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

Volume two

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CHAPTER EIGHT

CARCASS TREATMENT

This chapter explores how the inhabitants of the study sites used the carcasses of the animals they hunted. This involves analysis of:

- body part representation
- butchery marks
- other processing evidence (e.g. burning, bone fragmentation)

Due to small sample sizes for many taxa, the discussion here primarily concerns gazelle, with brief comment on equids, cattle, hare, fox and tortoise. Caprines are dealt with in Chapter 9.

Chapter 6 already establishes that humans were the principal bone collectors at all the study sites; questions of interest, therefore, relate to the types of activities taking place on sites. Animal procurement and treatment activities which might be expected include killing, primary butchery, skinning, preparation of skins, transportation of carcasses, secondary butchery, meat stripping, preservation of meat, marrow extraction, bone grease extraction, bone working, discarding, carnivore feeding and, of course, different kinds of meat cooking and consumption.

When an animal is killed, the whole carcass is **available** to the hunter(s), but it is not necessarily all used. Hunters may want certain materials only, or they may be limited by the amount of the carcass they can transport; this can influence decisions either to process animals at or near the kill, or to remove them elsewhere before any dismemberment takes place. The size of an animal may well be a factor in these decisions, as may be the distance of the kill from a 'base' site, or the number of people involved in a hunt, or indeed, the number of animals taken. The relative proportions of different animal body parts on a site provide a main line of evidence on these issues.

Attempting to filter out all of the possible non-behavioural pre- and post-depositional factors that can affect body part representation is problematic since there is great potential for 'over-printing'. To give an example: it may be that all body parts from a particular gazelle kill are returned to a site, including both skulls and extremities, indicating that very little processing had previously taken place. Over time, however, this pattern could change radically: skull parts may become 'invisible' through the shattering of teeth, weathering and trampling or the working of horn cores; phalanges may be removed from the site through their attachment to hides, and metapodia may be chewed by carnivores, or shattered for bone grease. The resulting pattern would be very different from the original 'whole carcass present' picture; in fact, it might be interpreted as the product of off-site skinning, where heads and extremities were removed before the carcass arrived on the site.

Such problems of equifinality - when patterns can be created in a number of ways - require means of separating out the factors which influence bone presence; it is the disentanglement of such factors which is attempted in this section.

Body part data for all animals (Tables 8.0-8.10, 8.17-8.26, 8.28-8.49) are presented in Appendix 4.

Gazelle

Body part representation

Methodology

Tables 8.0 to 8.10 show the primary data used for the investigation of gazelle body part representation. The skeleton is divided into skull parts, atlas/axis, forelimb, hindlimb and phalanges (anterior and posterior combined). During recording of the bone material, a decision was made to ignore ribs and vertebrae (except atlas and axis) because they are very time-consuming to identify and quantify accurately. This is now regrettable since evidence for presence or absence of the trunk parts of the carcass would provide interesting information in the body part study. The fact, however, that ribs and vertebrae often survive very poorly (Brain 1981:23; Binford and Bertram 1977:110) means that any quantification may not have been very meaningful.

Figures 8.0 to 8.10 plot the data in the 'actual representation' column, in the same order as in tables 8.0 to 8.10, for assemblages where sample size exceeds 200 MNE/NISP.

Analytical problems

One problem in comparing body part data from the different assemblages is that those studied before 1989 are represented by NISP counts, whereas those studied after 1989 have counts expressed by MNE data (see Chapter 5). In short, MNE adjusts for the effects of fragmentation, whilst NISP does not. One may expect, therefore, that certain elements which have a tendency to fragment will be over-represented in the tables relating to pre-1989 assemblages. To gain an impression of which elements might be differentially skewed by their NISP counts, the assemblages studied after 1989 (tables 8.6 to 8.10) show the 'actual representation' calculated using **both** NISP and MNE for comparison. It is stressed that the differences between the NISP and MNE on any body part are not necessarily 'constant' relationships; there is no guarantee that a distal femur will always fragment into a certain number of pieces; the degree of fragmentation of an element may well depend in part upon its treatment, or the extent of crushing and trampling. Nonetheless, comparison of NISPs and MNEs suggests that within assemblages where bones may have been subject to similar treatment and/or post-depositional factors, some elements frequently show a NISP representation of over 20% more than their MNE representation. These elements are distal humerus, distal femur, pelvis, distal metapodia and sometimes proximal metapodia. Mandibles may also be over-represented by a NISP count due to frequent high degrees of tooth shattering and, although this does not manifest itself in the examples given, it should be kept in mind when dealing with assemblages such as KH4 A, B and D where mandible representation appears very high. Where possible, for example with WJ6 A, a minimum number of elements (in this case half-jaws) has been calculated to supplement the NISP count.

A product of using NISP counts in body part representation is that the 'actual representation' percentages may sometimes exceed 100. This occurs when 'expected representation' figures based on MNI, are divided into NISP counts inflated by fragmentation.

A second problem in interpretation of the body part tables and figures is sample size. DH 2 and KH4 D have the largest sample sizes (MNE=4097 and NISP=7404 respectively) (see figures 8.10 and 8.4); both assemblages have all elements present despite variations in relative representation. Smaller samples such as WJ7 2 (MNE=250), UW18 (NISP=207), WJ22 B and C (MNE=279 and 77) and KH4 C (NISP=258) show absence of some body parts, often atlas, axis and skull parts. It is impossible to determine, in these cases, whether the absence of these parts is real or a function of smaller sample size, although the overall similar shapes of the KH4 D and C graphs, for example, would suggest that sample size is responsible for the absence of certain elements in C.

Because of these two analytical problems, the data on body part representation must be interpreted conservatively. Where single anatomical units appear to be over- or under-represented, therefore, explanations of small sample size or recording problems should be preferred over behavioural interpretations. For example, differences in representation between skull, occipital condyles, mandibles and mandibular condyles, are likely to reflect analytical problems. Conversely, groups of related anatomical units, such as skull parts, limbs or extremities, are less likely to be an artefact of small sample size or inconsistency in method of quantification.

Explanations of variation

Three main categories of factors affect the representation of body parts: retrieval, post-depositional factors and pre-depositional treatment of the carcass. The first two need to be accounted for, in order to explore the third, which is of primary interest.

1) Retrieval

For gazelle-sized animals, all bones used for body part representation are larger than the 0.5cm sieve mesh size which was used consistently at the study sites for retrieving faunal remains. Retrieval does not appear to be a major factor influencing variation in animals of this size category.

2) Post-depositional factors

Three related fields can be included here: the properties of the bone itself, carnivore activity and processes of weathering.

i) **Properties of bone**: It is well recognized that the size, form and structure of different skeletal parts can greatly determine their ability to withstand destruction, although this is ultimately dependent on particular conditions of deposition. Brain (1981) was one of the first workers to experiment with the relationship between the specific gravity of a bone part and its survival. He noted how the presence of spongy bone (e.g. in the proximal humerus and proximal tibia), as opposed to compact bone (in the distal ends of those bones), greatly decreased the chance of a bone surviving, as did its state of fusion. Binford and Bertram (1977) also demonstrated how bone density could condition the survival of body parts, and showed additionally that this varies with the age of an animal, with the pattern of increased density being non-allometric (1977:111). Bone density, therefore, is not easy to estimate; the implications are that the density of a particular element may vary between animals of different ages, sexes, and presumably also between those of differing states of health. In addition, bone densities obviously vary from species to species.

Studies do, however, appear to show some trends common to medium sized ungulates (see Lyman 1984:281, table 7). Lyman's detailed scanning of deer skeletons produced measurements of the 'volume density' for different bone parts, which were both more accurately calculated than the previous studies, and based on fair-sized samples of adult animals (generally > 20 for longbones) (Lyman 1984). The body parts which he found to have relatively low volume densities (less than .30 VD, where VD is calculated using maximum bone thickness and true density, see Lyman 1984:273-279, table 6) are atlas, axis, acetabulum, proximal humerus, olecranon of the ulna, distal femur, proximal tibia, and second and third phalanges. Those with fairly high bone density (between .50 and .60 VD) are proximal and distal metapodia, distal tibia, parts of the astragalus and calcaneum, and the distal end of the first phalanx. Bone parts showing very high volume density (over .60 VD) are proximal radius, distal humerus, and areas of the astragalus and calcaneum.

Lyman's study can be used as a rough guide: if the pelvis, proximal humerus, ulna, distal femur, proximal tibia, or second or third phalanges are under-represented in any of the gazelle body part figures, this can probably be explained as differential preservation. Bone density will also mediate other taphonomic processes, as is shown below.

ii) **Carnivore activity**: carnivores have the ability to severely damage or even completely destroy bone. Chewing and gnawing tends to occur particularly on the spongy, greasy, and therefore less dense, long-bone ends and vertebrae (Brain 1981; Marean and Spencer 1991; Morey and Klippel 1991). Digestion of bones has also been investigated, and experiments suggest that the kind of bones which will be swallowed by carnivores depends both on the size of the carnivore, and on the size, age and composition of available elements (Payne and Munson 1985); whether partially digested bones will survive to be found will relate to their density. Both gnawing/chewing and digestion leave distinct signatures on bone, although undoubtedly some material can be lost altogether through these processes.

Both wild carnivores and domestic dogs can ravage faunal assemblages: in eastern Jordan, hyaenas, wolves and jackals could have picked over bones after discard, and domestic dogs which may have been kept on some of the later sites, may have had bone parts fed to them, which would then fall into the category of pre-depositional factors. A point highlighted by Brain in his study of the goat bones discarded at recent Hottentot villages on the Kuiseb River, is that humans are capable of inflicting damage on bones with their teeth which can strongly resemble that of carnivores. He found that vertebrae, proximal humerus, proximal and distal femur (all low density parts) and distal metapodia could disappear through chewing, and longbone shafts were splintered for marrow extraction (Brain 1981:11-18). Such activity should also be classed as pre-depositional, although a major problem with this is that signatures of human gnawing, and pre- and post-depositional carnivore activity, are likely to be so similar that separation is probably not possible. The cautious approach is to treat any such damage as post-discard carnivore activity.

Even if carnivore activity has strongly affected an assemblage, signatures may not necessarily be present in abundance on the sites if the gnawed parts have been scavenged away, or even removed slightly off-site. I will assume, however, that certain of the following five lines of evidence would be discernible:

- osteological evidence for carnivores, and particularly domestic dogs, in the area.
- a pattern of body part representation consistent with carnivore attrition.
- evidence of carnivore-gnawed bones.
- evidence of partially digested bones.

- evidence of abundant longbone 'cylinders'.

Evidence for carnivores

Carnivores of wolf/dog/jackal size and larger are those presumed capable of altering the study assemblages, since foxes and small felids feed on small vertebrates, insects and fruit (Garrard 1980, table 3B). We know from the assemblages that wolf/jackal inhabited the area (see table 8.11), and hyaena is evidenced at KH4 B. There is, therefore, **potential** for wild carnivore destruction or removal of bone.

assemblage	*Canis* spp. MNE/B	%	sample size MNE/B
PPNC/LN			
B27 3	1	2.3?	44
B27 2	4	2.3	177
Jebel Naja	0	0	8
DH 2	11	0.2	6382
WJ13 3	6	0.8	796
WJ13 2	2	0.3	644
WJ13 1	12	0.5	1880
WJ25	0	0	110
PPNB			
DH 1	3	0.1	2202
Ibn el Ghazzi	0	0	20
WJ32	0	0	161
WJ26	0	0	12
WJ7 5	1	1.3?	79
WJ7 4	1	0.4	251
WJ7 3	0	0	185
WJ7 2	1	0.2	469
WJ7 1	0	0	258
L EPAL			
Khallat Anaza	1	3.0?	34
AZ18	1	1.0	104
M EPAL			
AZ17	0	0	29
WJ22 B	23	3.8	611
WJ22 C	1	0.4	243
WJ10	1	8.3?	12
WJ8	0	0	36
E EPAL			
UW18	1	0.6	169
UW14	0	0	8
KH4 D	3	0.1	3659
KH4 C	0	0	197
KH4 B	1	0.1	803
KH4 A	5	0.4	1132
WJ6 B	0	0	45
WJ6 A	4	0.5	848
U PAL			
WJ9	0	0	6

Table 8.11. The representation of *Canis* spp. (wolf/dog/jackal) per assemblage.

Evidence for domestic dogs is less clear. Measurements of *Canis* spp. bones are few and uninformative; none exist for teeth. An indirect indication that domestic dogs may have been present in the area in the PPNC/Late Neolithic comes from WJ13 2 where a shed deciduous incisor was found, tentatively suggesting that juvenile animals were kept on site.

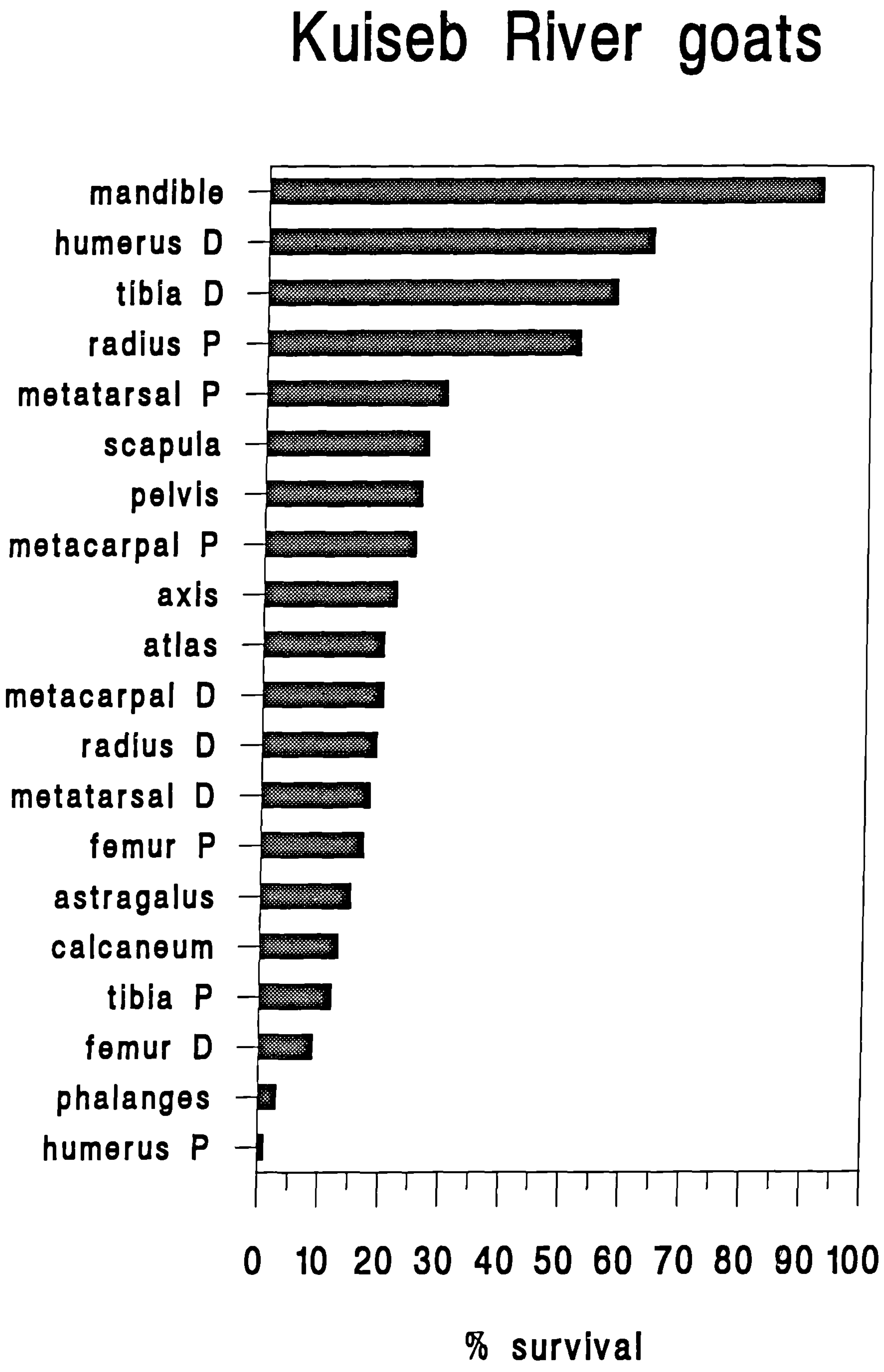


Figure 8.11. The relative frequency of goat body parts from the Kuiseb River villages (after Brain 1981:23 figure 18).

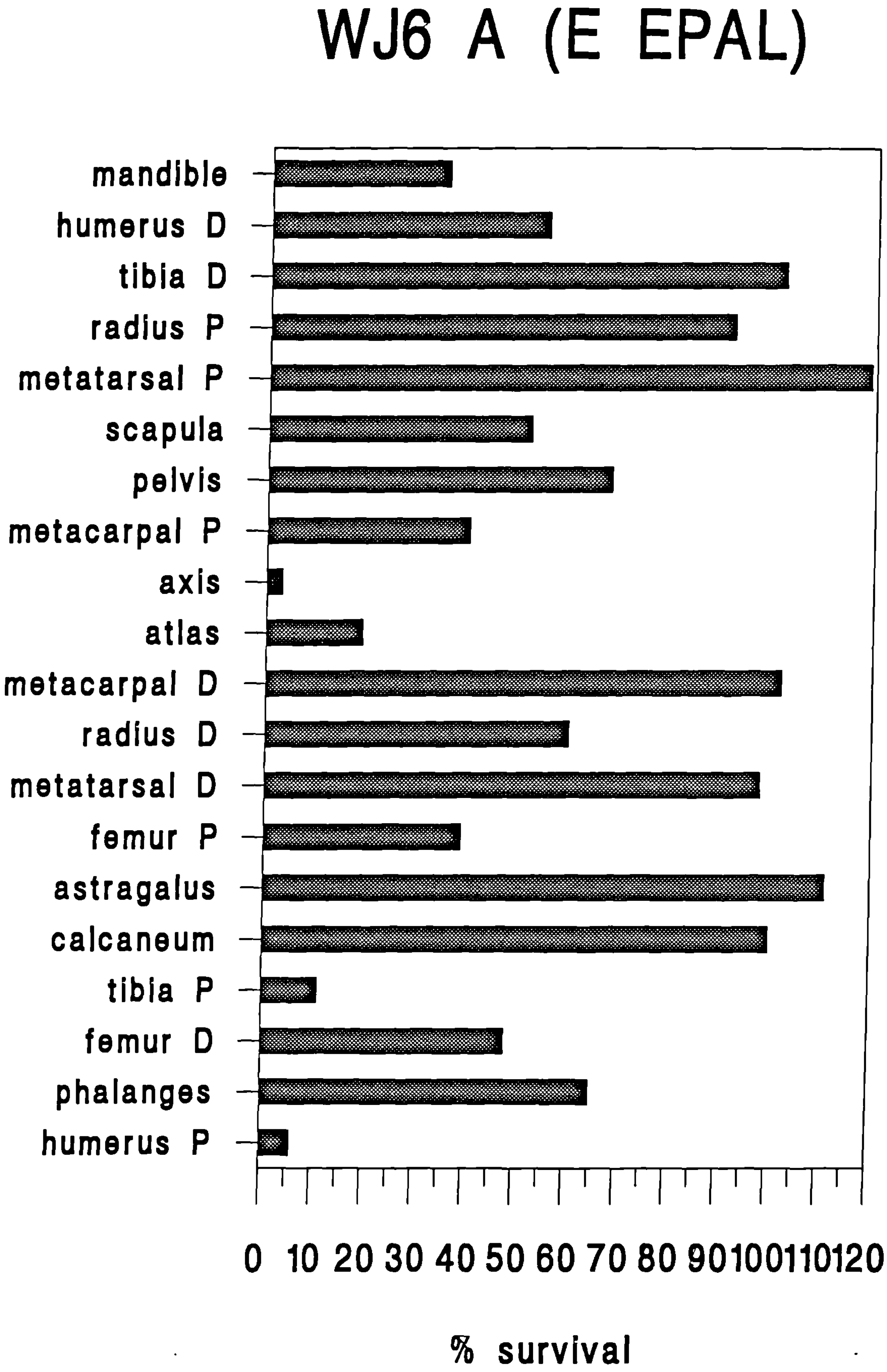


Figure 8.12a. Gazelle body parts from WJ6 A re-ordered according to Kuiseb River goats.

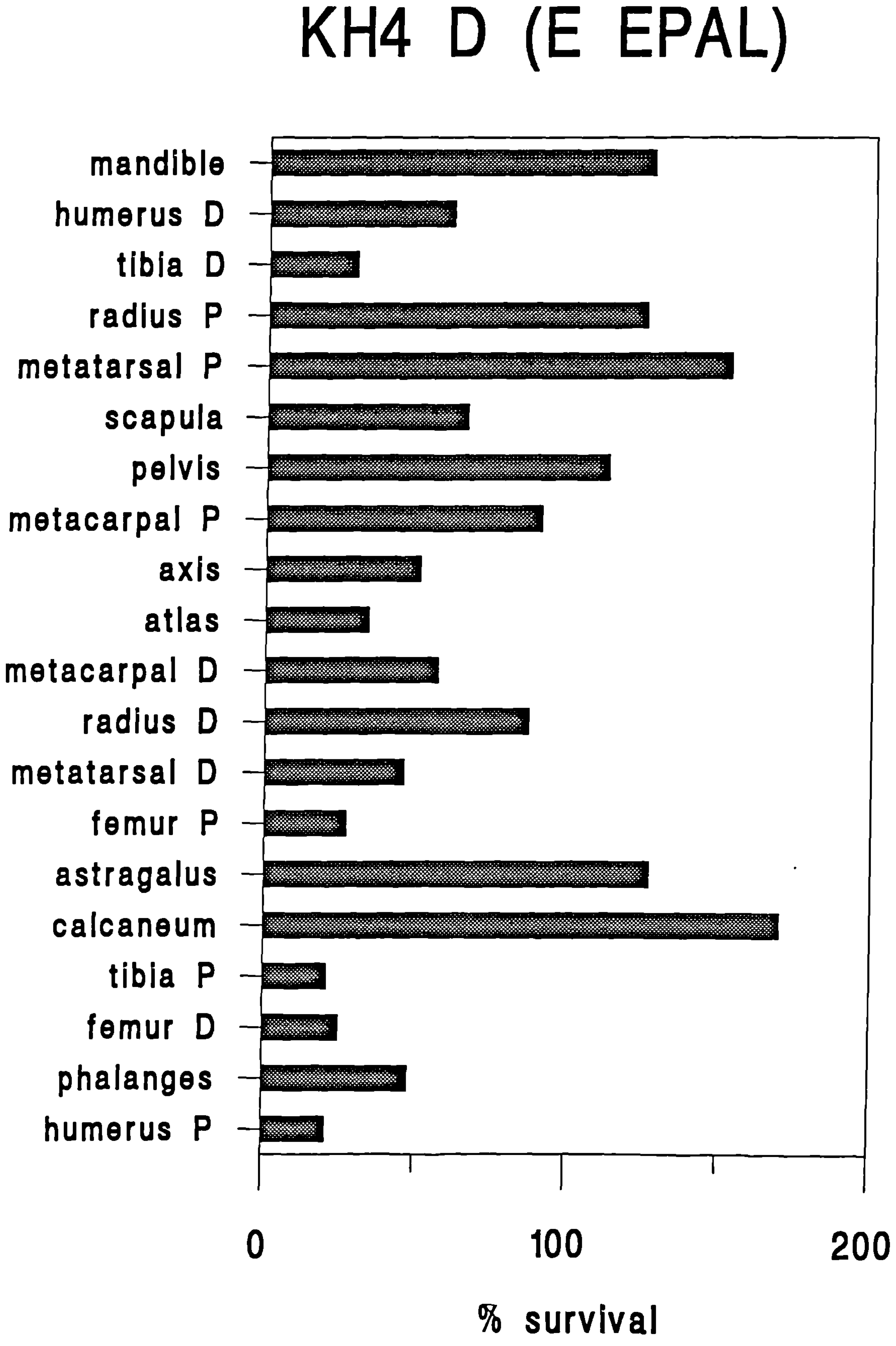


Figure 8.12b. Gazelle body part frequencies from KH4 D re-ordered according to Kuiseb River goats.

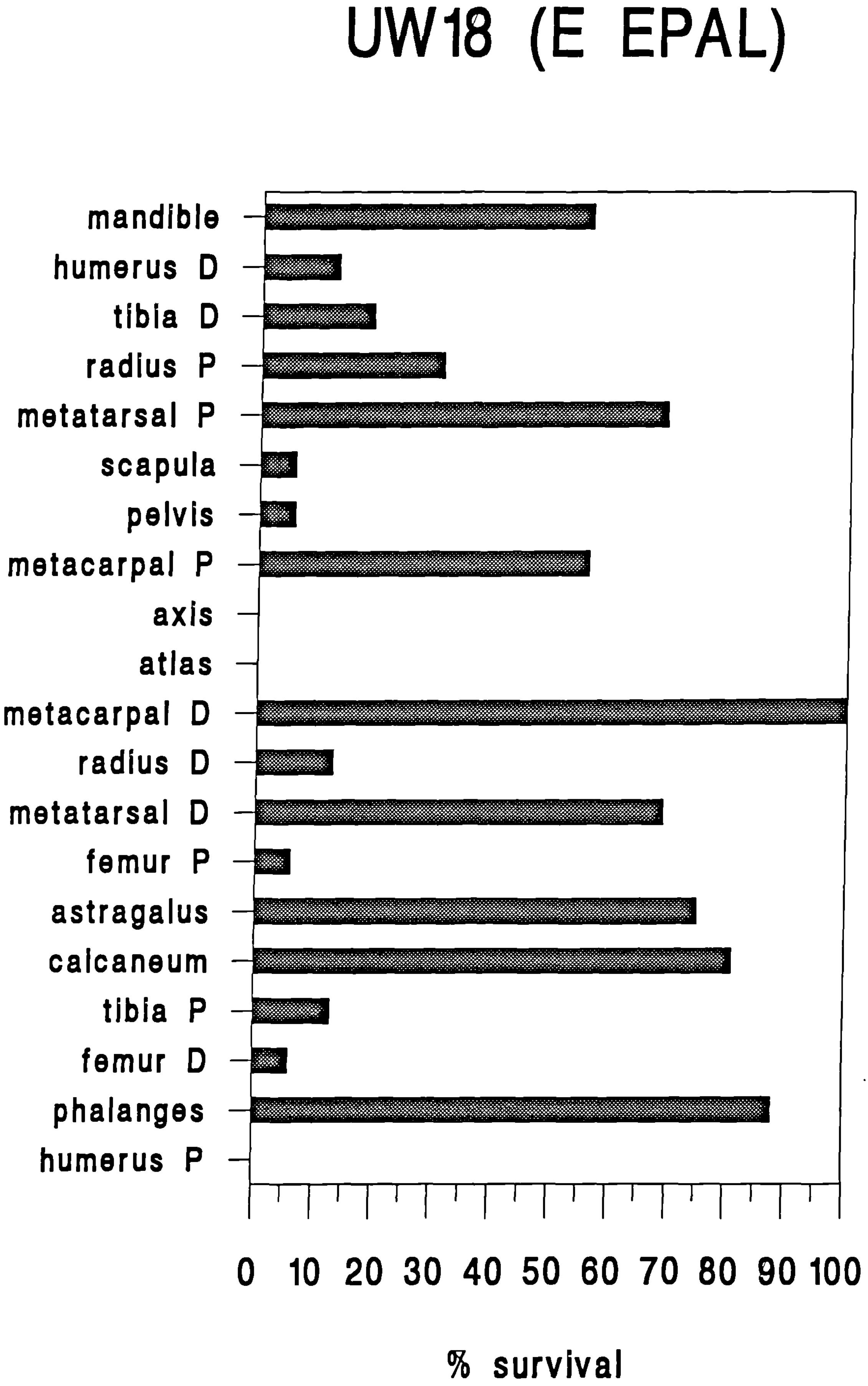


Figure 8.12c. Gazelle body part frequencies from UW18 re-ordered according to Kuiseb River goats.

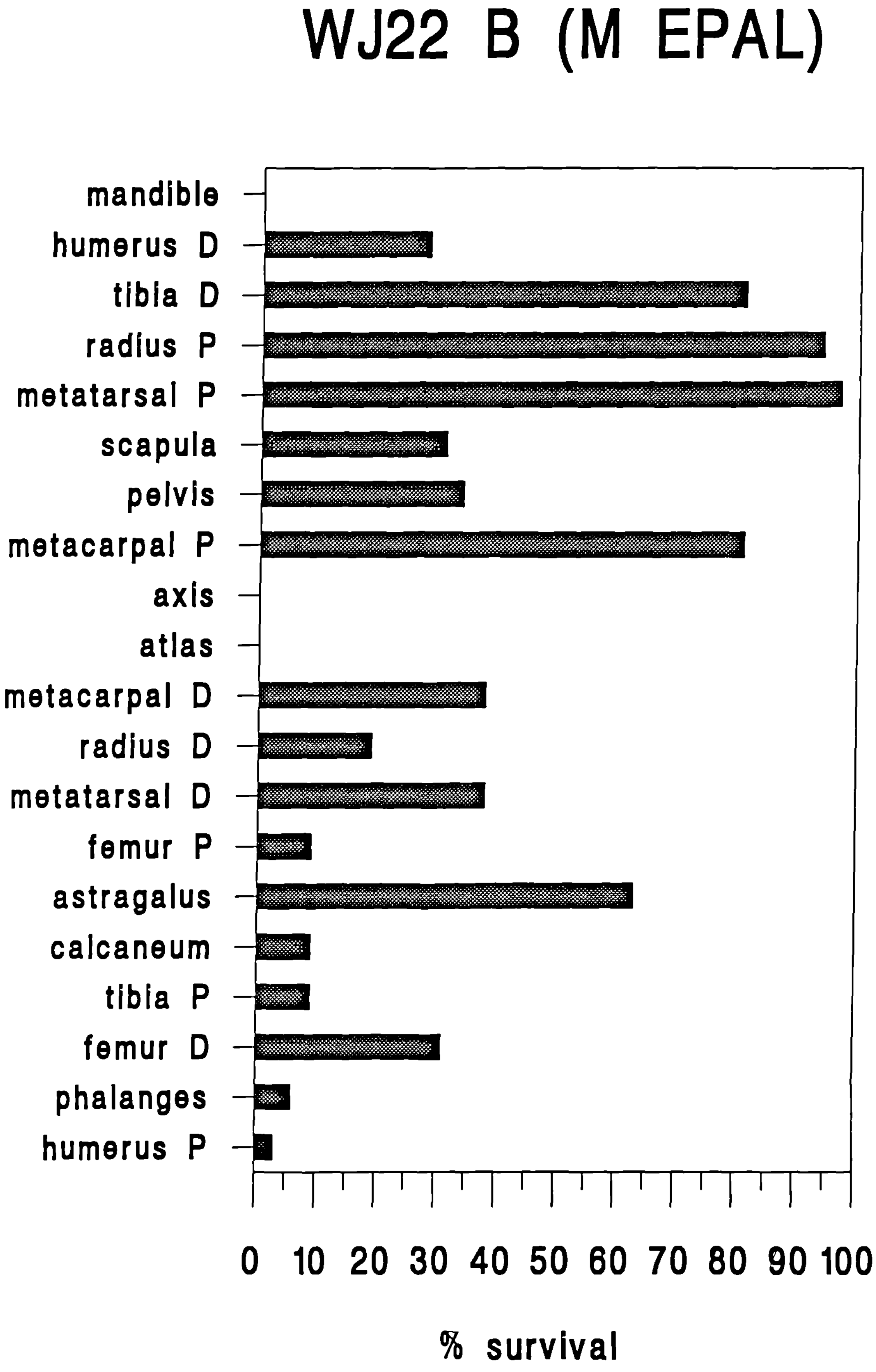
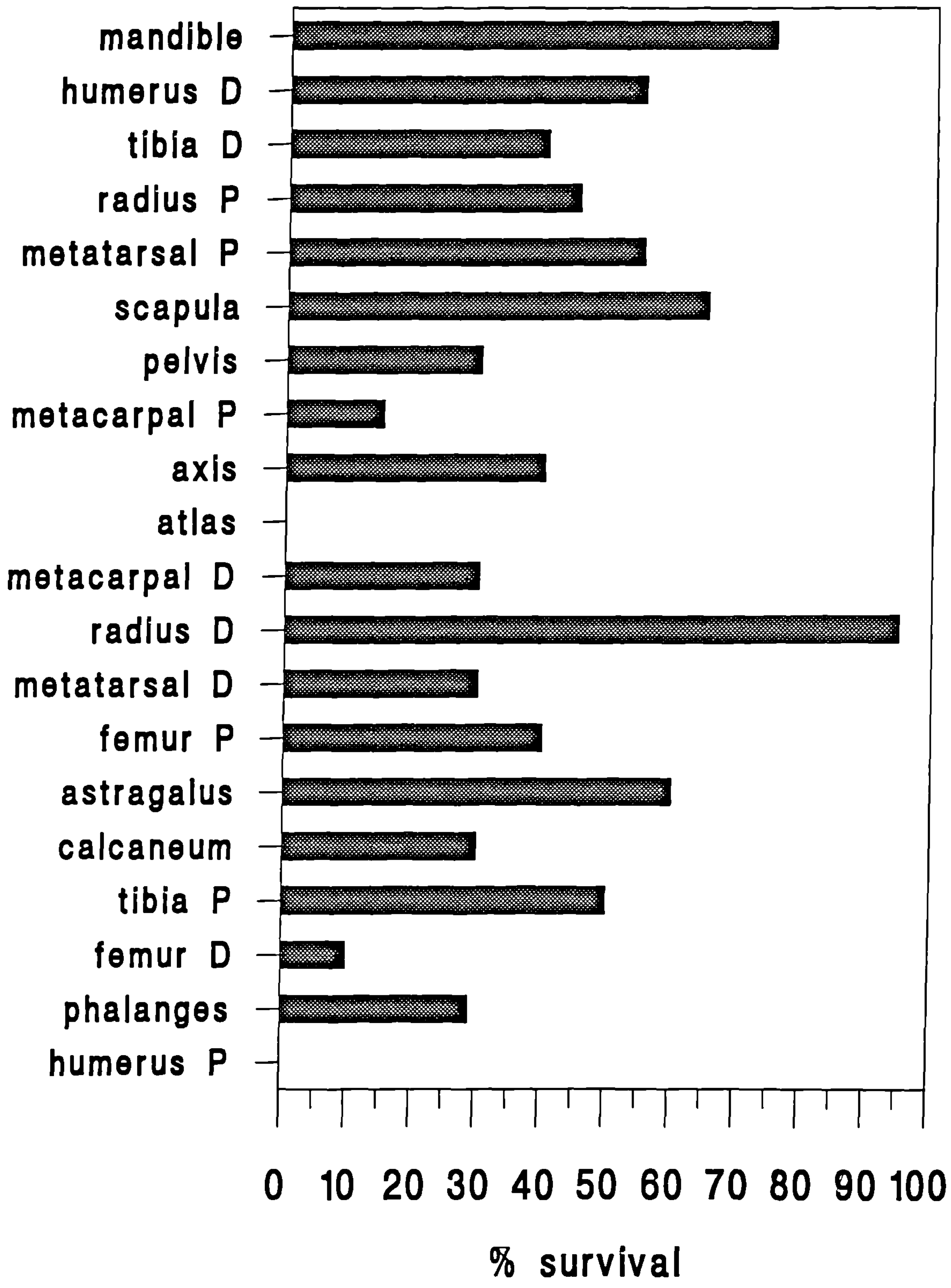


Figure 8.12d. Gazelle body part frequencies from WJ22 B re-ordered according to Kuiseb River goats.



WJ7 2 (PPNB)

Figure 8.13a. Gazelle body part frequencies from WJ7 2 re-ordered according to Kuiseb River goats.

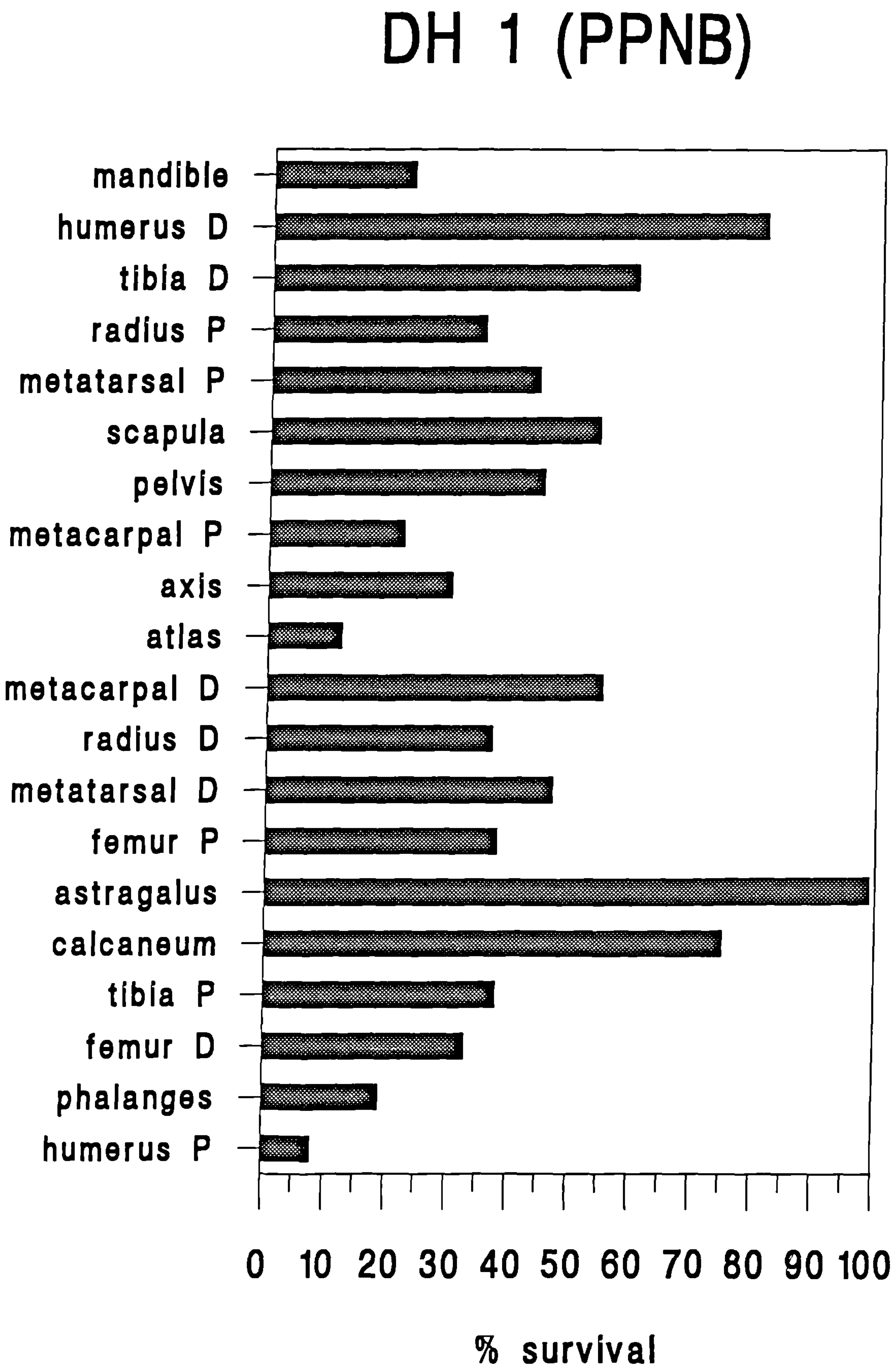
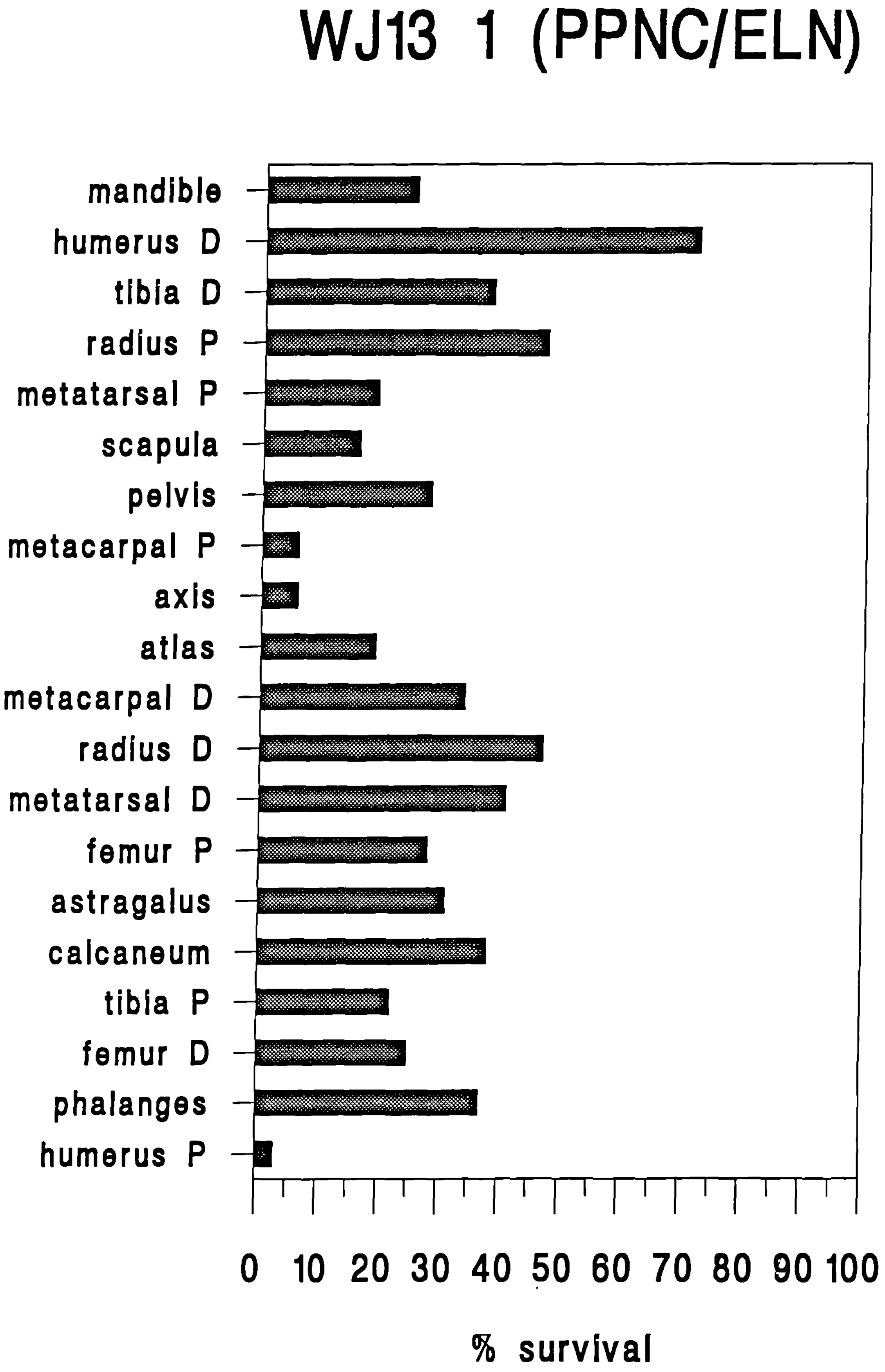


Figure 8.13b. Gazelle body part frequencies from DH 1 re-ordered according to Kuiseb River goats.



WJ13 1 (PPNC/ELN)

Figure 8.13c. Gazelle body part frequencies from WJ13 1 re-ordered according to Kuiseb River goats.

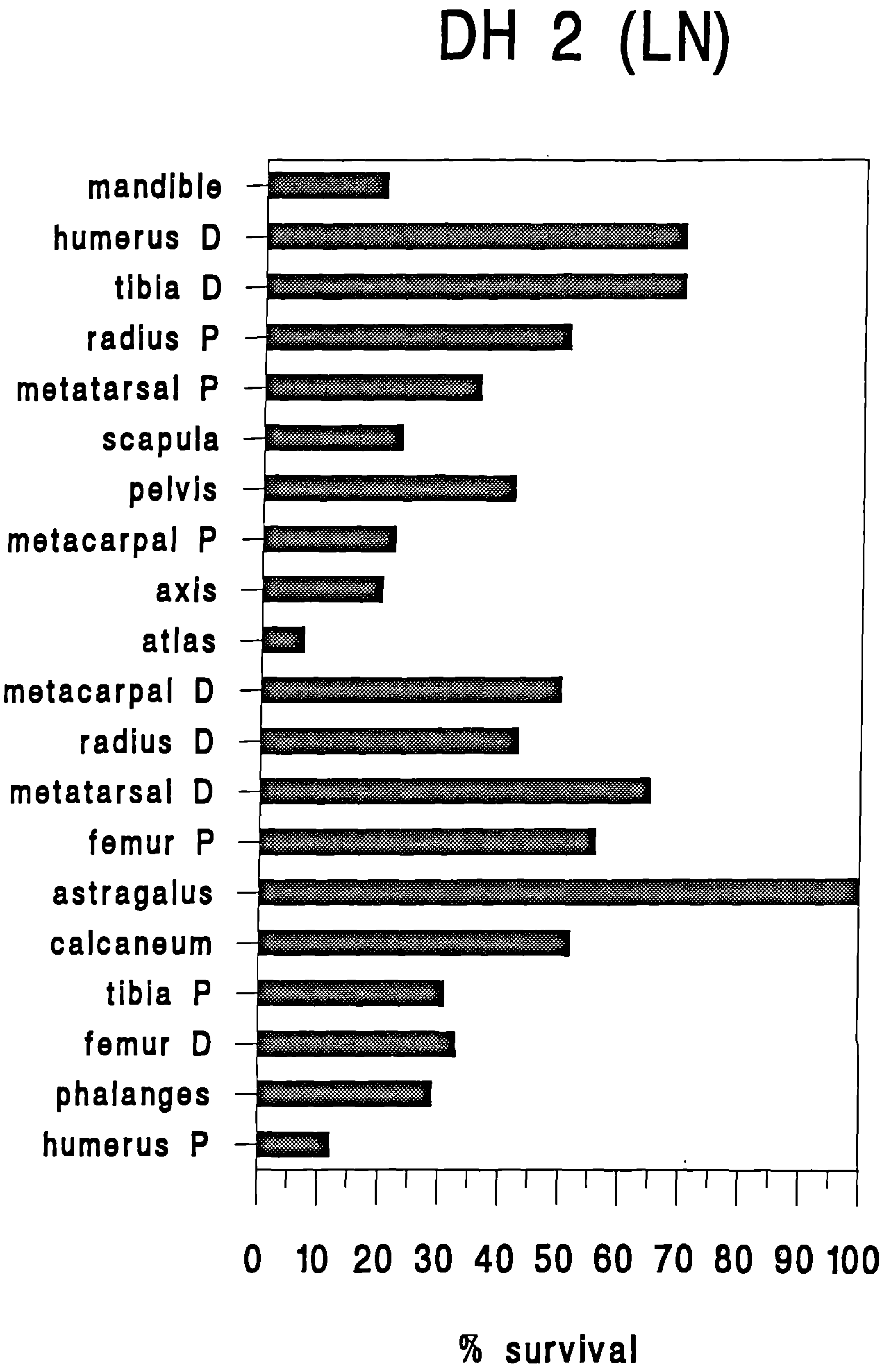


Figure 8.13d. Gazelle body part frequencies from DH 2 re-ordered according to Kuiseb River goats.

