6		11					0
Scapula	Right			5	1	6	2		19	1	22	9		19	12	40			6	3	9	1		1	1	3					0	2		6	7	15	1		1		2
Scapula	Unknown					0					0					0					0					0					0					0					0
Humerus	Left		1	8		9		1	35		36	1	8	26		35			11		11	1	4	15		20			2		2	1	2	8		11			2		2
Humerus	Right			9		9		11	29		40	1	8	38	2	49			14		14		2	8		10			1		1			6		6			4		4
Humerus	Unknown					0					0					0					0					0	2				2				1	1					0
Radius	Left	1		3		4	6		8		14	3		1		4			3		3	1				1					0	1				1	1		1		2
Radius	Right	3	1	5		9	9		7		16					0			1		1					0	1				1	1				1	2		2		4
Radius	Unknown					0					0					0					0					0					0					0					0
Pubis	Left			2	6	8	1		2	2	5	4		1	4	9			4	5	9	3		4	3	10	1			1	2	1		2	7	10			1		1
Pubis	Right	1		2	6	9	2		5	6	13			2	2	4			5	2	7			5	4	9	1			2	3	2		4	10	16			1	1	2
Pubis	Unknown					0					0					0					0					0					0					0					0
Femur	Left	1				1					0	5		6		11		1	1		2	4		2		6	1				1				1	1	1		1		2
Femur	Right					0			1		1	7	1	4		12	2		1		3	2		1		3			2		2	1				1			1	1	2
Femur	Unknown					0					0					0					0					0	1				1	1				1					0
Tibia	Left			7		7	3		19		22	5	2	12	1	20			7		7			2		2					0	4		3		7			2		2
Tibia	Right	1	1	4		6	4		15		19	4	2	24		30			3		3	1	1	3		5			1		1	2	2	3		7			2		2
Tibia	Unknown					0					0					0					0					0					0					0					0
Metacarpal	Left			9		9	1		12		13					0			3		3					0					0					0					0
Metacarpal	Right			3		3	1		13		14					0			1		1					0	1			1	2					0					0
Metacarpal	Unknown					0					0					0			1		1					0					0					0				1	1
Metacarpal 1/2	LM d/R Lat	3		2		3.5	13		11	1	12.5					0		1	4	1	3				1	0.5					0			1		0.5					0
Metacarpal 1/2	RM d/L Lat	3	2	6		6.5	9	1	9		9.5					0		2	6		4			1		0.5					0					0					0
Metacarpal 1/2	Unknown					0					0					0					0					0					0					0					0
Metatarsal	Left			7		7	3		8		11					0			1		1			1		1	1				1					0			1		1
Metatarsal	Right	2	1	6		9	3		13		16					0			2		2					0			1		1					0					0
Metatarsal	Unknown					0					0			1		1			1		1					0					0					0					0
Metatarsal 1/2	LM d/R Lat		1	1		1	12		3		7.5	1				0.5			2	1	1.5					0					0					0					0
Metatarsal 1/2	RM d/L Lat	4	1	4		4.5	7		5		6					0	2		2	2	3					0					0					0					0
Metatarsal 1/2	Unknown					0					0					0					0					0					0					0					0
Metapodial	Left					0					0					0					0					0					0					0					0
Metapodial	Right					0					0					0					0					0					0					0					0
Metapodial	Unknown					0					0					0					0					0	1		1	1	3					0			4	3	7
Metapodial 1/2	LM d/R Lat	1				0.5	3				1.5					0	1				0.5	2				1	2		3	1	3	5	1	4		5					0
Metapodial 1/2	RM d/L Lat					0	4		5	1	5	2				1	1		2	1	2					0	1		6		3.5	2		5		3.5					0
Metapodial 1/2	Unknown					0				1	0.5				1	0.5					0					0				3	1.5		1		1	1					0
First Phalanx	LM d/R Lat			12		12	2	2	19		23	3		21		24			16		16			1		1	2		8		10	2	1	10		13					0
First Phalanx	RM d/L Lat			12		12	1	1	21		23	1	2	33		36			24		24	1		4		5			9		9	3		12		15					0
First Phalanx	Unknown					0					0					0					0					0					0			2		2			3		6
Third Phalanx	LM d/R Lat				13	13				10	10				24	24				9	9				5	5				4	4				10	10					0
Third Phalanx	RM d/L Lat				5	5				12	12				16	16				7	7				1	1				4	4				8	8					0
Third Phalanx	Unknown					0					0					0					0					0					0					0				4	8
Astragalus	Left				15	15				33	33				28	28				12	12				7	7				4	4				8	8					0
Astragalus	Right				18	18				41	41				19	19				8	8				7	7				5	5				9	9				6	6
Astragalus	Unknown					0					0					0					0					0					0					0					0
Calcaneum	Left	2		4	5	11	7		5	2	14	10		3	9	22	3		3	1	7	2				2				1	1	5			4	9	1				1
Calcaneum	Right	4		4	2	10	4		8	6	18	9		4	5	18	3		6		9	8			1	9				1	1	7		1	7	15			2		2
Calcaneum	Unknown					0					0					0					0					0					0					0					0
Mandible with teeth	Left				1	1					0				29	29				2	2				2	2				1	1				7	7					0
Mandible with teeth	Right				3	3					0				42	42					0				1	1				1	1				3	3					0
Mandible with teeth	Unknown					0					0					0					0					0					0				7	7					0
	TOTAL					220					483.5					513					194					119					72					205					57