Some of the lines of evidence for carnivore activity described below show patterns which could support the suggestion of domestic dogs in the Neolithic, although these data are all problematic.

Body part representation consistent with carnivore attrition

A method of investigating whether assemblages have suffered heavy carnivore attrition is to compare them with one known to have been heavily ravaged by dogs - Brain's Kuiseb River goat collection (see also Legge and Rowley-Conwy 1988:70-73). Figure 8.11 shows the decending order of element survival of Kuiseb River goat bones, after they had been fed to dogs (after Brain 1981:23). Figures 8.12 and 8.13 show a selection of the larger and more representative eastern Jordan Epipalaeolithic and Neolithic gazelle assemblages, re-ordered according to the Kuiseb River sample. It is clear that there is little similarity in overall pattern between the archaeological samples and the Kuiseb example. Most of the archaeological samples show a low representation of proximal humerus, distal femur and proximal tibia, low atlas and axis, and a high representation of distal humerus and tibia (excepting UW18 and KH4 D), but these are the only consistent points of comparison. Brain's dog-gnawed assemblage has a much poorer representation of elements in the bottom half of the figure than any of the archaeological assemblages, and there are many other points of variation. The suggestion is that other factors, beyond carnivore activity, have been more important in shaping the eastern Jordan study assemblages.

Evidence of carnivore-gnawed bones

While traces of gnawing have been systematically recorded for assemblages studied from 1989 onwards, this may not be the case for those recorded before 1989. Table 8.12 shows the number of identifiable fragments (of all taxa) with gnaw marks, and also identifies the assemblages for which this information may not be accurate. Hence, although the apparent near-absence of gnawing from the Epipalaeolithic may be erroneous, the low percentage of gnawed fragments from the PPNB assemblages clearly contrasts with the higher incidence in the PPNC/Late Neolithic (except for DH 2), and differential observation/recording is unlikely to have created this contrast. Overall, however, the frequency of gnawing is very low.

Evidence of partially-digested bones

A similar problem is posed by the fact that signs of partially-digested bone were not systematically recorded in assemblages studied before 1989. Patterning can only be considered, therefore, for PPNB and PPNC/Late Neolithic assemblages in table 8.12.

Payne and Munson suggest that corrosion resulting from digestion can be distinguished from the effects of soil action, by the fact that digestive corrosion 'will only affect bones of a certain size - the size that a dog can comfortably swallow' (Payne and Munson 1985:38). The examples from the study sites are all small elements, or fragments of elements, (hare distal femur; fox phalanx 1; gazelle mandibular condyle; gazelle distal humerus; gazelle phalanx 1; gazelle phalanx 2 x 4; gazelle carpal; gazelle astragalus x 3; sheep/goat axis fragment x 2; sheep/goat/gazelle astragalus x 2; sheep/goat/gazelle phalanx 1; sheep/goat/gazelle naviculo-cuboid; sheep/goat/gazelle carpal), implying that their damage results from digestion.

Although patterning is not very clear, more PPNC/Late Neolithic assemblages show an occurrence of partially-digested bone than do PPNB assemblages. Again, where this trait has been systematically recorded, incidences are very low.

Evidence of longbone 'cylinders'

Longbone shaft cylinders, with their epiphyseal ends missing, have been taken to be characteristic of carnivore gnawed assemblages (Binford 1981:51; Marean and Spencer 1991). Cylinders can obviously be produced by various other means, although additional signatures such as thinned ends and gnaw marks would support the identification of carnivore activity. Cylinders have been recorded for the study assemblages (table 8.12), and they were only counted for medium-sized herbivores. They are expressed as a percentage of the total (MNE/B) medium-sized animal bones. Again, this information is not present for assemblages studied before 1989.

Carnivore activity								
assemblage	pre-1989	gnawing no.	%	digested no.	%	cylinders no.	%	sample size
PPNC/LN								
B27 3		6	13.6	0	0.0	1	5.2	44
B27 2		7	4.0	3	1.7	11	8.2	177
Jebel Naja	*	0	0.0	0	0.0	NA		8
DH 2		15	0.2	3	0.1	33	0.5	6382
WJ13 3		12	1.5	4	0.5	6	1.5	796
WJ13 2		18	2.8	1	0.2	5	1.3	644
WJ13 1		44	2.3	1	0.1	5	0.5	1880
WJ25		0	0.0	0	0.0	0	0.0	110
PPNB								
DH 1		9	0.4	1	0.1	30	1.4	2202
Ibn el Ghazzi	*	0	0.0	0	0.0	NA		20
WJ32		1	0.6	0	0.0	0	0.0	161
WJ26		0	0.0	0	0.0	0	0.0	12
WJ7 5		0	0.0	0	0.0	0	0.0	79
WJ7 4		0	0.0	0	0.0	0	0.0	251
WJ7 3		2	1.0	2	1.1	0	0.0	185
WJ7 2		0	0.0	0	0.0	1	0.3	469
WJ7 1		0	0.0	4	1.6	0	0.0	258
L EPAL								
Khallat Anaza	*	0	0.0	0	0.0	NA		34
AZ18	*	0	0.0	0	0.0	NA		104
M EPAL								
AZ17	*	0	0.0	0	0.0	NA		27
WJ22 B		0	0.0	2	0.3	8	2.2	611
WJ22 C		0	0.0	0	0.0	10	10.0	243
WJ10	*	0	0.0	0	0.0	NA		12
WJ8	*	0	0.0	0	0.0	NA		36
E EPAL								
UW18	*	0	0.0	0	0.0	NA		169
UW14	*	0	0.0	0	0.0	NA		8
KH4 D	*	1	0.1	0	0.0	NA		3659
KH4 C	*	0	0.0	0	0.0	NA		197
KH4 B	*	0	0.0	0	0.0	NA		803
KH4 A	*	0	0.0	0	0.0	NA		1132
WJ6 B	*	0	0.0	0	0.0	NA		45
WJ6 A	*	0	0.0	0	0.0	NA		848
U PAL								
WJ9	*	0	0.0	0	0.0	NA		6

Table 8.12. The 'gnawing' column shows the percentage of carnivore gnawed bones of the total sample. The 'digested' column shows the percentage of possibly digested bones of the total sample. 'Cylinders' are calculated as a percentage of the medium sized herbivore bones. A star (*) in the left hand column denotes assemblages recorded before 1989 which may not provide accurate data (see text).

With highly fragmented assemblages such as these, the possibility that cylinders may have 'collapsed' through other taphonomic factors is high, and these data should, therefore, be interpreted cautiously. Table 8.12 shows them to constitute relatively low proportions of assemblages, except at WJ22 C, B27 2 and 3. They are, however, more frequent in the PPNC/Late Neolithic than in the PPNB, although their frequencies at middle Epipalaeolithic WJ22 C and B suggests that this is not a simple temporal trend.

In conclusion, all four lines of evidence are consistent in suggesting that carnivores had little impact on the assemblages. The comparison of the body part frequencies with the Kuiseb River goat assemblage is an indirect approach (since body part representation is altered by other agencies too), and therefore ambiguous. The advantage of the method, however, is that it is applicable to both Epipalaeolithic and Neolithic assemblages (unlike the three other forms of evidence), and describes the whole assemblage, rather than a minority of altered specimens. The evidence of the three carnivore attrition 'signatures' confirms the picture presented by the body part frequencies that carnivore attrition of assemblages is very low.

The evidence for gnawed bone, partially-digested bone, and long-bone cylinders, however, all points to a slight increase in carnivore activity between the PPNB and the PPNC/Late Neolithic.

Does the review of carnivore evidence allow any conclusions to be drawn on whether the inhabitants of the sites were keeping **domestic dogs**, since direct morphological evidence for this is lacking? (Dogs are believed to have been domesticated in/by the Natufian (late Epipalaeolithic) in the Near East).

Firstly, a high incidence of gnawing in an assemblage has been taken as characteristic of domestic dogs on site: an Archaic period site in Tennessee, for example, where domestic dogs were present, showed that one in four (i.e. 25%) deer bones had signs of canid damage (Morey and Klippel 1991). None of the study assemblages shows this degree of gnawing (the high percentage at B27 3 should be treated with caution due to the extremely small sample size), but there is a substantial **increase** in the frequency of gnawing from the PPNB to the PPNC/Late Neolithic. WJ13 1, 2 and 3 and B27 2 and 3 exhibit higher proportions of gnawing than other assemblages (with Late Neolithic DH 2 interestingly having a low frequency, and, it is argued later that this is a hunting as opposed to herding site); WJ25 has no examples. This pattern could be interpreted as reflecting the keeping of dogs at WJ13 and B27.

The evidence of partially-digested bone is difficult to interpret. Davis uses the high proportions (5% of the fauna) of small corroded bones at Natufian Hatoula in Palestine as corroborative evidence for the presence of domestic dogs at the site, when earlier assemblages show none (Davis 1985; 1987:148). Horwitz, however, questions both the apparent lack of earlier partially-digested bones in the region, and whether the Hatoula examples can be unequivocally ascribed to dogs (Horwitz 1990). In eastern Jordan, although digested bones are evidenced in all periods, PPNC/Late Neolithic assemblages tend to show them more consistently. If one were to argue that domestic dogs are first seen in the PPNC/Late Neolithic in the area on the basis of both the shed deciduous tooth in WJ13 2 and the increase in gnawing, then the proportions of digested bones identified might be seen to reflect this. The frequency of cylinders also increases slightly between the PPNB and PPNC/Late Neolithic, but their high percentages at middle Epipalaeolithic WJ22 suggests that they correlate better with specific sites (and therefore other taphonomic factors) than with chronology. In view of the combined evidence it is tentatively suggested that domestic dogs were present on the PPNC/Late Neolithic sites.

iii) **Processes of weathering and sediment activity**

Whether a bone becomes buried quickly or remains exposed for a length of time after deposition, the recycling of their nutrients is a normal process (Behrensmeyer 1978). The effect of weathering on bones is generally not well understood, although habitat, exposure time, temperature, humidity, inequability of the environment, and the chemical properties of the soil are all believed to be factors influencing variability (Behrensmeyer 1978; Lyman and Fox 1989; White and Hannus 1983; Von Endt and Ortner 1984; Miller 1975). In addition, the pre-depositional treatment of the bone (e.g. method of cooking, degree of disarticulation, extent of processing), and other post-depositional factors, such as trampling, may well mediate the effects of weathering.

As Maltby states, on weathering and chemical action:

> ... Although (again intuitively) we may feel that such destruction would be density-related, this has yet to be tested empirically ... we are still at an early stage of research into all forms of taphonomic process.
>
> (Maltby 1985:41)

For the eastern Jordan sites, there has been no attempt to explore all the possible complex factors which may be relevant to weathering, since taphonomy is not a major focus of this thesis. The general condition of bone surfaces was recorded, however, for each context (on a rather subjective level of very poor/poor/mediocre/good/excellent); the results suggest that surface exfoliation and erosion are not important factors. Actual preservation of bone appears good. It was suggested, though, that the high degree of bone fragmentation could result from weathering conditions (Dennell pers. comm.), and that the extremes of temperature and moisture in eastern Jordan, both diurnally and seasonally, may have contributed towards bone shattering. Even if this were the case, the examination of bone surfaces suggests that the high degree of fragmentation has not led to great bone loss.

For present purposes, it is assumed (maybe simplistically) that bone elements which are **more likely** to disappear altogether from the archaeological record are those of low density (following Lyman 1984). A lack of low density elements will be interpreted cautiously, therefore, as the possible result of weathering factors, and will not be interpreted as the result of human behavioural.

2) Analysis: post-depositional sources of variation in body part representation

1) the low representation at most sites of axis and/or atlas (10 out of 11 assemblages), proximal humerus (10 out of 11 assemblages), proximal tibia (8 out of 11 assemblages), and to a lesser extent distal femur (5 out of 11 assemblages), may well be the result of post-depositional destruction (probably physical damage rather than carnivore attrition).

2) a general under-representation of teeth may be due to their extreme fragmentation, and therefore unidentifiability.

3) the high representation of 'mandible' at UW18, KH4 A, B and D may be due to a NISP over-representation of highly fragmented teeth.

4) the high representation of proximal radius, distal humerus, astragalus or calcaneum in most assemblages is probably the result of their durability in the face of post-deposition attrition.

4) Analysis: pre-depositional sources of variation in body part representation

Taking into account possible post-depositional effects, and viewing body-part data at a coarse level, two main patterns are observed:

(1) The following assemblages generally show all body parts present:

- KH4 A, B, C, D (C has some elements missing probably due to small sample size)
- WJ6 A
- DH 1 DH 2
- WJ22 B (complete absence of teeth is notable - may be due to extreme shattering, since other skull and mandible parts are present? missing elements may be due to small sample size)
- WJ7 2

- WJ13 1 (low representation of proximal metacarpal is notable, may be due to bone tool manufacture?)

(2) UW18 shows a low representation of upper forelimb and hindlimb parts (including high density parts), and a very high representation of foot bones (metapodia and phalanges). Skull parts are also well represented.

The presence of all gazelle body parts in most assemblages may result, in part, from assemblages representing broad phases of occupation. We do not have the temporal resolution to separate out discrete events, and the nature of the deposits (mixed and often deflated) has made it frequently impossible to identify meaningful contexts for examination. The assemblages therefore represent accumulations of activities, and potentially long or repeated occupations. As Binford (1978:483) notes, assemblages which represent short-term deposits will have more body-part patterning than those resulting from long time spans, because the latter may be blurred. In other words the 'lack' of visible patterning in most of the study assemblages may be because the superimposition of different types of carcass treatment has blurred the evidence for such activity.

Nevertheless, although individual events cannot be identified, the body-part data may inform on longer-term activity. Where all major body parts are present, this could either reflect a practice of returning whole carcasses to the site, or alternatively it could suggest consistent introduction (or discard) or removal of different parts to create the same pattern. This might occur, for example, if a site sometimes served as a kill-butchery location, and sometimes (within the same broad phase) as a base camp, although the likelihood that the same spot would suit both is extremely slim. It is argued, therefore, that the gazelle body part data reflects whole carcasses being brought onto sites. Whether animals were skinned and dismembered at the site of kill, and returned in this state to the sites, or whether they arrived unprocessed, cannot be determined from the body-part evidence. For all the assemblages except UW18, dismemberment practices cannot be gleaned from body-part representation since all elements are present.

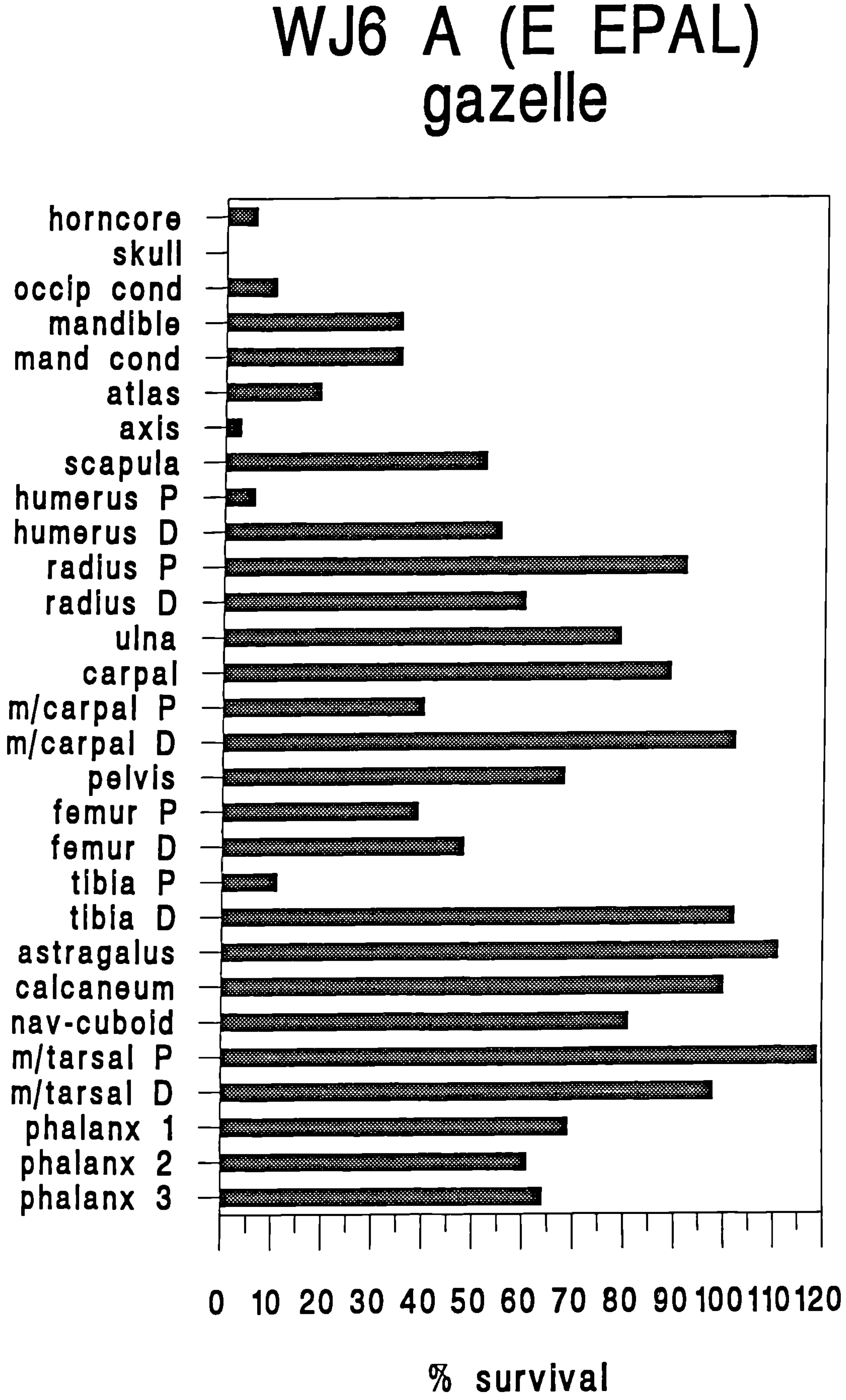


Figure 8.0. The relative frequency of gazelle body parts from WJ6 A.

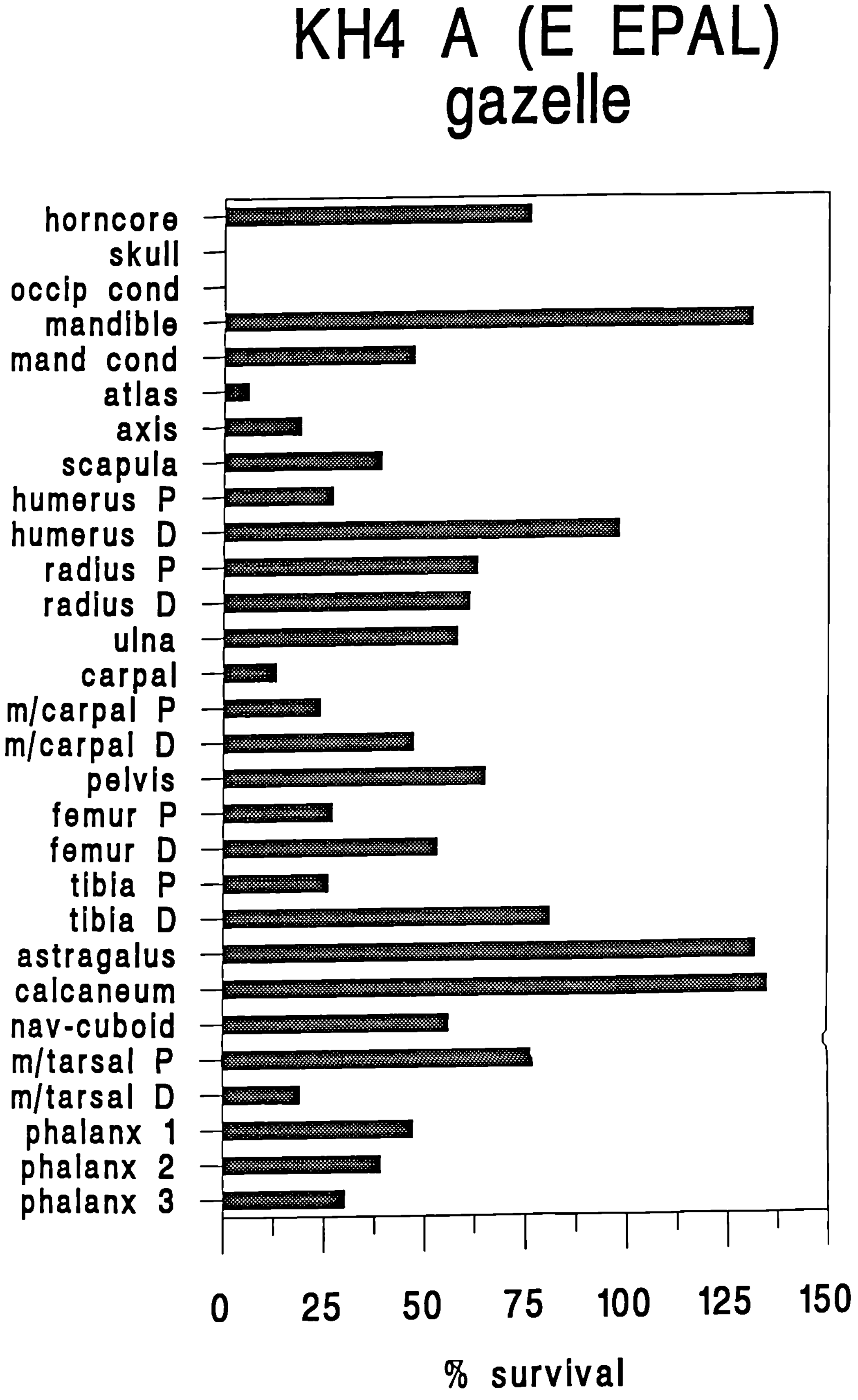


Figure 8.1. The relative frequency of gazelle body parts from KH4 A.

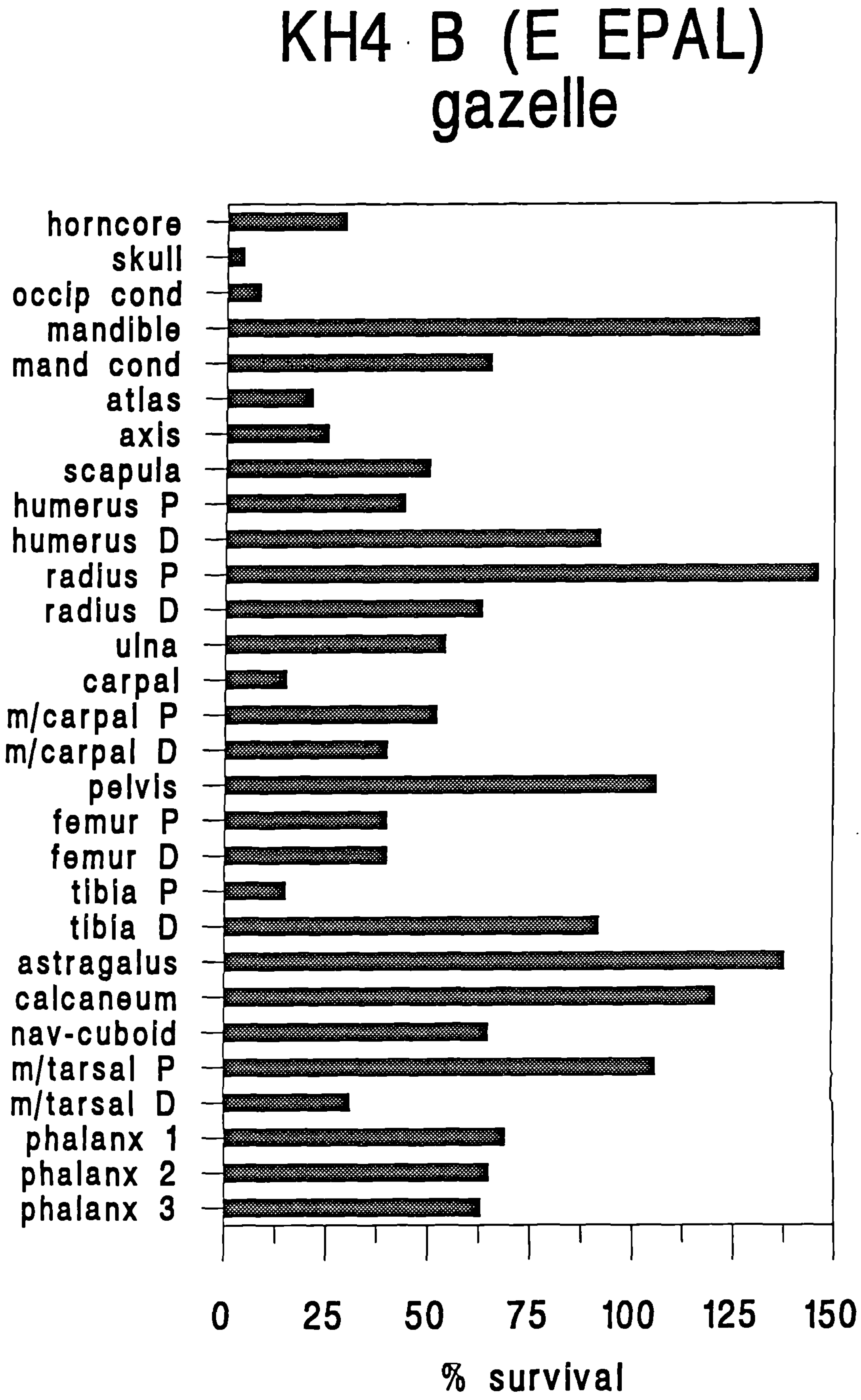


Figure 8.2. The relative frequency of gazelle body parts from KH4

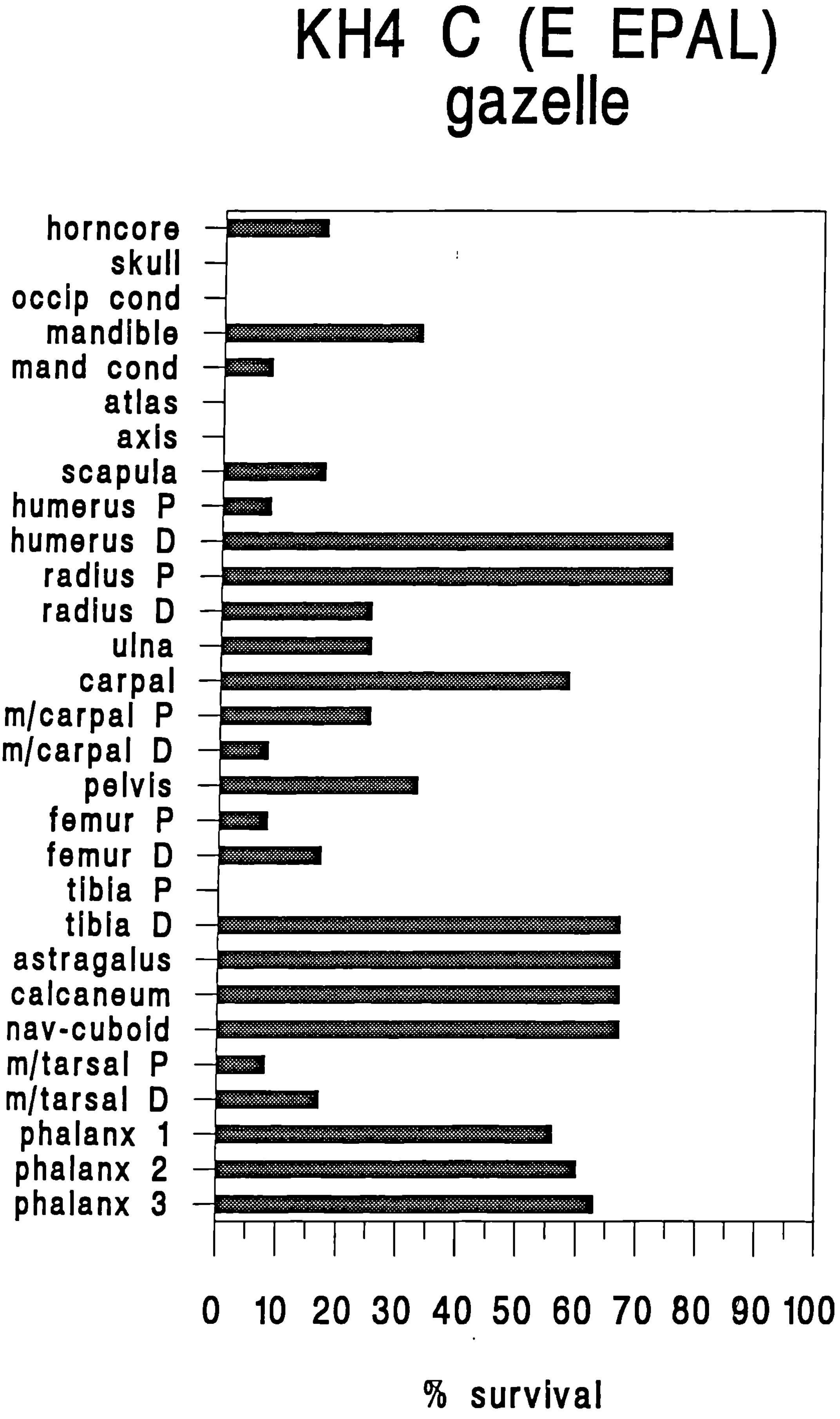


Figure 8.3. The relative frequency of gazelle body parts from KH4 C.

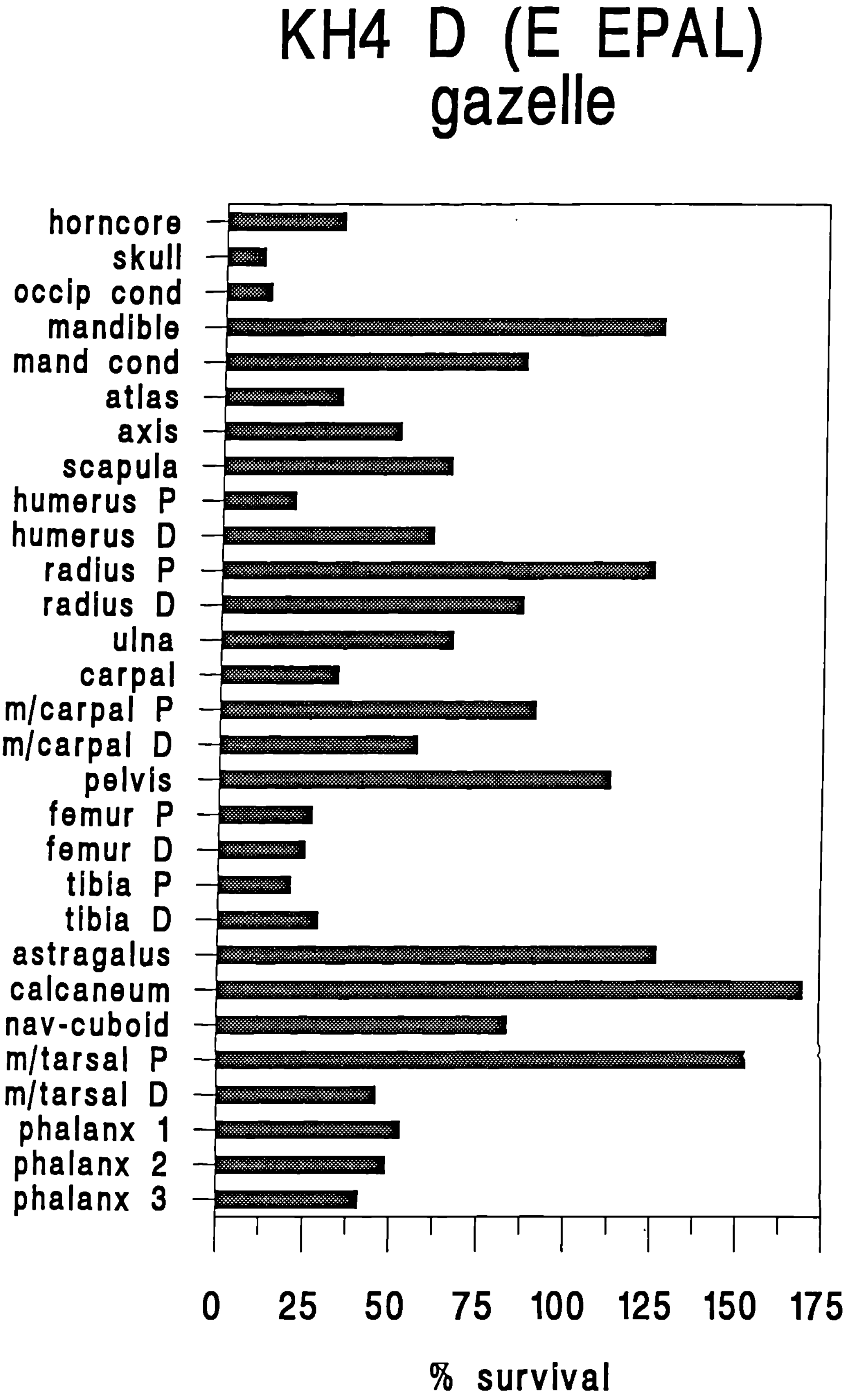


Figure 8.4. The relative frequency of gazelle body parts from KH4 D.

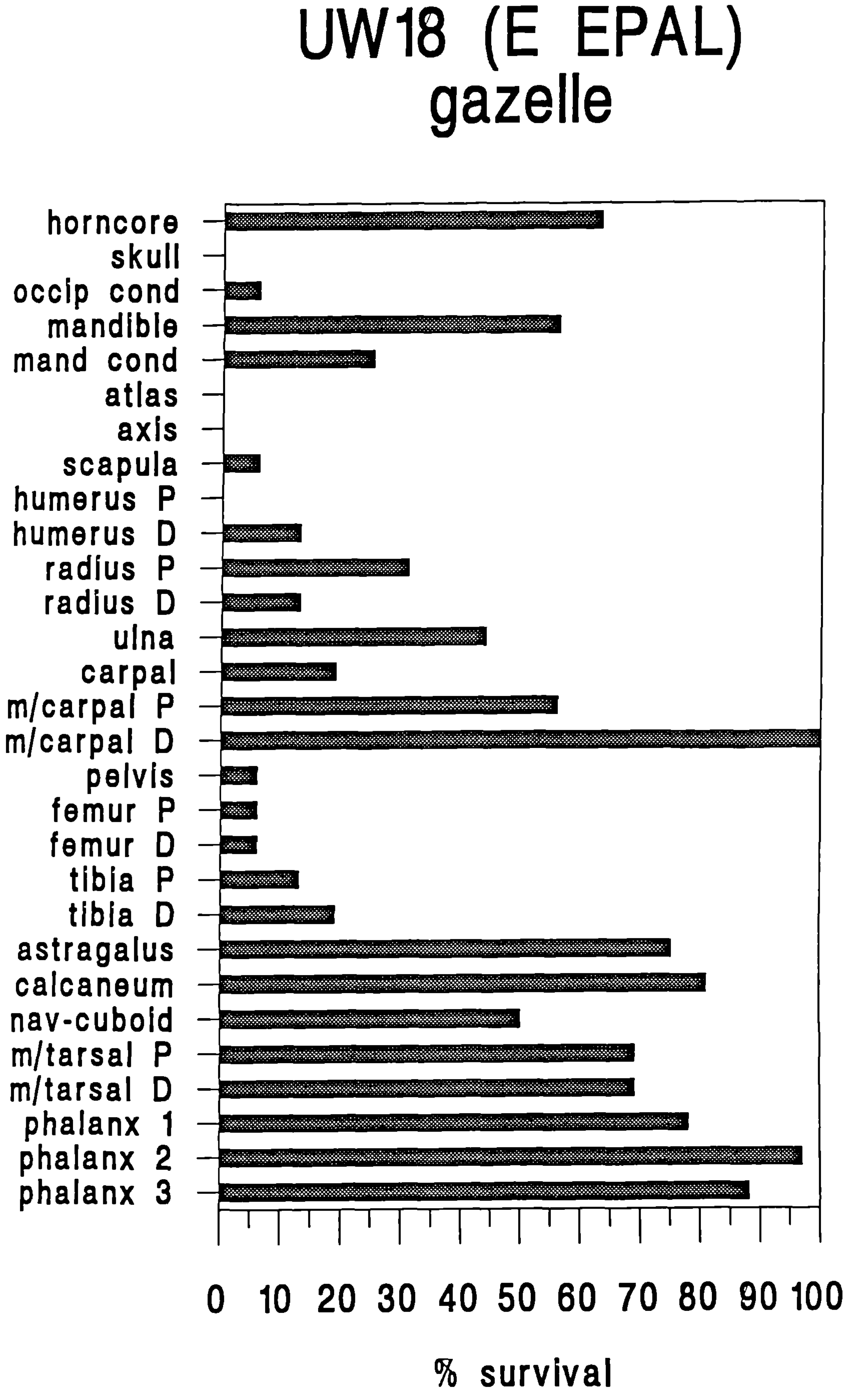


Figure 8.5. The relative frequency of gazelle body parts from UW18.

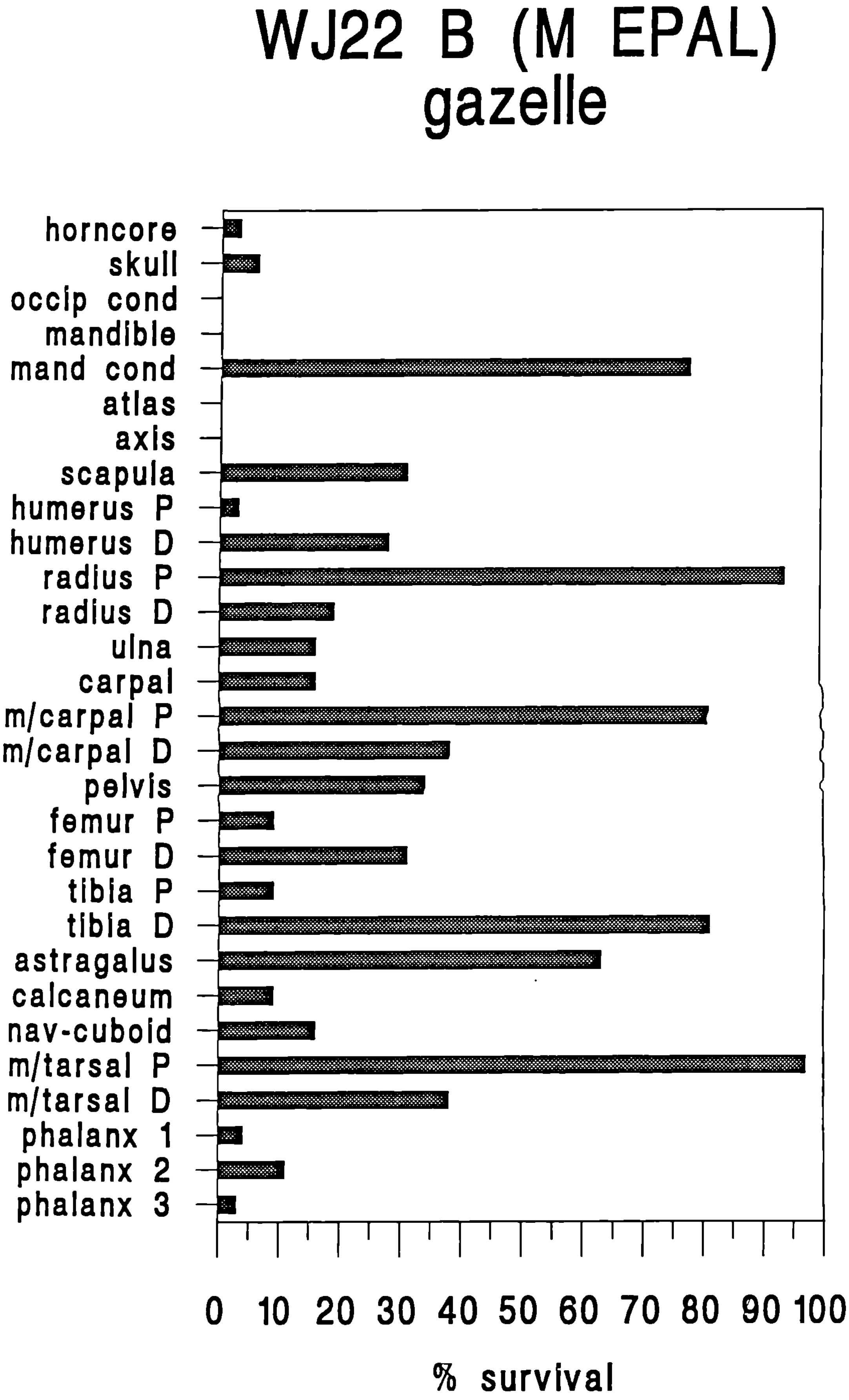


Figure 8.6. The relative frequency of gazelle body parts from WJ22 B.

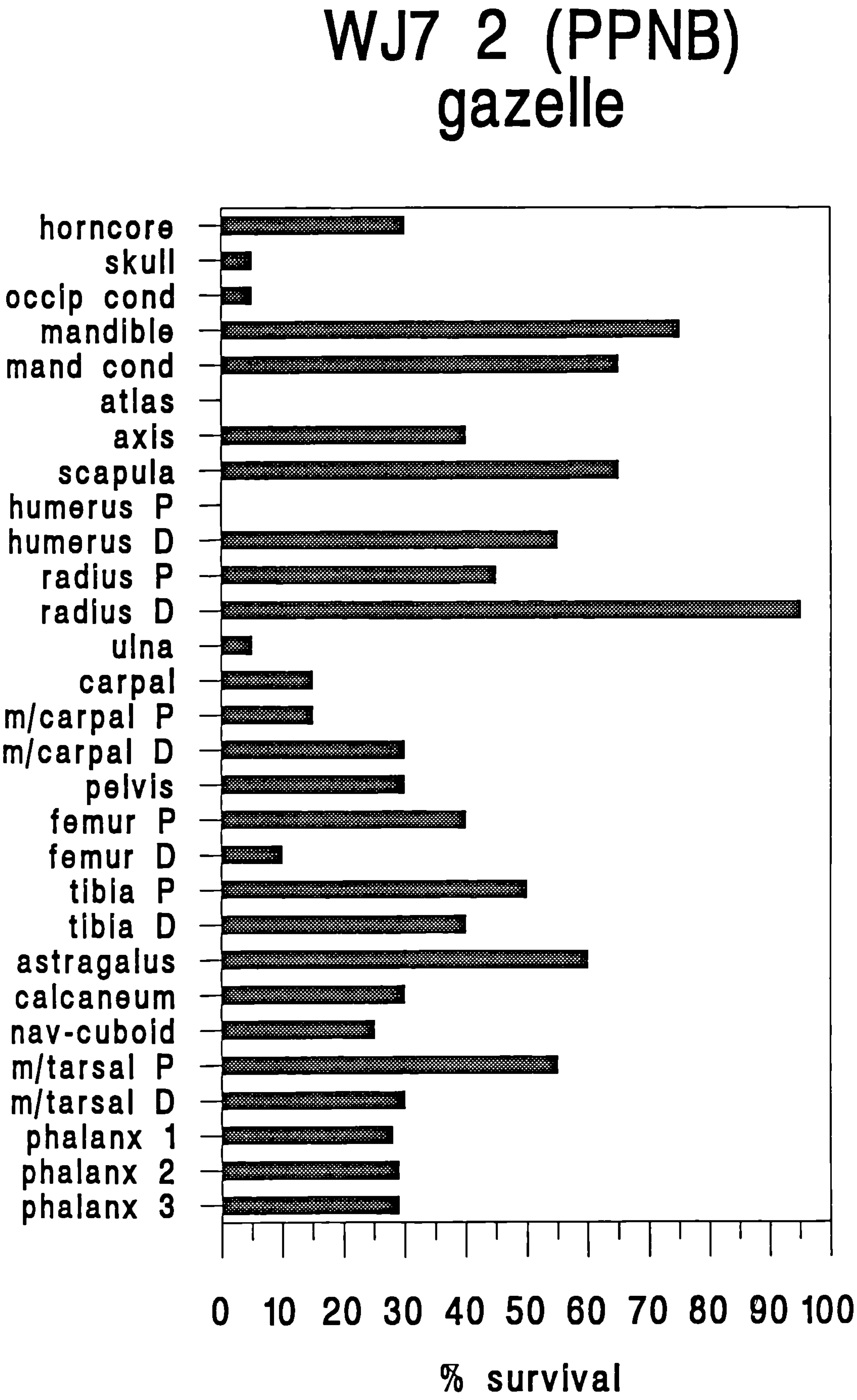


Figure 8.7. The relative frequency of gazelle body parts from WJ7 2.

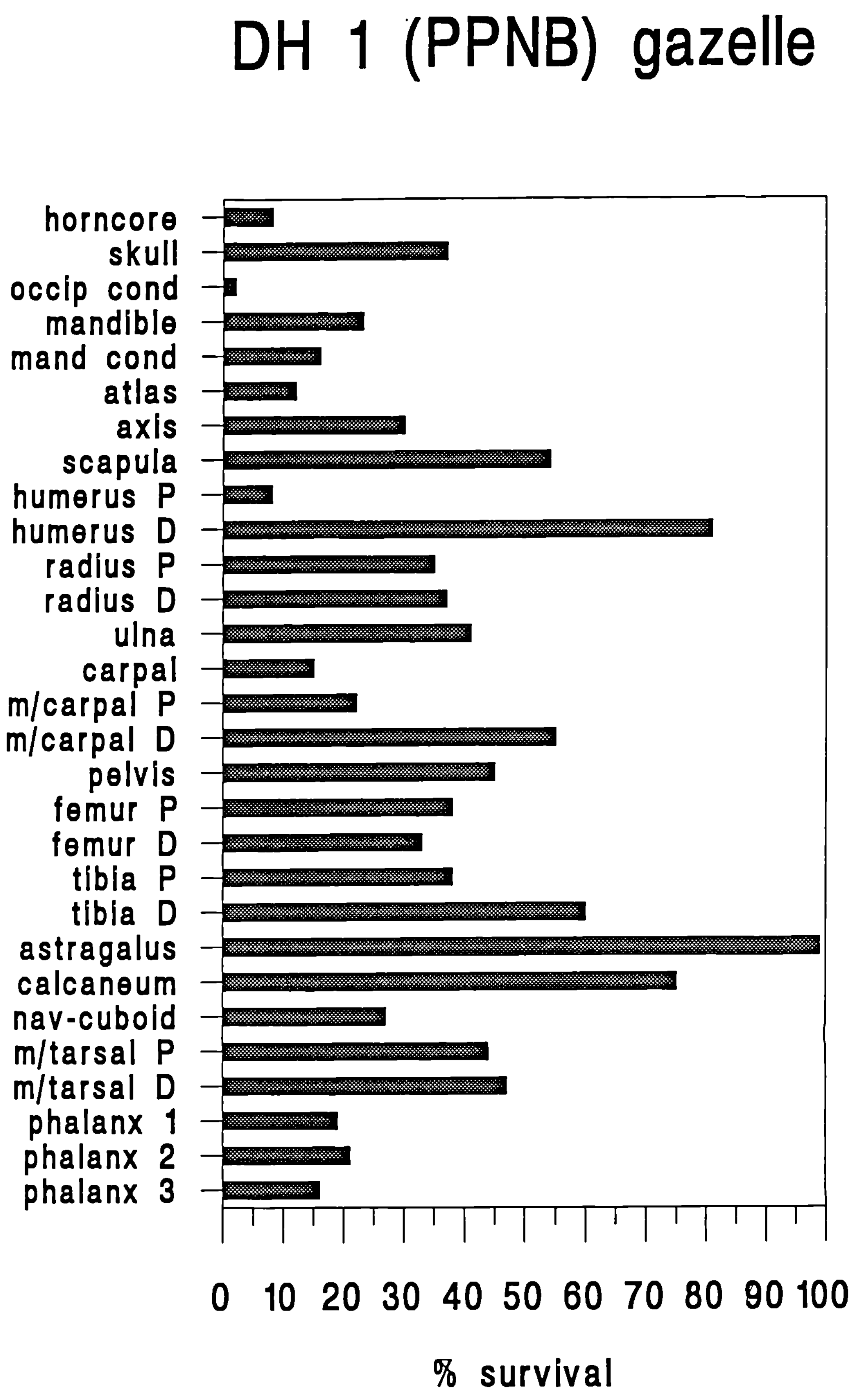


Figure 8.8. The relative frequency of gazelle body parts from DH 1.

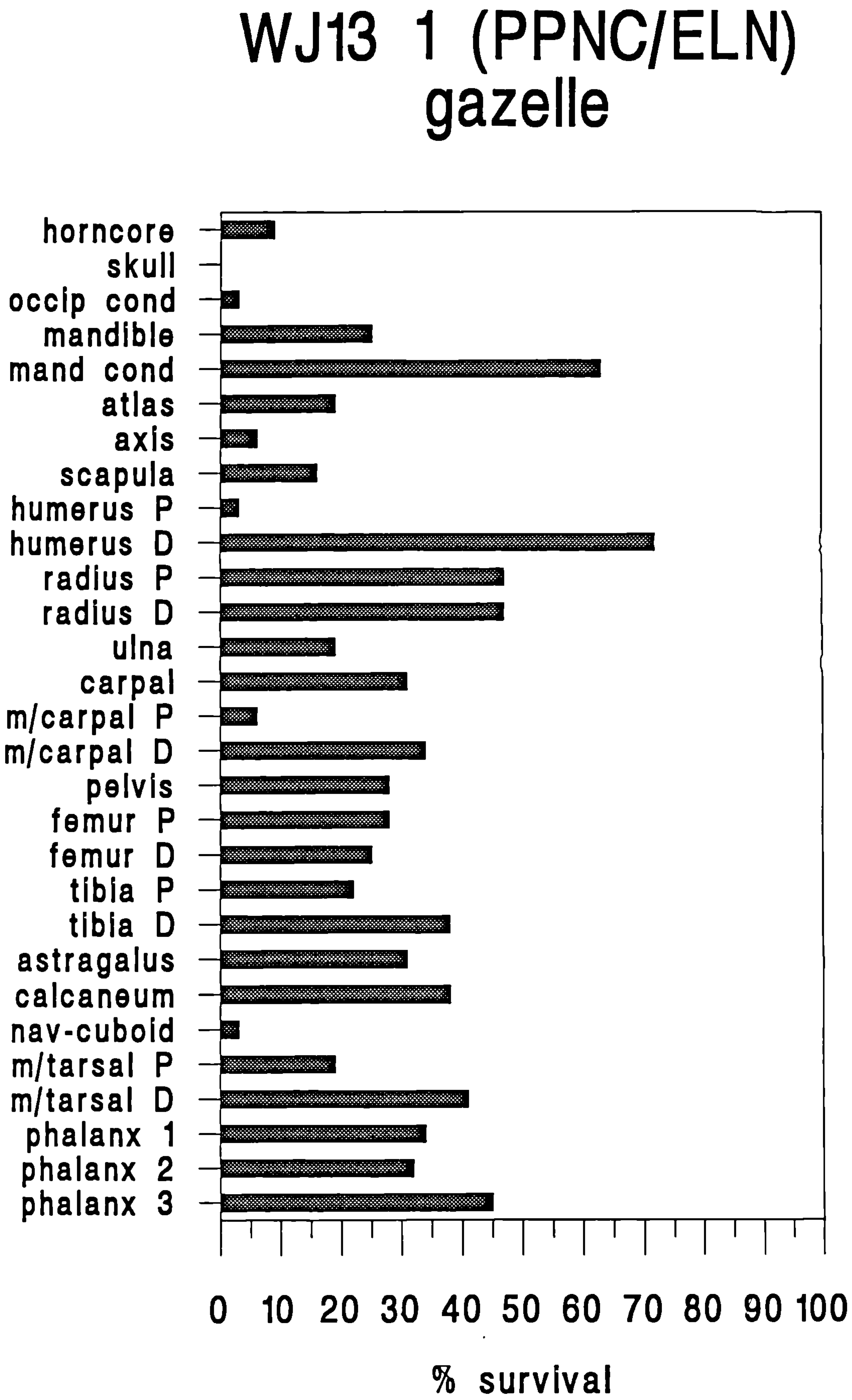


Figure 8.9. The relative frequency of gazelle body parts from WJ13 1.

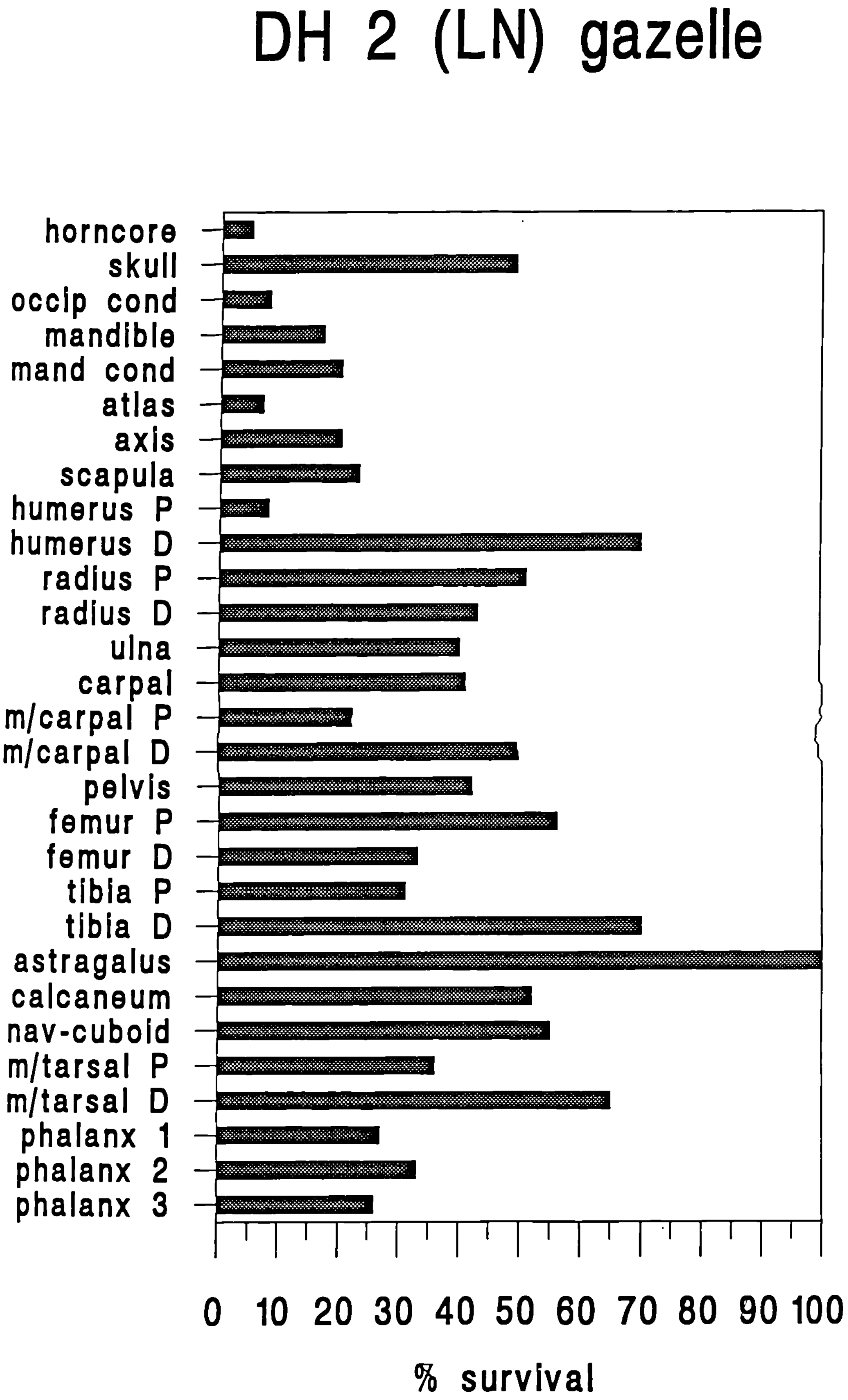


Figure 8.10. The relative frequency of gazelle body parts from DH 2.

At UW18, the high proportions of extremities (carpals, tarsals, metapodia, phalanges) and skull parts, and the low proportions of fore- and hind-limb parts, imply that some processing of the carcass had taken place and that the high meat-yielding elements (upper limbs) had been removed from the site. Dismemberment, at least of upper limb from lower limb and of skull from the rest of the carcass, had taken place.

Butchery evidence

There are two sources of evidence for butchery: firstly, cut marks, and secondly, breaks which are strongly suggestive of chopping.

Cut marks on gazelle bones are extremely few. Erosion of bone may have obscured marks, although surface alteration was not noted as being common. Fragmentation may also have hindered recognition of cut marks, particularly on shaft fragments, in that unidentifiable shaft splinters are less likely to have been closely examined (this would introduce a bias against the recognition of filleting marks - see below).

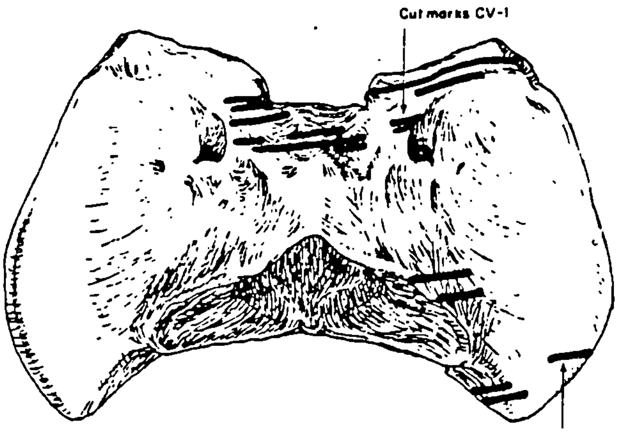
Cut marks, where they do occur, are typical of stone tool butchery (Binford 1981;105): they are short, often in groups of parallel strokes and open in cross-section. Examples of marks recorded for the study assemblages are shown in figure 8.14.

Interpretation of cut marks follows Binford (1981), who divides them into dismemberment, filleting or skinning marks, based on observations of Nunamiut Eskimo butchery. The frequency of these categories in assemblages where they are present is shown in table 8.13.

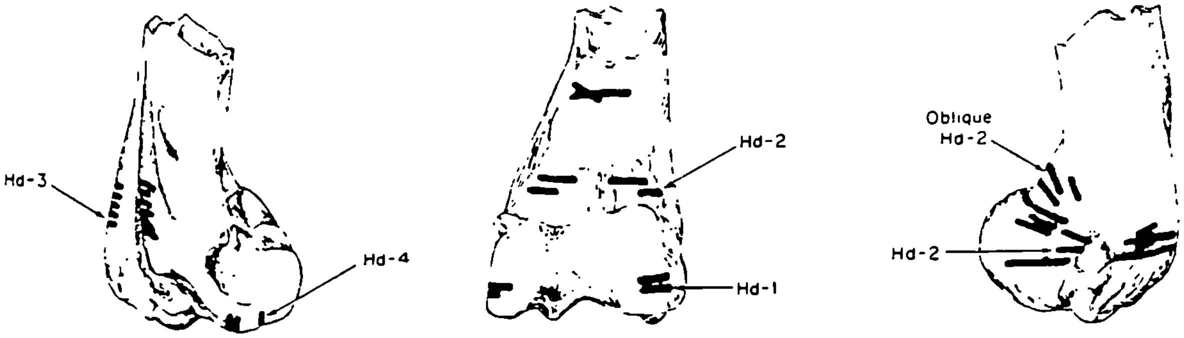
gazelle butchery evidence

assemblage	skinning cuts	dismemberment cuts		filleting cuts	chop marks
		head	limbs/joints		
PPNC/LN					
DH 2			MTd-1		RCp-1 MTp-1 PH1-1
WJ13 2			Hd-2 RCd-2 Tp-1	RCp-6	
WJ13 1	PH1	CV-1	Hd-4 C-1		
PPNB					
DH 1					Tp-t Tp-t Td-1 MTp-1 MTd-1
WJ7 5	PH1				
WJ7 2	S-4 MTd-2*		M-5 Hd-4 MTd-1		
M EPAL					
WJ22 C					MCd-1
WJ22 B			MTp-3 (x2)		
E EPAL					
KH4 D		CV-1 CV-3	Hd-1 Hd-2 (x2) RCd-2 C-1 MTp-3 MTd-1	Tp-3	
KH4 C			Td-3		
KH4 B			MTp-3 (x2)		
KH4 A	PH1(x4)				
WJ6 A	PH1(x11) PH2		RCp-5 (x2) RCd-2		

Table 8.13. The occurrence of cut marks is shown for assemblages where they are present. Codes for element/cut mark follow Binford 1981; if the same cut mark occurs more than once, the frequency is shown in brackets. The right hand column shows elements with evidence of chopping; the element codes used are the same as for cut marks, whilst the suffix describes whether the chop is transverse (t) or longitudinal (l). *The cut marks on the distal metatarsal in WJ7 2 are on the posterior of the shaft only, and may be more indicative of tendon removal than skinning.



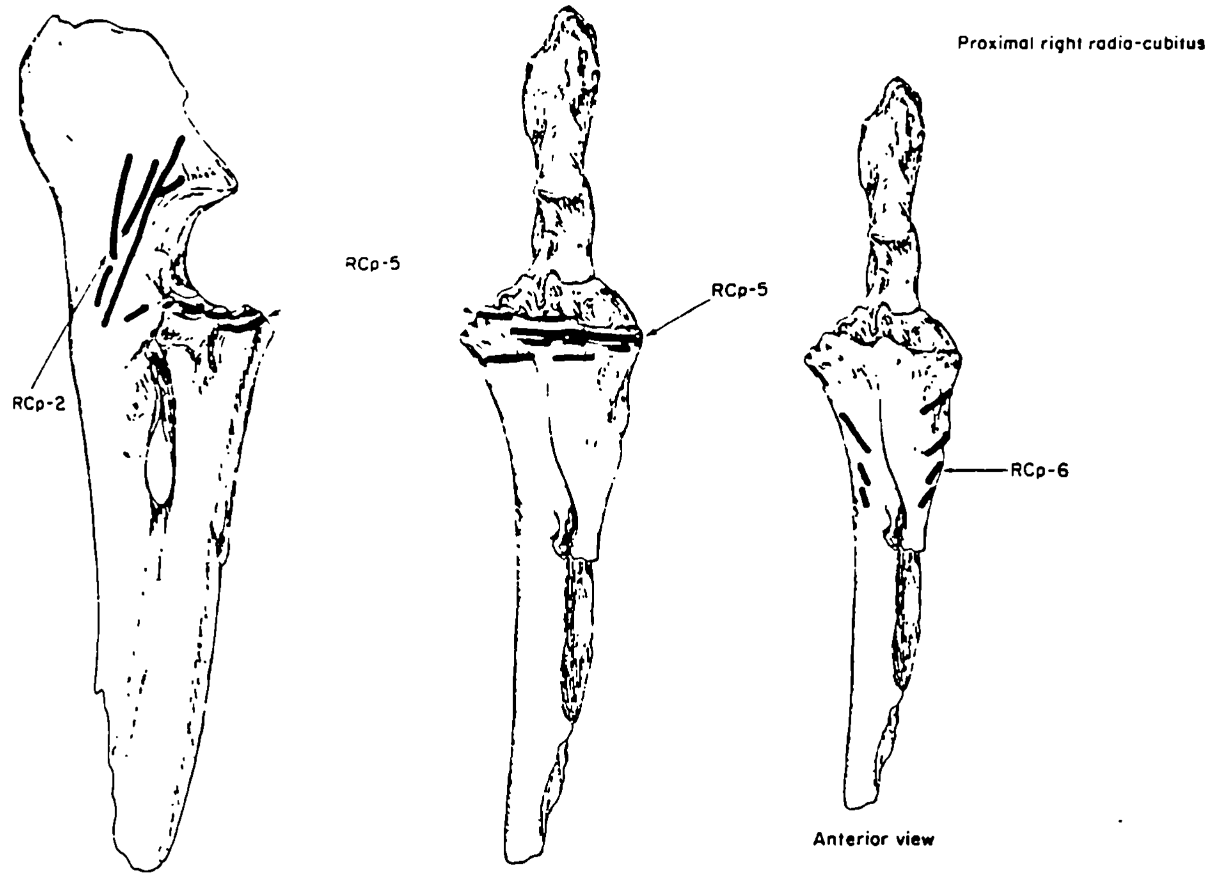
Ventral view



Right distal, lateral view

Right distal, anterior view

Right distal, medial view

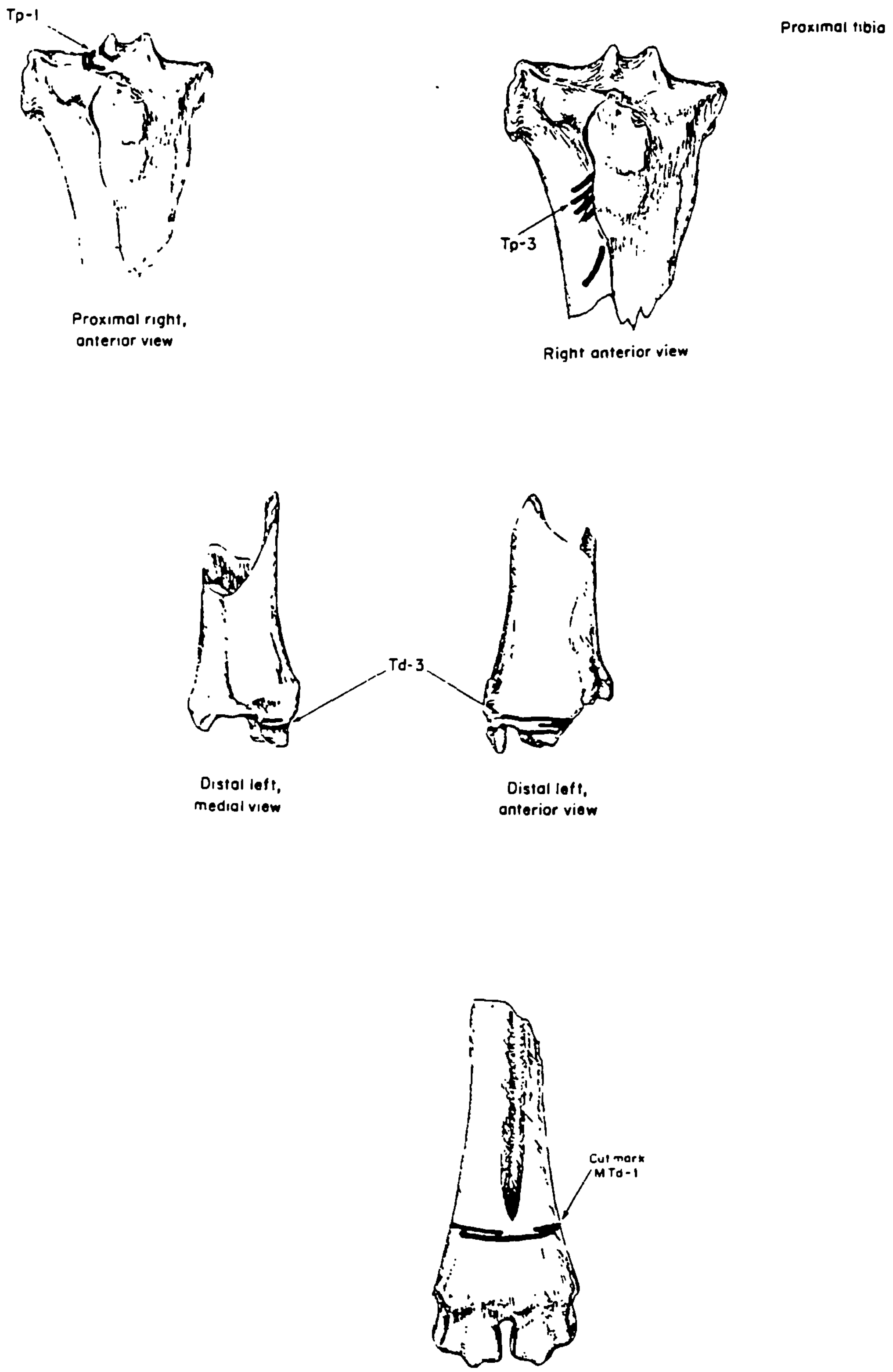


Lateral view

Interior view

Anterior view

Figure 8.14. Examples of the cut marks recorded for gazelle bones (after Binford 1981).



Proximal right, anterior view

Right anterior view

Distal left, medial view

Distal left, anterior view

Figure 8.14 (cont). Examples of the cut marks recorded for gazelle bones (after Binford 1981).

Figure 8.15. Gazelle tibias from DH 1 which have transverse chops across their proximal ends.

Cut marks are too few either to quantify or to examine on an assemblage-by-assemblage basis. Dismemberment marks on limb bones are most frequent, perhaps not surprisingly since these elements are the most common, and articular ends - where the marks occur - survive relatively well. Cut marks made by the removal of the animal's head from the neck are few, probably because the atlas, axis and occipital condyles upon which they would be found are themselves scarce. Filleting marks are very few, and as suggested above, this may result from the poor condition of long-bone shafts. Alternatively, the small size of gazelles may have meant that removal of meat from the bone - filleting - was not necessary for cooking. Skinning is evidenced in several assemblages, with a particularly high frequency of characteristically marked phalanges in WJ6 A.

A few assemblages show evidence that elements were chopped or split open. In these cases, no direct sign of percussion is visible, but the straightness of the break, plus the fact that they often occur across areas of bone which are unlikely to break naturally, have been taken as signs of chopping. Chop marks were not recorded for those assemblages studied before 1989, meaning that negative evidence should not be interpreted as an absence of chopping. The frequency of chop marks is shown in the right hand column of table 8.13.

Variation in the occurrence of dismemberment marks **between** assemblages is not due to sample size alone: KH4 D, which has the highest number of such marks (9) has a total of 3124 gazelle bone ends, whilst the larger sample of DH 2 (5918 gazelle bone ends) has only a single dismemberment cut. Either the two assemblages have been subject to different taphonomic processes which may have obliterated more cut marks at DH 2 than at KH4 D, or the results represent real differences in the method or intensity of butchery. An admittedly subjective examination of bone surface condition showed both assemblages to have fairly good preservation of bone, and so it is arguable that the virtual absence of dismemberment (and other) marks at DH 2, and also DH 1, is real. There are several possible explanations for this. Firstly, dismemberment may have been done primarily by chopping instead of cutting (cf. the two examples of transverse chops in DH 1). The stone tool assemblage from DH 2, however, includes nothing that could be classed as a chopping tool (it consists mainly of small flakes, blades, arrowheads, burins - see Chapter 3). Secondly, dismemberment may have left few traces if the butchers were adept and rarely touched the bone (since the aim of dismemberment is to cut through the flesh between the bones). A third possible explanation is that dismemberment actually occurred less at DH 1 and 2 than at other sites. A lack of limb dismemberment could be taken to reflect particular cooking or processing practices, for example, if whole limbs were roasted for consumption or smoked for preservation. This is interesting in view of the different cooking/processing methods hinted at for DH 1 and 2 in the next section.

Skinning marks from WJ6 A and KH4 A could be seen to reflect a spatially determined activity: from WJ6 A, seven of the 11 first phalanges displaying cut marks are from the same context. This deposit appears to be relatively undisturbed, evidenced by some bones remaining in articulation, and although it is fairly deep (11cm), might be interpreted as a skinning area. Three of the other marked phalanges from the assemblage are also from one context, suggesting a 'concentration' in one area. At KH4 A, the four phalanges showing skinning marks are not from the same actual contexts, and this is interesting since no other cut marks were observed from the whole phase, perhaps suggesting that the excavations might have hit a skinning area.

It should be noted that butchery (except skinning) does not necessarily have to occur before cooking; dismemberment, filleting and chopping can all be done on cooked joints, depending on practice.

Cooking and processing evidence

Unfortunately, these questions can only be considered for assemblages studied after 1989 since the relevant data were not recorded for the other assemblages.

It is assumed that gazelle bones on the sites could represent the remains either of consumption of cooked fresh meat, or of processing activities aimed at preparing meat for storage (most likely drying or smoking), or of both. The problem is how to identify which activities were taking place.

Identification of cooking methods from the bone alone can be problematic, firstly because debate exists as to whether different methods produce significantly different patterns, and secondly because, even if it accepted that they do, these patterns can be easily over-written through other pre- and post-depositional processes. Some argue that boiling or stewing of meat leaves few traces of burning on the bones; conversely, roasting of joints can produce charred articular ends where the bone is exposed to naked flames, while meat-covered shafts remain uncoloured (Crader 1984:458; Crader 1990:710; Gifford-Gonzales 1989:193). Pit cooking can presumably show results similar either to roasting or to stewing, depending on whether joints are in direct contact with hot stones or fuel, or whether they are steamed (Leach 1982). From her ethnographic work in the Kalahari, however, Kent disputes that frequency of burnt bone can distinguish roasting from boiling:

> ... there is no significant correlation between type of major mode of cooking conducted at a site and the number of charred bones ... roasting does not significantly increase the number of charred bones in an assemblage ... I conclude that it is not appropriate to use burning as evidence of cooking.
>
> (Kent 1993:348)

Instead, Kent attributes most cases of charring to secondary events rather than to cooking.

If preservation of meat for storage is the aim, removal of meat from the bone before smoking or drying is the common procedure (Binford 1978), and hence burning would not be a relevant trait.

Accepting the problems of interpreting burning, table 8.14 shows the percentage of 'burnt ends' of gazelle bones, which could infer roasting, alongside percentages of completely burnt fragments and unburnt fragments. 'Burning' is taken to mean either charring (blackening) or oxidization (white/grey/blue calcination) (Brain 1981:54-55; David 1990). As can be seen, the occurrence of burnt bone ends is very rare (1% or less), and when compared with the percentages of completely burnt fragments shown alongside, it could be argued that secondary burning has obscured any original roasting signatures. Indeed, secondary burning will also obscure the presence of unburnt bone - the signature of stewing/boiling. If it is accepted that completely burnt fragments of bone represent secondary burning, then assemblages which show a high incidence of this, e.g. WJ7 5 (73%) and DH 2 (53%), provide little insight into cooking methods.

Most of the other assemblages (except WJ25 and B27 which have very small sample sizes) have a high percentage of unburnt bones (>60%). Following one line of interpretation, these could be seen as resulting from a predominantly stewing or boiling method of cooking, where bones do not come into contact with fire. On the other hand, Kent's study advises caution in drawing such conclusions.

gazelle bones - evidence for burning (MNE)				
assemblage	% burnt ends only	% all burnt	% unburnt	sample size
PPNC/LN				
B27	0	0	100	17
DH 2	0.04	53	47	7575
WJ13 3	?	2	98	143
WJ13 2	?	11	89	139
WJ13 1	?	10	90	478
WJ25	0	11	89	9
PPNB				
DH 1	0.2	25	74	2512
WJ7 5	0	73	27	37
WJ7 4	0	40	60	68
WJ7 3	1	18	81	82
WJ7 2	1	26	73	311
WJ7 1	1	12	87	107
M EPAL				
WJ22 B	0.6	17	83	636
WJ22 C	0	1	99	112

Table 8.14. The percentages of gazelle bones (MNE) with burnt ends, complete burning, or no traces of burning. For WJ13 1, 2, 3, burnt ends were not recorded.

Another way to examine the question is through other archaeological evidence, and the requirements of the different cooking/preparation methods. Roasting of meat, at its simplest, requires little more than fuel and a hearth. Pit-cooking also needs only fuel. Boiling or stewing methods of cooking require containers and liquid, as well as the fuel needed to heat it (either by direct fire or heating stones to be put in the liquid). Preservation of meat by either drying or smoking would probably necessitate the construction of racks or lines, firstly to keep as much of the meat surface exposed to the air/smoke as possible, and secondly to raise it above ground level. If meat was preserved through smoking, then hearths and fuel would be employed.

Which of the above methods of cooking/preparation would be likely to be witnessed in the archaeological record? Hearths are commonly found, and even if they are dismantled, groups of blackened stones and ashy lenses suggest their presence. Pits are also definable, although their function may not always be clear; associated burnt stones and ash perhaps imply cooking, rather than use in storage or refuse. The evidence for cooking containers is problematic: all of the sites are aceramic (even in the Late Neolithic in this area), but the use of leather or wooden containers should be considered (see Ryder 1966), although not evidenced. Pot-boilers - stones showing signs of heat-cracking and glazing through contact with liquid - would provide a source of indirect evidence for cooking in containers, but for the sites under consideration, none of these have been identified (or they may not have been classed separately from hearth stones). Preserving racks or lines, if made of wood or rope, will not be evidenced. The function of stone structures, for example platforms, is so open to interpretation as to make speculation meaningless, although their use in preserving of meat is not impossible.

The only classes of evidence which can be examined, therefore, are hearths and pits. Table 8.15 shows the occurrence of each of these by site/phase. The distinction between hearths and pits is not always clear from the reports and site records, especially when some features are described as "small shallow fire pits". Generally, however, hearths are taken to mean above ground, defined, burning areas (even if they are sometimes in depressions), whereas pits are clearly excavated hollows.

The picture which emerges is of hearths being much more common than pits at all sites in the limestone desert, throughout the time sequence. In contrast, the sites in the Basalt desert (DH 1 and 2, Jebel Naja, B27 2) all show pits outnumbering hearths. Fire pits are only evidenced outside the Basalt area at KH4 D and WJ13 1 and 3, where they are less frequent than hearths in each case.

The fire pits described from DH 1 are rounded, less than 1m in diameter, ringed at the top with basalt stones, and full of loose ashy soil (Betts, in press). Many are associated with short sections of wall, which Betts interprets as windbreaks. Some of the pits are internally lined with plaster and could serve other purposes, but it seems that most of these features could probably be viewed as cooking pits. The Late Neolithic phase of occupation at this site - DH 2 - sees very different activities: structural remains are predominant, and the general absence of any *in situ* firing areas except one pit, suggests either that such activities were taking place elsewhere, or that repeated use of the area has disturbed cooking features. The fire pits reported from Jebel Naja and B27 2 are not fully described, but the suggestion from B27 2 is that they are associated with basalt stones and ash (Betts 1985:36; McCartney 1992:37).

assemblage	fire pits	hearths
PPNC/LN		
B27 2	3	0
Jebel Naja	3	0
DH 2	1	0
WJ13 3	2	6
WJ13 2	0	0
WJ13 1	1	5
WJ25	0	2 (1?)
PPNB		
DH 1	12	3
Ibn el-Ghazzi	0	0
WJ32	0	0
WJ26	0	7
WJ7 5	0	0
WJ7 4	0	2
WJ7 3	0	1
WJ7 2	0	1
WJ7 1	0	0
L EPAL		
Khallat Anaza	0	0
AZ18	0	0
M EPAL		
AZ17	0	0
WJ22 B	0	1
WJ22 C	0	0
WJ10	0	0
WJ8	0	0
E EPAL		
UW18	0	3
UW14	0	1
KH4 D	1	5
KH4 C	0	1
KH4 B	0	1
KH4 A	0	1
WJ6 B	0	0
WJ6 A	0	1
U PAL		
WJ9	0	0

Table 8.15. The numbers of fire pits and hearths recorded from each site/phase.

One explanation for this pattern may be that fuel is likely to be scarce in the Basalt area since it is drier than the limestone region and supports a more desertic vegetation (see Chapter 3); pit cooking, using heated basalt stones, may require less fuel. The extremely high percentage of burnt bone at DH 2 (53%) may possibly reflect the use of bones as fuel. Hearth cooking would appear to be the common form of cooking elsewhere, although the few examples of fire pits in this area are intriguing.

One is from early Epipalaeolithic KH4 D where the open-area excavations revealed a living floor, the remains of five separate hearths, and a pit (90cm diameter), surrounded by post-holes which appear to delineate a structure (Muheisen 1988:362). The occupational debris is described as ashy, and abundant animal bone and charcoal came from this area. It may be possible to see hearths and the pit serving different cooking purposes, with the smaller, more numerous hearths being used for smaller joints, and the larger pit perhaps serving as an oven for larger, possibly articulated pieces to be roasted.

The other pits are from PPNC/Late Neolithic WJ13 1 and 3 - the two major structural phases of this site. The pits and the more frequent hearths are all within a large oval structure. Garrard *et al.* (1994) suggest that this structure may have "had a role which extended beyond the pure domestic", firstly because of its large size (10 x 6.5m) compared to coeval structures in the region, and also because of the associated collection of figurines and large masonry 'statues', some of which were decorated with incisions. Although it is, of course, possible that hearths and pits were used indiscriminately, it may tentatively be suggested that they served different cooking needs. As with KH4 D, the hearths may have been used for roasting or stewing food, including small joints of meat. Pits, on the other hand, could cater for the roasting of whole carcasses. Although there is no faunal evidence to support the idea, pits and hearths in this case could be taken to reflect different modes of food preparation and hence consumption, with most meat perhaps being prepared on hearths, and pit-roasts being a less frequent occurrence.

The question of whether hearths - the prevalent cooking feature in the limestone area - were used for stewing/boiling, roasting or smoking meat remains unanswered, and there is no evidence available to suggest certain of these were practised above others. To conclude, cooking/processing practices are extremely difficult to elucidate in the study assemblages, and using all the available evidence, faunal and otherwise, the picture of how groups were cooking or preserving the gazelle meat which was returned to the sites is obscure.

Marrow extraction

In an attempt to explore whether the extraction of bone marrow was practised at the study sites, bone fragmentation patterns were recorded, but only for assemblages studied after 1989.

Marrow cracking is commonly inferred from breakage patterns of bone. The signatures associated with marrow extraction from long-bones are spiral fractures on shafts, 'bayonet' breaks (where one side of a shaft is missing), 'cylinders' (but see also carnivore gnawing above), mid-diaphysis smashes, bones with one end missing, and bones with burning evidence on one end (although Kent 1993:338 observes ethnographically that bones heated to firm the marrow did not leave evidence of charring) (Binford 1981; Brain 1981:15; O'Connell and Hawkes 1988). The eastern Jordanian bone assemblages are generally so fragmented that long bones never survive intact, and most are represented only by ends, end splinters, and shaft splinters. These fragmentation patterns would make the breakage signatures associated with marrow extraction, had they existed, impossible to identify: the intact shaft segments needed to identify 'bayonets', 'cylinders', 'mid-diaphysis smashes' or 'bones with one end missing' have generally collapsed. (The only bones which could suggest any such signature are two tibia shaft fragments from DH 1 which have transverse chops across their proximal ends (see table 8.13 and figure 8.15); these are 'bones with one end missing'.) Finally, bones with burning evidence on one end (see table 8.14) are not necessarily reflective of marrow extraction.

Noy-Nygaard (1977) has suggested that another way of viewing marrow-cracking procedures is through the number of fragments which a bone element has broken into. This assumes that fragmentation is not attributable to other taphonomic factors. This idea is explored for the study sites through the creation of a fragmentation index for certain body parts. The index is derived by dividing the number of identifiable specimens (NISP) for a particular body part by the minimum number of ends (MNE) of the same part (an adaptation of Klein and Cruz-Uribe 1984:25). Table 8.16 gives the fragmentation index for distal humerus, proximal metacarpal, distal tibia and astragalus for the study sites studied after 1989. These elements were selected because distal humerus, proximal metacarpal and distal tibia have a similar bone density (Lyman 1984), and therefore survivability, and in sheep (probably analogous to gazelle) they have relatively high marrow indeces (Binford 1978:27). The astragalus is included as a dense element which does not have a marrow cavity.

gazelle bone fragmentation index - NISP/MNE				
assemblage	d humerus VD >.60	p m'carp VD.50-.60	d tibia VD.50-.60	astrag VD >.60
DH 2	1.6	1.3	1.4	1.3
WJ13 1-3	1.2	1.3	1.0	1.1
DH 1	1.3	1.3	1.2	1.1
WJ7 1-5	1.1	1.1	1.1	1.0
WJ22 B	2.1	1.7	1.8	1.2
WJ22 C	1.3	1.6	1.2	1.0

Table 8.16. The fragmentation index (NISP divided by MNE) for selected gazelle bone elements for assemblages studied post-1989. The different phases of WJ7 and WJ13 have been treated together since samples were small. VD refers to the volume density of the bone element according to Lyman 1984:273-279.

The fragmentation index ranges between 1.0 and 2.1. A figure of 1.0 indicates that each end of a bone is represented by a single fragment; 2.0 means that an average of two identifiable fragments make up an end. There is obviously a point at which an element is so fragmented as to make identification impossible, and these counts therefore represent firmly identifiable fragments only.

Two conclusions can be drawn from table 8.16. Firstly, since the astragalus shows a degree of fragmentation in four of the six assemblages, it can be assumed that there are processes beyond marrow extraction which are fragmenting bone.

Secondly, the highest indices of fragmentation tend to be **within** particular assemblages (WJ22 B and DH 2) and **across** all the elements considered. This would strongly suggest that fragmentation is more assemblage-specific than bone-specific, and relates to the particular assemblage histories. Further, comparisons of the distal humerus index in WJ22 B (2.1) and WJ7 (1.1) and of the distal tibia index in WJ22 B (1.8) and WJ13 (1.0), show that degrees of fragmentation are not determined solely by the natural structure and inherent weaknesses of these bones.

A further point is that there is no consistent correlation between fragmentation and the degree of burning in an assemblage (compare tables 8.14 and 8.16). DH 2 has a high percentage of burnt gazelle bones (53%) and also high fragmentation indices, but WJ22 B, which has generally higher fragmentation indices, has a relatively low incidence of burning (17%). This implies that whilst burning may affect bone fragmentation, other factors are also involved.

It cannot be stated that marrow extraction was not taking place in the study assemblages, only that no positive evidence for it was found. The fragmentation of the bone may well be due, in part, to marrow-cracking, or indeed bone-grease extraction procedures, but other factors (e.g. cooking, weathering, trampling) are also at play. Whilst it may be possible in future to filter out these other factors through a detailed taphonomic study, the present investigation into marrow-cracking has proved inconclusive.

Worked bone

The early Epipalaeolithic assemblages of WJ6 A and B each showed a gazelle distal metatarsal worked to a point, and several other pieces of worked bone of indeterminate taxon (Garrard *et al.* 1986; Garrard pers. comm.). At KH4 B, gazelle horn cores were placed either side of the skull of a burial (Rolston 1982:222), which, although not an example of worked bone, shows how these elements may be used. The PPNC/Late Neolithic assemblages of WJ13 contain three bead waste products identifiable as gazelle first phalanges (Powell 1992:39; Martin in Garrard *et al.* 1994), which suggests on-site bead manufacture. Many other tools and beads may be made of particular gazelle bones, although working has often removed evidence allowing taxon/element identification. Bone working should be considered as another use of the carcass, and also as a means by which certain body parts may 'disappear' from faunal assemblages.

Equids

Body part representation

Tables 8.17 to 8.26 show the primary data for equid body part representation. The body parts used are the same as for gazelle, except that maxillary teeth are counted instead of horn-cores. Samples are generally very small, and results should be treated with caution. As with gazelle, NISP counts will over-represent some body parts, particularly teeth, and because of this the minimum number of jaws (dental MNE) has been used instead. As described for gazelle, post-depositional processes and differential preservation may have affected patterns.

Figures 8.16 to 8.25 plot the relative abundance of the different body parts. Two contrasting patterns may tentatively be identified:

1) At WJ6 A, WJ22 B and KH4 D most body parts are represented; there is no over- or under-representation of any body part (figures 8.16, 8.22, 8.19). WJ22 C, KH4 B, DH 1 and DH 2 probably have the same pattern, masked by small sample sizes (skull, upper limbs and feet are all represented) (figures 8.21, 8.18, 8.24, 8.25).

2) KH4 A, AZ18 and UW18 consist overwhelmingly of foot and head parts, with upper limbs best represented at KH4 A, the largest of the three assemblages (figures 8.17, 8.23, 8.20).

The first group could be interpreted as showing all body parts being brought onto sites, either resulting from the return of whole (although possibly dismembered) animals, or the import of different carcass parts over time.

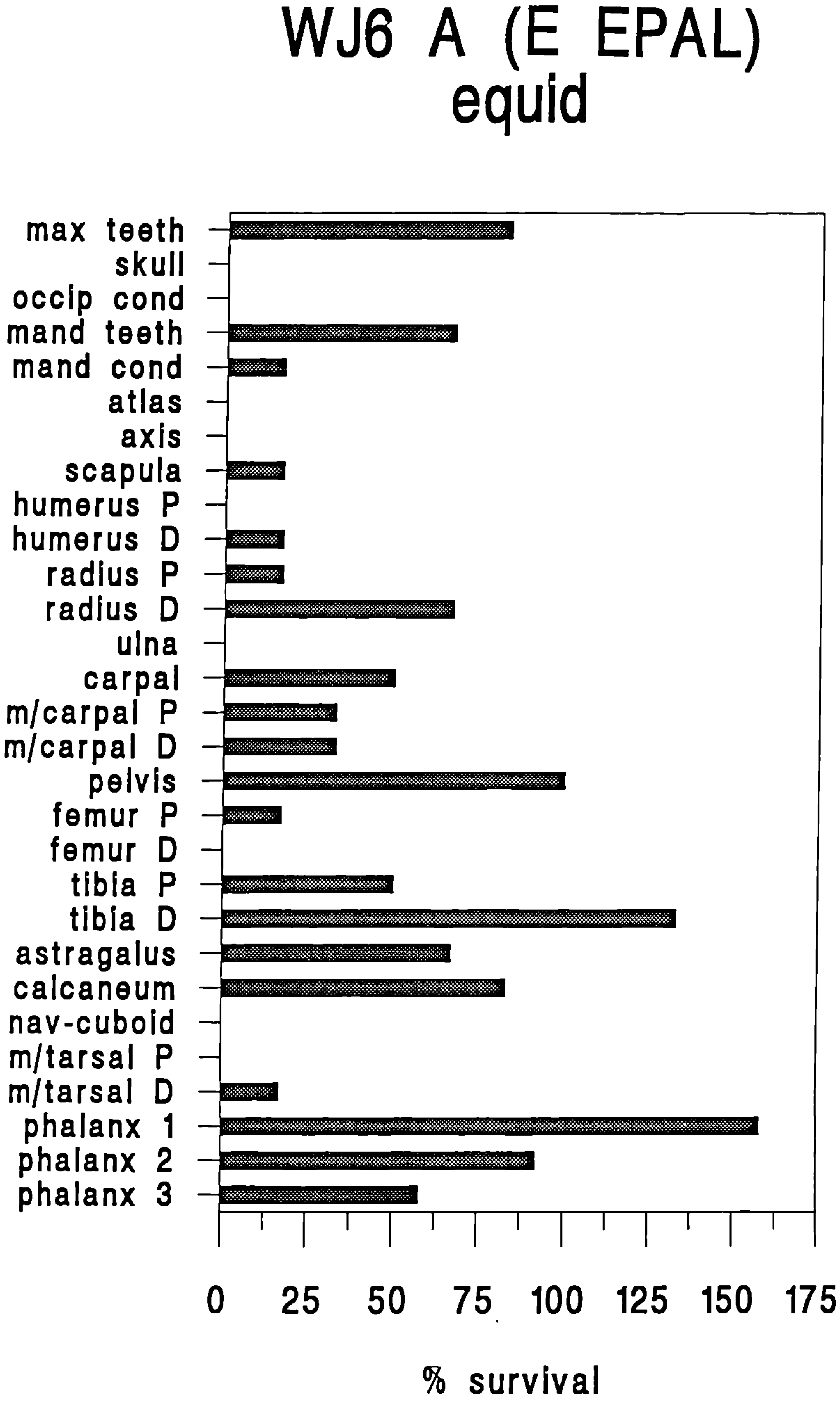


Figure 8.16. The relative frequency of equid body parts from WJ6 A (NISP=89).

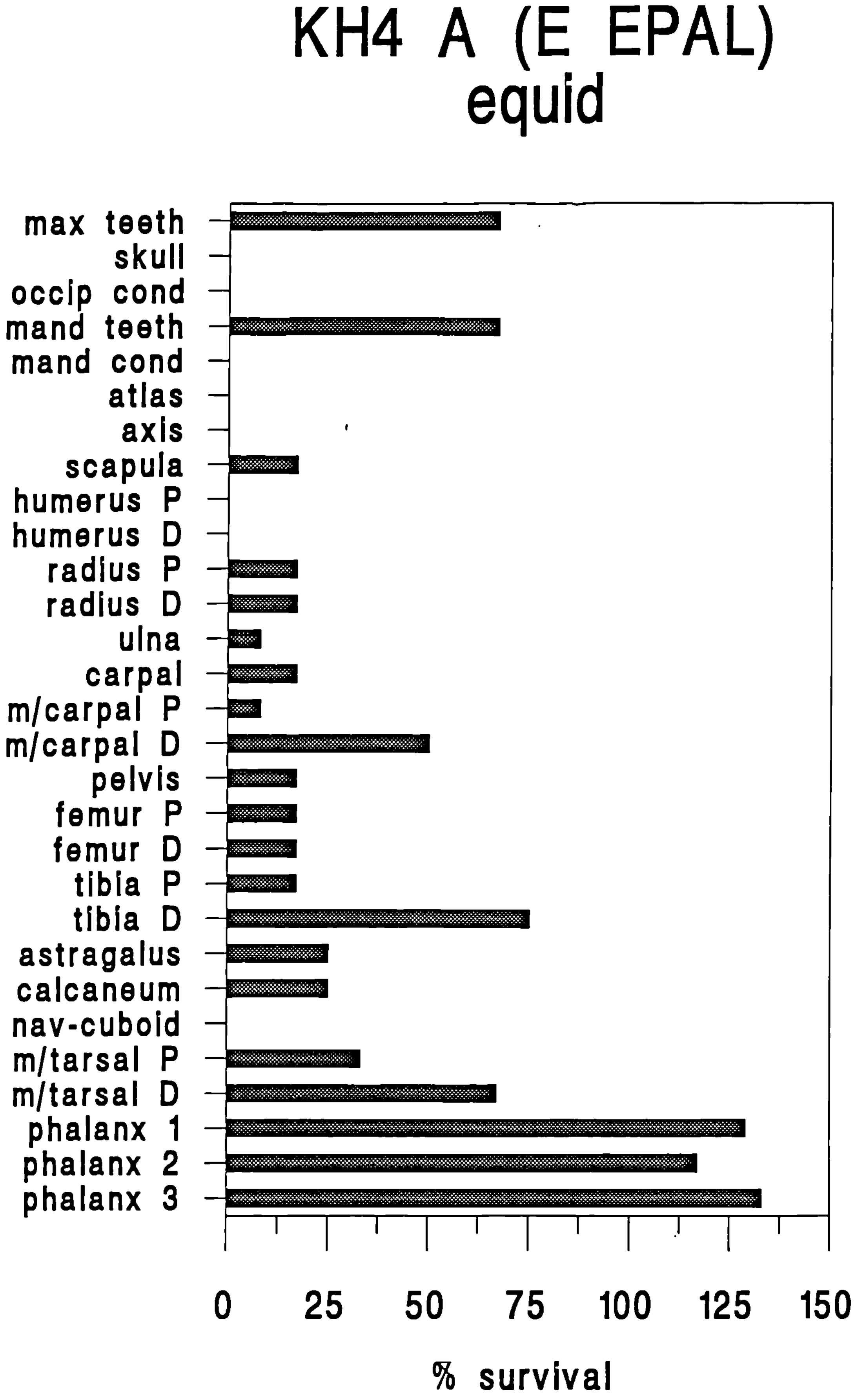


Figure 8.17. The relative frequency of equid body parts from KH4 A (NISP=158).