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Mandibular tooth	Left				2	2					0				59	59					0					0				3	3				1	1				1	1
Mandibular tooth	Right				1	1				1	1				65	65				1	1					0				7	7				28	28				1	1
Mandibular tooth	Unknown					0					0					0					0					0				1	1					0				8	8
Horncore	Left				6	6				1	1				1	1				4	4					0				1	1					0					0
Horncore	Right				5	5				3	3				1	1				3	3					0				1	1					0					0
Horncore	Unknown				3	3					0				2	2				5	5					0				1	1					0					0
	TOTAL					17					5					128					13					0					14					29					10

Species	adj NISP	%
Goat	220	11.8
Sheep	483.5	25.9
Goat/Sheep	513	27.5
Gazelle	194	10.4
Small Ruminant	119	6.4
Cattle	72	3.9
Pig	205	11.0
Equid	57	3.1
TOTAL	1863.5	100.0

Table C.8: 'Ain Ghazal PPNC Bone Counts (adjusted NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Scapula	Left	1		7	2	10	1	1	12	1	15	9		12	17	38
Scapula	Right			9		9		1	13	1	15	13		13	5	31
Scapula	Unknown					0					0					0
Humerus	Left		1	7		8			21		21	1	4	28	1	34
Humerus	Right			18		18		2	17		19	1	5	14	2	22
Humerus	Unknown					0					0					0
Radius	Left			1		1	2		7		9		1	1		2
Radius	Right	2	1			3	4		3		7					0
Radius	Unknown					0					0					0
Pubis	Left			1	1	2	1		5	4	10			3		3
Pubis	Right	1		1	2	4			6	5	11			2	8	10
Pubis	Unknown					0					0					0
Femur	Left					0					0	3	1	2		6
Femur	Right					0			1		1	2	1	3		6
Femur	Unknown					0					0					0
Tibia	Left			5		5			15		15	3	1	26		30
Tibia	Right			1		1	1		10		11	3		23		26
Tibia	Unknown					0					0					0
Metacarpal	Left	1	1	4		6			7		7					0
Metacarpal	Right	1		1		2			11		11				1	1
Metacarpal	Unknown					0			1		1					0
Metacarpal 1/2	L Med/R Lat	2	1	3		6	2		1		3	1				1
Metacarpal 1/2	R Med/L Lat	2	1	6		9	3		4	1	8					0
Metacarpal 1/2	Unknown					0			1		1					0
Metatarsal	Left			9		9			6		6					0
Metatarsal	Right	1		4		5	1		13		14					0
Metatarsal	Unknown					0					0					0
Metatarsal 1/2	L Med/R Lat	1		1		2	5		5	1	11	1				1
Metatarsal 1/2	R Med/L Lat	3		3		6	2		6		8	1				1
Metatarsal 1/2	Unknown					0					0					0
Metapodia	Left					0					0					0
Metapodial	Right					0	1				1					0
Metapodial	Unknown					0					0					0
Metapodia 1/2	L Med/R Lat					0	1		2		3	2				2
Metapodia 1/2	R Med/L Lat	1				1	1		2	1	4	1				1
Metapodia 1/2	Unknown					0					0					0
First Phalanx	L Med/R Lat			13		13		1	18		19	1		18		19
First Phalanx	R Med/L Lat			9		9		2	18		20	2	1	23		26
First Phalanx	Unknown					0					0					0
Third Phalanx	L Med/R Lat					0				4	4				11	11
Third Phalanx	R Med/L Lat				2	2				4	4				7	7
Third Phalanx	Unknown					0					0					0
Astragalus	Left				9	9				29	29				7	7
Astragalus	Right				10	10				25	25				9	9
Astragalus	Unknown					0					0					0
Calcaneum	Left	1		1		2	2	1	9		12	9		2	5	16
Calcaneum	Right	1		5	2	8	4		6	1	11	7		4	5	16
Calcaneum	Unknown					0					0					0
Mandible with teeth	Left				3	3				2	2				89	89
Mandible with teeth	Right				2	2				2	2				76	76
Mandible with teeth	Unknown					0					0					0
	TOTAL					165					340					491

POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left			6	2	8	2		3		5			1		1	3		2		5			2	1	3
Scapula	Right			7	1	8	2				2			1		1	2		3	4	9			2	2	4
Scapula	Unknown					0					0					0					0					0
Humerus	Left			6		6			2		2					0	1		1		2	1		10		11
Humerus	Right		1	6		7	1	2	7	1	11			2	1	3	1	1	2		4		1	7		8
Humerus	Unknown					0					0					0					0					0
Radius	Left			1		1					0					0					0					0
Radius	Right					0	1				1					0	1				1			1		1
Radius	Unknown			4	3	7					0					0					0					0
Pubis	Left			2	2	4			2	3	5			1	2	3			2	3	5			6	2	8
Pubis	Right					0			4	3	7	1		1	1	3	1		1	3	5	1		4	1	6
Pubis	Unknown	1		2		3					0					0					0					0
Femur	Left	2		1		3			1		1					0	1				1					0
Femur	Right					0	1			1	2			1		1					0			2		2
Femur	Unknown			1		1					0					0					0					0
Tibia	Left					0			3		3	1		1		2			1		1	1		2		3
Tibia	Right			1		1			5		5			2		2	1				1			4		4
Tibia	Unknown					0					0					0					0					0
Metacarpal	Left			1		1					0					0					0					0
Metacarpal	Right			1		1					0		1	1		2					0					0
Metacarpal	Unknown			1		1					0					0					0					0
Metacarpal 1/2	L Med/R Lat					0			1		1					0					0					0
Metacarpal 1/2	R Med/L Lat			3		3					0					0	1				1					0
Metacarpal 1/2	Unknown			2		2					0					0					0					0
Metatarsal	Left					0				1	1					0					0					0
Metatarsal	Right	1		2		3					0					0					0					0
Metatarsal	Unknown	1		1		2					0					0					0					0
Metatarsal 1/2	L Med/R Lat					0					0					0					0					0
Metatarsal 1/2	R Med/L Lat					0					0					0	1				1					0
Metatarsal 1/2	Unknown					0					0					0					0					0
Metapodia	Left					0					0					0					0					0
Metapodial	Right					0					0			1		1					0					0
Metapodial	Unknown					0					0	1		4		5					0			9	1	10
Metapodia 1/2	L Med/R Lat					0					0	1				1	1		1		2					0
Metapodia 1/2	R Med/L Lat	1				1	1				1					0	3		3		6					0
Metapodia 1/2	Unknown					0					0	1				1					0					0
First Phalanx	L Med/R Lat			16		16			2		2			5		5	1		1		2					0
First Phalanx	R Med/L Lat			12		12			4		4			7		7	2	1	3		6					0
First Phalanx	Unknown					0					0					0			3		3			12		12
Third Phalanx	L Med/R Lat				4	4				2	2				2	2					0					0
Third Phalanx	R Med/L Lat				7	7				3	3				3	3				1	1					0
Third Phalanx	Unknown					0					0					0					0				6	6
Astragalus	Left				2	2				4	4				3	3				3	3				2	2
Astragalus	Right				5	5				7	7				3	3				3	3				3	3
Astragalus	Unknown					0					0				1	1					0					0
Calcaneum	Left	1	1	3		5	3			2	5					0	4			3	7					0
Calcaneum	Right	3		1	1	5	2			1	3	1		1		2	3		1	1	5			2		2
Calcaneum	Unknown					0					0					0					0					0
Mandible with teeth	Left				9	9				3	3				1	1				1	1					0
Mandible with teeth	Right				10	10				2	2					0				7	7					0
Mandible with teeth	Unknown					0					0					0				4	4					0
	TOTAL					138					82					53					86					85

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Mandibular tooth	Left					0					0				49	49
Mandibular tooth	Right					0				1	1				57	57
Mandibular tooth	Unknown					0					0					0
Horncore	Left				18	18				1	1				4	4
Horncore	Right				19	19				3	3				3	3
Horncore	Unknown				1	1				2	2				1	1
	TOTAL					38					7					114

Non POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Mandibular tooth	Left					0					0				2	2					0				2	2
Mandibular tooth	Right					0					0				4	4				2	2				10	10
Mandibular tooth	Unknown					0					0				11	11				2	2					0
Horncore	Left				12	12					0					0					0					0
Horncore	Right				10	10					0					0					0					0
Horncore	Unknown				8	8				5	5					0					0					0
	TOTAL					30					5					17					4					12