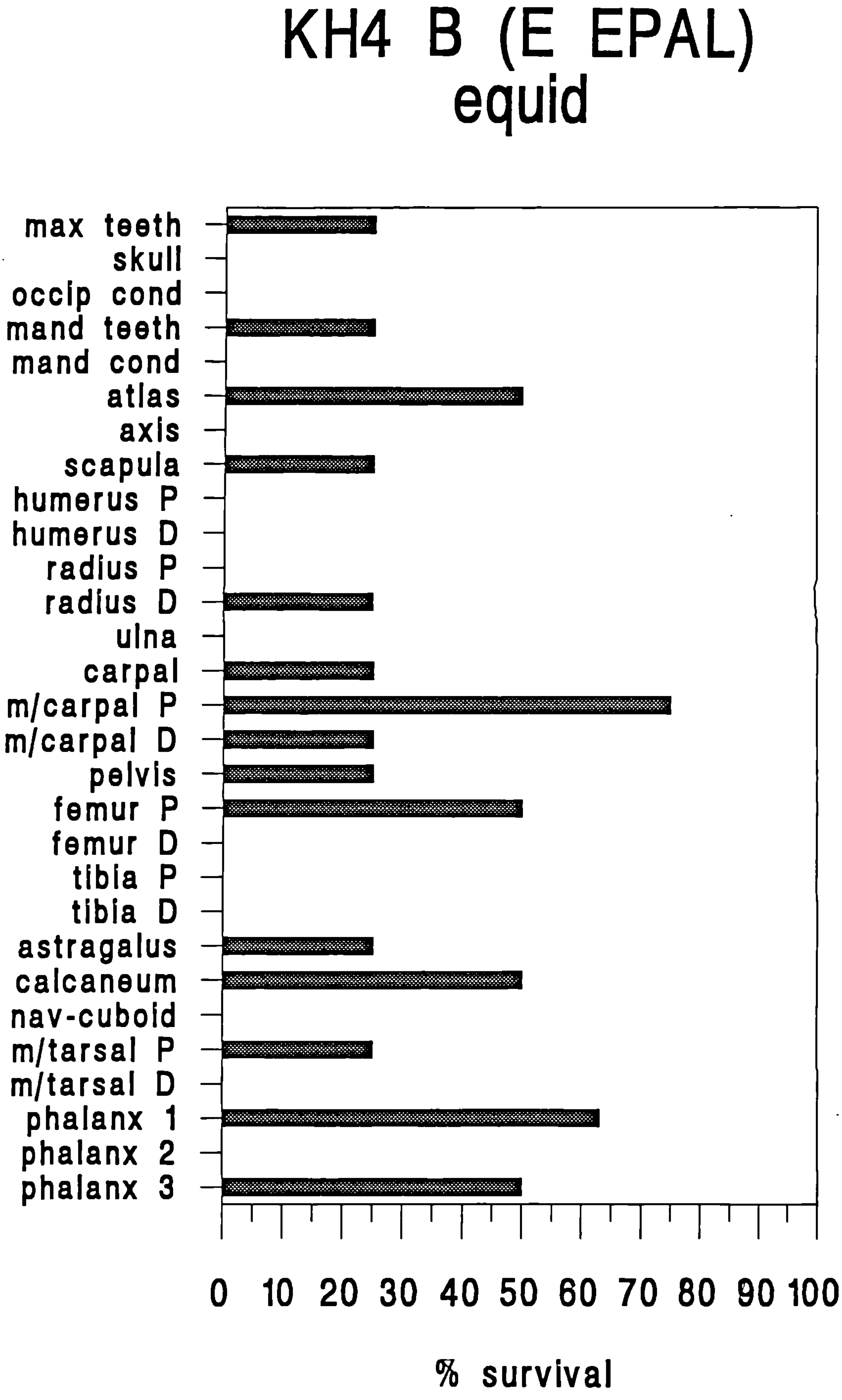


Figure 8.18. The relative frequency of equid body parts from KH4 B (NISP=26).

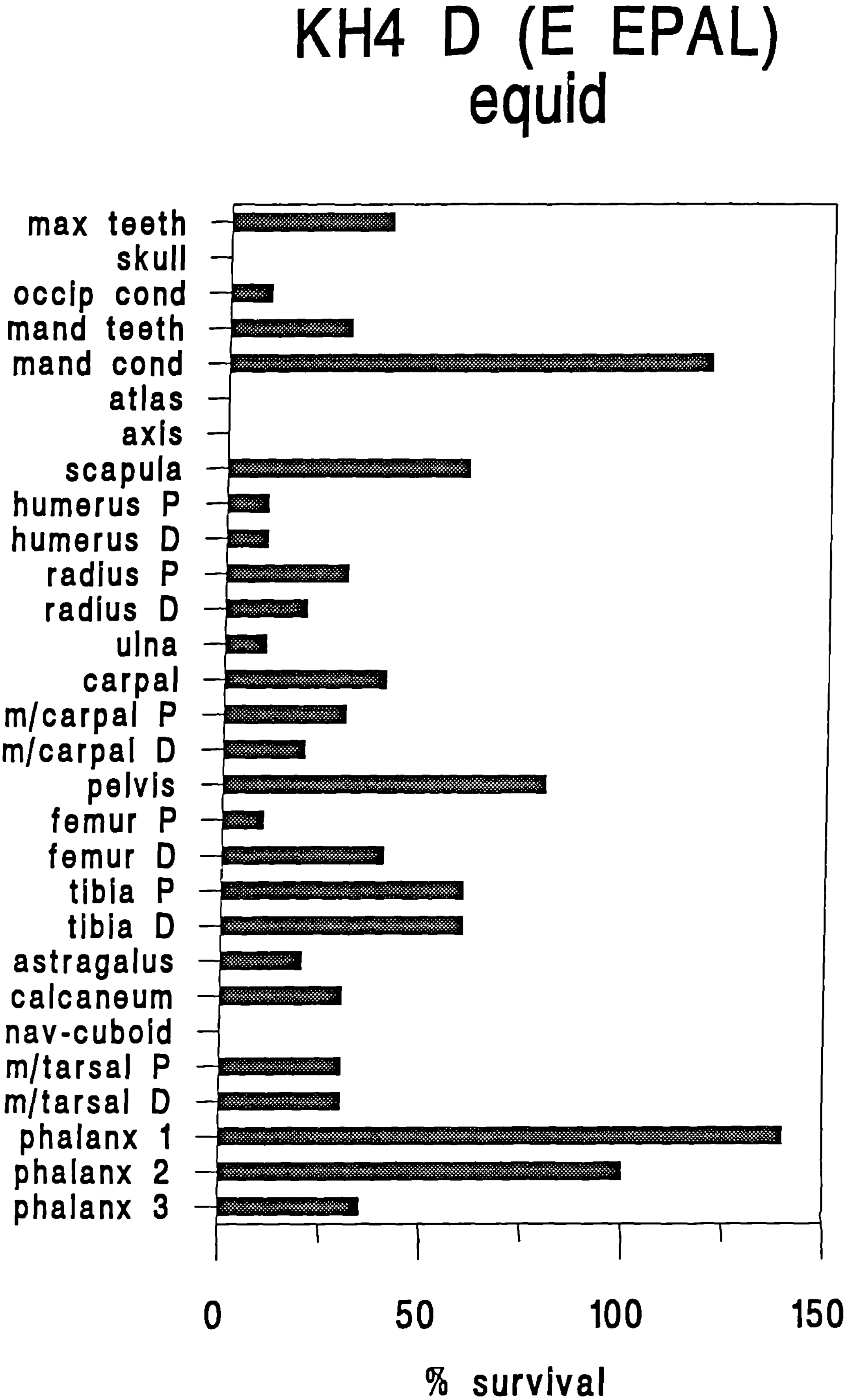


Figure 8.19. The relative frequency of equid body parts from KH4 D (NISP=134).

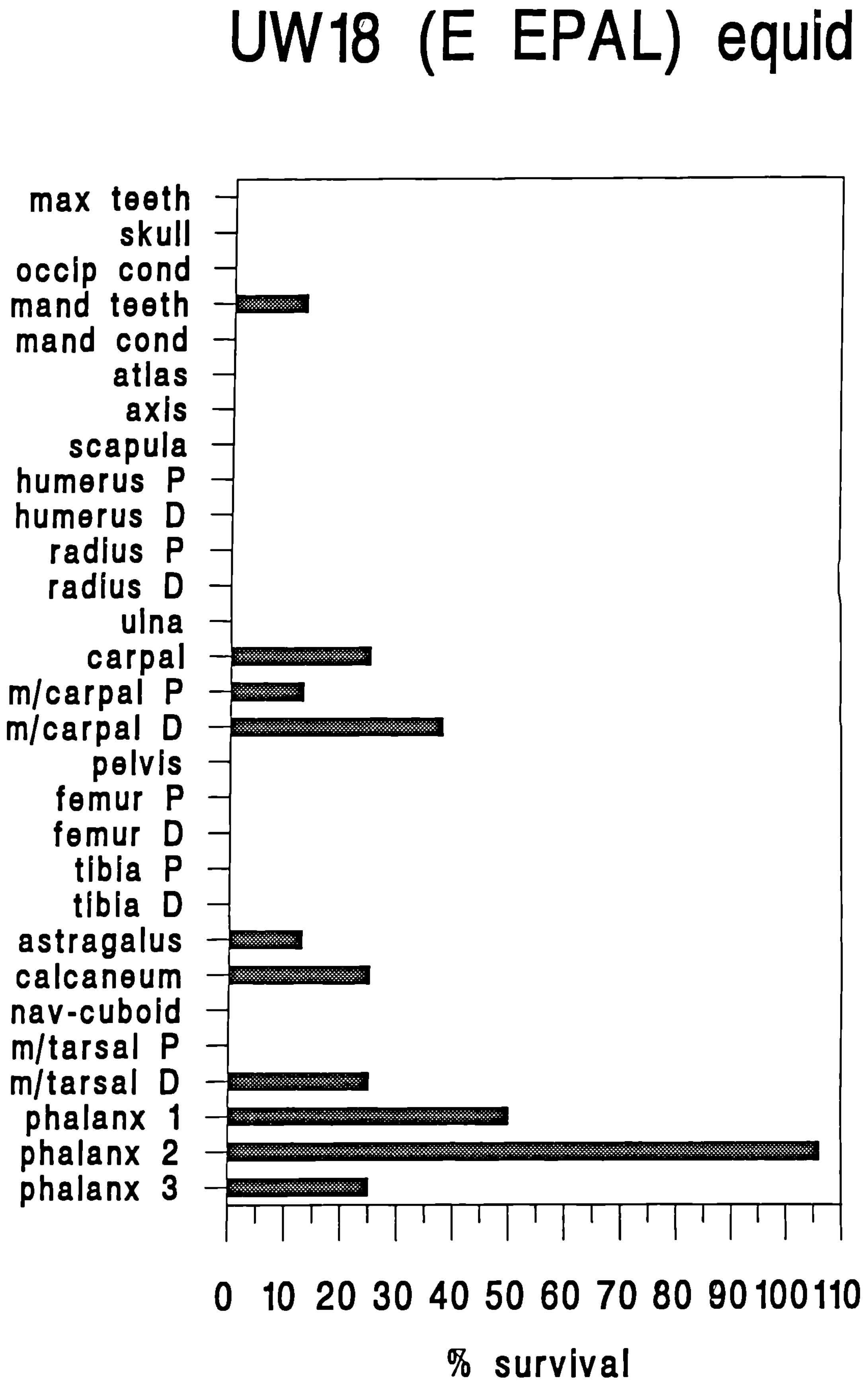


Figure 8.20. The relative frequency of equid body parts from UW18 (NISP=41).

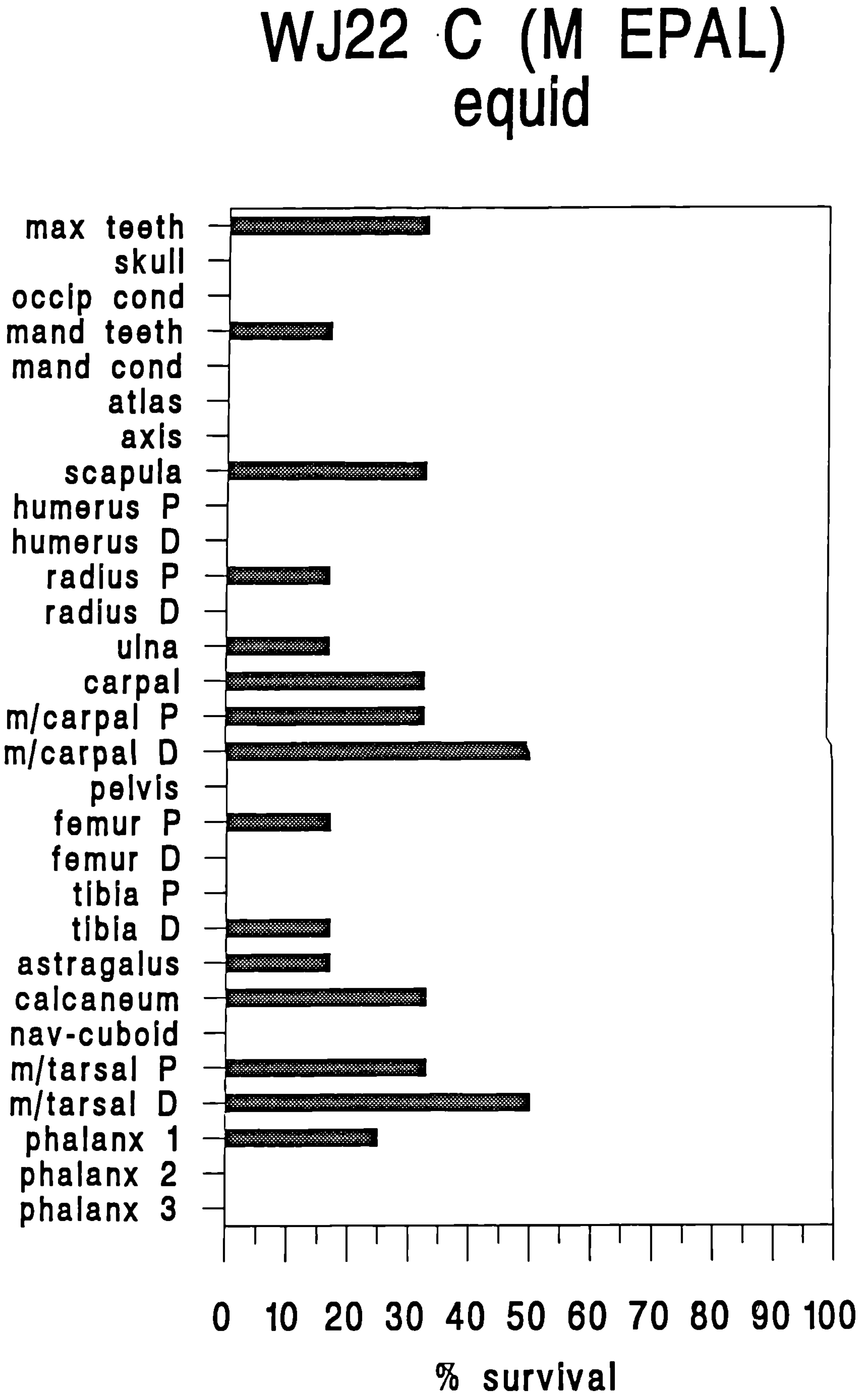
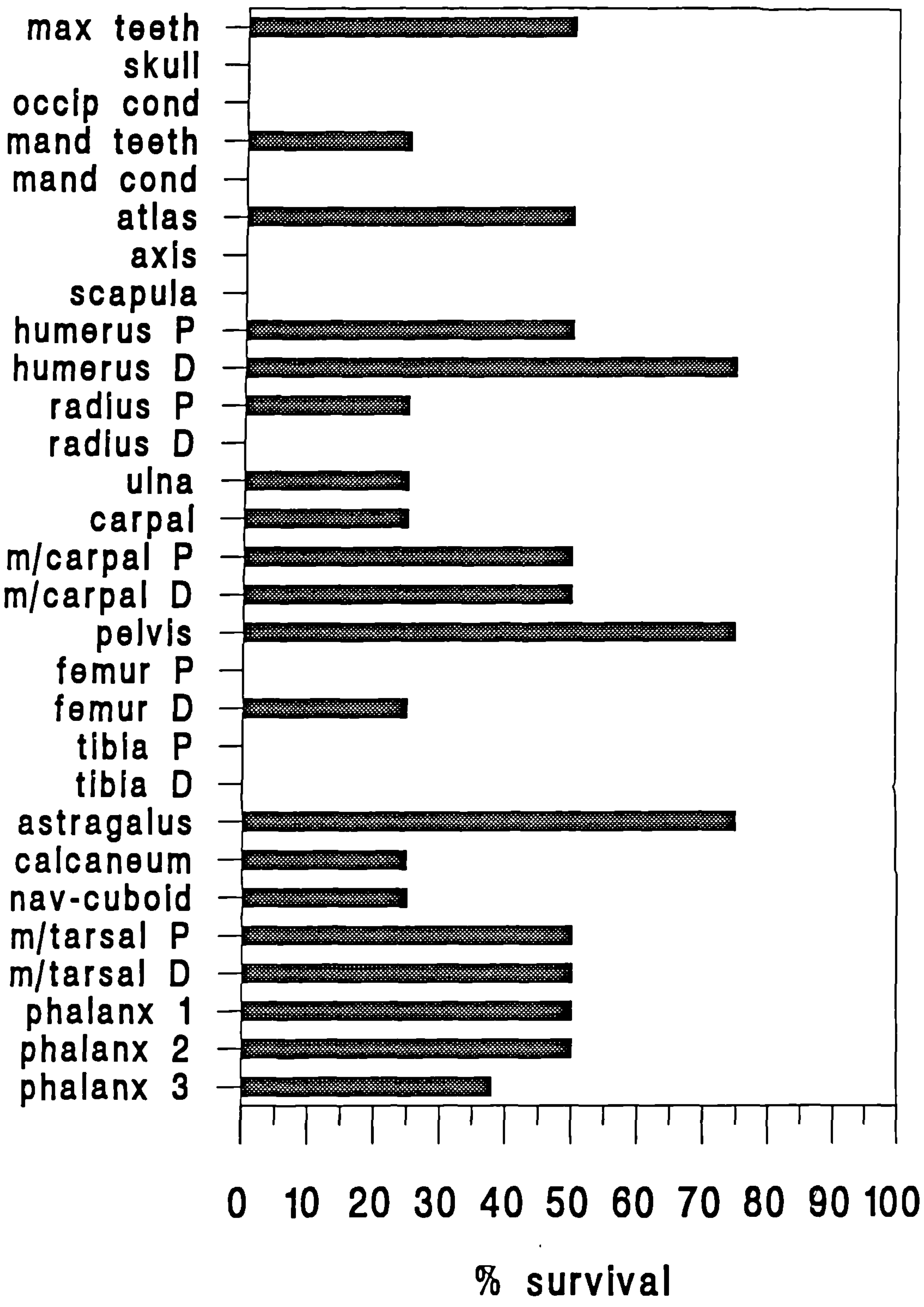


Figure 8.21. The relative frequency of equid body parts from WJ22 C (MNE=27).



WJ22 B (M EPAL)
equid

Figure 8.22. The relative frequency of gazelle body parts from WJ22 B (MNE=40).

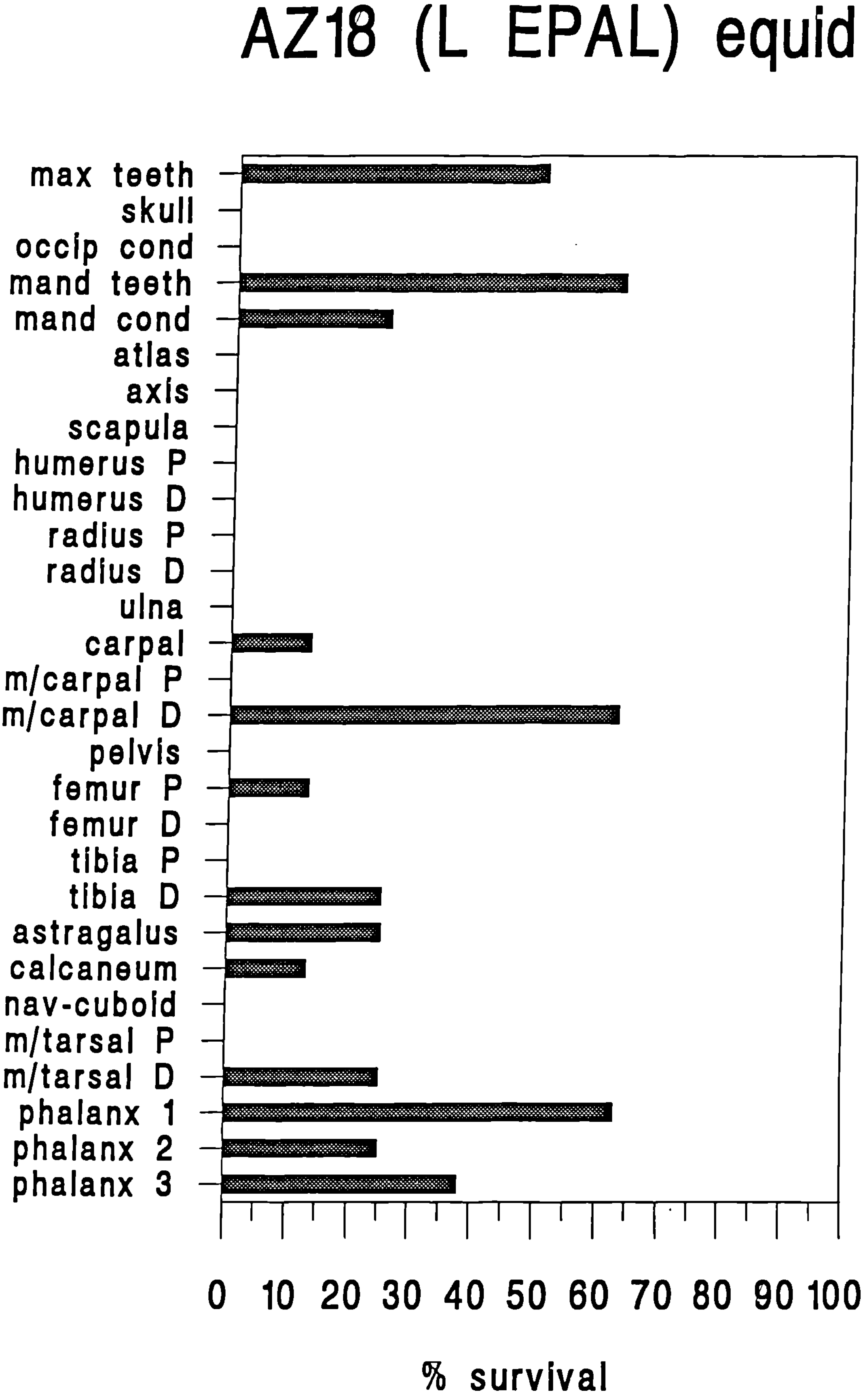


Figure 8.23. The relative frequency of equid body parts from AZ18 (NISP=45).

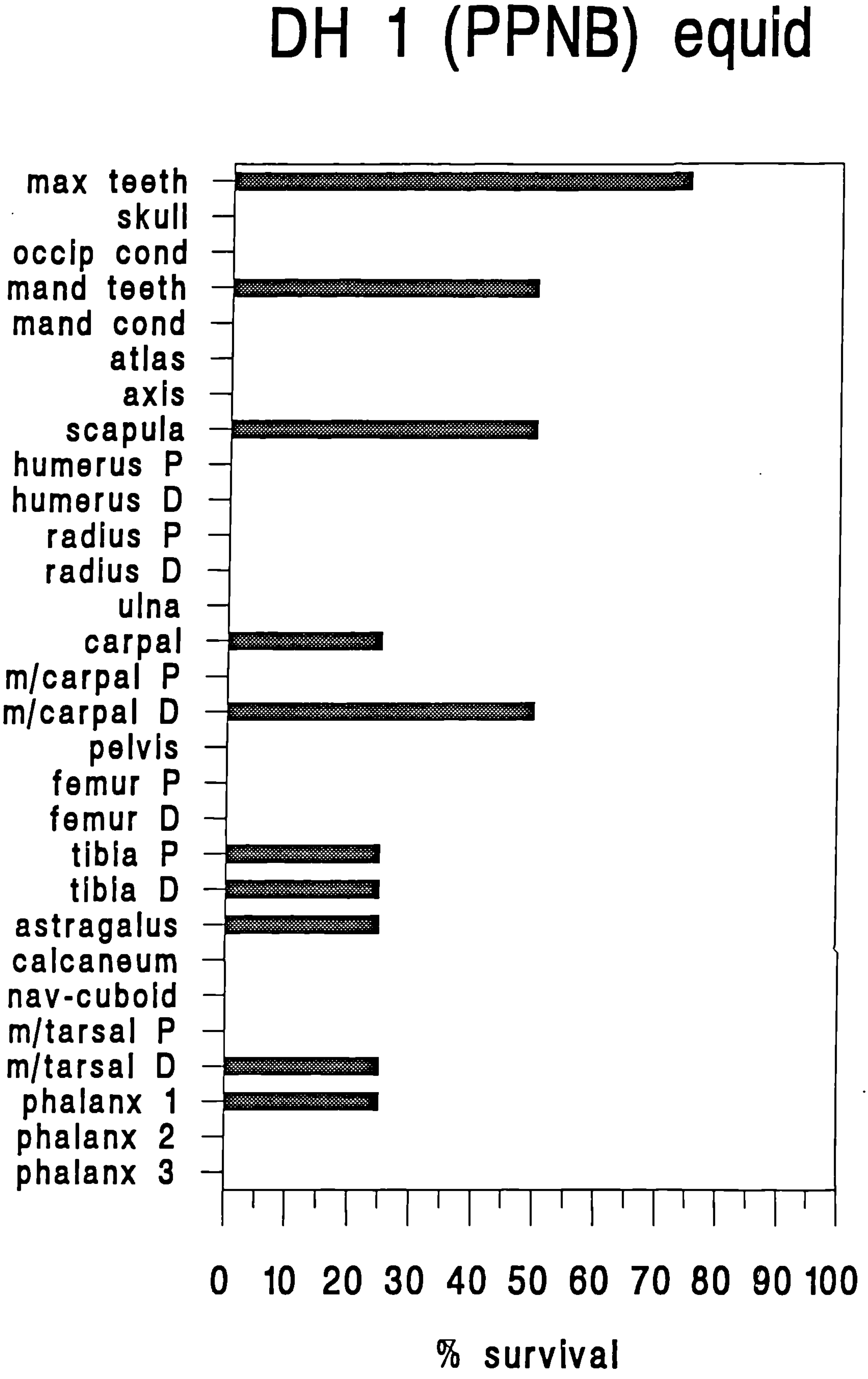


Figure 8.24. The relative frequency of equid body parts from DH 1 (MNE=16).

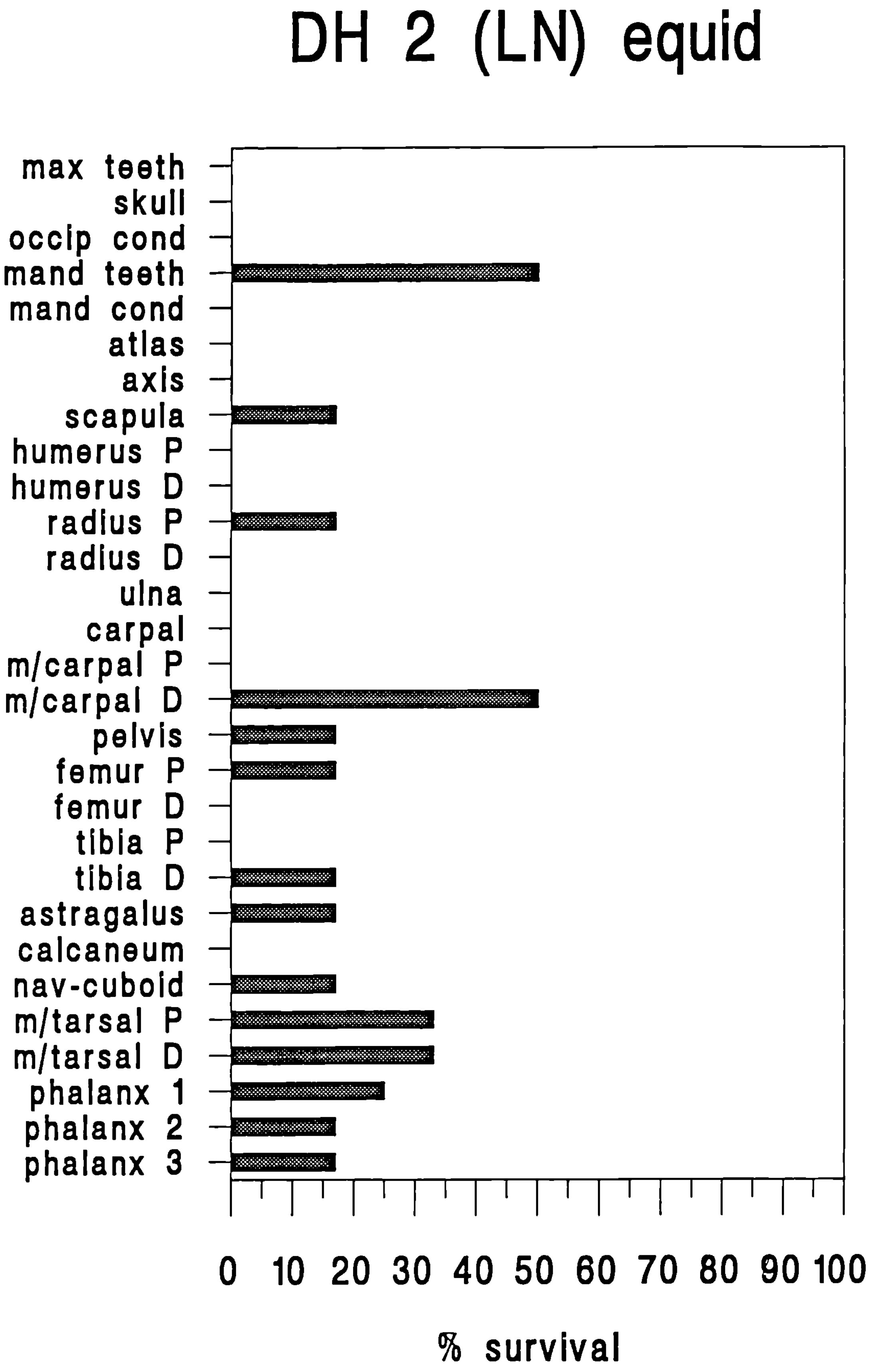


Figure 8.25. The relative frequency of equid body parts from DH 2 (MNE=24).

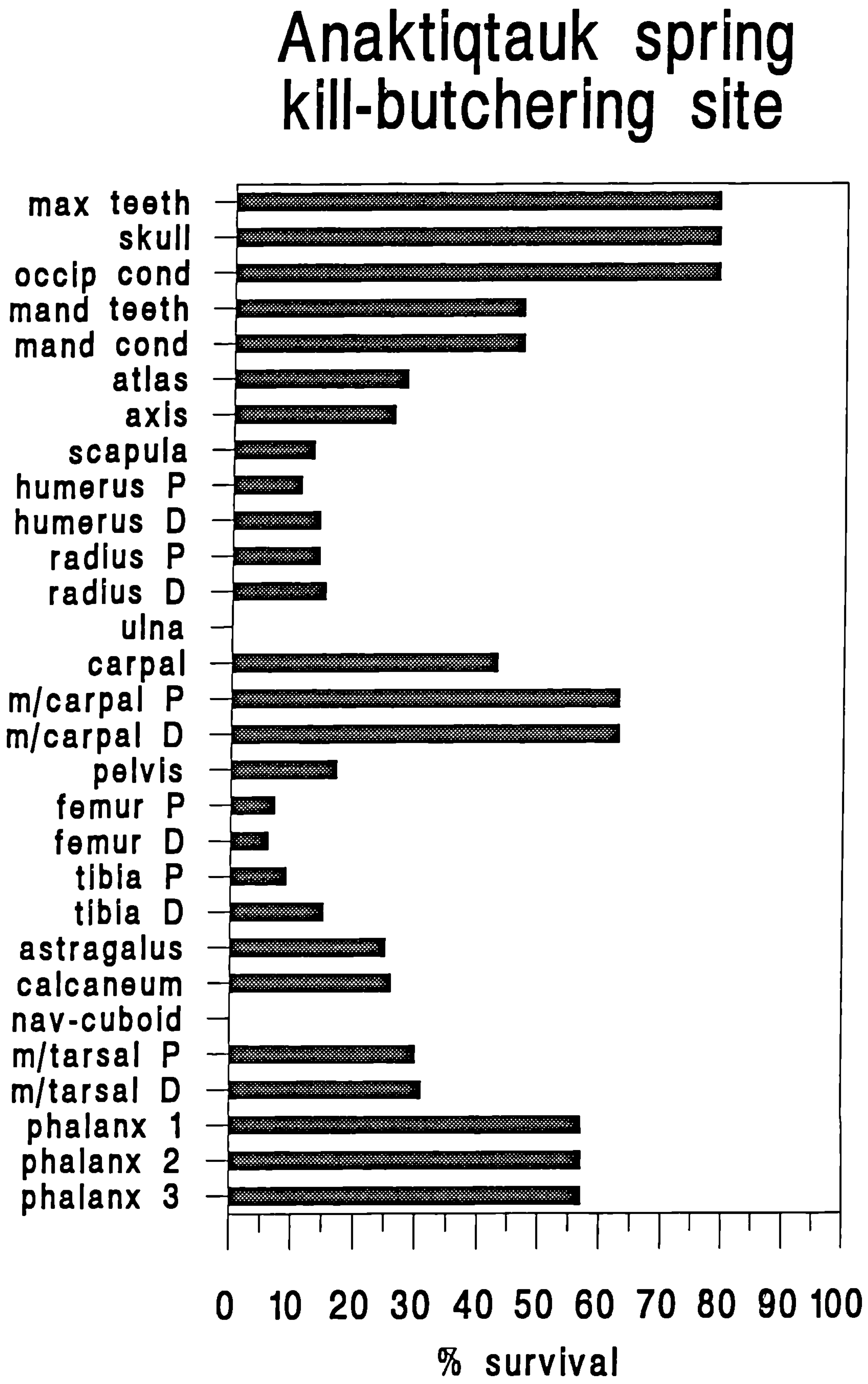


Figure 8.26. The relative frequencies of caribou body parts from the Anaktiqtauk spring kill butchering site (after Binford 1978, figure 2.11).

The patterns of the second group are more suggestive of kill-butchering sites. The body part frequencies from these assemblages have been compared with data from Binford's study of modern Nunamiut hunter-gatherers (Binford 1978), since this is the only study available which shows assemblages produced and documented under known conditions. Such comparisons should be treated with great caution; there are many problems in attempting to draw analogies, both in terms of the likely cultural differences in the ways people hunt animals and treat carcasses, as well as in the nature and behaviour of the prey and in the environment.

Frequencies from KH4 A, AZ18 and UW18 compare best with Binford's inventories of parts remaining at a spring kill-butchering site (Anaktiqtauk, Binford 1978 table 2.9 and figure 2.11), which has been plotted for comparison in figure 8.26. There is obviously no great match between exact frequencies, but similarities exist in the predominance of foot bones and skull parts. Binford's observations show this pattern to have been created by hunters processing a large number of animals, with the aim of transporting on high meat-yielding parts (1978:75-85). KH4 A, AZ18 and UW18 do not seem to have large numbers of equids (MNI=6, 4 and 4 respectively), but their body part frequencies may tentatively suggest they served as locations where equids underwent primary dismemberment, where heavy, low meat-yielding parts were discarded and meaty upper limb bones were transported away.

Alternatively, these body part frequencies may result from excavation bias in which specific activity areas were sampled. A skinning area, for example, might show a high proportion of discarded metapodia, phalanges and skulls. Contextual information, however, argues against this in that for all three assemblages, the equid remains do not derive from single levels, and are unlikely to represent discrete events in space or time.

It is particularly interesting to note that gazelle bones from UW18 display the same body part pattern as the equids, suggesting primary processing activities were taking place in the same location for both animals; at KH4 A this is not the case, since all gazelle body parts are present (and the small sample of gazelle bones from AZ18 shows a wide array of carcass parts represented also).

Butchery/processing evidence

Table 8.27 shows the frequency of the few butchery and chop marks on equid bones from the study assemblages. None shed further light on the interpretations made above of the body part data; in all cases it can be assumed that skinning and dismemberment took place at some stage. It is interesting, however, to note chop marks at WJ22 B and C and DH1 and 2, since these imply the splitting of bones for extraction of nutrients other than meat (i.e. marrow, bone grease).

equid butchery evidence

assemblage	skinning	dismemberment		filleting	chop marks
		head	limbs/joints		
DH 2					MPp-1
DH 1					PH1-1 PH1-1 PH1-1
AZ18			Td-1		
WJ22 B	MPd-1				CAL-1
WJ22 C					MPd-1 MPd-1 PH1-1
KH4 D			Hd-1		

Table 8.27. The occurrence of butchery/chop marks on equid bones (each entry represents a single example). Codes for butchery marks, and their interpretation, follow Binford 1981. Chop marks use the same element codes, with the suffix ’l’ indicating a longitudinal chop.

Cattle

Body part representation

Only AZ18 has sufficient *Bos* sp. bone for consideration. Figure 8.27 shows the relative survival of body parts, and table 8.28 gives the data upon which this is based. MNE counts have been used for horn-core and tooth representation, since the shattering of these elements leads to over-inflated NISP counts.

The sample size is extremely small, but it is interesting to note that skull parts and foot bones are most frequently represented. Following the arguments forwarded for equid remains which show similar body part frequencies, it might be suggested that AZ18 served as a primary butchery location for cattle, although the presence of pelvis, femur and tibia parts indicate that, if this were the case, the onward transport of upper limb parts was not consistently practiced. Alternatively, the pattern may reflect spatial separation in the use and discard of cattle body parts; upper limb bones may predominate in unexcavated areas of the site. It is, however, interesting that the cattle body part frequencies mirror those for equids at this site.

There are no cattle bones bearing evidence of butchery or processing. Worked *Bos* sp. bone is known from KH4, where a complete metacarpal was found with a hole drilled through the distal part of the shaft (Muheisen pers. comm.). Also, an almost complete horn-core from AZ18 shows holes at its base which are possibly artificial (Garrard *et al.* 1987:20-21).

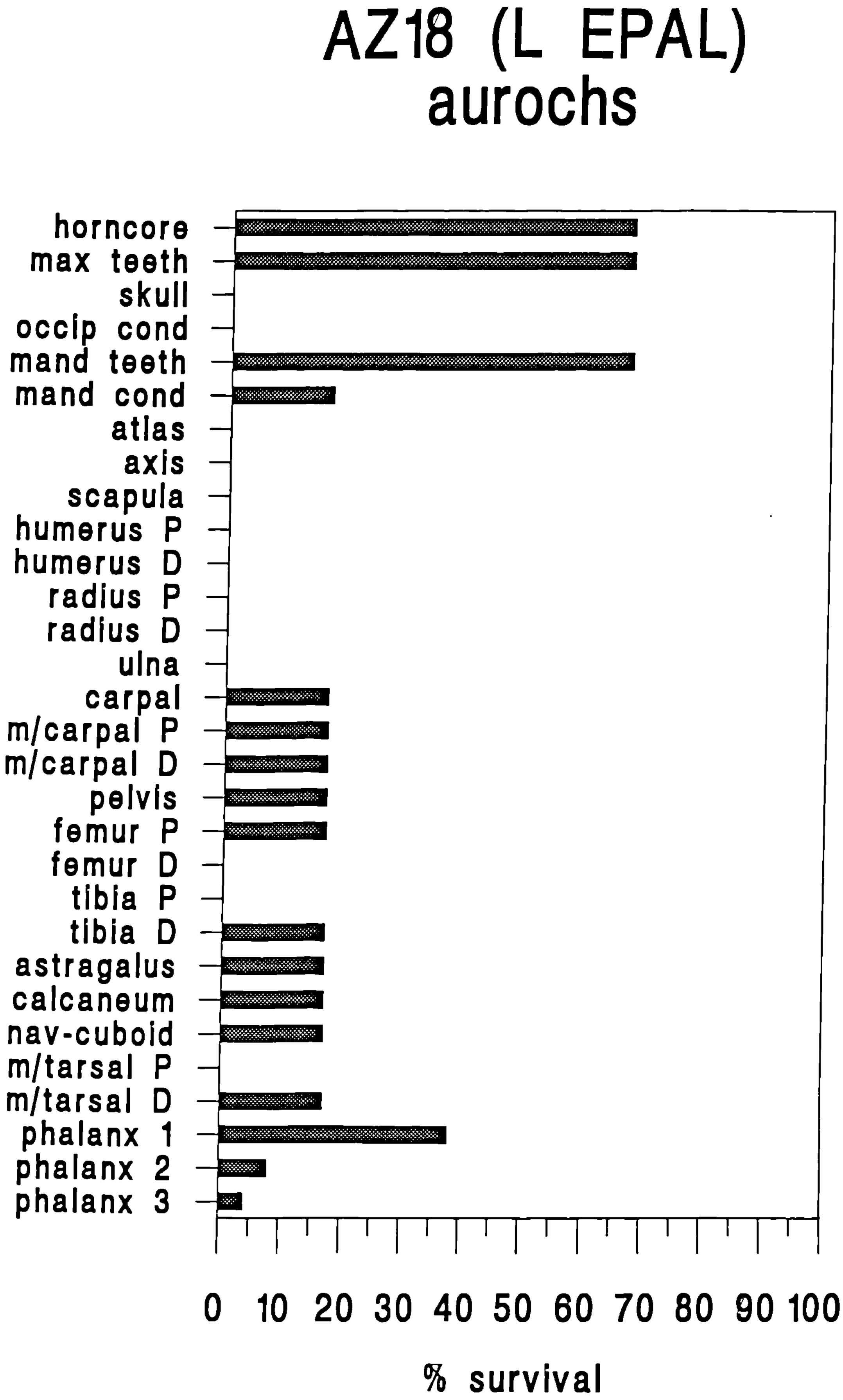


Figure 8.27. The relative frequency of aurochs body parts from AZ18 (NISP=35).

Hare

Body part representation

Tables 8.29 to 8.45 show the primary data for body part representation. Figures 8.28 to 8.44 plot the 'actual representation' column as percentage survival: due to the often high fragmentation of teeth, MNEs have been calculated for those sites where other elements are expressed as NISP. An absence of skull parts, phalanges, carpals and tarsals should not be interpreted as meaningful, since they may have been biased against in retrieval; metapodia, however, should have been retrieved in sieving. Three patterns are observed:

1) All body parts are present at KH4 D, WJ22 B, DH 1 DH 2, WJ7 1, WJ7 4, WJ32 and WJ13 1 (figures 8.31, 8.32, 8.39, 8.44, 8.33, 8.36, 8.38, 8.41).

2) Heads are absent at WJ7 3, WJ7 5, WJ25, WJ13 2 and WJ13 3 (although sample size is very small at the latter) (figures 8.35, 8.37, 8.40, 8.42, 8.43).

3) Foot bones are absent at KH4 A and B (although sample sizes are small), WJ6 A and WJ7 2 (figures 8.29, 8.30, 8.28, 8.34).

Most assemblages, therefore, have all body parts represented, indicating, not surprisingly, that whole animals were brought onto sites. Taphonomic factors could be responsible for the absence of head parts, since skulls and teeth are particularly susceptible to post-discard shattering. Alternatively, the lack of heads could reflect discard activities, if these were disposed of off-site. The absence of foot bones may be more meaningful, particularly the larger sample from WJ7 2. Here, the bones derive mostly from primary occupation deposits within a structure. The absence of hares feet could either indicate spatial activity - that skinning was being done elsewhere - or that foot bones were leaving the site attached to skins. It should be noted that the three body part groupings (1-3 above) show no chronological patterning.

A single hare bone (long-bone shaft fragment) from WJ32 showed evidence of cut marks. Hare bones, particularly long-bone shafts, appear to have been commonly used in bone bead manufacture at WJ13 (Powell 1992:39; Martin in Garrard *et al.* 1994), and this has the potential to affect body part frequencies.

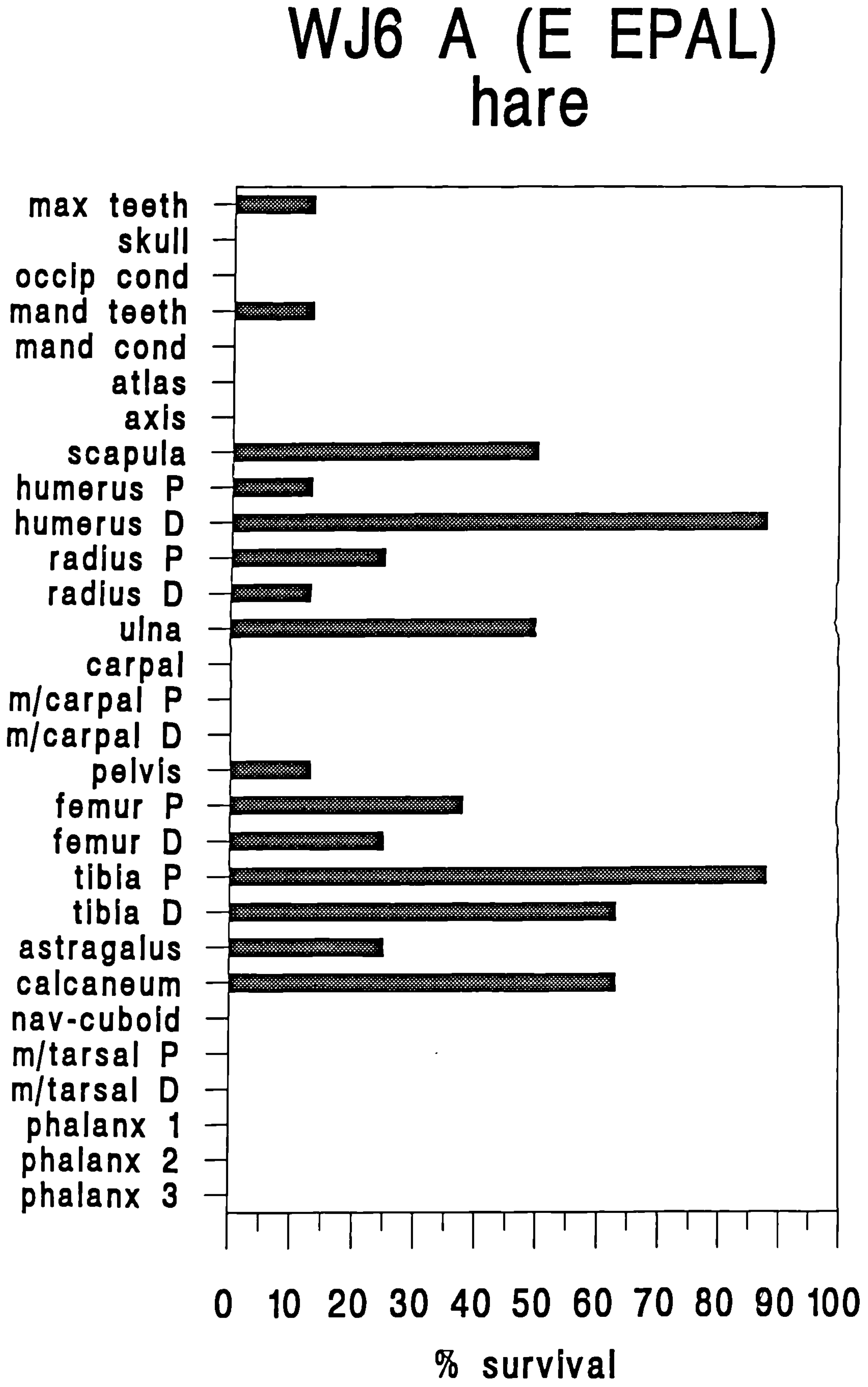


Figure 8.28. The relative frequency of hare body parts from WJ6 A (NISP=46).

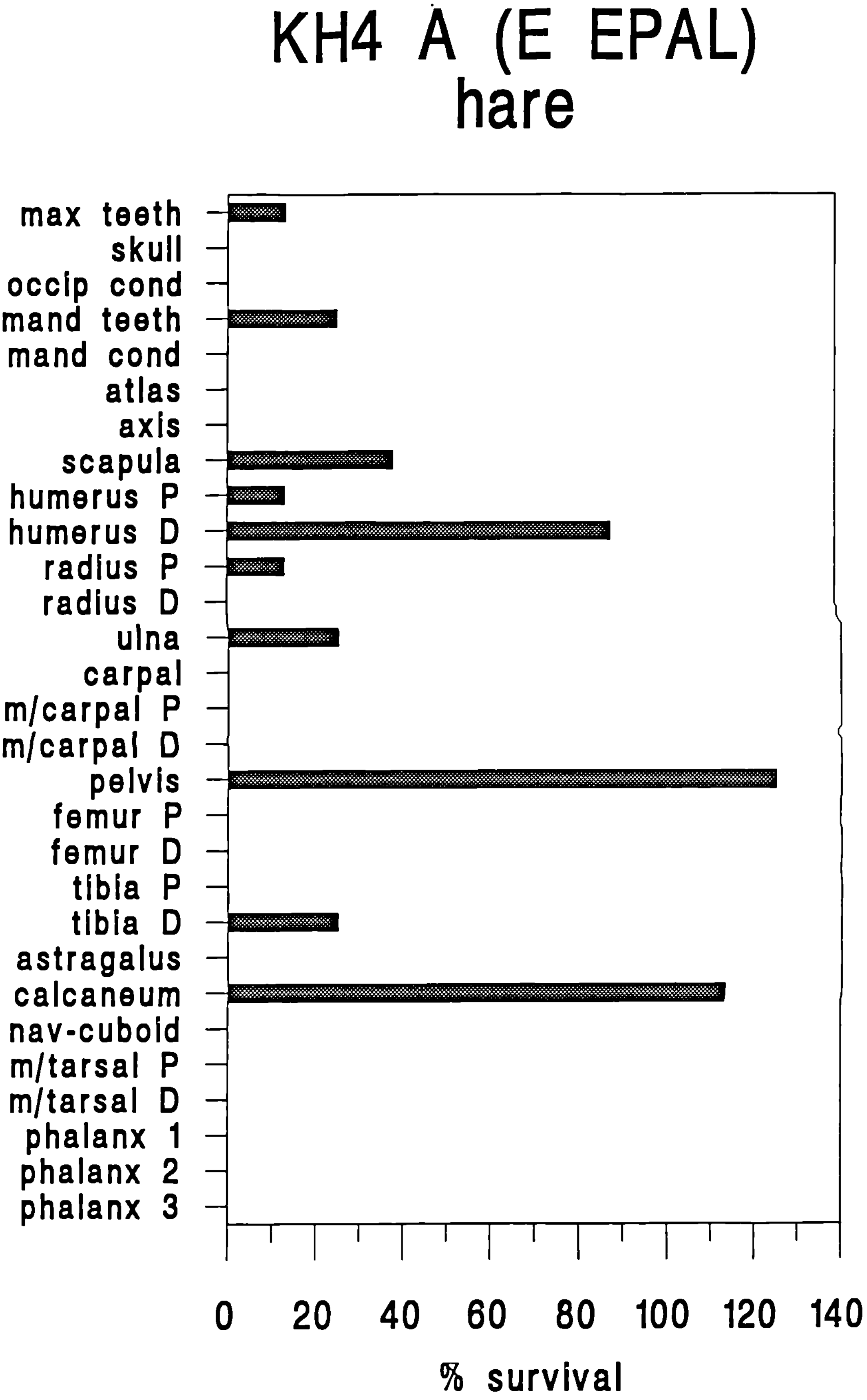


Figure 8.29. The relative frequency of hare body parts from KH4 A (NISP=38).

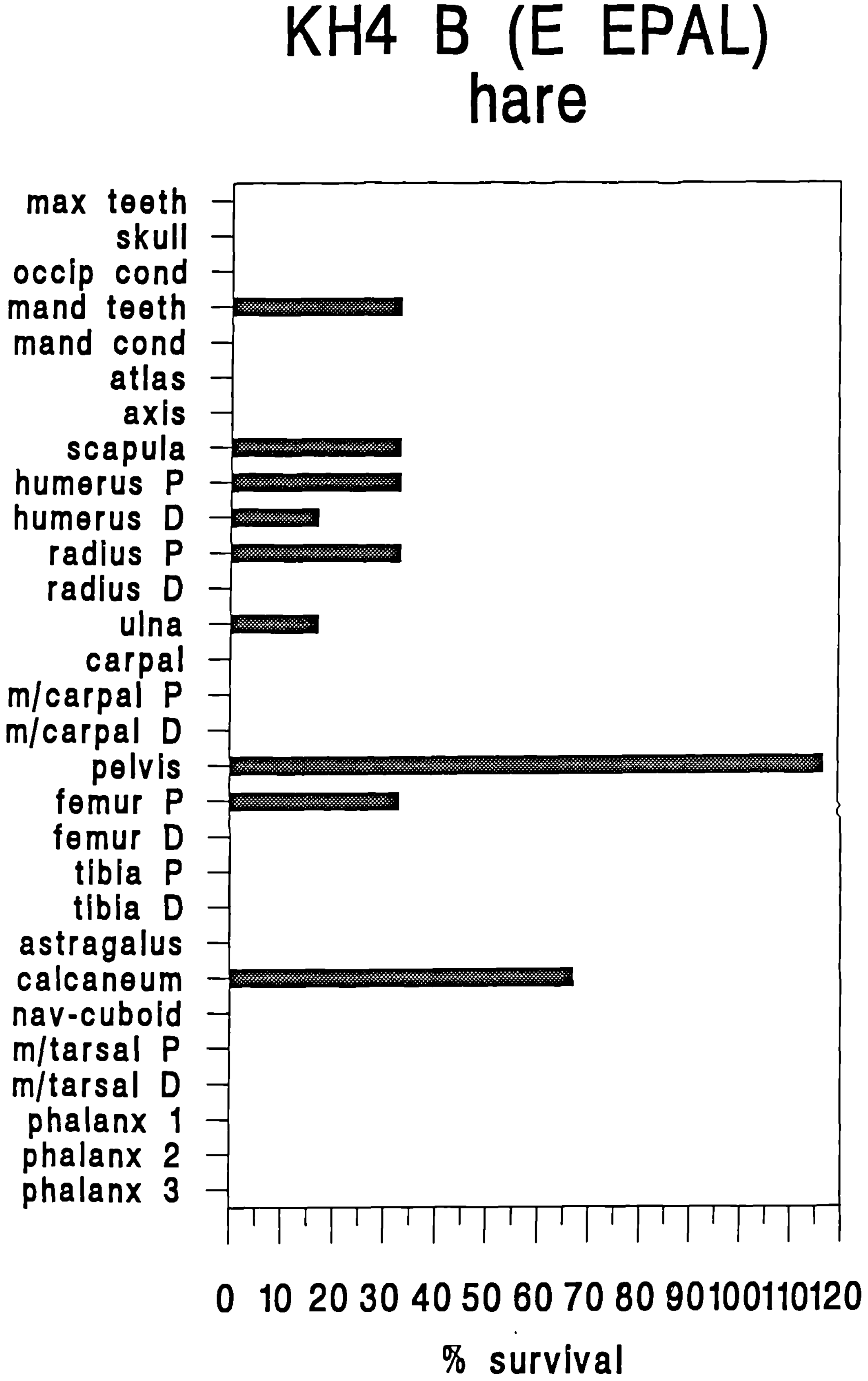


Figure 8.30. The relative frequency of hare body parts from KH4 B (NISP=23).

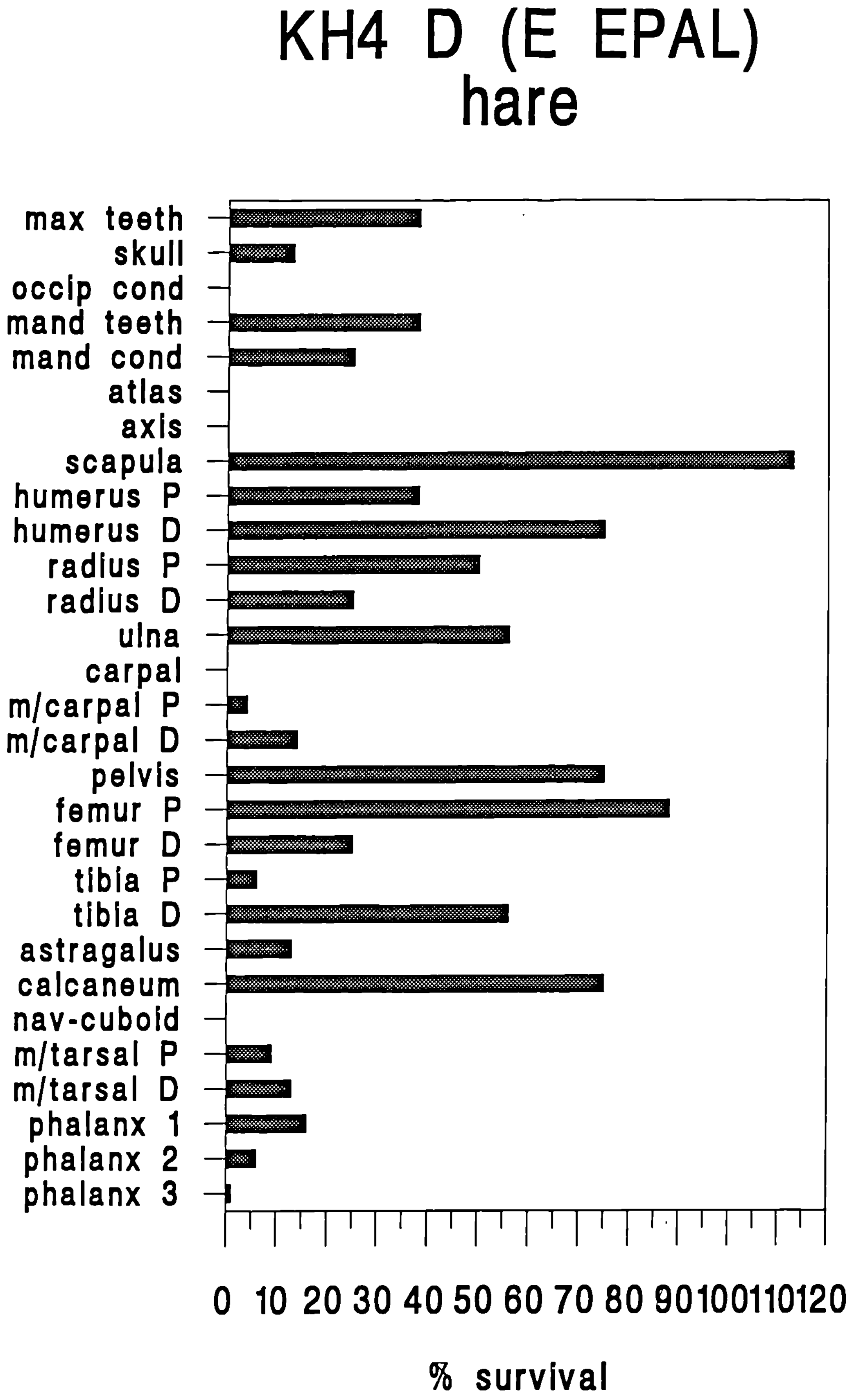


Figure 8.31. The relative frequency of hare body parts from KH4 D (NISP=204).

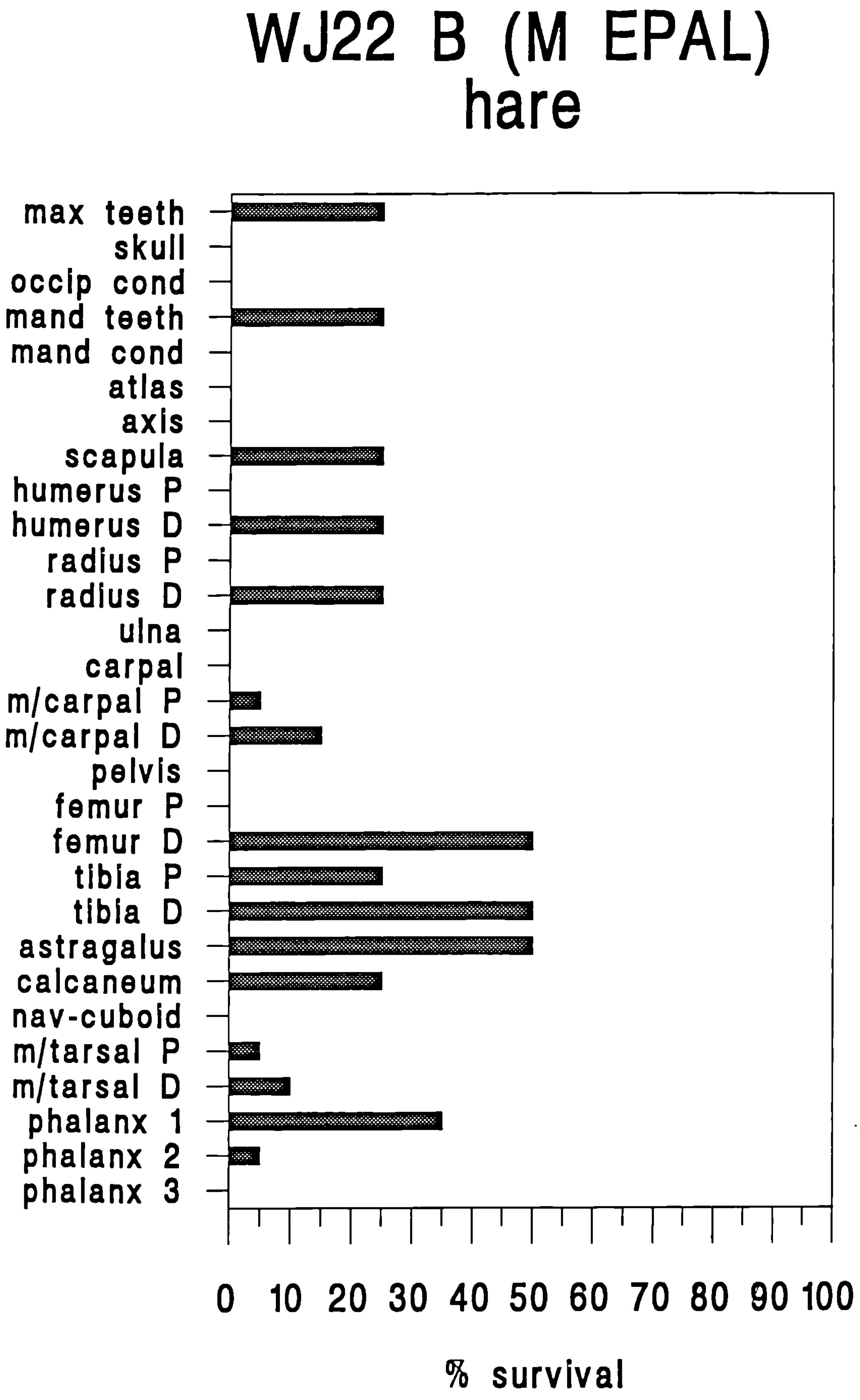


Figure 8.32. The relative frequency of hare body parts from WJ22 B (MNE=36).

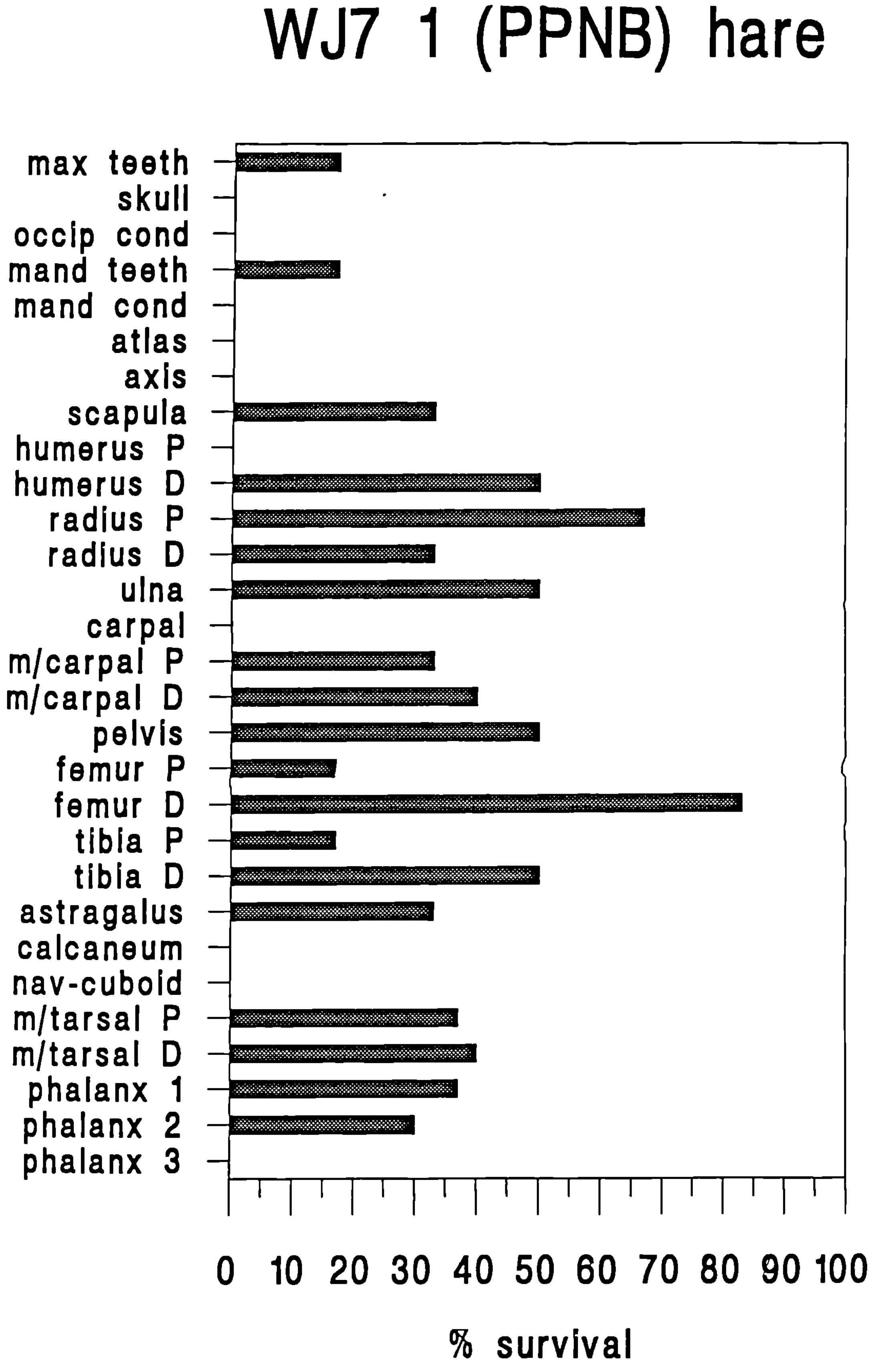


Figure 8.33. The relative frequency of hare body parts from WJ7 1 (MNE=116).

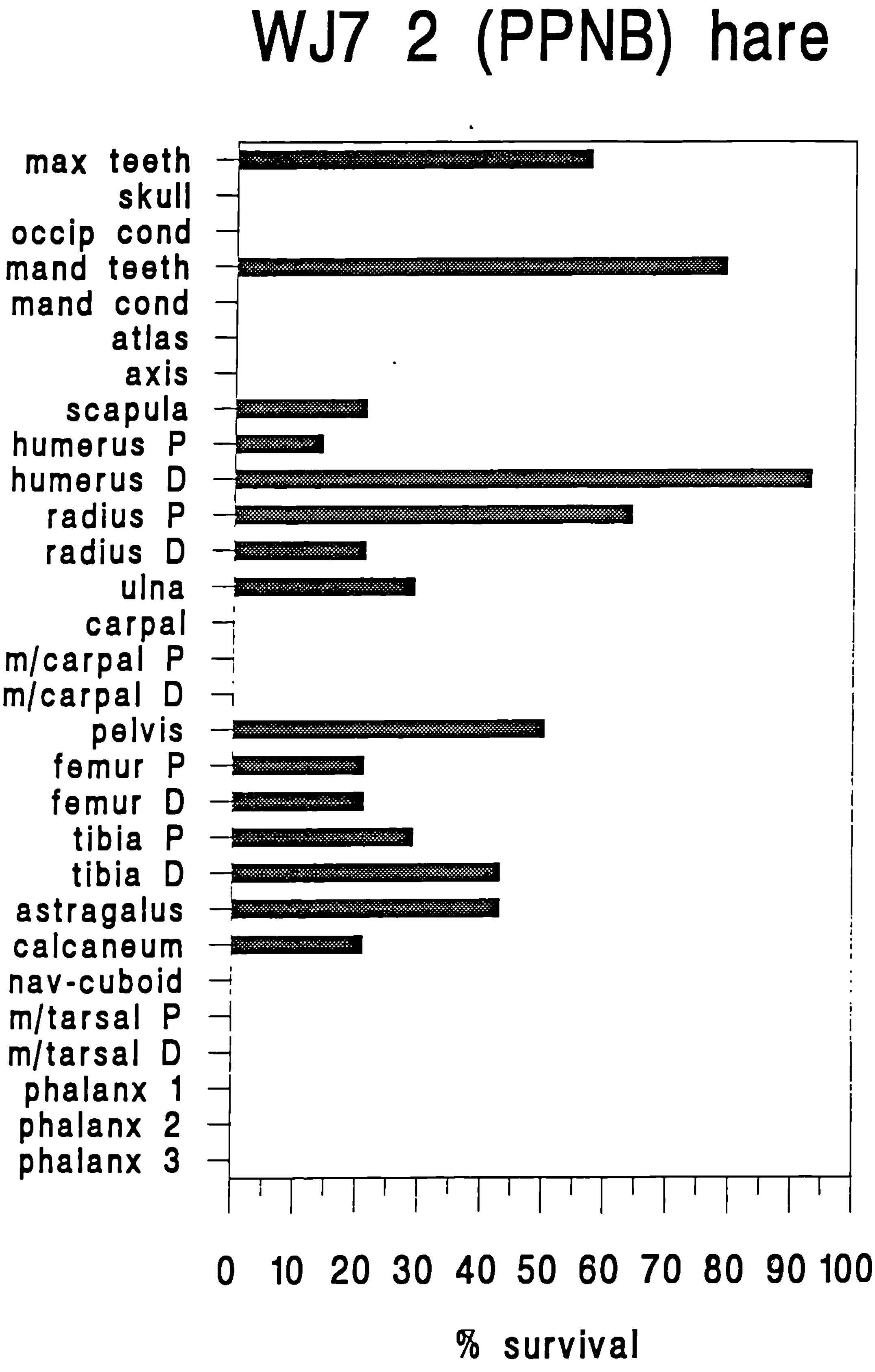


Figure 8.34. The relative frequency of hare body parts from WJ7 2 (MNE=85).

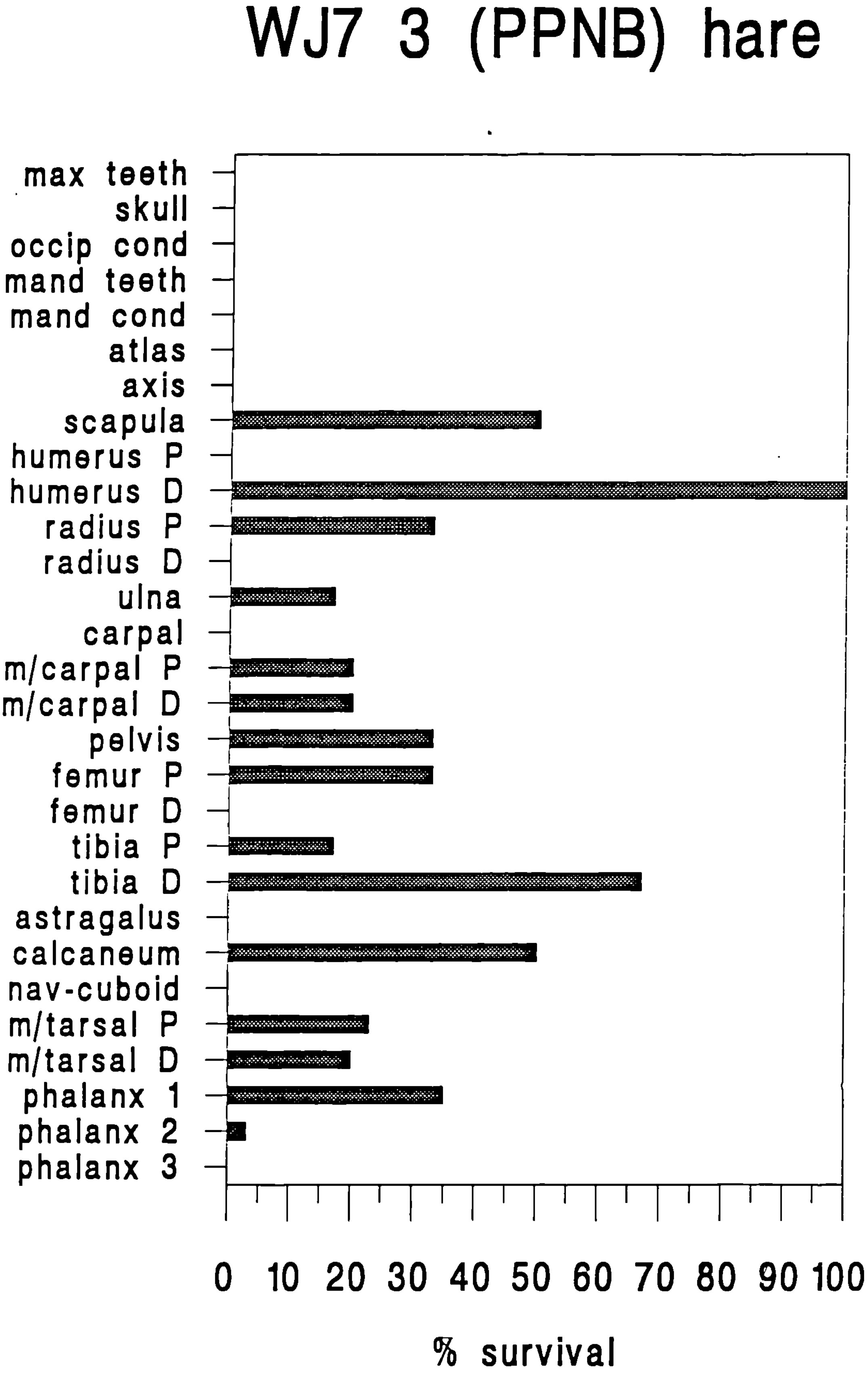


Figure 8.35. The relative frequency of hare body parts from WJ7 3 (MNE=72).

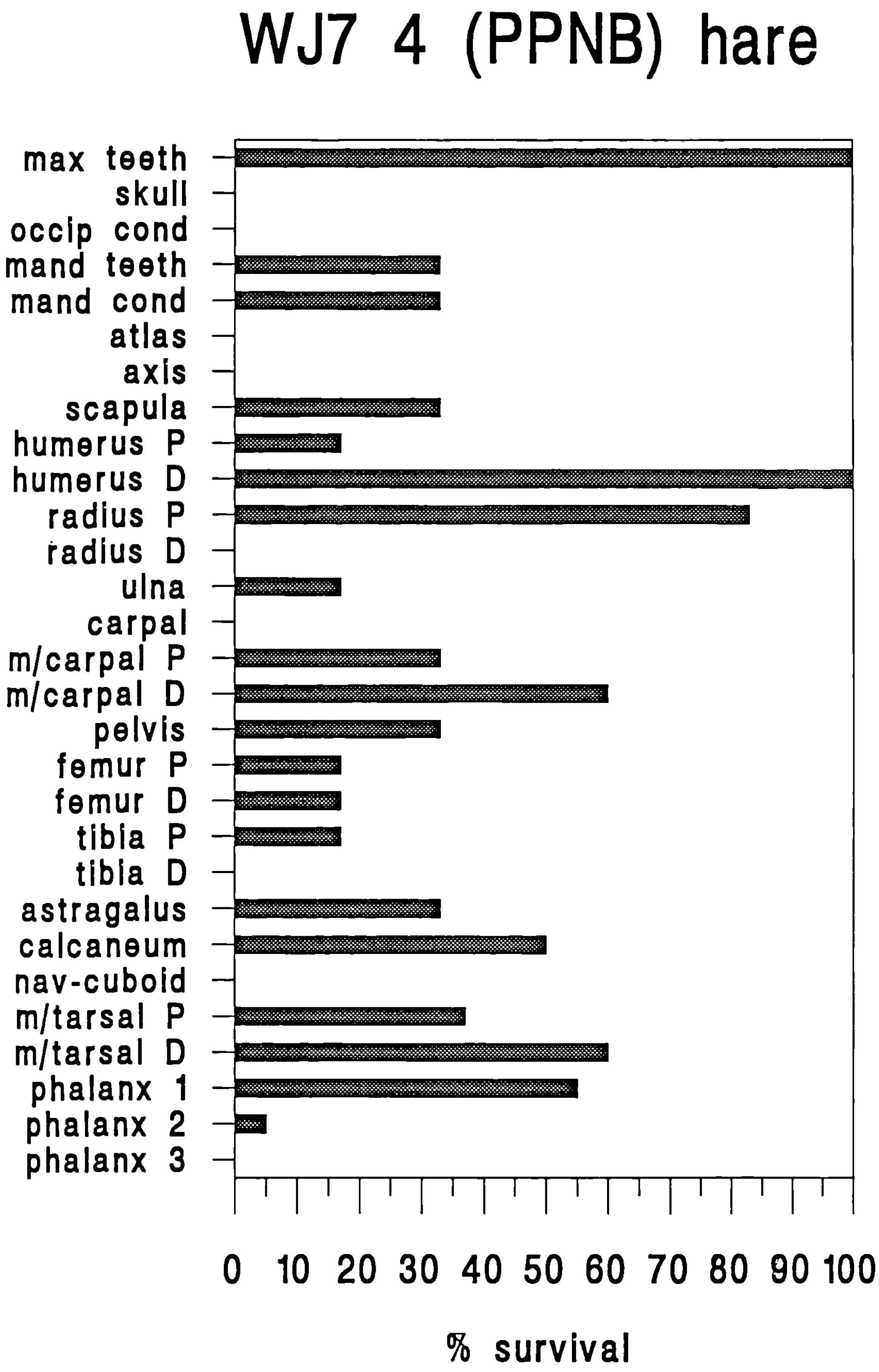


Figure 8.36. The relative frequency of hare body parts from WJ7 4 (MNE=128).

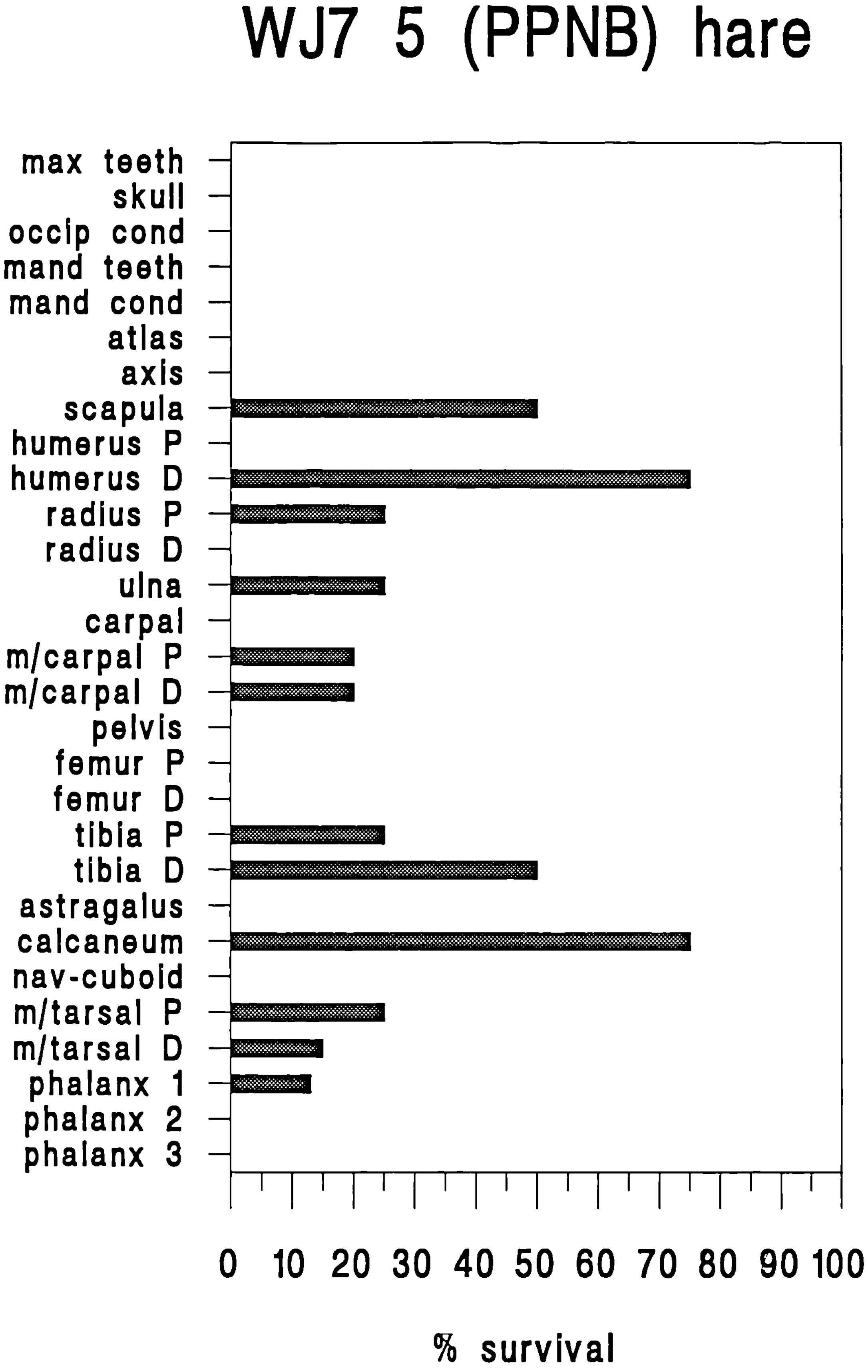


Figure 8.37. The relative frequency of hare body parts from WJ7 5 (MNE=34).

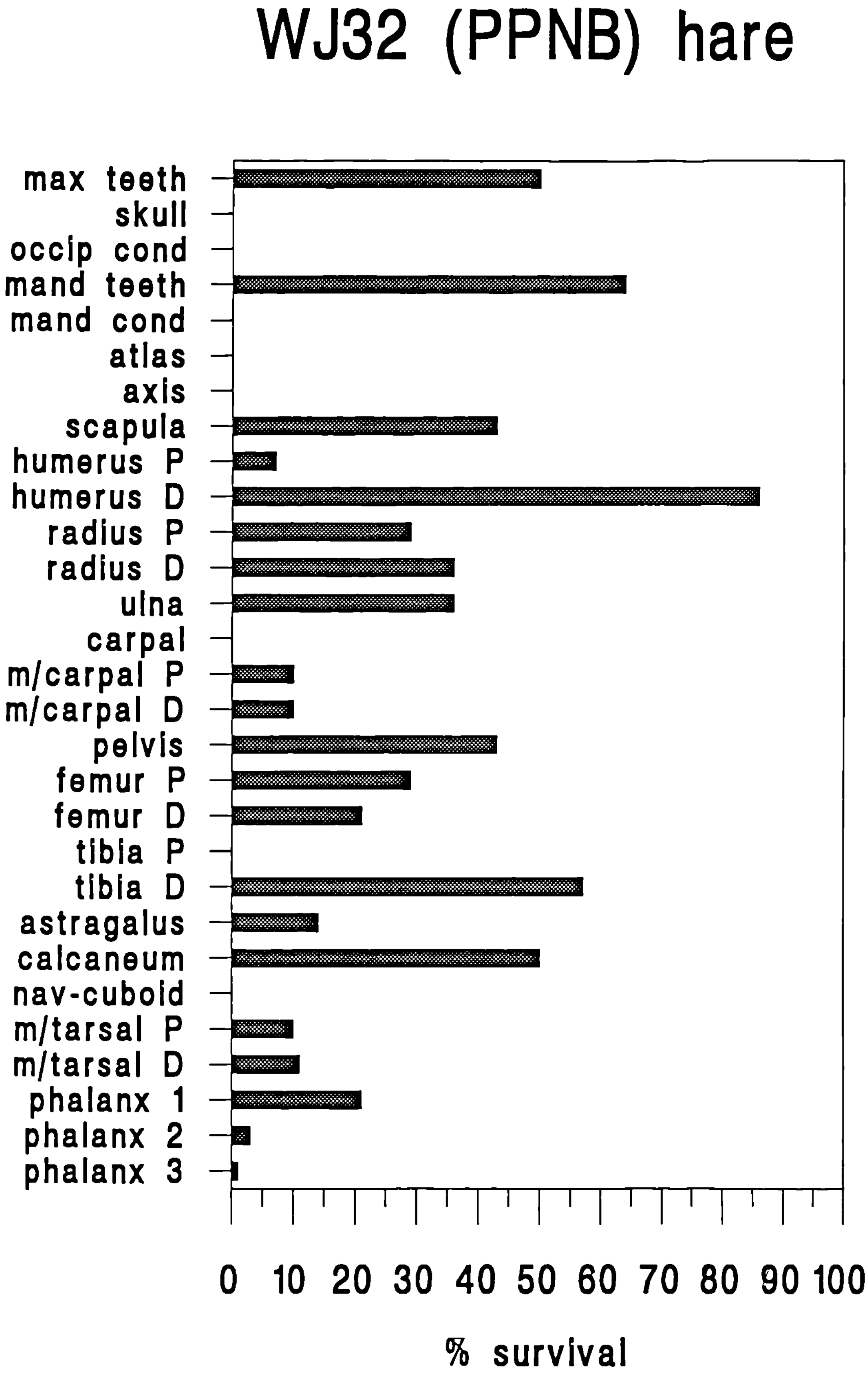


Figure 8.38. The relative frequency of hare body parts from WJ32 (MNE=143).

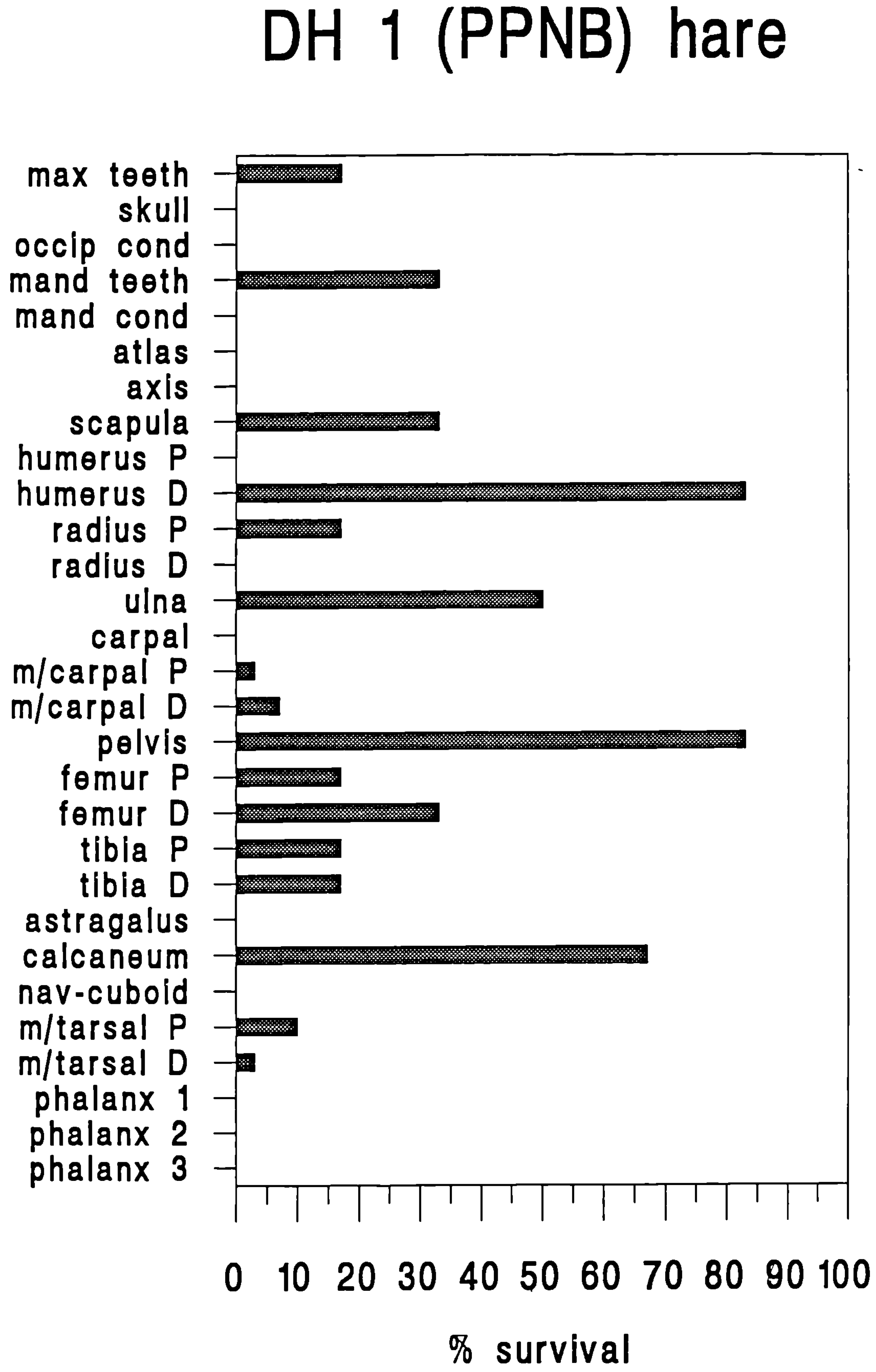


Figure 8.39. The relative frequency of hare body parts from DH 1 (MNE=35).

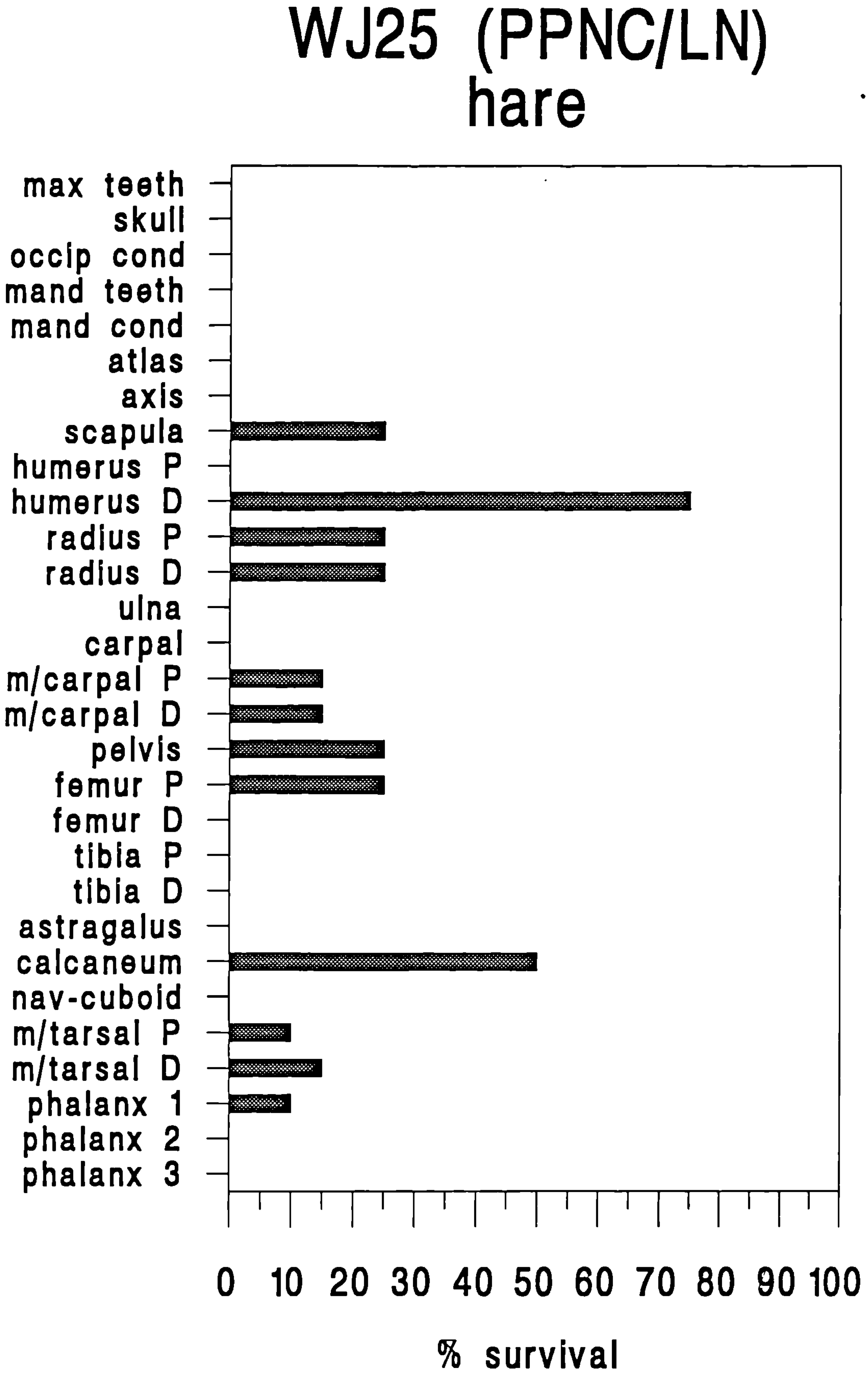


Figure 8.40. The relative frequency of hare body parts from WJ25 (MNE=26).