Species	NISP	%
Goat	165	11.5
Sheep	340	23.6
Goat/Sheep	491	34.1
Gazelle	138	9.6
Small Ruminant	82	5.7
Cattle	53	3.7
Pig	86	6.0
Equid	85	5.9
TOTAL	1440	100.0

Table C.9: 'Ain Ghazal Yarmoukian Bone Counts (NISP)

POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Scapula	Left	1		7	2	10	1	1	12	1	15	9		12	17	38
Scapula	Right			9		9		1	13	1	15	13		13	5	31
Scapula	Unknown					0					0					0
Humerus	Left		1	7		8			21		21	1	4	28	1	34
Humerus	Right			18		18		2	17		19	1	5	14	2	22
Humerus	Unknown					0					0					0
Radius	Left			1		1	2		7		9		1	1		2
Radius	Right	2	1			3	4		3		7					0
Radius	Unknown					0					0					0
Pubis	Left			1	1	2	1		5	4	10			3		3
Pubis	Right	1		1	2	4			6	3	11			2	8	10
Pubis	Unknown					0					0					0
Femur	Left					0					0	3	1	2		6
Femur	Right					0			1		1	2	1	3		6
Femur	Unknown					0					0					0
Tibia	Left			5		5			15		15	3	1	26		30
Tibia	Right			1		1	1		10		11	3		23		26
Tibia	Unknown					0					0					0
Metacarpal	Left	1	1	4		6			7		7					0
Metacarpal	Right	1		1		2			11		11				1	1
Metacarpal	Unknown					0			1		1					0
Metacarpal 1/2	L Med/R Lat	2	1	3		3	2		1		1.5	1				0.5
Metacarpal 1/2	R Med/L Lat	2	1	6		4.5	3		4	1	4					0
Metacarpal	Unknown					0			1		0.5					0
Metatarsal	Left			9		9			6		6					0
Metatarsal	Right	1		4		5	1		13		14					0
Metatarsal	Unknown					0					0					0
Metatarsal 1/2	L Med/R Lat	1		1		1	5		5	1	5.5	1				0.5
Metatarsal 1/2	R Med/L Lat	3		3		3	2		6		4	1				0.5
Metatarsal 1/2	Unknown					0					0					0
Metapodial	Left					0					0					0
Metapodial	Right					0	1				1					0
Metapodial	Unknown					0					0					0
Metapodial 1/2	L Med/R Lat					0	1		2		1.5	2				1
Metapodial 1/2	R Med/L Lat	1				0.5	1		2	1	2	1				0.5
Metapodial 1/2	Unknown					0					0					0
First Phalanx	L Med/R Lat			13		13		1	18		19	1		18		19
First Phalanx	R Med/L Lat			9		9		2	18		20	2	1	23		26
First Phalanx	Unknown					0					0					0
Third Phalanx	L Med/R Lat					0				4	4				11	11
Third Phalanx	R Med/L Lat				2	2				4	4				7	7
Third Phalanx	Unknown					0					0					0
Astragalus	Left				9	9				29	29				7	7
Astragalus	Right				10	10				25	25				9	9
Astragalus	Unknown					0					0					0
Calcaneum	Left	1		1		2	2	1	9		12	9		2	5	16
Calcaneum	Right	1		5	2	8	4		6	1	11	7		4	5	16
Calcaneum	Unknown					0					0					0
Mandible with teeth	Left				3	3				2	2				89	89
Mandible with teeth	Right				2	2				2	2				76	76
Mandible with teeth	Unknown					0					0					0
	TOTAL					133					321					488

POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Scapula	Left			6	2	8	2		3		5			1		1	3		2		5			2	1	3
Scapula	Right			7	1	8	2				2			1		1	2		3	4	9			2	2	4
Scapula	Unknown					0					0					0					0					0
Humerus	Left			6		6			2		2					0	1		1		2	1		10		11
Humerus	Right		1	6		7	1	2	7	1	11			2	1	3	1	1	2		4		1	7		8
Humerus	Unknown					0					0					0					0					0
Radius	Left			1		1					0					0					0					0
Radius	Right					0	1				1					0	1				1			1		1
Radius	Unknown			4	3	7					0					0					0					0
Pubis	Left			2	2	4			2	3	5			1	2	3			2	3	5			6	2	8
Pubis	Right					0			4	3	7	1		1	1	3	1		1	3	5	1		4	1	6
Pubis	Unknown	1		2		3					0					0					0					0
Femur	Left	2		1		3			1		1					0	1				1					0
Femur	Right					0	1			1	2			1		1					0			2		2
Femur	Unknown			1		1					0					0					0					0
Tibia	Left					0			3		3	1		1		2			1		1	1		2		3
Tibia	Right			1		1			5		5			2		2	1				1			4		4
Tibia	Unknown					0					0					0					0					0
Metacarpal	Left			1		1					0					0					0					0
Metacarpal	Right			1		1					0		1	1		2					0					0
Metacarpal	Unknown			1		1					0					0					0					0
Metacarpal 1/2	L Med/R Lat					0			1		0.5					0					0					0
Metacarpal 1/2	R Med/L Lat			3		1.5					0					0	1				0.5					0
Metacarpal	Unknown			2		1					0					0					0					0
Metatarsal	Left					0				1	1					0					0					0
Metatarsal	Right	1		2		3					0					0					0					0
Metatarsal	Unknown	1		1		2					0					0					0					0
Metatarsal 1/2	L Med/R Lat					0					0					0					0					0
Metatarsal 1/2	R Med/L Lat					0					0					0	1				0.5					0
Metatarsal 1/2	Unknown					0					0					0					0					0
Metapodial	Left					0					0					0					0					0
Metapodial	Right					0					0			1		1					0					0
Metapodial	Unknown					0					0	1		4		5					0			9	1	10
Metapodial 1/2	L Med/R Lat					0					0	1				0.5	1		1		1					0
Metapodial 1/2	R Med/L Lat	1				0.5	1				0.5					0	3		3		3					0
Metapodial 1/2	Unknown					0					0	1				0.5					0					0
First Phalanx	L Med/R Lat			16		16			2		2			5		5	1		1		2					0
First Phalanx	R Med/L Lat			12		12			4		4			7		7	2	1	3		6					0
First Phalanx	Unknown					0					0					0			3		3			12		24
Third Phalanx	L Med/R Lat				4	4				2	2				2	2					0					0
Third Phalanx	R Med/L Lat				7	7				3	3				3	3				1	1					0
Third Phalanx	Unknown					0					0					0					0				6	12
Astragalus	Left				2	2				4	4				3	3				3	3				2	2
Astragalus	Right				5	5				7	7				3	3				3	3				3	3
Astragalus	Unknown					0					0				1	1					0					0
Calcaneum	Left	1	1	3		5	3			2	5					0	4			3	7					0
Calcaneum	Right	3		1	1	5	2			1	3	1		1		2	3		1	1	5			2		2
Calcaneum	Unknown					0					0					0					0					0
Mandible with teeth	Left				9	9				3	3				1	1				1	1					0
Mandible with teeth	Right				10	10				2	2					0				7	7					0
Mandible with teeth	Unknown					0					0					0				4	4					0
	TOTAL					135					81					52					81					103

Non POSAC	Side	Gt uf	Gt fg	Gt F	Gt ?	Gt Total	Sp uf	Sp fg	Sp F	Sp ?	Sp Total	Gt/Sp uf	Gt/Sp fg	Gt/Sp F	Gt/Sp ?	Gt/Sp Total
Mandibular tooth	Left					0					0				49	49
Mandibular tooth	Right					0				1	1				57	57
Mandibular tooth	Unknown					0					0					0
Horncore	Left				18	18				1	1				4	4
Horncore	Right				19	19				3	3				3	3
Horncore	Unknown				1	1				2	2				1	1
	TOTAL					38					7					114

Non POSAC	Side	Gz uf	Gz fg	Gz F	Gz ?	Gz Total	SR uf	SR fg	SR F	SR ?	SR Total	Ct uf	Ct fg	Ct F	Ct ?	Ct Total	Pg uf	Pg fg	Pg F	Pg ?	Pg Total	Eq uf	Eq fg	Eq F	Eq ?	Eq Total
Mandibular tooth	Left					0					0				2	2					0				2	2
Mandibular tooth	Right					0					0				4	4				2	2				10	10
Mandibular tooth	Unknown					0					0				11	11				2	2					0
Horncore	Left				12	12					0					0					0					0
Horncore	Right				10	10					0					0					0					0
Horncore	Unknown				8	8				5	5					0					0					0
	TOTAL					30					5					17					4					12

Species	adj NISP	%
Goat	153	10.8
Sheep	321	22.7
Goat/Sheep	488	34.5
Gazelle	135	9.5
Small Ruminant	81	5.7
Cattle	52	3.7
Pig	81	5.7
Equid	103	7.3
TOTAL	1414	100.0

Table C.10: 'Ain Ghazal Yarmoukian Bone Counts (adjusted NISP)