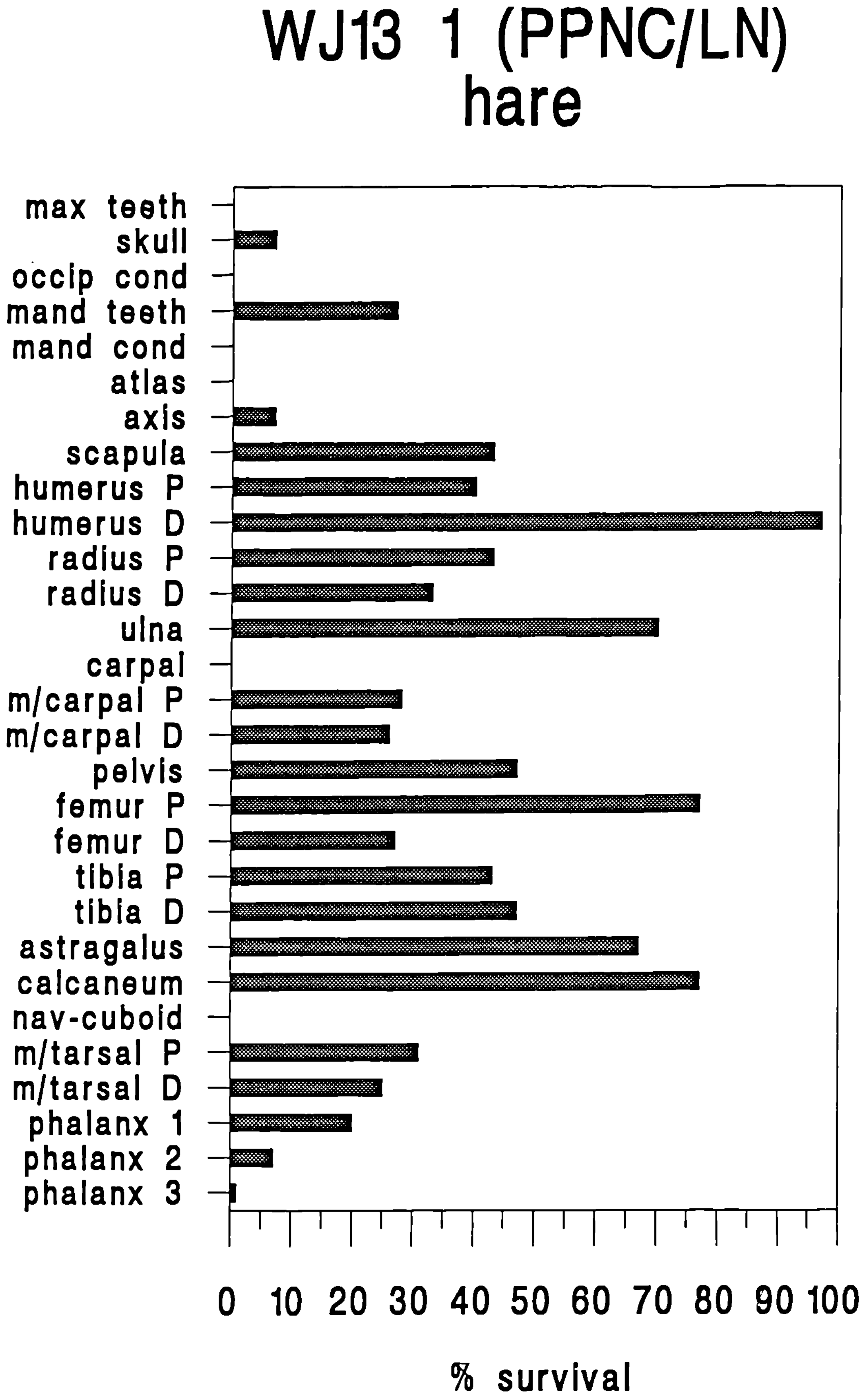


Figure 8.41. The relative frequency of hare body parts from WJ13 1 (MNE=472).

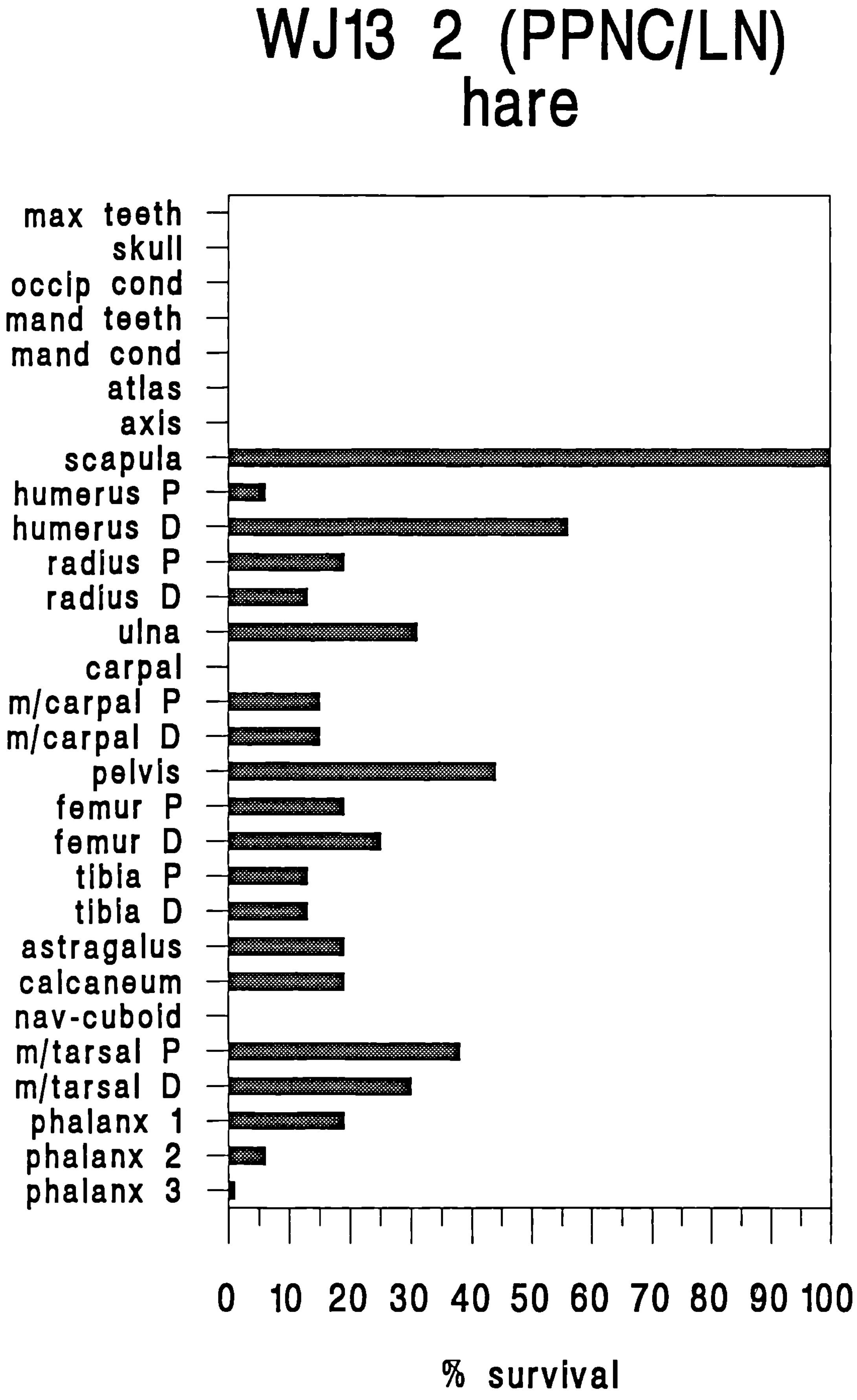


Figure 8.42. The relative frequency of hare body parts from WJ13 2 (MNE=180).

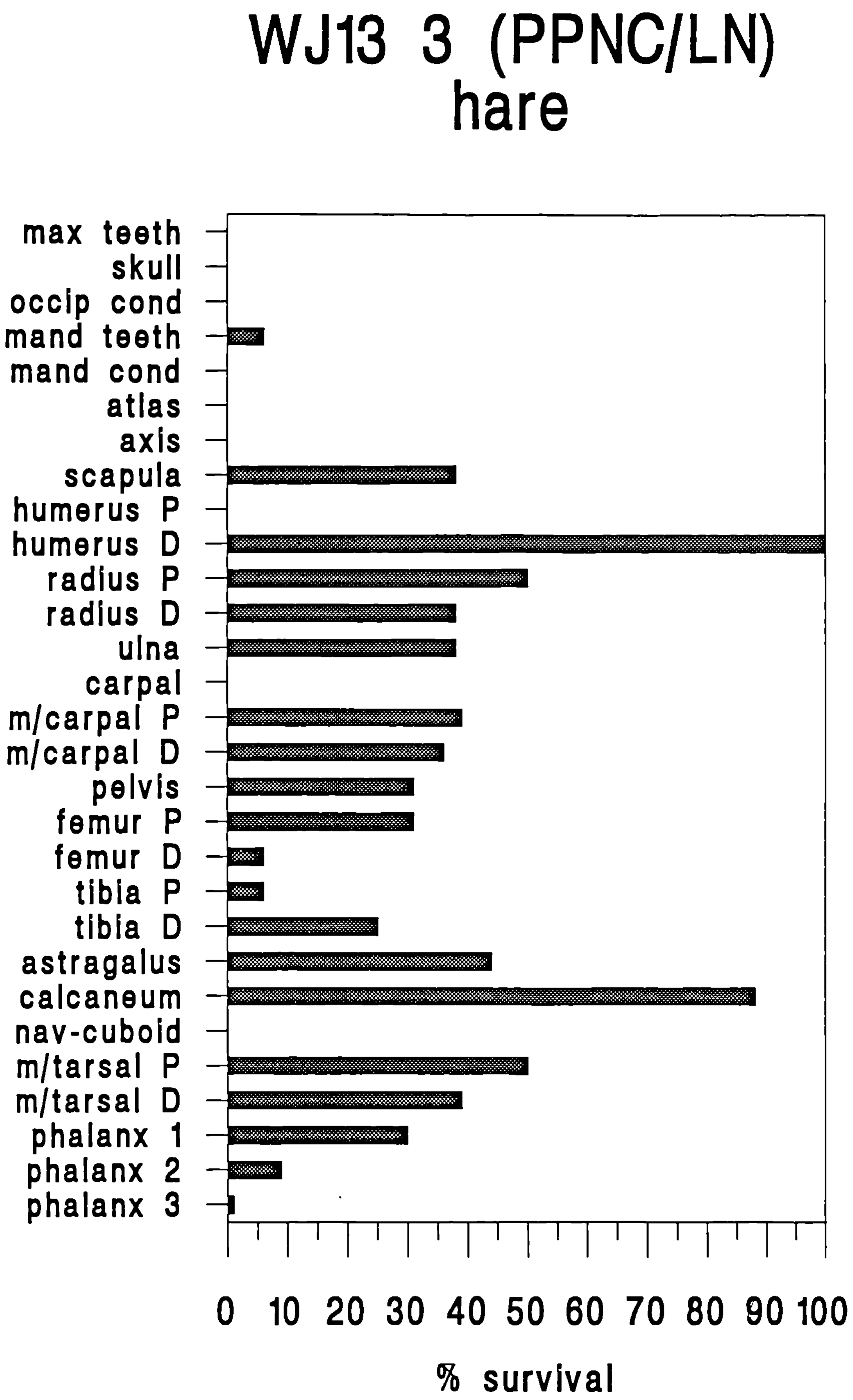


Figure 8.43. The relative frequency of hare body parts from WJ13 3 (MNE=274).

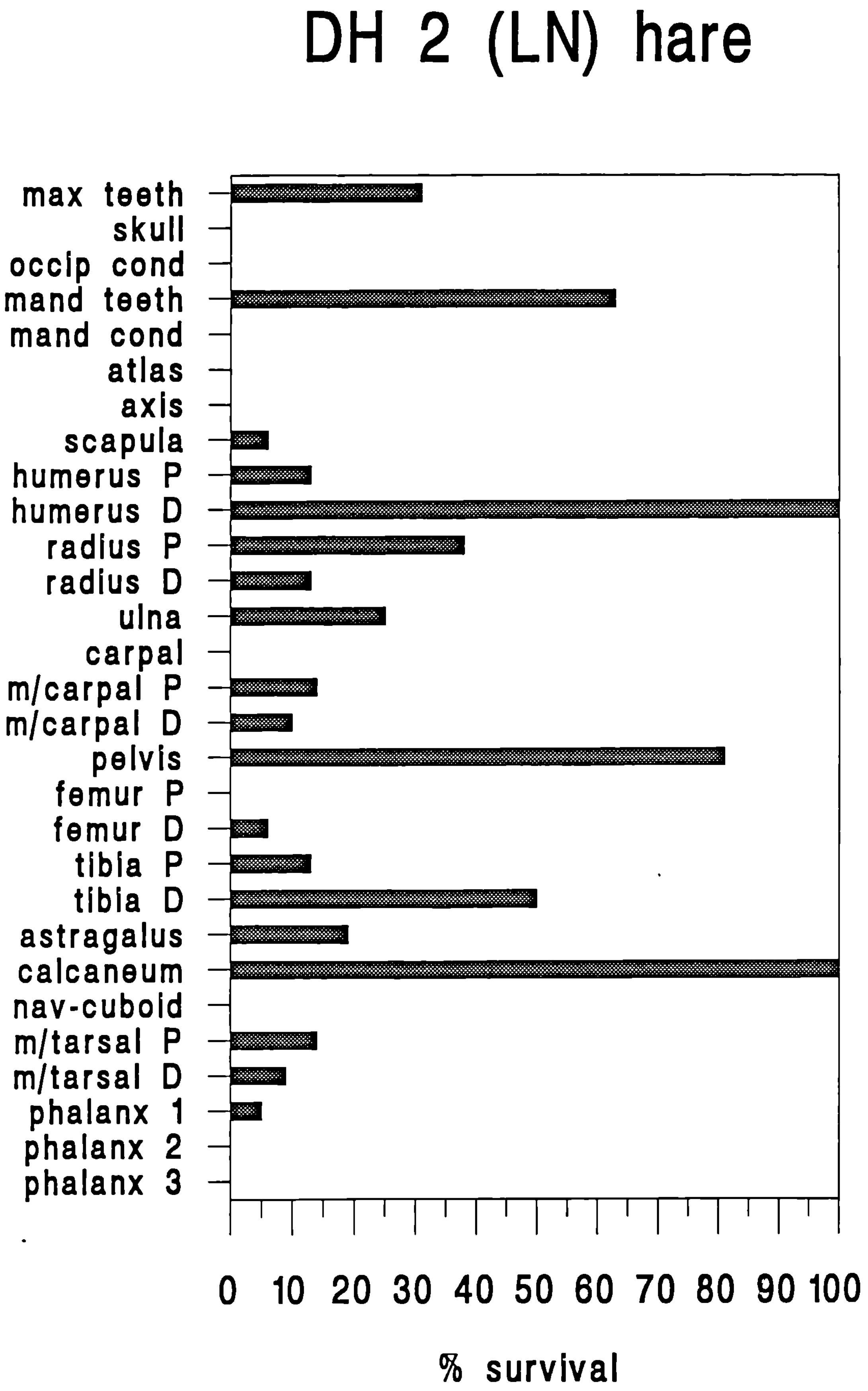


Figure 8.44. The relative frequency of hare body parts from DH 2 (MNE=134).

Fox

Body part representation

Primary data are presented in tables 8.46 to 8.49, and figures 8.45 to 8.48 show the percentage of body part survival for the few assemblages where numbers of fox bones are large enough. As with hares, fox phalanges and other small bones may not have been caught in sieving.

KH4 D and WJ13 1 have most body parts present. The absence of phalanges at KH4 B might be explicable as retrieval bias. That metapodials are also extremely rare, however, may indicate that feet are not generally present in the assemblage. As with hare, this pattern implies either that skinning was undertaken elsewhere, or that feet were leaving the site attached to skins. WJ13 3 has no skull parts, which could reflect disposal patterns, although the sample size is very small.

There is no butchery/processing evidence for foxes. A fox metapodial from WJ7 shows signs of working; this piece is a waste-product of bead manufacture, and may suggest that other fox bones were made into beads, although the final products themselves do not allow taxon/element identification of the original bones (Martin in Garrard *et al.* 1994).

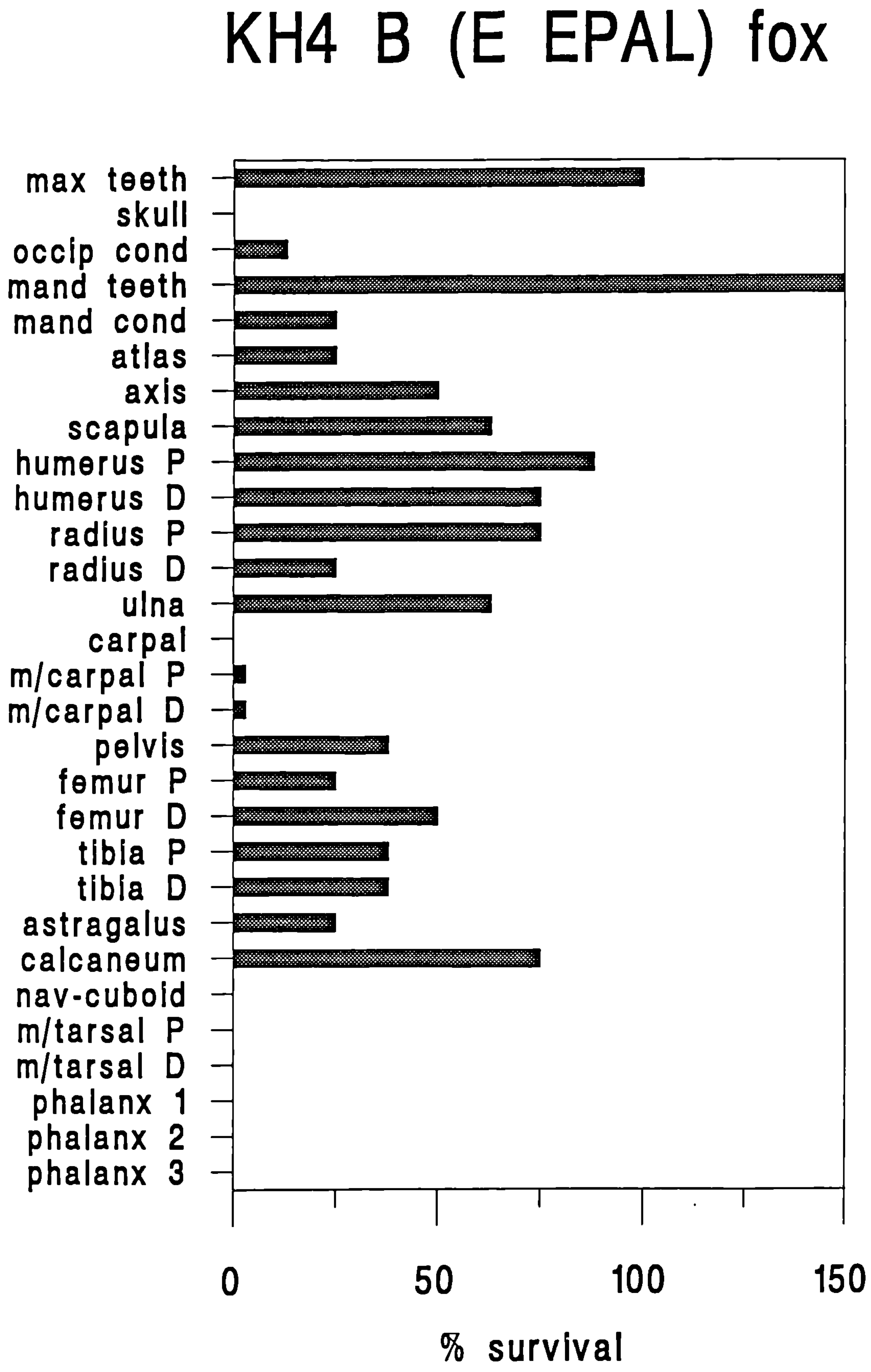


Figure 8.45. The relative frequency of fox body parts from KH4 B (NISP=84).

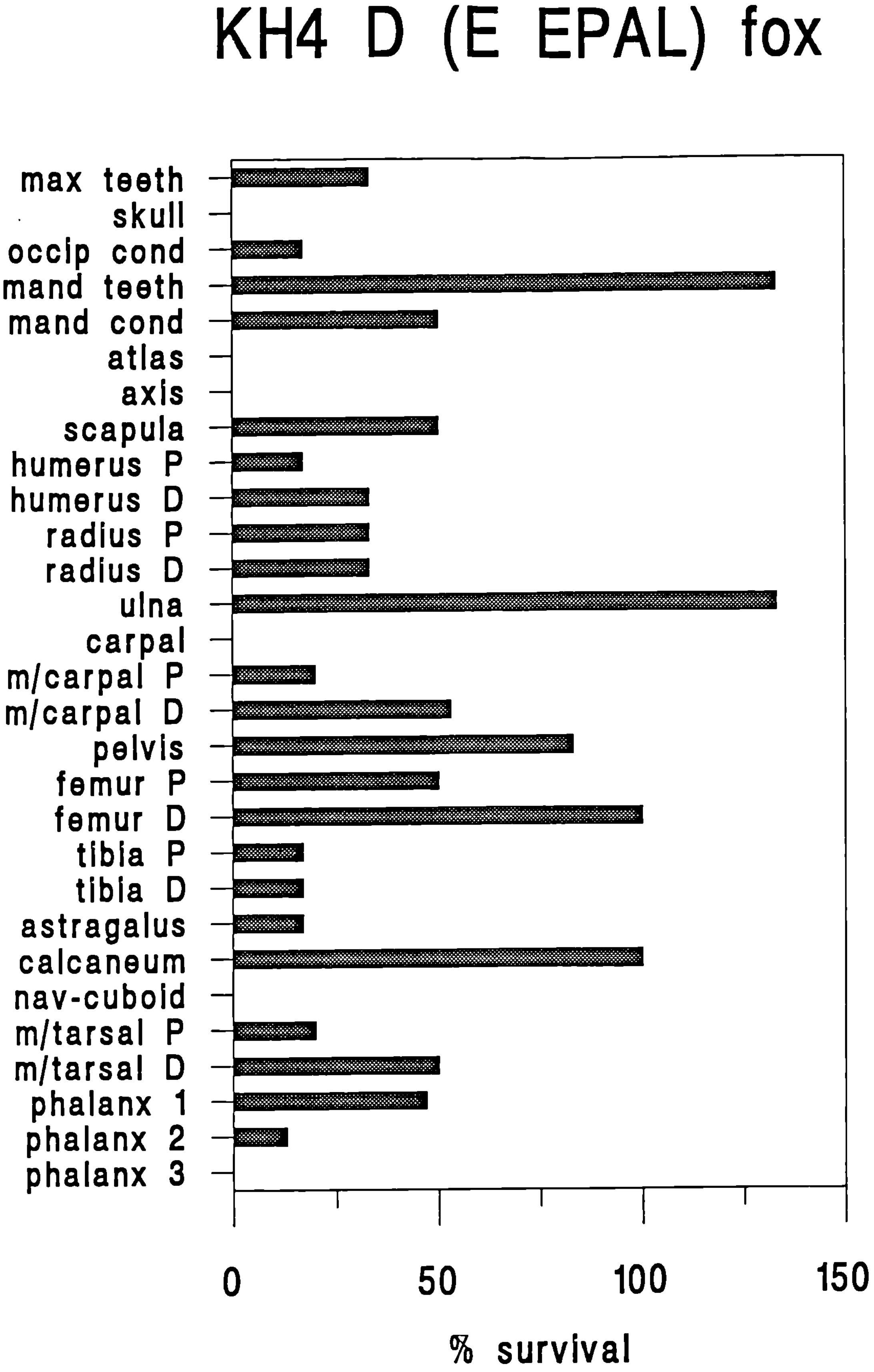


Figure 8.46. The relative frequency of fox body parts from KH4 D (NISP=144).

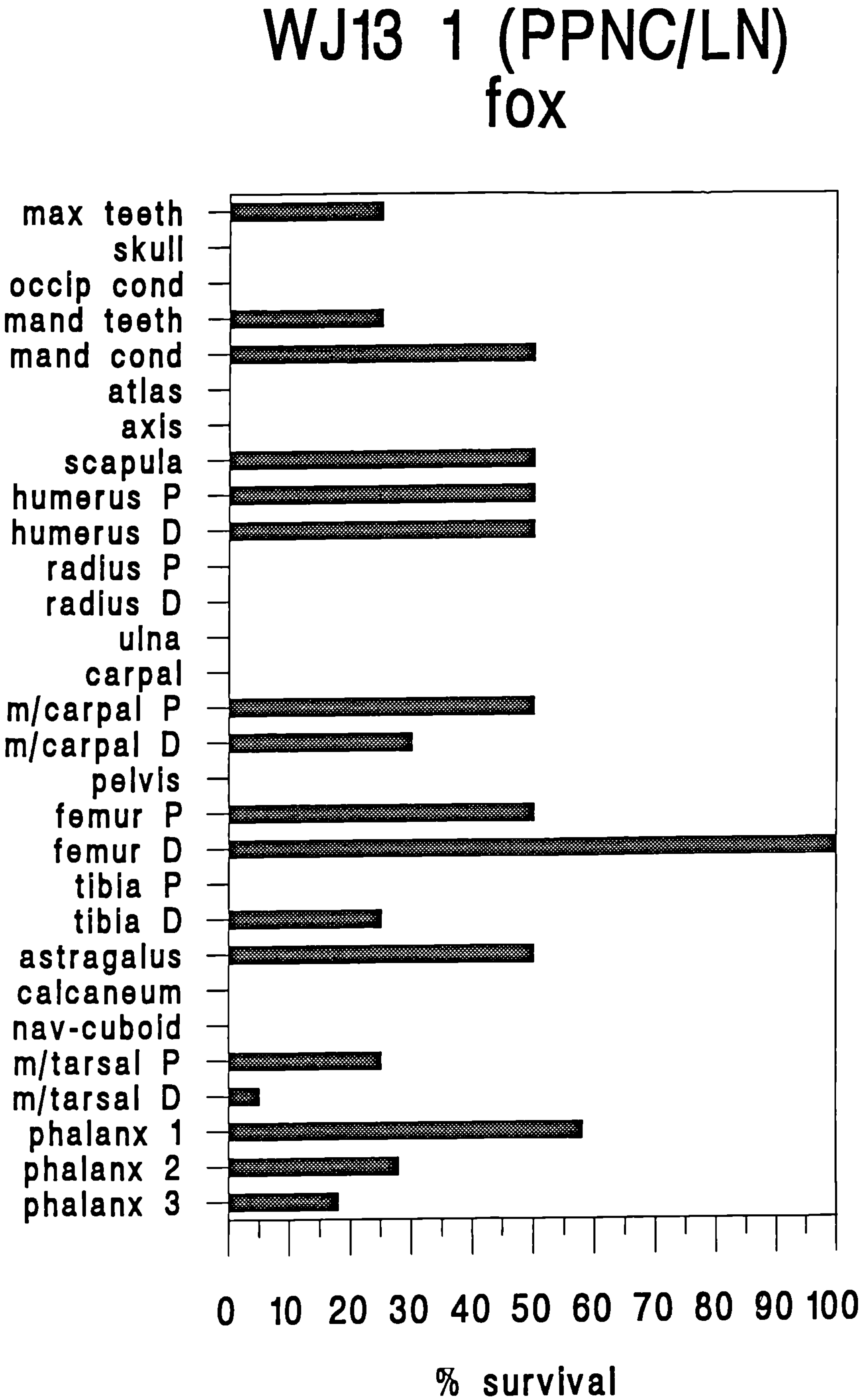


Figure 8.47. The relative frequency of fox body parts from WJ13 1 (MNE=82).

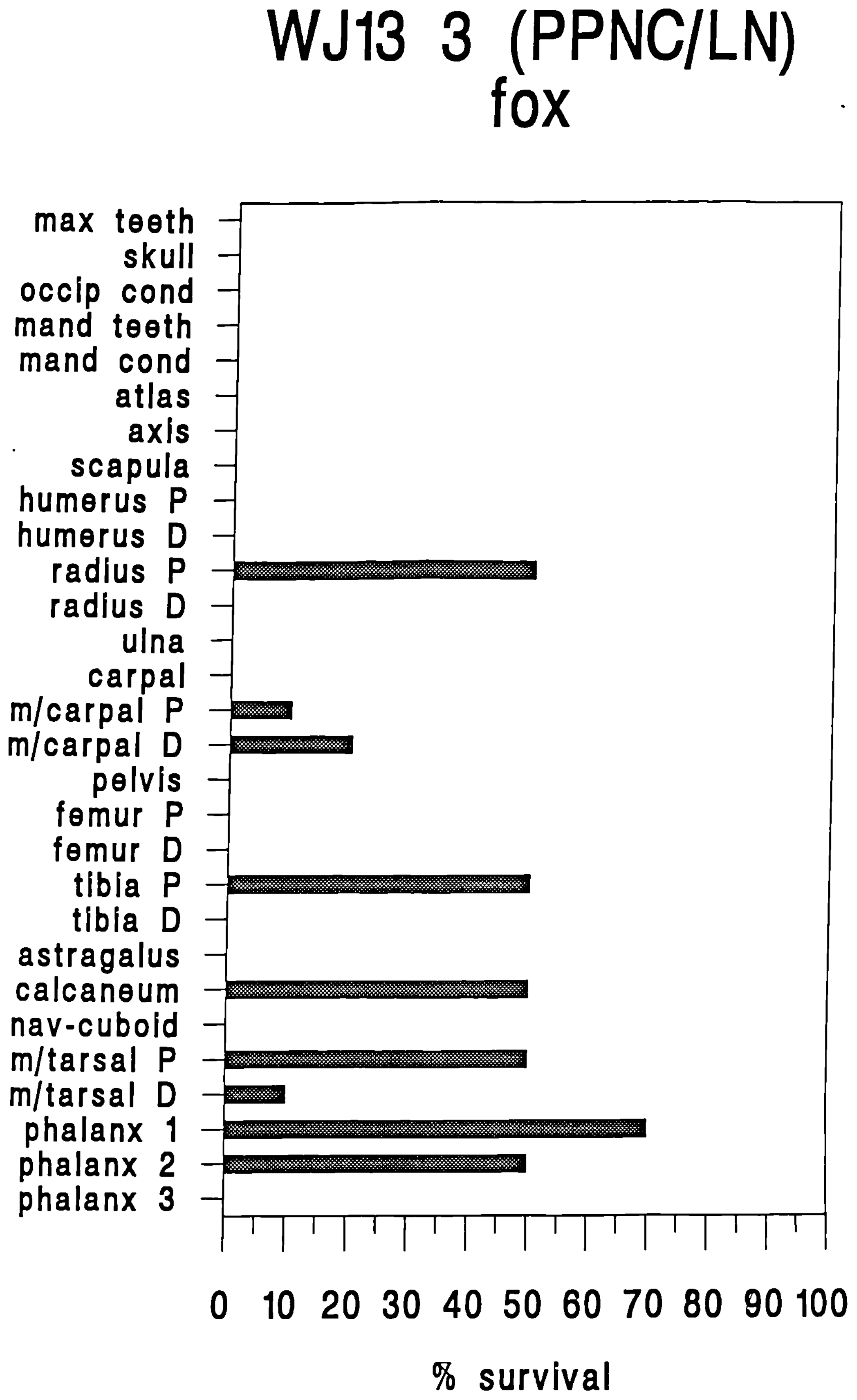


Figure 8.48. The relative frequency of fox body parts from WJ13 3 (MNE=36).

Tortoise

Tortoise bones and scutes have a significant presence in some assemblages. Tortoises burrow at certain times of the year to control body temperature (Alderton 1988:40), and it is possible that some remains represent natural death accumulations and are intrusive. It seems an unlikely explanation for most of the material, however, since burrows and their contents, and any disturbed deposits, were isolated during excavation.

The possible use of tortoises at the sites has been explored through the evidence of burning on bones/scutes. Their presence may be as food, in which case roasting in the shell over direct fire would be one way of cooking them, or boiling/stewing another. With the former method, one might expect a high frequency of burnt shell, but with boiling this would not be the case. Alternatively, or maybe additionally, Garrard (Garrard *et al.* 1986:9) has suggested that tortoise shells may have served as containers, which need not result in burning.

Table 8.50 shows the frequency of burnt tortoise carapace fragments for assemblages where this information was recorded. In the assemblages where tortoise bones are in their highest numbers, WJ22 B and C, the degree of burning is small. When compared to the figures for burnt gazelle bone in table 8.14, WJ22 B has a much lower percentage of burnt tortoise bone (2% compared to 17% gazelle), and WJ22 C has even less (0.04% compared to 1% gazelle). The tortoise bone sample sizes from other assemblages are too small to compare in the same way, but the general impression is that the relative frequency of burnt tortoise remains is less than the equivalent for gazelle.

That most assemblages contain **some** burnt tortoise bone, albeit small, suggests they are contemporaneous with occupation (although this need not be the case). Contextual information, such as fairly even distribution of tortoise remains (at WJ22 they are present in every level) and the absence of burrows, supports the argument for tortoises being brought onto site, rather than dying there naturally. The burning evidence suggests that if they were used as food, they were not predominantly roasted. Tortoises may have served other purposes, for example the shells could become vessels, or the keratinous layer may have been a desired material, but evidence which may elucidate this is either lacking or ambiguous.

tortoise remains				
assemblage	tortoise shell/bone NISP	no. burnt	% burnt	% gazelle bone burnt
DH 2	1	1	3.0	10.0
WJ13 3	7	5		
WJ13 2	6	2		
WJ13 1	74	2		
WJ25	1	0		
WJ32	38	9		
WJ7 4	44	7		
WJ7 3	18	0		
WJ7 1	49	3		
WJ22 C	2840	1	0.04	1.0
WJ22 B	4229	91	2.0	17.0

Table 8.50. The number of tortoise scutes and bones in assemblages are shown, alongside the number burnt and the percentage this forms. The right hand column shows the percentage of burnt gazelle bone fragments of the total (taken from table 8.14).

Discussion

Transformation of deposited assemblages to fossil assemblages

For all taxa it is likely that some remains, and less dense body parts in particular, have disappeared since their original deposition. For gazelle, this is exemplified by the frequent absence of atlas and axis, and low representation of proximal humerus and tibia. Reasons for the deterioration of bone probably include weathering, and the chemical and mechanical activity of soil. Carnivore ravaging of assemblages is believed to be slight, although evidence shows that they had some impact on remains, which increases somewhat in the PPNC/Late Neolithic.

Retrieval of faunal remains during excavation does not seem to have biased the representation of gazelle, equid or *Bos* sp. body parts, although smaller bones (carpals, tarsals, phalanges) of hare and fox may be absent for this reason.

Transport of hunted animals

Body part frequencies inform on two questions concerning carcass transport:

1) they can be used to explore factors affecting the parts of a carcass which are returned to a site from the place of kill.

2) they suggest which animal parts were subsequently transported away from sites.

1) Transport of carcasses to sites

In eastern Jordan, the actual locations where animals were killed, like the bison kill sites in the American Great Plains or New Mexico (e.g. Frison 1978, Speth 1983) are not found. Instead, the faunal evidence suggests that the study sites represent either longer-term camps or primary-processing locations. Carcasses were transported to each of these from the places of kill.

Klein and Cruze-Uribe (1984:66-67) have compared body part frequencies from small and medium-large bovids at Bloomplaas Cave, and they argue that animal size governed the decisions made as to how much of the carcass was transported back to the cave from the kill. For the study assemblages, discussion above suggests that all gazelle, equid and cattle parts were initially taken to the sites (where they are present), despite the subsequent removal of some elements after processing. None of the body part frequencies show the sole introduction of certain skeletal parts (e.g. only high meat-yielding bones), whether for gazelle, equids or cattle.

This suggests firstly that decisions relating to carcass transport did not differ between the smaller and larger animals (e.g. between gazelles and equids/cattle); all skeletal parts arrive on site regardless of animal size. Secondly, the patterns might imply that hunting occurred fairly close to the sites, particularly for the heavier equids and wild cattle which may have needed reducing in bulk if they were being carried long distances. Gazelles on the other hand, are small, light animals, and even if killed in numbers at some distance from base camps, their weight might not necessitate the discard of parts.

The evidence for all body parts of gazelle, equids and cattle being initially taken onto sites also implies a fairly intensive use of carcasses. All skeletal parts which have a potential use were introduced to the study sites; none appear to be consistently discarded at the kills. Differential body part transport dependent on a utility index of what is 'valuable' (e.g. Binford 1978) is not evident. Possible reasons for this 'intensive use' will be discussed below.

Carcasses of hares and foxes are interpreted, not surprisingly, as arriving complete on site.

2) Transport of carcass parts off-site

The second question concerns animal parts which were transported away from the study sites. For gazelles, the only assemblage which strongly suggests the removal of particular body parts is UW18, where the absence of meat-yielding upper limb bones argues for the site being a primary-processing location.

Similar patterns in equid bones - i.e. a predominance of skulls and foot bones - are seen at KH4 A, AZ18 and UW18, and the cattle remains at AZ18 comply. These body part frequencies appear to indicate primary-processing activities, with the removal/onward transport of upper limb parts.

Hare and fox body part data from WJ6 A, KH4 A and B and WJ7 2 show hints of skins being removed off site, evidenced in the absence of foot bones.

What activities were taking place at sites?

Identification of particular activities relating to carcasses is hindered by poor and ambiguous evidence. There is very little firm data relating to skinning, butchery, cooking activities, or other practices such as marrow or bone-grease extraction, and presumably, a huge scope for variation. Consequently, it is essential to theorize about possible activities, and to imagine which combinations of practices are feasible, compatible and likely. We are helped slightly in this by ethnographic studies of the way hunter-gatherer groups deal with carcasses. Observations show that groups butcher, process and cook animals according to traditional practices (Binford 1978:47-59 for Nunamiuts; Binford and Bertram 1977:90-93 for Navajo; O'Connell and Hawkes 1988:118 for Hadza; Yellen 1991 for !Kung San; Wheat 1972:98-100 for Osage). Different taxa may well be treated differently, but animals of the same type are basically processed in a similar manner. Although there may be within-taxon variation in procedures, in sequences of butchering for example, or in how extensively an animal is used, the practices themselves do not alter greatly because they are traditionally correct and express sets of cultural rules. Thus it is reasonable to suggest that standard ways of carcass-processing structured each assemblage.

For all of the assemblages we can assume skinning, evisceration and dismemberment of gazelles and larger animals. Equids and cattle probably underwent these stages at the site of kill to ease carrying, but gazelles could have been subjected to primary processing either at the kill or at the consumption sites - probably depending on how far away from the latter the animal was killed (skinning is easier when an animal is warm, Frison 1978). Cut mark evidence cannot help answer this question of where primary butchery was taking place, because all body parts were generally returned to sites, and it is not evident whether skinning or dismemberment marks were inflicted before or after this. Evidence from two early Epipalaeolithic assemblages - WJ6 A and KH4 A - suggests careful skinning: Binford (1981:107) notes that cut marks around the phalanges reflect fairly complete skinning, as opposed to cutting the hide higher up the leg, for example above the metapodial.

For the smaller animals - hare and fox - the body part data from several assemblages probably indicate processing for skins, but this does not preclude the animals also being cooked and consumed. The absence of hare heads at several Neolithic sites (WJ7 3 and 5, WJ13 2, WJ25) might reflect a dismemberment practice, with heads being discarded off site.

Dismemberment and filleting activities for both gazelle and larger animals are impossible to gauge in many assemblages. At the Epipalaeolithic sites of UW18, AZ18 and KH4 A, however, inferences can be drawn from the fact that certain elements are absent. The non meat-yielding elements of gazelles (at UW18), equids (at UW18, AZ18 and KH4 A) and cattle (at AZ18) were predominantly discarded in these assemblages (maybe after the extraction of marrow, brains, grease), whilst meaty fore- and hind-limb bones are lacking (indicating that they were not filleted first).

Actual cooking, meat-preservation or marrow-extraction activities find no direct evidence in the study assemblages, although it can be safely assumed that some, if not combinations of these, were taking place.

Comparison of activities at different sites

Even without definition of carcass processing activities, assemblages can be compared in terms of how many activities they potentially represent.

As discussed above, of the assemblages examined in this chapter, most represent multiple activities (skinning, dismemberment, processing, cooking, consumption, discard), whilst KH4 A, AZ18 and UW18 differ in that they represents dismemberment, primary processing (maybe consumption of some parts) and removal of parts off-site. In terms of activities, therefore, two types of site are visible.

Many of the study assemblages have not featured in this chapter on carcass utilization because sample sizes are too small for these analyses. Necessarily, only the larger samples have been considered, and these probably result from either longer occupations, repeated occupations, or larger sites. Of the smaller assemblages (all < 40 bones), those from late Upper Palaeolithic WJ9, early Epipalaeolithic UW14, middle Epipalaeolithic WJ8, WJ10 and AZ17 may represent very short-term occupations, or single activities. They may, for example, be kill-butchery locations or hunting camps, but the bone remains themselves are too few to allow interpretation; the discussion in Chapter 10 involving other forms of evidence from the sites (such as artifacts, site densities), however, may be informative.

Activity areas

Little spatial activity in the treatment of animal carcasses has been observed at the study sites, except a possible gazelle skinning area at WJ6 A. This may be in part due to the small scale excavations at some sites. It may also result from the level of analysis, where contexts have been amalgamated within broad phases in order to create adequate samples. Further, at some sites, clear contextual information is either dubious or absent (due to deflation or mixing). Longer-term, or repeated occupation in itself tends to obscure discrete activities.

The 'negative evidence' for spatial activities is informative in itself. Assemblages such as WJ6 A, KH4 A, B, C, D, and WJ22 B and probably many of the others also, are believed to be the debris of groups' repeated visits to the sites; they show the same exact area being reused. This reuse, or reoccupation, is believed to be by the same groups since each phase/assemblage shows internally consistent material culture (mainly lithics). The areas excavated into these sites are generally small (see Chapter 6, table 6.1) compared to the extent of the site i.e. they represent a small sample of the site. If the hunter-gatherer groups who were repeatedly visiting the site maintained a strong and consistent use of space, and if their animal processing activities were spatially defined, we might expect to see strong patterning in the excavated areas, for example in representation of animals' body parts (horizontal movement is believed to be minimal at these sites). That this is not the case strongly suggests that these people did not adhere to strict activity areas over time (at least in terms of their animal processing activities), even though they used the same locations repeatedly.

Discard activities

All of the sites under discussion show bones discarded alongside other occupation material; they are frequently on floor surfaces, in midden levels or within structures. Animal bones are not found, therefore, in spatially distinct contexts such as pits or purely bone-dumping areas. There is one PPNB site in the Wadi el-Jilat, WJ26, which may differ in this respect: two structures which were completely excavated, and one external hearth area, yielded just 12 fragments of identifiable bone and relatively little unidentifiable material. Since preservation does not appear to have been a biasing factor at WJ26, it is argued that disposal of animal bones may have occurred off-site (Martin in Garrard *et al.* 1994). If any of the other sites under consideration had 'off-site' bone disposal, it was not to the exclusion of disposal 'on-site' where bones are found amongst other occupation material.

Discard may be a haphazard affair, with material including bone being left near to their last place of 'use'. Alternatively, discard may be structured, with different categories including bone being treated distinctly (Moore 1981; 1986:102). Further, animal bones themselves may be categorized according to such criteria as taxon, anatomical part, treatment and mode of consumption, which may affect discard patterns. This will be explored in future by mapping the frequency of taxa/elements onto site plans in relation to features and artifact categories.

Walters (1988) points out, with reference to Australian Aboriginal groups, that burning of bone can be a discard activity, sometimes as a general burning of living floors; non-burning of bone can also be significant since some groups have pollution taboos against the mixing of hearths and refuse. He suggests that a high proportion of burnt bone may represent a maintenance activity in living space, and this is interesting in relation to the high percentage of burnt bone at DH 2, WJ7 4 and 5 which is interpreted as secondary burning. Again, future spatial mapping of these data may elucidate patterning.

All that can be said at present is that animal bone appears to have been deposited in the living areas of the eastern Jordanian sites (except WJ26), and whether this represents refuse, markers of space, boundaries or raw material (e.g. for bone working) cannot be determined.

CHAPTER NINE

CAPRINES

Sheep and goat remains are, in short, extremely rare at Epipalaeolithic and PPNB sites in eastern Jordan, and only present in significant proportions in the PPNC/LN. Results of previous faunal studies suggest that eastern Jordan is not a location of caprine domestication, since wild caprines are extremely rare in the area (Garrard *et al.* 1988; Baird *et al.* 1992; Garrard *et al.* 1994). This chapter describes the presence of caprines through time in the area, and discusses how they were used by human groups in each case where they are present.

The chapter consists of four sections. The first reviews evidence for caprines in the study area, integrating new data with previously published results. The second assesses the domestic or wild status of all the caprines. The third examines aspects of caprine management, and in the fourth, caprine carcass treatment is discussed. Finally, the issue of their appearance in significant numbers in eastern Jordan is explored.

Section 1: The presence of caprines in time and space

Table 9.0 shows the percentages of sheep, goat, inseparable caprines (refered to as 'indeterminate') and all caprines from sites in eastern Jordan, ordered chronologically. Similar information is presented in tables 9.1 and 9.2, where results from sites in the limestone area and Basalt Desert have been grouped together to give a regional/chronological picture. Several patterns are observed:

Limestone area:

1) All Epipalaeolithic assemblages (plus one late Upper Palaeolithic) have yielded three indeterminate caprine bones. This suggests that wild caprines were very rare in the area.

2) Only two indeterminate caprine bones have been found in PPNB assemblages; both are from the small late PPNB sample from AZ31 on the basalt margins.

3) In the PPNC/ELN, high numbers of caprines are found, averaging 21%. Both sheep and goat are present, with the former being more than twice as common as the latter.

Basalt area:

1) A single late Epipalaeolithic site is known from this area, and produced a very small sample of animal bones (n=34); over half are caprines of which the only further identifiable material belongs to goat.

2) Both (late) PPNB assemblages have some caprines: a very small percentage of caprines (including 1 sheep bone) is present in the large sample from DH 1; two indeterminate caprine bones were identified from the very small total sample (n=20) from Ibn el-Ghazzi.

3) The later late Neolithic average of 4% caprines (table 9.2) hides two extremes: DH 2 has less than 1% of caprine material from a very large sample (with both sheep and goat represented); B27 2 has 35% caprines (with more positively identified sheep than goats) in an adequate sample. The other assemblage of this period, Jebel Naja, has only nine bones, two of which are sheep, one goat.

	% caprines (based on NISP)				
assemblage	% sheep	% goat	% sh/gt	tot % caprine	sample size (NISP)
LLN					
B27 2	4.3	0.5	30.0	34.8	210
Jebel Naja	22.2	11.1	11.1	44.4	9
DH 2	0.1	0.04	0.32	0.46	8418
PPNC/ELN					
WJ13 3	5.9	2.4	8.4	16.7	971
WJ13 2	8.7	4.0	11.5	24.2	781
WJ13 1	6.4	2.4	10.3	19.1	2373
WJ25	17.0	0.6	42.8	60.4	159
PPNB					
DH 1	0.04	0	0.14	0.18	2786
Ibn el-Ghazzi	0	0	10.0	10.0	20
AZ31*	0	0	3.6	3.6	56
WJ32	0	0	0	0	194
WJ26	0	0	0	0	12
WJ7 5	0	0	0	0	91
WJ7 4	0	0	0	0	365
WJ7 3	0	0	0	0	277
WJ7 2	0	0	0	0	704
WJ7 1	0	0	0	0	375
L EPAL					
Khallat Anaza	0	5.9	47.1	53.0	34
AZ18	0	0	0	0	295
M EPAL					
AZ17	0	0	0	0	49
WJ22 B	0	0	0.02	0.02	5238
WJ22 C	0	0	0	0	3107
WJ22 E	0	0	0	0	19
WJ10	0	0	0	0	67
WJ8	0	0	1.1	1.1	92
E EPAL					
UW18	0	0	0.2	0.2	553
UW14	0	0	0	0	11
KH4 D	0	0	0	0	7404
KH4 C	0	0	0	0	294
KH4 B	0	0	0	0	1572
KH4 A	0	0	0	0	1836
WJ6 C	0	0	0	0	6
WJ6 B	0	0	0	0	112
WJ6 A	0	0	0	0	2575
L U PAL					
WJ9	0	0	0	0	102

Table 9.0. The percentages of sheep, goat, sheep/goat and the total percentage of caprines (based on NISP) from all prehistoric sites in eastern Jordan. *Azraq 31 (AZ31) has not been mentioned before in the present work; the preliminary results presented here are taken from Martin (in Baird *et al.* 1992). Results from WJ13 follow Mylona (1992) and Powell (1992).

frequency of caprines per period, limestone area incl. Azraq & Uwaynid						
period	tot sheep	tot goats	tot no caprines	total sample	% caprines	sites
PPNC/ELN	304	112	900	4,284	21.0	WJ25 WJ13 1 2 & 3
PPNB	0	0	2	2,074	0.1	AZ31
LUP/EPAL	-	-	3	23,332	0.01	UW18 WJ8 WJ22 B

Table 9.1. The frequency of caprine bones (NISP) in the limestone area, including Azraq and Uwaynid sites, by period.

frequency of caprines per period basalt area						
period	tot sheep	tot goats	tot no caprines	total sample	% caprines	sites
LLN	19	5	116	2837	4.0	DH 2 B27 2 Jebel Naja
PPNB	1	-	7	2806	0.2	DH 1 Ibn Gh
LUP/EPAL	-	2	18	34	53.0	Kh An

Table 9.2. The frequency of caprine bones (NISP) in the basalt area, by period.

Section 2: Assessing the status of caprines: are they hunted/wild or herded/domestic?

The criteria used for assessing the status of the caprines are those outlined in Chapter 2, and include consideration of the broad regional perspective of human-animal interaction. Non-faunal aspects of the archaeological record are also drawn upon.

Epipalaeolithic

Caprines from this period are almost certainly hunted wild animals. In the limestone area, that most sites have no caprines at all, and just three sites have one caprine bone each, hints that they were actually scarce in the area, rather than present in greater numbers and avoided. None of the three bones found allowed identification beyond the 'caprine' category.

The evidence from Khallat Anaza shows that goats (either wild goat or ibex) were present in the Basalt Desert. This single sample, however, does not permit speculation as to their frequency or distribution.

PPNB

It is during this period that an increase in the proportional representation of caprines is seen in some other areas of the Levant, for example in the Jordan Valley and Euphrates region (see Chapter 2). No sharp increases are observed in eastern Jordan, but the few caprine remains that there are must be considered in the light of events elsewhere, i.e. domestic sheep and goats are known from the Levantine late PPNB. The extremely small numbers of bones found preclude application of any of the criteria for identifying domesticates described in Chapter 2.

The two caprine bones from late PPNB AZ31 could be from either wild or domestic animals. Firstly, the site borders the limestone and basalt areas, both of which have produced wild caprines, albeit few. It is therefore possible that the bones are from wild animals, hunted with a range of other taxa. Also, the increase in caprines in a later (Late Neolithic) phase of the site (Powell pers. comm.) might represent the introduction of herded animals, suggesting that the earlier specimens are wild. On the other hand, that AZ31 had contact with areas to the west or north is attested by finds of marine shells and by the character of the lithic assemblage, and also strongly suggested by the identification of cultivated barley grains and a seed of free-threshing wheat from the site (Colledge pers. comm.). The possibility of domestic animals being exchanged at this time, therefore, should not be ruled out.

Similar arguments could equally apply to the presence of caprines at late PPNB DH 1. This site has been interpreted as a hunting camp (Betts in press) which might favour an interpretation of the caprines being wild. The extremely low frequency of caprines, also, might not immediately suggest herded animals. That sheep has been identified, however, could cast doubt on this, since there are no previous finds of this taxon in the area; an alternative explanation may be that the caprines represent herded animals which are available to the occupants of DH 1 through contacts, although they are clearly not very important in the economy of this site. In short, it cannot be ruled out that the caprines are wild; it also cannot be ruled out that they were brought onto the site as domesticates, or the bones of domestic animals introduced as joints.

The same problems exist in interpreting the two indeterminate caprines from late PPNB Ibn el-Ghazzi: there is not enough evidence to assess their status.

PPNC/Early Late Neolithic

In the limestone region, WJ25 and all levels of WJ13 (1, 2, 3) have much higher proportions of caprines than any earlier assemblage in the area, e.g. 17-60% compared to a maximum of 1% seen at WJ8 (table 9.0). There is no reason to believe that environmental change led to changing animal distributions at this time, and it therefore seems reasonable to assume that the WJ25 and WJ13 caprines represent human introductions. The zoogeographic argument (see Chapter 2) for the introduction of domesticates, therefore, pertains in this case. When the WJ25 and WJ13 assemblages are compared to those of preceding PPNB WJ7 (1-5), an adjacent site, the major differences between them can be seen to be the presence of caprines at the later sites.

Having argued for the WJ25 and WJ13 caprines being introduced herded animals, there is little reason to examine their cull patterns for this purpose. It is relevant, however, to ask whether the bones show signs of belonging to **morphologically** domestic animals.

Sheep:

No horn cores from either WJ25 or WJ13 allow assessment of morphological variation.

An exploration of the size of the WJ25 and WJ13 sheep is limited firstly by the small number of measurable bones from the assemblages (due to their fragmentary state), and secondly by the lack of published comparative data from coeval sites in the region.

Figure 9.0 shows the sheep bones from eastern Jordan plotted alongside those from other Levantine sites of various periods. The sheep from PPN Cafer Hukuk, Epipalaeolithic Hatoula, Ramat Harif, Rosh Horesha and Wadi Judayid are believed to be wild. Those from Bronze Age (BA) Jericho, and maybe also from PPNC Ain Ghazal (see Chapter 2), are believed to be domestic. The histogram follows the method proposed by Uerpmann (1979) and adapted by Meadow (1983) for plotting measurements of all elements of a taxon together to overcome the problem of small samples. In short, logarithms of each archaeological measurement are subtracted from the logarithm of the same comparative measurement (=Uerpmann's 'standard animal' - a modern wild sheep from the Taurus); the difference of logarithms is plotted for **all anatomical elements** on the same histogram in order to explore overall size variation between assemblages. The drawbacks of this method have been reviewed by Meadow (1983) and Ducos (1991); the main problems are conceptual, in terms of understanding what size variation can mean.

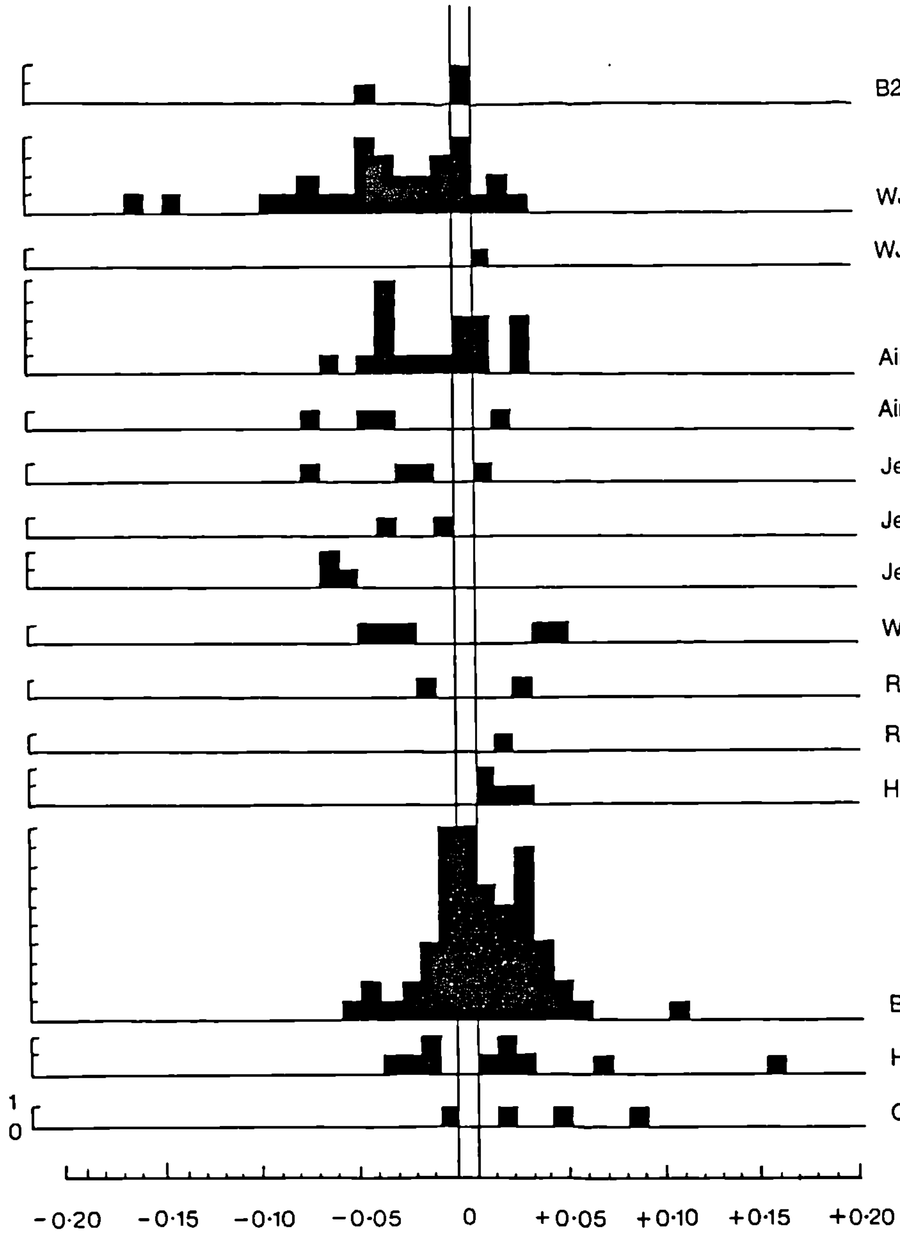


Figure 9.0. The size of sheep bones from PPNC/LN WJ25, WJ13, DH 2 and B27 2 compared with those from selected Levantine sites. The histogram follows the 'standard animal' method of Uerpmann (1979) and Meadow (1983). Sources: Helmer 1985b; Buitenhuis 1988; Davis 1985; Davis *et al.* 1982; Henry and Turnbull 1985; Clutton-Brock 1979; Köhler-Rollefson 1989; Wasse pers. comm.).

Firstly, each histogram does not represent an animal population, but potentially animals from multiple populations; differences might represent natural population size variation. Secondly, variation may result from different sized animals being selected within populations: predominantly male or larger animal culls will produce different histograms from those showing predominantly females or smaller animals. Thirdly, variation observed may be real, and may relate either to climatic/environmental factors, or to the selective forces associated with human management of animals.

Figure 9.0 shows WJ13 to have some smaller sheep elements than any of the other assemblages plotted. These elements are smaller than any of the bones from coeval deposits at Ain Ghazal, or from any of the Neolithic or Bronze Age deposits at Jericho. Sample sizes, however, are far too small for adequate consideration of the potential sources of variation outlined above, leaving morphometric data inconclusive in an assessment of whether the WJ25 and WJ13 sheep are morphologically domestic.

Goat:

Fewer goat than sheep bones were found at WJ25 and WJ13. There are no goat horn cores which permit assessment of whether they are morphologically domestic or wild; material is very fragmented.

Measurements are too few for any detailed analysis. Instead, the ranges of certain goat bone measurements have been compared with those from similar period Levantine sites. Samples are very small and therefore any patterns tentative.

Goat phalanx 1 GL measurements from WJ13 (table 9.3) fall within the range of Bronze Age domesticates from Jericho and at the lower end of the PPNB ranges from Jericho and Abou Gosh. The phalanx BP measurements from WJ13, however, show a similar range to the assumed morphologically wild specimens from Abou Gosh. The single WJ13 metacarpal Bd measurement (table 9.4) is also within the range of those from Bronze Age Jericho, and smaller than the PPNB examples. The WJ13 goat humerus BT measurement (table 9.5) is within the range of those from Ain Ghazal; the two WJ13 tibias (table 9.6) are smaller than those from Ain Ghazal.

In sum, some WJ13 goat measurements fall at the smaller end of equivalent PPNB size ranges, some overlap them, and some are within the ranges of Bronze Age domesticates. Any metrical analysis, with such small sample sizes, is inconclusive as to the morphological (domestic/wild) status of the goats.

Phalanx 1 GL:			
site	period	range (mm)	sample size
Jericho	PPNA-PPNB	37.10-50.40	27
	Bronze Age	32.00-46.55	41
Abou Gosh	PPNB	37.20-51.60	54
WJ13	PPNC/ELN	35.35-42.40	3
Phalanx 1 Bp:			
Abou Gosh	PPNB	11.80-18.60	54
Mallaha	Natufian	14.10-16.80	4
WJ13	PPNC/ELN	11.41-18.41	15
WJ25	PPNC/ELN	13.60	1

Table 9.3. Goat phalanx 1 GL and Bp measurements from Levantine sites (after Clutton-Brock 1979:153; Ducos 1978:112-113; Bouchud 1987) and those from WJ25 and WJ13. The Bronze Age goats from Jericho are assumed to be morphologically domestic; those at Abou Gosh are morphologically wild, but said to be under cultural control (see arguments in Chapter 2); Mallaha wild goats are not argued to be under cultural control.

Metacarpal Bd:			
site	period	range (mm)	sample size
Jericho	PPNA-PPNB	29.35-38.95	7
	Bronze Age	24.05-30.50	20
Beisamoun	PPNB	28.20-34.00	3
Mallaha	Natufian	32.60-34.80	2
WJ13	PPNC/ELN	26.62	1

Table 9.4. Goat metacarpal Bd measurements (after Clutton-Brock 1979:153; Davis 1978:197; Bouchud 1987:78) and those from WJ13. The Bronze Age goats from Jericho are assumed to be morphologically domestic; the status of the PPN goats from Jericho and Beisamoun is unknown; those from Mallaha are wild.

Humerus BT:

site	period	range (mm)	sample size
Ain Ghazal			
	PPNB	27.00-39.00	?
WJ13			
	PPNC/ELN	34.39	1

Table 9.5. Goat humerus BT measurements from Ain Ghazal (after Köhler-Rollefson 1989:143) compared to a single measurement from WJ13. Ain Ghazal goats are argued to under cultural control (see Chapter 2).

Tibia Bd:

site	period	range (mm)	sample size
Ain Ghazal			
	PPNB	25.00-33.00	?
WJ13			
	PPNC/ELN	23.30-23.40	2

Table 9.6. Goat tibia Bd measurements from Ain Ghazal (after Köhler-Rollefson 1989:143) and WJ13. Ain Ghazal goats are argued to be under cultural control (see Chapter 2).

Later Late Neolithic

At DH 2 in the Basalt Desert, caprines (both sheep and goat) are present in very low frequencies (0.5%), and the sample is too small for the application of normal criteria for assessing their domestic/wild status. Discussion of the issue would be the same as those used for the earlier phase of the site - DH 1 (see above). As with DH 1, DH 2 is also interpreted as a hunting occupation, perhaps suggesting that the caprines are more likely to be wild than domestic, although evidence is ambiguous.

The sheep and goats at B27 2, also in the Basalt Desert, constitute a fairly high percentage of the total assemblage (35%). Samples of measurable bones, however, are again too small for morphometric analyses to be informative on the question of their status (e.g. see figure 9.0). I would argue that the sheep are likely to be herded, and therefore domestic, firstly because their proportions are higher than at any other site in the basalt area (disregarding the extremely small sample from Jebel Naja: n=9, MNI=1), and secondly, because their dominance over goats mirrors the picture at other sites in the region (e.g. WJ25, WJ13), where it has been argued (above) that caprines are herded. The status of the goats is more difficult to assess since wild goats are known to have inhabited the basalt region (e.g. Khallat Anaza). I would, however, favour an interpretation of the B27 2 goats also being herded since the examples of WJ13 and WJ25 suggest that herded sheep and goat arrive in eastern Jordan together as a package. It should be kept in mind that they could possibly have been caught (and domesticated?) locally, since they are native to the area.

From Jebel Naja, the faunal sample is clearly too small for comment (n=9), except to note that both sheep and goat have been identified.

In conclusion, I would argue that the caprines from PPNC/ELN WJ25 and WJ13 in the Wadi el-Jilat are herded animals, on the basis of the increase in their representation from the preceding period (PPNB). The caprines from LLN B27 2 on the basalt margins would also appear to be herded on the basis of their proportions within the assemblage, and the ratio of sheep to goats. The morphological status of the sheep and goats from these sites is inconclusive. Following these arguments, herded sheep and goats reach the limestone area before they are visible in the Basalt Desert (although this may be excavation bias).

The status of the caprines at DH 1 and DH 2 is impossible to assess. Their low frequencies, and the interpretation of the site as being a hunting encampment (Betts in press; Martin in press), however, might favour an interpretation of them being wild; activities at DH 1 and 2 appear very focused towards gazelle hunting, and this would probably not combine well with the need to graze animals, which might disperse gazelle herds.

Caprines from PPNB Ibn el-Ghazzi, PPNB AZ31 and LLN Jebel Naja are also of unknown status.

Section 3: Aspects of caprine management: what were people doing with caprines in eastern Jordan at WJ25, WJ13 and B27 2?

If it is accepted, as argued above, that convincing evidence for herded domestic caprines is found only at WJ25, WJ13 (1, 2, 3) and B27 2, then this section applies only to these assemblages. However interesting it may be to ask similar questions (e.g. about cull strategies) of wild caprine acquisition, their sample sizes do not permit scrutiny.

Proportions of caprines within the assemblages

The relative proportion of caprines varies considerably between the three sites, but is similar within the three phases of occupation at WJ13 - 1, 2 and 3:

assemblage	% caprine	tot sample size
B27 2	35%	210
WJ13 3	17%	971
WJ13 2	24%	781
WJ13 1	19%	2373
WJ25	60%	159

Caprines do not dominate the assemblages of WJ13 and B27 2, where most of the fauna is from wild animals. They are much more common at WJ25 (although note the small sample size). Several explanations for this variation are considered in the discussion below.

Ratios of sheep:goats

In each assemblage sheep outnumber goats, meaning that a high percentage of caprines does not necessarily equal a high percentage of both sheep and goats. This trend is extremely pronounced at WJ25, fairly pronounced at B27 2, and less so at WJ13:

assemblage	**sheep:goat**
B27 2	9:1
WJ13 3	2.5:1
WJ13 2	2.2:1
WJ13 1	2.7:1
WJ25	27:1

Sheep and goats have different tolerances, feeding habits physiological conditions and behavioural traits; these are discussed below.

Age structures

The data needed to construct age profiles for caprines - (e.g. dental eruption and wear sequences and bone epiphyseal fusion sequences) are very poor from WJ25, WJ13 and B27 2.

Dental data:

Caprine teeth and tooth rows have preserved badly at eastern Jordanian sites, precluding the creation of age profiles based on dentition. Table 9.7 shows a count of deciduous to permanent mandibles; sheep and goat jaws could not be separated. The sample sizes are clearly too small for comment. It is interesting to note a higher count of adult jaws at WJ13, although this could result from preservational biases against the survival of juvenile/subadult material.

	sheep/goat MNI mandibles	
assemblage	deciduous	permanent
B27 2	0	2
WJ13 1 2 3	4	13
WJ25	1	0

Table 9.7. Counts of deciduous and permanent sheep/goat mandibles (MNI).

Fusion data:

Tables 9.8 to 9.12 give caprine fusion data for WJ25, WJ13 (1, 2, 3) and B27 2. In the cases of WJ25 and B27 2 too few bones yield fusion data to allow comment, even when sheep and goat are considered together.

For WJ13, that each of levels 1, 2 and 3 shows a consistent picture for sheep (tables 9.9 to 9.11) justifies the amalgamation of these smaller samples into one table (9.13) for the site. It should be stressed that the fusion ages given are approximate, and variation is potentially great between different populations. The age ranges are used here only to give a rough impression of different age groups culled. The resulting picture suggests that no sheep were killed in the first 10 months of life. Roughly 56%, however, were culled below two and a half years of age, and 76% of the herd were culled before reaching three and a half year of age. In short, most animals were killed in the first few years of life, and most of these in the first two and a half years.

Data for WJ13 goats are based on a very small sample of bones (n=23, table 9.14); all phases of the site have been amalgamated. The results differ slightly from those of sheep in that only 56% were culled before reaching four years of age; resolution of the earlier age stages is lacking. If such a small sample can be considered at all representative, then it could be argued that, as with sheep, most goats were culled in the first four years of life, but the proportion of these is less for goats than it is for sheep (56% versus 76%).

Sex ratios

Table 9.15 shows the poverty of data available for assessing the ratio of males to females culled. The only count worth noting is the higher number of female sheep pelves than males at WJ13.

	element/sex			
	horn cores		pelves	
taxon/ assemblage	female	male	female	male
sheep				
B27 2	-	-	-	-
WJ13 1 2 3	-	-	6	1
WJ25	-	-	-	-
goat				
B27 2	-	-	-	-
WJ13 1 2 3	-	-	-	1
WJ25	-	-	-	-
sheep/goat				
B27 2	-	-	-	-
WJ13 1 2 3	-	-	1	2
WJ25	-	-	-	-

Table 9.15. Counts of sexed horn cores and pelves of sheep, goats and sheep/goats from WJ25, WJ13 (1, 2 and 3 together) and B27 2.

Herd management

The age and sex data for sheep, and particularly goats, are clearly too few to interpret how people may have managed caprine herds at WJ25, WJ13 and B27 2. Questions about the products which may have been used, or the different treatment of sheep and goat, cannot be properly explored, and only approached very tentatively for WJ13.

The high proportion of young/subadult sheep found at WJ13 fits fairly with Payne's (1973) kill-off pattern where meat is the main concern. Following his model, young male (and sometimes female) animals are culled when they reach their optimum weight, leaving a primarily female breeding stock. The WJ13 age data do not resemble a 'wool curve', and do not show the high cull within the first year that is expected from a classic modern 'milk herd'. It is unlikely that herds were kept for a single product, however, or kept for purely economic reasons either. The occupants of WJ13 clearly killed an array of wild animals as well as sheep and goats, i.e. they were not completely reliant on them. They may have felt seasonal pressures to kill animals, or had particular occasions at which they did so. They may equally have had reasons not to kill certain animals, if for example they were used in exchange or had particular social significance. In short, although most sheep were killed young, and we suspect, at this date (due to lack of evidence from elsewhere to the contrary) that a major product of caprines was their meat (and fat), comparison of cull patterns with a model of modern husbandry practice does not explain herd management decisions.

Goats at WJ13 might be seen as showing a similar cull pattern to sheep, but a lack of resolution precludes further comment.

Section 4: Aspects of carcass treatment

Body part representation

Tables 9.16 to 9.20 show the sheep/goat body part data for WJ25, WJ13 1, 2, 3 and B27 2. Only certain sheep and goat anatomical elements tend to be separable, and by far the majority fall into a category of sheep/goat. For this reason an analysis of body parts which separates sheep and goats is more likely to reflect the ability to categorize particular elements, than human treatment of the animals. Hence, sheep, goat and sheep/goat have been treated together.

Only WJ13 has provided sufficient material for examination, and even these samples are rather small (level 1 n=361; level 2 n=151; level 3 n=131). Figures 9.1 to 9.3 plot the data for the three levels. In each, skull parts, forelimbs, hindlimbs and extremities (metapodials and phalanges) are present.

As with the similar analysis for gazelles (Chapter 8), alternative reasons for differing representation of body parts should be considered. The assessment of carnivore attrition in whole assemblages in Chapter 8 has already concluded that dogs, wolves, jackals and foxes probably had little destructive influence at most sites: gnaw marks, partially-digested bones, and long-bone 'cylinders' (signatures of gnawing) are found in low frequencies (except at B27 2 where they may be significant). Another argument against heavy destruction of caprine bones at WJ13 comes from a comparison of WJ13 1 with Brain's (1981) Kuiseb River goat sample, which is known to have been subject to intensive carnivore attrition. Figure 9.4 shows the WJ13 1 caprine material, ordered according to Brain's sample: the patterns differ sufficiently to suggest that carnivores did not play a major role in shaping the WJ 13 1 assemblage.

Density-related disappearance of some body parts does not appear to be an overriding factor (the presence of atlas, axis, proximal humerus and proximal tibia - all low density parts - is fairly high in WJ13 1 and 2). The low frequency of some skull parts results from a difficulty in identifying them securely as sheep/goat; they are therefore categorized as 'medium herbivore', and their absence from figures 9.1 to 9.3 may not be meaningful. The mandible evidence suggests that skulls are present. Small sample size could explain the absence of some body parts at WJ13 3.

The body part patterns at WJ13, therefore, can probably be taken as representing caprine carcass treatment. The presence of all major body parts indicates, not surprisingly, that all animal parts arrived on site. No body parts appear to have left the site consistently enough to be noticeable. A comparison of the WJ13 1 pattern with that of gazelles from the same assemblage shows a broad similarity, with all body parts present.

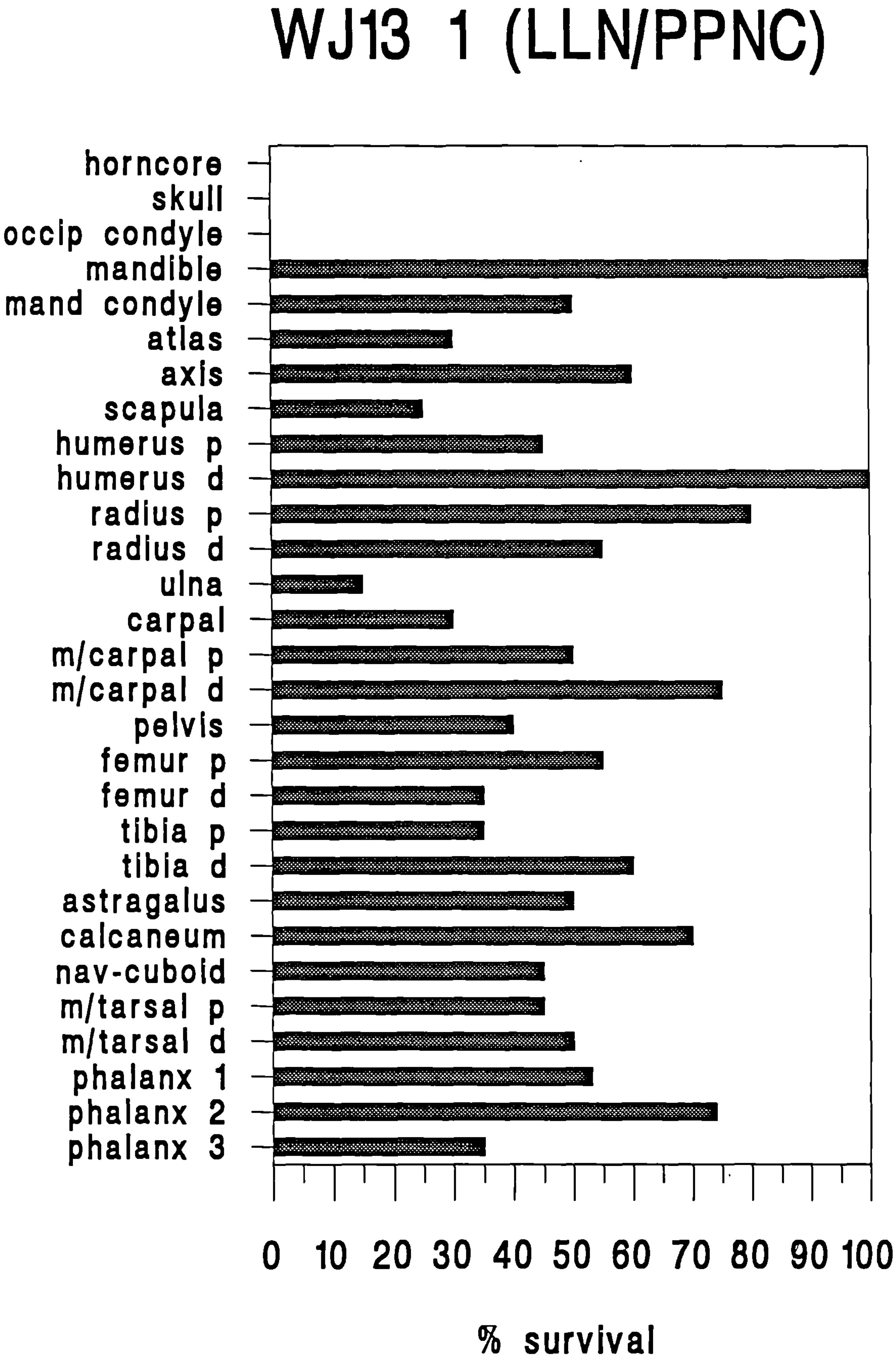


Figure 9.1. The relative frequency of caprine body parts from WJ13 1.

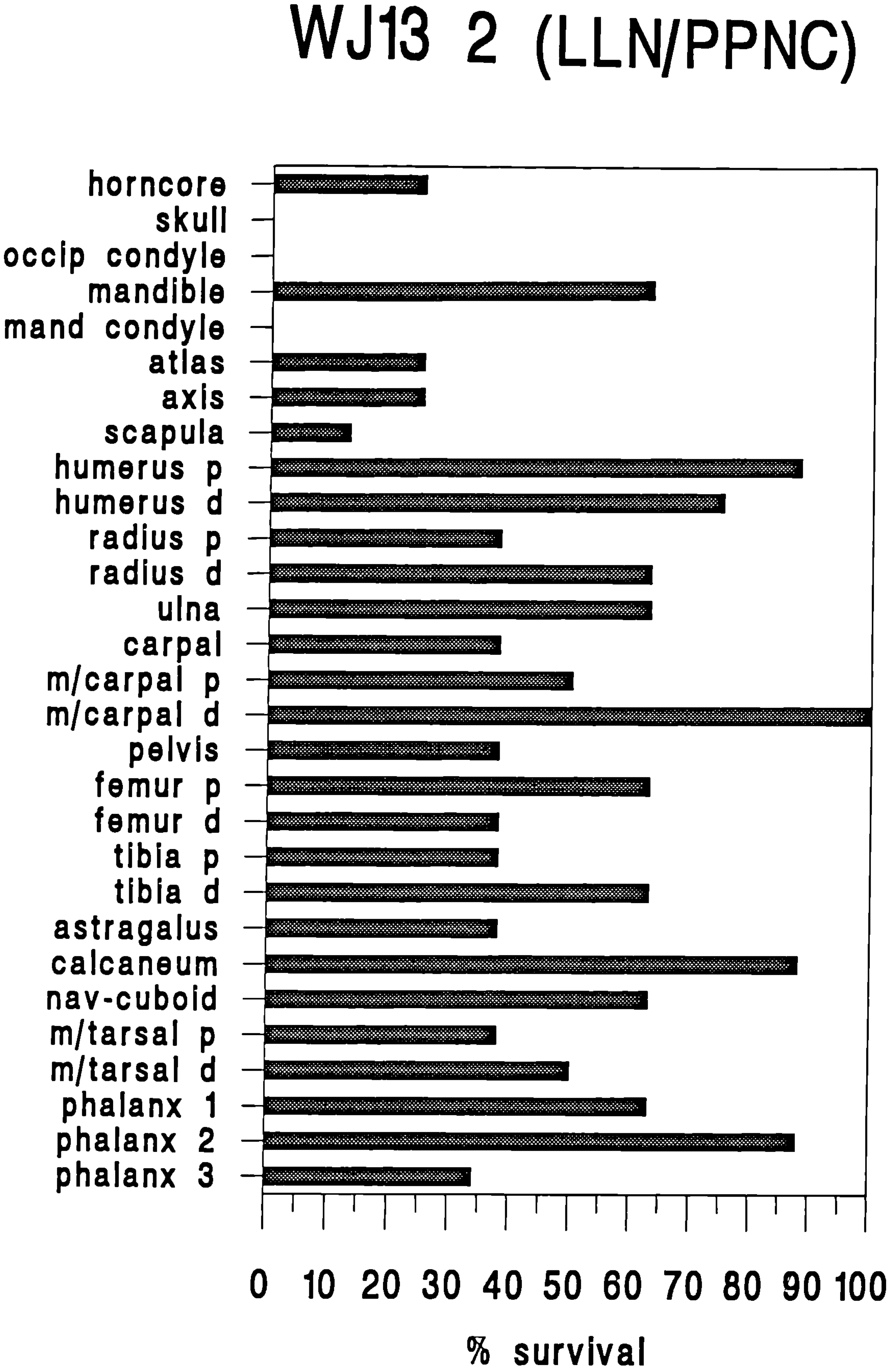


Figure 9.2. The relative frequency of caprine body parts from WJ13 2.

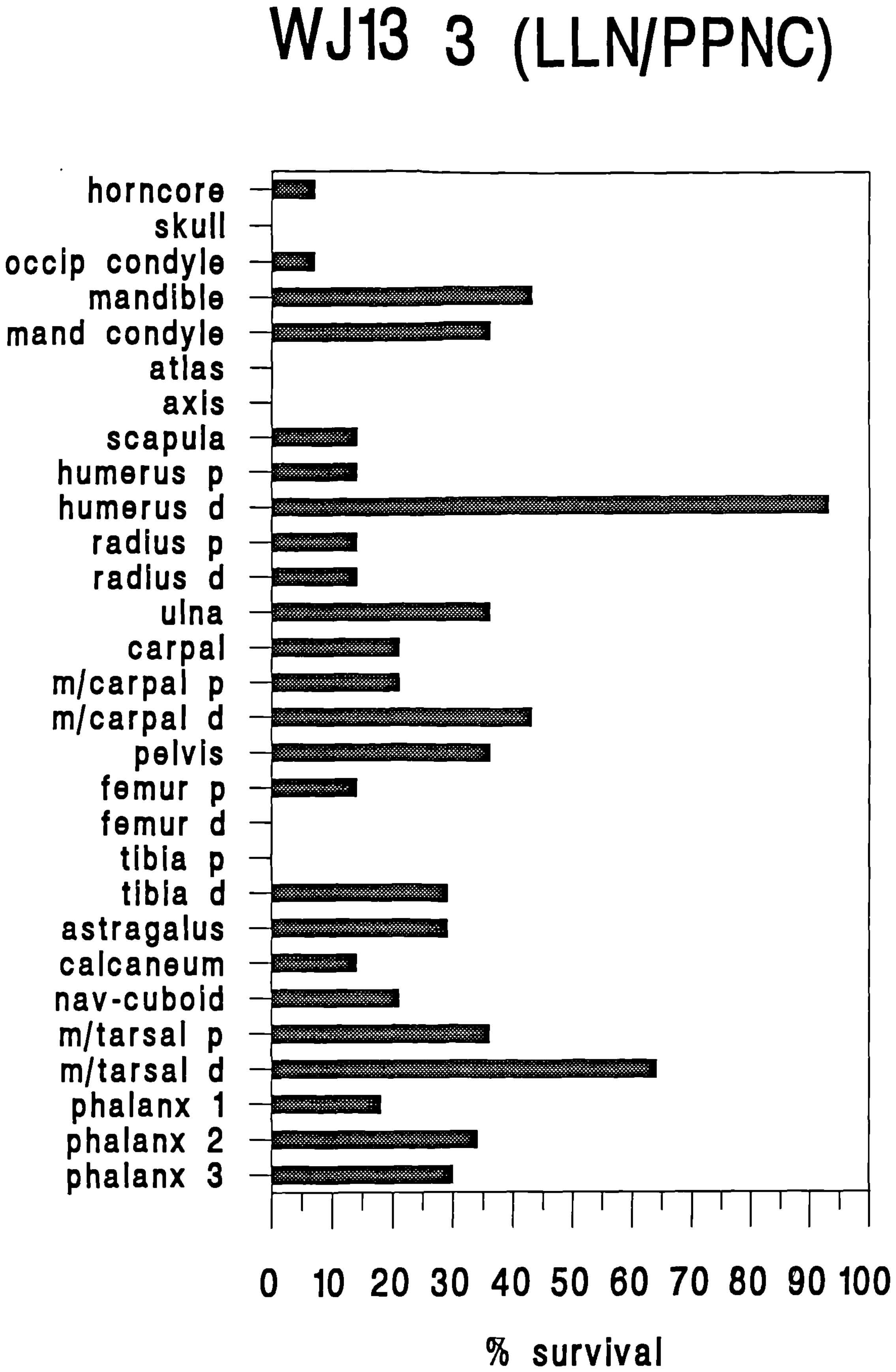


Figure 9.3. The relative frequency of caprine body parts from WJ13 3.

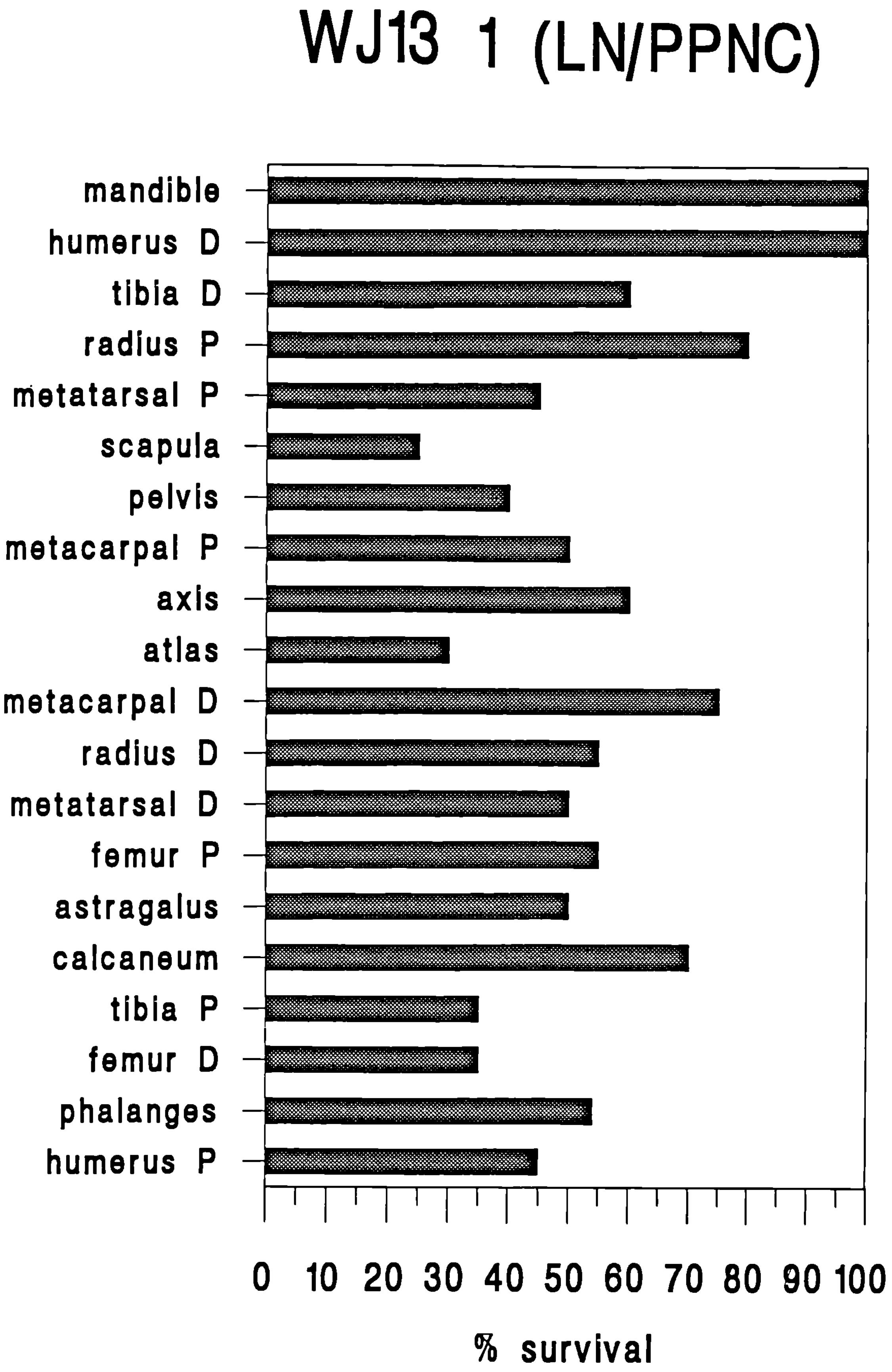


Figure 9.4. The frequency of caprine body parts from WJ13 re-ordered according to Kuiseb River goat sample (Brain 1981:23); see figure 8.11.

Butchery evidence

No cut marks were found on caprine bones from WJ25 and B27 2. Those seen on WJ13 material are shown in table 9.21. They are too few for quantification, or for comparison between taxa or levels.

The interpretation of cut marks follows Binford (1981), who divides them into skinning, dismemberment and filleting cuts. Each of these activities is evidenced at WJ13.

sheep/goat butchery evidence					
assemblage	skinning cuts	dismemberment cuts head	limbs/joints	filleting cuts	chop marks
sheep					
WJ13 3					
WJ13 2	PH3				
WJ13 1	PH1	CV-3	Hd-2 RCp-5		
goat					
WJ13 3					
WJ13 2					
WJ13 1	PH3				
sheep/goat					
WJ13 3					
WJ13 2			PS-7		
WJ13 1	PH1		Fd-3	Tp-4 RCp-7	

Table 9.21. The occurrence of cut marks on caprine bones. Codes for element/cut mark follow Binford 1981; each entry represents a single identified mark.

Discussion

The only plausible evidence for domestic caprines comes from the PPNC/ELN sites of WJ25 and WJ13 in the Wadi el-Jilat (limestone area) and from later Late Neolithic deposits at B27 2 on the basalt margins. It is not yet known whether these animals were morphologically domestic: morphometric data are not sufficient to permit secure comparisons, although some of the sheep bones from WJ13 are small and overlap the size range of Bronze Age (assumed domestic) sheep from Jericho. Whether physically 'domestic' or not, the sheep and goats from WJ25 and WJ13 are interpreted as being closely herded on the basis of their sharp increase in frequency relative to their presence at all earlier sites in the area (due to an absence of sites covering long time sequences, changes are necessarily observed on a regional basis). Zoogeographic criteria, therefore, support the idea of their introduction into the area by human groups.

The same argument cannot necessarily be used for the proportions of sheep and goat from B27 2 since (wild) caprines have been recorded from earlier sites in this area, although it is not known how common they may have been. Rather, the B27 2 caprines appear to be closely herded for the following reasons: 1) sheep are present, and these are **not** known in the wild from the area (i.e. only goat securely recorded from Khallat Anaza); 2) the assemblage is broadly similar to those from WJ25 and WJ13, where sheep outnumber goats, and they are both believed to be herded.

The caprine evidence from other coeval sites in the basalt desert remains ambiguous. Small sample sizes preclude a detailed treatment of some assemblages (e.g. late PPNB Ibn el-Ghazzi and late Late Neolithic Jebel Naja). Further, inadequate knowledge of ancient mammal distributions make it impossible to infer whether the few sheep bones, and even fewer goat bones, found at DH 1, DH 2 and Jebel Naja belonged to wild or domestic animals.

The timing of the appearance of domestic caprines

Table 9.22 gives the radiocarbon dates of the eastern Jordanian deposits which are argued to contain domestic caprines. Although the determinations are very few, they are consistent with the results of a lithics analysis which ties them in to well-dated sequences in other areas of the southern Levant (Baird 1993). Domestic sheep and goats, therefore, are first seen at c. 8,000bp.

C14 dates (BP)

B27 2	7,270±80bp	
WJ13 3	7,900±80bp	7,829±89bp
WJ13 2		
WJ13 1	7,920±80bp	7,870±100bp
WJ25	8,020±80bp	

Table 9.22.

Chapter 2 reviews the evidence for the earliest domestic sheep and goats in the southern Levant as a whole. Data currently available suggest domestic sheep to be present at Basta in southern Jordan by the late PPNB (8,500-8,000bp) and probably at Ain Ghazal on the Jordanian plateau by the final PPNB/PPNC (8,000-7,500bp). The case for goats is more complex: authors have argued that several middle PPNB sites (9,000-8,500bp - Aswad II, Abou Gosh, Ain Ghazal, Beidha) show goats to be kept in states of management or cultural control, whilst morphologically domestic populations are reported only from late PPNB Basta (8,500-8,000bp). The picture is far from clear, but patterns at two late/final PPNB/PPNC sites (Ain Ghazal, Ghoraife II) have sheep replacing goat as the dominant taxon.

The presence of domestic caprines at WJ25 and WJ13, therefore, can be seen to post-date evidence for some control of goats further west and north; they also possibly post-date the evidence for domestic sheep at Basta in southern Jordan (although firm dating of this is awaited); they are more broadly coeval, however, with the first evidence of domestic sheep at the site of Ain Ghazal at c. 8,000-7,500bp, a site which is c. 50km to the west of the Wadi el-Jilat. Furthermore, in this period at Ain Ghazal, sheep appear to rise in importance, at the expense of goat. Sheep and goat herding in the Wadi el-Jilat, therefore, might tentatively be seen as reflecting events at sites such as Ain Ghazal in this period. The introduction of sheep and goats into the Wadi el-Jilat area, and elsewhere in the eastern Jordanian steppe, does not mirror any stages of control (of goats first, then sheep), now suspected for the Levantine corridor (see Chapter 2); both animals arrive together.

That the first evidence to date for domestic caprines in the Basalt Desert is later than that in the limestone area may relate to a lack of faunal samples from the period 8,000-7,500bp, or alternatively, use of the area may have differed. Preliminary results from a study of the faunal remains from the PPNC/ELN phase of AZ31 in the Azraq oasis show caprines in very similar proportions to those at WJ13, and indeed the ratio of sheep to goats is also mirrored (Powell pers. comm.). This suggests that sheep and goat were being herded at least as far east as the western basalt margins.

The proportion of caprines within assemblages

Basta and Ain Ghazal - two large 'village' settlements in the Levantine Corridor - have 76% and 68% caprines in their assemblages respectively. By comparison, the caprine frequency from WJ13 is very low (20%), and that from B27 2 is also low (35%), whilst the proportion from WJ25 is more similar (60%). It is clear that the hunting or trapping of wild animals was important at these sites, to varying extents, and that groups mixed hunting and herding practices.

The difference in caprine proportions between WJ25 and WJ13 is particularly interesting since these are neighbouring and possibly coeval sites. One explanation could be that subsistence practices actually differed between the two sites, with more herded animals killed at WJ25 and more wild animals at WJ13. Another possibility is that the difference results from sample bias, e.g. lots of caprine bones were deposited outside the excavated area at WJ13, or deposited gazelle bones remain unsampled at WJ25.

Alternatively, the contrast might reflect a difference in use of the two sites, by one extended group. Many aspects of material culture between the two sites are identical (i.e. lithic assemblages, stone beads, shell beads); they are approximately 300m apart, and radiocarbon dates from the two sites overlap. The main differences between the sites are that WJ13 is larger, has an array of decorative and 'art' objects, and has been interpreted as having a partly non-domestic function (Garrard 1994), whilst WJ25 is smaller and has a greater frequency of grinding and pounding tools. I have already tentatively suggested in Chapter 8 that the presence of pits, in addition to hearths, at WJ13 might reflect a mode of meat preparation (roasting) and consumption which differs from that at other Neolithic sites in the area (which lack pits). An alternative interpretation, therefore, of the animal bone evidence might be that a single group used the structures at WJ25 and WJ13 more-or-less contemporaneously; spatial differentiation of consumption practices may have resulted in more caprine bones being deposited at the WJ25 building, and more gazelle bones in the large WJ13 structure, where the preparation and consumption of these animals may have been undertaken differently, by larger numbers of people. Ideas of domestic animals (sheep and goat) representing private property and wild animals (gazelle) being shared food may be relevant here (cf. Ingold 1980).

The ratios of sheep to goats; implications for mobility

Goats are generally adapted to hot, arid conditions, whilst sheep tolerate colder, wetter environments (Redding 1984; Lancaster and Lancaster 1991). These tolerances relate, in part, to the greater water requirements of sheep, which are less effective than goats at reducing water loss through reducing urine (Russell 1988:57-58). In addition, sheep are primarily grazers which feed mainly on annuals; their movements are fairly restricted to areas where such forage is provided. Goats, on the other hand, prefer to browse, allowing them a wider range of habitats. Goats are likely to be more productive than sheep if herded year-round in areas which are not well-watered. It may be surprising, given the evidence for an arid early Holocene climate in the southern Levant (see model in Chapter 3), to find a predominance of sheep over goats at sites in the semi-arid eastern Jordan region.

There are many possible reasons why groups may have preferred to keep more sheep than goats. Sheep are believed to be easier to control than goats - perhaps a valuable characteristic in areas of possible crop cultivation (Köhler-Rollefson 1987; 1988). Lancaster and Lancaster describe how sheep store their fat - a much sought after resource? - in more discrete, extractable deposits than goats, whilst sheep milk, if indeed this was used at such an early date, has a higher fat content (1991:130). It seems equally possible, however, that the herd composition was something introduced from elsewhere (from the west?), maybe with the herd itself, particularly since PPNC Ain Ghazal appears to have a higher proportion of sheep than goats also. In this case, the predominance of sheep may have had a significance which cannot be explained on functional grounds.

The implications of keeping herds with such compositions may be easier to suggest. High numbers of sheep would probably have tied herders into seasonal movements, following rains and seeking fresh graze whilst staying in proximity to water. Russell states that mixed sheep and goat herds need water every three days, and are restricted to feeding within 20-30kms of the nearest waterholes (Russell 1988:57-58). Lancaster and Lancaster note a slightly smaller range of 16-20kms for herds in eastern Jordan today (1991:130). It is unlikely that Neolithic caprine herders would have been able to use more arid areas of the steppe in summers; areas such as the Wadi el-Jilat and Burqu may have provided grazing during the autumn-winter-spring period, but animals would have needed moving to lusher pastures in the summer months.

The presence of newborn sheep-goat bones at each of the sites provides some supportive evidence that the Wadi el-Jilat and Burqu areas were used during the winter-spring months: WJ25 has five; WJ13 has five; B27 2 has two. Occupation at other times is obviously not precluded.

Today caprines birth in December/January in the region, although a review of practice in different parts of Arabia suggests that lambing occurs anytime between October and February (Lancaster and Lancaster 1991). The animals which provided these data, however, were probably provided with additional feed in winters and water in summers. I would argue that without supplementary feeding and watering, caprines may have been subject to similar breeding constraints as gazelle herds in the area (see Chapter 4). These animals birth in spring, after females have built up fat stocks to ensure their own, and their offspring's survival; they avoid birthing in harsh winters when vegetation growth is arrested. Although speculative, I would suggest that sheep and goats in Neolithic eastern Jordan may have birthed in spring, and that bones of newborn animals may reflect spring occupation.

Summer mobility; regional contacts

If faunal evidence and ecological reasoning tentatively suggest that herders used WJ25, WJ13 and B27 2 in the autumn-winter-spring period, where might they have moved in summers? There are two main possibilities. Firstly, people could have remained in eastern Jordan, staying close to lusher ground and standing water, for example near Azraq oasis or in major *wadi* systems. Secondly, they may have moved to the west of the plateau or to the Jordan Valley area.

The animal bone evidence alone clearly does not permit reconstruction of mobility patterns. To understand which other parts of the archaeological record could help approach the question, the main models for use of the steppe in this period need discussing.

In a series of papers Köhler-Rollefson has argued for the development of nomadic pastoralism on the Transjordanian plateau sometime in the PPNC/ELN or LLN (Köhler-Rollefson 1988; 1989a; 1989b; 1992). Multiple lines of evidence from the PPNB/PPNC site of Ain Ghazal on the plateau serve as foundations for her proposal. In brief, she argues convincingly for the control of goats in the PPNB at the site (see Chapter 2), where the inhabitants are interpreted as being sedentary agriculturalists. At the end of the PPNB, when many other large sites were abandoned, Ain Ghazal continued to grow and dependency on goats appeared to increase, whilst other evidence has been taken to suggest a depletion of resources (e.g. wood and wild fauna) from the vicinity of the site. Köhler-Rollefson believes that caprine herding may have become spatially separated from crop cultivation at this time, and that caprine 'pastoralism' (based on milk products) could in part explain the success of a settlement in an area of environmental degradation. Her model proposes that caprines were moved east into the steppes and deserts, firstly to keep animals away from crop fields during the growing season (i.e. spring), and secondly, because pasture land closer to settlements had come under cultivation.

The model has met criticism from some (e.g. Goren and Goldberg 1991) who feel that settlements such as Ain Ghazal would not have made such a negative impact on their local environments. It is, however, attractive in many ways. The first appearance of caprines in the steppe in the PPNC/ELN fits with Köhler-Rollefson's proposal. The PPNC caprine material from Ain Ghazal, after recent re-analysis, appears to contain more sheep than goats (Wasse pers. comm., contra Köhler-Rollefson *et al.* 1988), mirroring herds in eastern Jordan. Further, I have argued above that WJ25, WJ13 and B27 2 are autumn/winter/spring occupations, which concords with her model of seasonality, where herds would probably have been moved towards settlements in the west in summers. Following Köhler-Rollefson's ideas, then, sites such as WJ13 and WJ25 should have arisen in the PPNC/ELN in response to an overuse of land further west.

Several points, however, contradict this scenario. Firstly, WJ25 and WJ13 are not sites which are markedly different from those of the preceding period (PPNB) in eastern Jordan. In fact, they tend to show strong continuity from the PPNB in many spheres: architectural style and construction method is similar (Garrard *et al.* 1994); the lithic technology between the periods is consistent (Baird n.d.a.); Dabba 'marble' bead manufacture is known from both PPNB and PPNC/ELN sites (Wright in Garrard *et al.* 1994); and subsistence practices are broadly parallel, except for the addition of caprines at WJ25 and WJ13. WJ25 and WJ13 appear to belong to a tradition of settlement which extends back to the early PPNB, which perhaps suggests more that caprines were integrated into existing systems than caprine pastoralists moved into steppic areas at this time.

A second point which challenges Köhler-Rollefson's model is that the sheep cull patterns do not support a picture of herds being kept for their milk products, although cull data are admittedly very poor (see above). Köhler-Rollefson suggests that a prerequisite for the separation of herding (in the steppes and deserts) from cultivation (around settlements further west) would be a shift from meat to milk production. This would allow pastoralists to live primarily from the products of their herds, without continuously diminishing herd size. The sheep age data from WJ13 implies, if anything, cull practices more consistent with meat production.

Given this, another scenario to be considered is that milking female caprines may have remained at settlements further west such as Ain Ghazal forming 'fallow herds' (Dahl and Hjort 1976), whilst younger animals (both female and male) were winter-pastured in the steppe. The culling of these herds could have produced the 'meat curve' at WJ13. Although it is, of course, possible that herders were milking sheep and goats in the PPNC/ELN or LLN, we have no evidence to support this idea, whether from animal bones (Horwitz and Smith 1991) or artifacts.

I would therefore argue that WJ25 and WJ13 do not necessarily witness the beginnings of large scale specialized pastoralism, but rather the merging of herding with hunting, gathering and possibly crop cultivation activities.

This leads to a final point, to the evidence for domestic cereals in the steppe, which could contradict Köhler-Rollefson's proposal of a separation of herding and cultivation between the 'desert and the sown', if they were locally grown. Colledge (in Garrard *et al.* 1994) has identified domestic einkorn and domestic emmer from WJ13, as she also has from the PPNB site of WJ7. She has also found small quantities of einkorn and emmer chaff (glumes) which might suggest, although not necessarily, that the final processing of these cereals was done locally. Whilst it is, of course, possible that grain was imported in a partly processed state, the evidence could equally imply local cultivation of cereals. The archaeobotanical evidence remains ambiguous, but if cultivation was taking place around WJ13 and WJ25 then the suggestion that animals were pastured away from agricultural areas does not hold.

An alternative model for use of the steppe in this period is forwarded by Byrd (1992) who argues that the PPNB and PPNC occupants of eastern Jordan were hunter-gatherers who selectively integrated domestic resources into their economy, maybe as a means of reducing risk. The eastern Jordanian evidence discussed above, firstly for strong continuity between PPNB and PPNC/ELN sites, secondly for the use of domestic cereals from the early PPNB, and thirdly for the later introduction of domestic caprines, appears to fit this scenario better. Contact is clearly attested between these steppe-dwellers and the larger agricultural settlements to the west (with the introduction of domestic resources to the steppe being a likely result of this contact). Evidence, however, points to eastern Jordanian traditions being more separate from those further west, rather than fully integrated with them.

Following this, one might envisage the herders from WJ25 and WJ13 making year-round movements within the area. Animals may have been pastured in slightly lusher areas in summers; in fact the PPNC/ELN site of AZ31 at the Azraq oasis has elements of material culture, such as the architecture and Dabba 'marble' beads (Baird *et al.* 1992) which confirm contacts between the Jilat and Azraq areas.

Mobility and contacts between the desert and the sown are difficult to gauge, but the emerging picture is of eastern Jordanian sites adopting some elements of agricultural life, rather than being fully integrated with larger agricultural settlements to the west.

SHEEP/GOAT POSTCRANIAL AGEING DATA

Assemblage: WJ25

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	0	
d humerus	10	0	2	
p radius	10	0	2	
TOT >6-10 months		0	4	100
d tibia	18-24	0	0	
d metacarpal	18-24	1	2	
d metatarsal	20-28	0	1	
TOT>18-28 months		1	3	75
p ulna	30	0	0	
p femur	30-36	1	0	
calcaneum	30-36	0	0	
p tibia	30-36	0	0	
d radius	36	0	1	
d femur	36-42	0	0	
p humerus	36-42	0	0	
TOT>30-42 months		1	1	50

Total number of bones with fusion data=10

Table 9.8. WJ25 sheep/goat fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep (ages for sheep have been used because, although most bones with fusion data are identifiable only to sheep/goat category, where they are separable in the complete assemblage the sheep:goat ratio is 27:1).

Assemblage: WJ13 1

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	1	
d humerus	10	0	1	
p radius	10	0	9	
TOT >6-10 months		0	11	100
d tibia	18-24	0	6	
d metacarpal	18-24	5	2	
d metatarsal	20-28	6	2	
TOT>18-28 months		11	10	48
p ulna	30	1	0	
p femur	30-36	2	1	
calcaneum	30-36	3	2	
p tibia	30-36	0	0	
d radius	36	7	0	
d femur	36-42	1	0	
p humerus	36-42	1	2	
TOT>30-42 months		15	5	25

Total number of bones with fusion data=52

Table 9.9. WJ13 1 sheep fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep.

Assemblage: WJ13 2

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	1	
d humerus	10	0	0	
p radius	10	0	1	
TOT >6-10 months		0	2	100
d tibia	18-24	0	1	
d metacarpal	18-24	3	3	
d metatarsal	20-28	2	0	
TOT>18-28 months		5	4	44
p ulna	30	1	0	
p femur	30-36	0	2	
calcaneum	30-36	3	0	
p tibia	30-36	0	0	
d radius	36	3	0	
d femur	36-42	0	0	
p humerus	36-42	0	1	
TOT>30-42 months		7	3	30

Total number of bones with fusion data=21

Table 9.10. WJ13 2 sheep fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep.

Assemblage: WJ13 3

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	0	
d humerus	10	0	1	
p radius	10	0	0	
TOT >6-10 months		0	1	100
d tibia	18-24	1	2	
d metacarpal	18-24	2	1	
d metatarsal	20-28	4	1	
TOT>18-28 months		7	4	36
p ulna	30	1	0	
p femur	30-36	0	0	
calcaneum	30-36	1	0	
p tibia	30-36	0	0	
d radius	36	2	0	
d femur	36-42	0	0	
p humerus	36-42	0	0	
TOT>30-42 months		4	0	0

Total number of bones with fusion data=16

Table 9.11. WJ13 3 sheep fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep.

Assemblage: B27 2

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	3	
d humerus	10	0	3	
p radius	10	0	0	
TOT >6-10 months		0	6	100
d tibia	18-24	1	2	
d metacarpal	18-24	1	2	
d metatarsal	20-28	2	1	
TOT>18-28 months		4	5	56
p ulna	30	1	0	
p femur	30-36	2	0	
calcaneum	30-36	0	0	
p tibia	30-36	0	0	
d radius	36	0	0	
d femur	36-42	0	0	
p humerus	36-42	0	0	
TOT>30-42 months		3	0	0

Total number of bones with fusion data=18

Table 9.12. B27 2 sheep/goat fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep (ages for sheep have been used because, although most bones with fusion data are identifiable only to sheep/goat category, where they are separable in the complete assemblage the sheep:goat ratio is 9:1).

Assemblage: WJ13 1, 2, 3 (together)

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
scapula-coracoid	6-8	0	2	
d humerus	10	0	2	
p radius	10	0	10	
TOT >6-10 months		0	14	100
d tibia	18-24	1	9	
d metacarpal	18-24	10	6	
d metatarsal	20-28	12	3	
TOT>18-28 months		23	18	44
p ulna	30	3	0	
p femur	30-36	2	3	
calcaneum	30-36	7	2	
p tibia	30-36	0	0	
d radius	36	12	0	
d femur	36-42	1	0	
p humerus	36-42	1	3	
TOT>30-42 months		26	8	24

Total number of bones with fusion data=89

Table 9.13. WJ13 1, 2, 3 (together) sheep fusion data. *Approximate ages of fusion taken from Silver (1969:285-286), based on domestic sheep.

GOAT POSTCRANIAL AGEING DATA

Assemblage: WJ13 1, 2, 3 (together)

ELEMENT	FUSION AGE* (months)	NUMBER UNFUSED	NUMBER FUSED	% FUSED
p radius	4-9	0	0	
scapula-coracoid	9-11	0	1	
d humerus	11-12	1	2	
TOT >4-12 months		1	3	75
d tibia	19-?24	1	2	
TOT>19-24 months		1	2	67
d metacarpal	23-30	3	1	
d metatarsal	23-30	3	2	
p femur	23-36	0	0	
p tibia	23-?36	0	0	
calcaneum	23-48	3	1	
d femur	23-48	0	0	
p humerus	23-48	0	0	
d radius	33-48	0	3	
TOT>23-48 months		9	7	44

Total number of bones with fusion data=23

Table 9.14. WJ13 1, 2, 3 (together) goat fusion data. *Approximate ages of fusion taken from Noddle (1974), based on feral and domestic goats.

SHEEP/GOAT BODY PART DATA

Assemblage: WJ25

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	0			4	0
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBLE	1			4	25
MANDIBULAR COND	0			4	0
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	0			4	0
HUMERUS PROX	0			4	0
HUMERUS DIST	2		2	4	50
RADIUS PROX	1			4	25
RADIUS DIST	2			4	50
ULNA	1			4	50
CARPALS	0			4	0
METACARPAL PROX	3			4	75
METACARPAL DIST	3			4	75
PELVIS	1			4	25
FEMUR PROX	1			4	25
FEMUR DIST	0			4	0
TIBIA PROX	0			4	0
TIBIA DIST	0			4	0
ASTRAGALUS	0			4	0
CALCANEUM	1			4	25
NAVICULO CUBOID	0			4	0
METATARSAL PROX	0			4	0
METATARSAL DIST	2			4	50
PHALANX 1	20			16	100
PHALANX 2	19			16	100
PHALANX 3	6			16	38
TOTAL	63				

Table 9.16. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

SHEEP/GOAT BODY PART DATA

Assemblage: WJ13 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	0			20	0
PETROUS (SKULL)	0			20	0
OCCIPITAL COND	0			20	0
MANDIBLE	21			20	100
MANDIBULAR COND	10			20	50
ATLAS	3			10	30
AXIS	6			10	60
SCAPULA	5			20	25
HUMERUS PROX	9			20	45
HUMERUS DIST	20		10	20	100
RADIUS PROX	16			20	80
RADIUS DIST	11			20	55
ULNA	3			20	15
CARPALS	6			20	30
METACARPAL PROX	10			20	50
METACARPAL DIST	15			20	75
PELVIS	8			20	40
FEMUR PROX	11			20	55
FEMUR DIST	7			20	35
TIBIA PROX	7			20	35
TIBIA DIST	12			20	60
ASTRAGALUS	10			20	50
CALCANEUM	14			20	70
NAVICULO CUBOID	9			20	45
METATARSAL PROX	9			20	45
METATARSAL DIST	10			20	50
PHALANX 1	42			80	53
PHALANX 2	59			80	74
PHALANX 3	28			80	35
TOTAL	361				

Table 9.17. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

SHEEP/GOAT BODY PART DATA

Assemblage: WJ13 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	2			8	25
PETROUS (SKULL)	0			8	0
OCCIPITAL COND	0			8	0
MANDIBLE	5			8	63
MANDIBULAR COND	0			8	0
ATLAS	1			4	25
AXIS	1			4	25
SCAPULA	1			8	13
HUMERUS PROX	7			8	88
HUMERUS DIST	6			8	75
RADIUS PROX	3			8	38
RADIUS DIST	5			8	63
ULNA	5			8	63
CARPALS	3			8	38
METACARPAL PROX	4			8	50
METACARPAL DIST	8			8	100
PELVIS	3			8	38
FEMUR PROX	5			8	63
FEMUR DIST	3			8	38
TIBIA PROX	3			8	38
TIBIA DIST	5			8	63
ASTRAGALUS	3			8	38
CALCANEUM	7		4	8	88
NAVICULO CUBOID	5			8	63
METATARSAL PROX	3			8	38
METATARSAL DIST	4			8	50
PHALANX 1	20			32	63
PHALANX 2	28			32	88
PHALANX 3	11			32	34
TOTAL	151				

Table 9.18. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

SHEEP/GOAT BODY PART DATA

Assemblage: WJ13 3

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	1			14	7
PETROUS (SKULL)	0			14	7
OCCIPITAL COND	1			14	7
MANDIBLE	6			14	43
MANDIBULAR COND	5			14	36
ATLAS	0			7	0
AXIS	0			7	0
SCAPULA	2			14	14
HUMERUS PROX	2			14	14
HUMERUS DIST	13		7	14	93
RADIUS PROX	2			14	14
RADIUS DIST	2			14	14
ULNA	5			14	36
CARPALS	3			14	21
METACARPAL PROX	3			14	21
METACARPAL DIST	6			14	43
PELVIS	5			14	36
FEMUR PROX	2			14	14
FEMUR DIST	0			14	0
TIBIA PROX	0			14	0
TIBIA DIST	4			14	29
ASTRAGALUS	4			14	29
CALCANEUM	2			14	14
NAVICULO CUBOID	3			14	21
METATARSAL PROX	5			14	36
METATARSAL DIST	9			14	64
PHALANX 1	10			56	18
PHALANX 2	19			56	34
PHALANX 3	17			56	30
TOTAL	131				

Table 9.19. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

SHEEP/GOAT BODY PART DATA

Assemblage: B27 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	2			6	33
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBLE	2			6	33
MANDIBULAR COND	4			6	67
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	4			6	67
HUMERUS PROX	0			6	0
HUMERUS DIST	4			6	67
RADIUS PROX	0			6	0
RADIUS DIST	0			6	0
ULNA	2			6	33
CARPALS	1			6	17
METACARPAL PROX	5		3	6	83
METACARPAL DIST	3			6	50
PELVIS	0			6	0
FEMUR PROX	3			6	50
FEMUR DIST	1			6	17
TIBIA PROX	0			6	0
TIBIA DIST	3			6	50
ASTRAGALUS	1			6	17
CALCANEUM	2			6	33
NAVICULO CUBOID	0			6	0
METATARSAL PROX	1			6	17
METATARSAL DIST	2			6	33
PHALANX 1	10			24	42
PHALANX 2	0			24	0
PHALANX 3	3			24	13
TOTAL	53				

Table 9.20. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

CHAPTER TEN

SUMMARY, DISCUSSION AND CONCLUSIONS

The first chapter of this thesis set the archaeological, environmental and palaeoenvironmental background to the Epipalaeolithic and Neolithic southern Levant, and described the well researched areas which provide both a backdrop and close parallels for the study area. Regional diversity, in terms of phytogeography, settlement types and patterns and material culture traditions, was highlighted. Subsistence evidence for the same periods and areas, and interpretations of subsistence strategies, was summarized in Chapter 2; the focus was on faunal remains, and particular attention was paid to the treatment of gazelle, equid, hare and caprine remains, since these taxa are most common at the study sites. The study area - steppic eastern Jordan - was described in Chapter 3. Chapters 4 and 5 are methodological: the latter outlined the archaeozoological techniques used to create the data; the former presented a reconstruction of gazelle ethology for prehistoric eastern Jordan, which is a major interpretative tool in the examination of the gazelle bones which dominate at many of the study sites.

Chapter 6 presented the primary animal bone data - the relative proportions of taxa - for each site/assemblage, and drew out the patterns. Gazelle dominate at many Epipalaeolithic sites; caprines appear in significant numbers in the area only in the PPNC/ELN; equids tend to decline throughout the Epipalaeolithic-Neolithic sequence; hare bones constitute relatively high proportions of most PPNB/LN assemblages. The exploration of these patterns was separated out in the subsequent three chapters, where issues of selective practices, cull patterns, ecology, carcass treatment and herding were dealt with discretely. Here, these issues are brought together and integrated with the rest of the archaeological evidence for discussion of the overall economy of sites, the types of occupation which the study sites represent and how the area of eastern Jordan was used in the periods of interest.

Late Upper Palaeolithic

The single assemblage of this period - WJ9 - produced so few identifiable animal remains (NISP 101; MNB 5) that it is uninformative. The few equid, gazelle and hare bones, but higher number of tortoise carapace fragments, cannot be integrated meaningfully with Byrd's (1988a) observations of a relatively large occupation, or palimpsest of occupations, thick deposits and high densities of stone tools.

Early Epipalaeolithic

The lower levels of WJ6 (B, C) have very small samples of bone, too few for comment; Byrd interprets both assemblages as short term encampments on the basis of the depth of occupation, density of artifacts and narrow range of tool types.

WJ6 A is one of the eastern Jordan 'mega-sites' (Garrard and Byrd 1992), one of the largest known Epipalaeolithic sites in the Levant, which appears to consist of a palimpsest of activities, representing repeated use. Byrd (1988) has identified a diversity of tools, interpreted as reflecting a wide range of tasks, although characteristic of this assemblage, and most contemporaneous ones, is the intensive production of microliths (hunting armatures). From the faunal remains, hunting is seen to have focused on gazelle (73%), and to a lesser extent on equids (9%). As with the other Epipalaeolithic sites at which gazelle dominate, this is not seen to be positive selection of this animal since it is predicted to have been present in large numbers in the area. I have argued that gazelle are hunted by simple encounter methods, from the presence of newborns, and probably also mothers (indicated by a slight bias towards females); thus, vulnerable individuals which would have been isolated from the main herds appear to have been targetted, suggesting stalking. There is, however, no strong selectivity in the cull patterns. Hunting is seen to have taken place in winter/spring at least, and the juvenile count (32%) is in accord with their expected proportion in nature in those seasons.

All gazelle body parts are represented at WJ6 A, as are equid parts, a pattern which is interpreted as whole carcasses being returned to the site. This firstly hints that animals were hunted and killed fairly close to the site, particularly in the case of the heavier equids where some body parts might have been discarded if the carcass was to be transported long distances. Secondly, the introduction of whole carcasses onto the site might be seen as a fairly intensive use of the animal. A gazelle skinning area has been identified, and the cut marks show careful removal of the phalanges from the hide (Binford 1981). Dismemberment marks on gazelle bones are also noted, and the absence of hare foot bones (with all other body parts present) suggests that skinning of these animals is either a spatially identifiable activity, or that skins were leaving the site, with foot bones attached. From such insights, it is tempting to suggest that a wide range of carcass processing and preparation activities was undertaken at the site, although direct evidence for most is lacking.

The lithic and bone evidence, thickness of deposits, the ochred plaster floors (presumably of a structure), the marine shell beads and bone tools are all strongly suggestive of a living area, a base camp or multiple activity site. The activities appear to focus mainly on hunting, and predominantly gazelle hunting, although a whole range of animals from the local environment (aurochs, equids, boar, hare, wolves/jackals, foxes, birds and tortoises) were taken, and potential plant foods have been identified from the site (Colledge in Garrard *et al.* 1988). I have argued that people occupied the site in winter/spring - the wet, lusher season, when gazelles were obviously birthing nearby, and herds may have been attracted into the *wadi* to feed on the new spring vegetation growth. The idea that WJ6 A was a seasonal aggregation site, where groups repeatedly reoccupied the same locale, perhaps partly due to the flint sources or water availability, or because the area had territorial significance (Garrard and Byrd 1992), or maybe in part because the *wadi* served as a gazelle fawing ground, seems attractive.

The four phases at KH4 (A, B, C, D) appear to represent very similar types of occupation to WJ6 A. The site has not been subject to the same kind of specialist studies as WJ6, but it can also be classed as an eastern Jordanian 'mega-site' (Garrard and Byrd 1992); the depths of deposits, living floors, burials, hints of a structure and range of artifacts all argue for repeated use of a longer-term base camp/multiple activity site.

The faunal remains are similar to those from WJ6 A, with gazelle dominating each phase (82-91%). Again, winter/spring hunting is evidenced, and no selectivity is found, either in choice of taxa, or in the age or sex classes of gazelle culled (except for a slight bias towards females at KH4 B). Whole gazelle and equid carcasses were brought onto the site; there is evidence for gazelle skinning in KH4 A, and dismemberment in KH4 B, C and D, and a whole range of processing activities could be envisaged. The equid bones from KH4 A are intriguing, since their body part representation shows a predominance of head and foot bones, maybe suggesting the onward transport of the meat-yielding upper limb parts. The primary dismemberment activities suggested by this pattern are slightly at odds with the interpretation of the site as a base camp and processing site. There is some evidence also for hare skins leaving the site in phases A and B (although the lack of hare foot bones could also result from skinning being a spatially separated activity). As with WJ6 A, the faunal remains from KH4 would support interpretation of the site as a winter/spring aggregation location.

Of the other early Epipalaeolithic assemblages, **UW14** has too few bones to be informative, but the upper phase of **UW18** tells a different story to WJ6 A or KH4 in terms of site function. Here, gazelles still dominate (72%), with equids the next most frequent (9%) (the low representation of cattle (1%) is perhaps surprising in this moist location). Gazelle body part data shows a high representation of foot bones and skull parts, and a correspondingly low representation of upper limb parts: the high meat-yielding elements are missing. Interestingly, this same pattern in observed for the equids, where there is an overwhelming dominance of head and foot parts. Both animals, therefore, show similar treatment; high meat-yielding elements appear to have been transported off-site, which might suggest that UW18 was a kill-butchering, or primary-butchering location (after Binford 1978).

Byrd (1988a), however, has interpreted the site as one seeing longer-term or repeated use, on the basis of occupation depth and density of artifacts, and the presence of shell beads and worked basalt objects might indicate more varied activities than a simple butchery place. There is no reason why a longer-term camp site should **not** see the consistent onward movement of some carcass parts, but the case of UW18 is interesting, firstly because the body part evidence is slightly at odds with the expectations of the contextual evidence, and secondly because it shows how on-site animal treatment (in this case primary-processing) is not necessarily predictable from the artifactual evidence and overall nature of the site.

Middle Epipalaeolithic

Middle Epipalaeolithic **WJ8** and **WJ10** in the Wadi el-Jilat, and **AZ17** in Azraq, yielded too few animal bones for any integrated analysis; Byrd's (1988a) interpretation of all of them is as longer-term or repeated use sites.

All three occupation phases of **WJ22** (B, C, E) are also believed to represent longer-term or repeated usage (Byrd 1988). The lower phase (E) has too few bones for analysis. The others show lower frequencies of gazelle than the early Epipalaeolithic assemblages (B=55%; C=37%), and relatively high proportions of tortoise (B=13%; C=12%), equids (C=15%) and birds (C=28%). The high frequency of birds in phase C may be due in part to the marsh around the site, which is evidenced in the sediments. The absence of cattle from this site has been noted as perhaps surprising in a location with standing water.

The gazelle from WJ22 B and C show evidence for being hunted in both spring and early summer, which differs from the pattern seen in the early Epipalaeolithic (when only spring culls are firmly evidenced). The proportion of juvenile animals from WJ22 B is 36%, which does not suggest selective culling. The skeletal part analysis shows all body parts of gazelle, equids and hare to be present, indicating that whole carcasses arrived on site and that joints were not removed. I have argued that the large numbers of tortoise bones (mainly carapace fragments) in these assemblages are likely to have been brought onto, and used on, sites and are not intrusive.

Late Epipalaeolithic

Of the late Epipalaeolithic/Natufian sites, **Khallat Anaza** has too few animal bone remains for meaningful integration with other evidence. The sample from **AZ18**, however, allows fairly detailed analysis. This assemblage has broadly similar frequencies of equids, cattle and gazelle, which is interpreted as representing fairly opportunistic hunting: each of these animals would be expected to inhabit or visit the lush lake-side area of the site. Byrd (1988a) classes the site as a longer-term or repeated use location; and the relatively high proportions of worked stone objects, shell beads and worked bone, plus the burials below the main occupation level, might support this view. He finds the tool-kit, however, to show a special emphasis on hunting, compared to other Natufian lithic assemblages from moister areas (Byrd 1989).

The analyses of skeletal part representation for equid and cattle from the site both show similar patterns: skull parts and foot bones (metapodials and phalanges) predominate (although cattle have other parts also). The interpretation of this could be that the site served as a primary-butchery location, where the meaty upper limbs of these animals were transported on elsewhere. Alternatively, and perhaps more likely considering the burial and artifactual evidence, the excavations could have sampled a particular cattle and equid processing area or a longer-term site, where extremities were discarded (in skinning?), whilst other activities were undertaken on other parts of the site.

It is evident that all Epipalaeolithic occupations which have produced sufficient bone for detailed analysis are those viewed as longer-term or repeated use sites. The three deposits listed by Byrd (1988a) as short-term or single activity sites (WJ6 B and C, UW14) yielded small and uninformative faunal assemblages. It is likely, therefore, that the animal bone samples which have been discussed in detail in this thesis derive from aggregation/base camp sites rather than the range of other site types (kill sites, look-outs) which could be expected, simply because these other sites are archaeologically invisible, or because the animal bone remains are too few to interpret. A related problem is that it is difficult to identify many activities from the bone from the deeper accumulated deposits which show little time or 'event' resolution. All that has been possible is the identification of certain dismemberment and bone transport (or spatially separated) practices. Investigation of different processing activities (e.g. preparing meat for everyday consumption, feasting, storage, marrow and bone grease extraction etc.) has not been possible.

An effect of the sample size problems is that all sites yielding data on the season(s) of culls - always spring or spring/early summer - are the larger, deeper ones. It is possible to predict, therefore, that most sites discussed above are winter/spring/early summer occupations, when plant, animal and water resources would be available and favourable in these *wadi* locations. Attempts to reconstruct hunter-gatherer mobility are impossible given these data, but it is tempting to suggest that if larger, repeated-use sites generally represent winter/spring occupations, then groups may have either dispersed or moved to other areas during the dry summers when resources were more scarse; resulting summer sites may be either outside the study area, or if within it, more ephemeral, and therefore archaeologically undetectable.

PPNB

The site of **WJ7** spans the PPNB (from early PPNB phase 1 to middle/late PPNB phase 5). Each phase has a roughly similar faunal composition, although the proportion of gazelle varies between 28% and 57%, and hare representation ranges from 15% to 47%. Nevertheless, hare bones are consistently more common than at any of the earlier sites in eastern Jordan. Large herbivores are represented by only two bones (0.2%) - both from WJ7 2 - one of which belongs to *Bos* sp.. The presence of this taxon defies expectations for this period which is assumed to be arid, and it is suggested that the aurochs/cattle bone may represent an imported joint/bone/animal.

Small sample sizes preclude detailed faunal analyses. There is no evidence for the season(s) of culls, although the presence of cultivated wheat and barley in phases 1 and 3 **might** suggest that groups inhabited the site in the early summer at least, when cereals would have been harvested. The proportion of juvenile gazelles in WJ7 2 is 42%, only marginally higher than the 40% predicted in herds between spring and autumn. I have argued (in Chapter 7.3) that this juvenile count **might** imply a degree of selection for juvenile animals, or intensive hunting, but the data are too poor and ambiguous to make a case for this, and non-selective hunting would be an equally valid interpretation.

All gazelle body parts are present in WJ7 2, the only assemblage large enough for meaningful study. Regarding hare, all body parts are present in WJ7 1 and 4; heads are absent in WJ7 3 and 5, which could reflect either discard practices or taphonomic 'disappearance'; and feet parts are absent in WJ7 2, which has been interpreted as a product of skinning, whereby foot bones could have left the site attached to skins.

Movement of materials and/or artifacts through the limestone steppe is witnessed by the presence of basalt artifacts, shell beads and cultivated cereals at WJ7. It may therefore be appropriate to suggest that animal parts were also leaving (i.e. hare skins) or entering (cattle parts) the area. As with the Epipalaeolithic sites, 'activities' are difficult to elucidate, although a full range of processing and consumption activities might be expected. The change in the lithic assemblage mid-way through the PPNB (from predominantly angle burins to predominantly truncation burins, plus the addition of burin spalls and bifaces, Baird 1993; n.d.a) shows no correlation in the faunal remains.

The only other site in the limestone area (Wadi el-Jilat) to yield a sufficient quantity of faunal remains for meaningful results is middle/late PPNB **WJ32**. This assemblage differs from all WJ7 phases in that it is dominated by hare bones (86%), whilst gazelle constitutes only 3%. There is no evidence for the season(s) of occupation at this site.

One explanation for the contrast between WJ32 and WJ7 could involve arguments of the seasonal availability of animals, with WJ32 being occupied at a time when gazelle were not in the area (Martin in Baird *et al.* 1992). The gazelle behaviour model presented in

Chapter 4, however, predicts that gazelle are never absent from the area: herds are probably much less dense in summers than in the wetter winter/spring season, but I have argued that they would not move out of the area on a seasonal basis. It would seem more appropriate to interpret the differences in the WJ32 and WJ7 fauna as reflecting differences in the focus of animal procurement activities (the sites could, of course, be occupied at different times of the year, but we have no evidence for this).

Differences in activities are not particularly evident in a comparison of either the lithic assemblages between the two sites (WJ32 has the same components as WJ7 2, 3, 4, 5 - middle/late PPNB), or the architecture (both sites have circular/oval structures built using the same techniques). Possible differences, however, have been noted in the ground stone assemblages: although both sites have objects made from non-local basalt, WJ7 has a wide range of ground stone household artifacts, whilst WJ32 has a small set of miscellaneous types (Wright in Baird *et al.* 1992). A more limited range of activities may be envisaged for WJ32.

The faunal assemblage from late PPNB **DH 1** in the Basalt Desert differs from either of those described above. It is dominated by gazelle (93%), 55% of which are juvenile; I have argued that this figure is higher than the highest proportion of juveniles expected within herds at any time of year. This pattern could have been created either by intensive hunting, perhaps using 'kite' structures (whereby lots of animals are killed consistently, and the population structure cannot be maintained - leading to more juveniles), or by selective culling of juveniles, whether intentional or not.

Gazelle fusion evidence points to DH 1 being inhabited at least during the early summer, when I have argued that gazelle herds would have been clustered around the diminishing areas of standing water, and hence vegetation. It is possible that drive hunting of gazelle using 'kites' was practiced, although there is no direct evidence that these structures are of a PPNB date, and the analysis of cull patterns has proved uninformative on the issue of whole herd hunting. I have suggested, however, that tightly grouped animals may have lent themselves to driving or mass capture techniques.

All gazelle body parts are present at DH 1 (even when analysis is done at the sub-phase level, Martin in press), indicating that whole carcasses were returned to the site. If it is accepted that hunters may have been killing large numbers of animals, then the presence of whole carcasses might imply that this was done fairly close to the site; some discard of heavier body parts would probably be expected if large numbers of carcasses were to be transported long distances.

It has proved extremely difficult to identify different carcass processing and consumption activities which potentially took place at the sites, since cut marks are generally few and bone fragmentation may have obscured the signatures of some practices (e.g. marrow extraction and bone grease rendering). There are a few slight hints, however, that activities at DH 1 may have included meat preservation. Firstly, the high number of ash-filled pits is more suggestive of large-scale processing than day-to-day consumption. Secondly, the complete absence of dismemberment marks on bone could be interpreted as whole limbs being roasted or smoked. Thirdly, if large numbers of animals were being culled in a relatively short space of time, this could imply firstly that they required quick processing, and secondly that preservation/storage of some part of the harvest might have been an attractive option.

All equid and hare body parts are also present at DH 1. Three equid phalanges show longitudinal chopping, which may have been for marrow extraction, implying intensive use of carcass products. The single sheep bone from the assemblage is rather enigmatic, since wild sheep have not been identified from the area, and domesticates have been claimed in this period from southern Jordan (Basta) and the Damascus Basin (Ghoraife II). We can only guess at whether this specimen represents a hunted wild animal, or an imported herded animal or joint.

The faunal assemblages from middle PPNB **WJ26** and late PPNB **Ibn el-Ghazzi** are too small for detailed analysis.

As with the Epipalaeolithic occupations, all PPNB sites discussed above seem to have witnessed repeated use. Considerable variation in the **type** of settlement and kind of animal use is seen, with WJ32 appearing to have limited activities (mainly hare trapping), whilst nearby and perhaps coeval WJ7 sees a broader range, including hunting, trapping and the possible cultivation of cereals. DH 1 appears to be a more specialized gazelle hunting camp; no cultivated cereals were found here, but only wild, locally available plants.

Evidence for the season(s) of occupation comes only from DH 1, which is used in late spring/early summer, at least. It is tempting to suggest that the other sites saw winter/spring/early summer occupation also, since water availability would have constrained occupation in these locations during the summers. Although there is much evidence for strong contacts with areas further west in the PPNB (e.g. in lithics, architecture, shell beads, cereals), recent lithic studies suggest that eastern Jordanian hunter-gatherers had relatively distinct traditions in the steppe (Baird 1993; n.d.a.). If this is translated to mean that groups inhabited the region year-round rather than seasonally, then we could suggest that people moved to the areas of standing water during summers (Azraq, Burqu), although there is, as yet, no evidence to support this idea.

PPNC/LN

It is during the PPNC/ELN period that two sites in the limestone region - **WJ25** and **WJ13** - show the earliest convincing evidence for herded caprines in eastern Jordan. This conclusion is based on the dramatic increase in the proportions of sheep and goat in these assemblages (60% and 20%), compared to any earlier (1.1%). Gazelle and hare are still important at WJ13, but less so at WJ25. I have argued in Chapter 8 that the slight increase in the incidence of carnivore gnawing on bones at WJ13 (and B27 2), and a shed deciduous *Canis* sp. tooth at this same site, could tentatively indicate the presence of domestic dogs. If this is accepted, then the arrival of herded animals and domestic dogs in the region is synchronous.

The difference in caprine representation between the two sites is notable (60% compared to 20%). In Chapter 9 I have interpreted this **not** as a difference in animal procurement activities between the sites (more hunting at one; more herding at the other), but as different **use** of the two structures by the same groups. WJ25 operated more as a household, and herded (owned?) animals were primarily eaten there. The neighbouring large structure at WJ13 could have held much larger groups, and appears to have seen more ritual activity (i.e. the frequent decorative and art objects). It is suggested that the higher number of gazelle bones here could indicate more communal consumption of gazelle meat - perhaps being shared food (cf. Ingold 1980). Also, the presence of ash pits at WJ13 could reflect different food preparation methods (roasting of larger portions?) compared to the smaller hearths seen at most sites in the area. Radiocarbon dates, chipped stone tools, stone beads and architecture all strongly suggest that the two sites are broadly coeval.

WJ13 alone provides cull pattern data for sheep (the small sample of goat bones precludes analysis). That 56% of the sheep were culled before reaching two and a half years of age, and 76% were culled before three and a half, does not suggest that these herds were being maintained into old age for products (milk or wool). Rather, it appears more like Payne's (1973) 'meat curve' where the majority of animals were killed relatively young. It is therefore tentatively suggested that sheep were used primarily for their meat and fat.

Also, only WJ13 has sufficient gazelle bones for detailed analysis. In WJ13 1, the juvenile gazelle count is 32% - lower than in any other Neolithic deposits. This could imply either less selective practices (towards juveniles), less hunting pressure, or a different season of hunting to PPNB WJ7 2, where the juvenile count was 42%. There is little evidence to support one of these explanations above the others, but if frequent hunting **had** pushed the age structure of herds downwards in the PPNB, then the introduction of caprines in the PPNC/ELN may have alleviated the pressure on gazelle herds, allowing more animals to survive into adulthood, and hence producing the lower percentage at WJ13.

Both WJ25 and WJ13 appear to have seen some occupation in spring - based on the evidence of five newborn sheep/goat bones at each site, and one newborn gazelle bone at WJ13. A spring use of the sites might also be suggested by the herded caprines (and particularly sheep's) need for fresh graze and access to water. The presence of cultivated type wheat and barley at WJ13 might also imply early summer occupation, when these crops would require harvesting, if the arguments for local cultivation are accepted.

Body part evidence suggests that the whole carcasses of gazelle, and perhaps not surprisingly also sheep and goats, were discarded at WJ13 1. This could imply that hunting was a fairly local activity. A few cut marks hint at an array of carcass processing activities for both gazelle and caprines (skinning, dismemberment, filleting). WJ25 and WJ13 witness a broad range of activities: in addition to the hunting, herding and trapping of animals, the possible growing of cereals (seen at WJ13) and collection of wild plants, both sites show on-site stone bead manufacture, WJ13 has bone beads in various stages of working, and both occupations have fairly large ground stone assemblages (although that from WJ25 appears fairly 'domestic' whilst many pieces from WJ13 are of obscure function).

At LN **B27 2** on the basalt margins, sheep and goat are most commonly represented (32%), and they are also interpreted as herded animals. As with WJ25 and WJ13, sheep outnumber goats (with a ratio of 9:1); hare is also frequently found (16%), and gazelle is fairly common (10%) indicating that groups both hunted and herded. The samples of caprine and gazelle bones from B27 2 is unfortunately too small for the examination of any age profiles or management practices. Two newborn sheep/goat bones indicate that the site was visited in spring (at least).

By contrast with each of the above-discussed Late Neolithic sites, the occupation at **DH 2** appears to reflect only hunting activities. Gazelle dominates the assemblage (94%) as they did in DH 1 - the PPNB phase at the site - and other animals constitute very small proportions. It is possible that the small number (0.5%) of sheep and goat bones represent imported herded animals or joints of meat, since domesticates are known in the region by this time, but they could equally well be hunted wild animals. Whatever the case, activities at the site were clearly focused on gazelle hunting.

As in DH 1, there is a relatively 'high' proportion of juvenile gazelles in the DH 2 assemblage (44%) (although not as extreme as at DH 1), which is believed to slightly exceed the proportion expected in herds, even in the summer months when the juvenile count is highest (gazelle culls are evidenced in spring and early summer months). As argued for DH 1, there is no evidence to suggest that gazelles were subject to any form of management involving selective culling for herd maintenance; the assemblage may, however, reflect a slight bias (whether intentional or not) towards the killing of juvenile animals, or the pattern might even result from gazelle herds suffering frequent and large-scale culling, which may alter the population structure. This is particularly interesting in view of the incorporation of a 'kite' wall into the structure at DH 2 (Helms and Betts 1987; Betts in press), which suggests that these animal drives were in use in the LN.

All gazelle body parts are present, indicating the return of whole carcasses to the site, and perhaps also implying fairly localized hunting, particularly if large numbers of animals may have been taken at once (in drives?). The arguments above for meat preservation (smoking?) taking place at DH 1 could equally apply to DH 2, although only a single ash pit was noted in this later phase; it is possible, however, that *in situ* firing areas underwent disturbance, since they would not have been dug into the ground surface as they were in DH 1. The ashy nature of many of the deposits, the extremely high incidence of burnt bone (53%) and high fragmentation of bones is suggestive of intensive carcass processing activities.

Both equids and hare at DH 2 show all carcass parts present; a chop mark on an equid metapodial could indicate marrow extraction.

The above discussions show a variety of settlement types in the PPNC/LN of eastern Jordan. The groups inhabiting WJ25 and WJ13 were involved in multiple activities, including hunting, herding and trapping, possible cereal growing, and the working of stone and bone beads. The two sites differ, however, in that the former has a rather domestic character (mainly in the ground stone assemblage) whilst the latter has been interpreted as seeing activities of a perhaps more ritual orientation (e.g. having figurines, statues), at certain times of its occupation, at least. B27 in the basalt margins shows a similar subsistence pattern in the mix of hunting and herding; no plant remains have been found. DH 2 differs in that is a specialized hunting camp, and only wild plants have been identified from here. Strong continuity in activities can be noted between the PPNB and LN phases at DH. In the Wadi el-Jilat also, most characteristics of the LN occupations can be directly linked to the local PPNB; the major differences in the LN are the addition of herded caprines to the economy, and the building of larger structures.

All of the PPNC/LN appear to represent repeated occupations, and all are likely to be only seasonally inhabited. Evidence from WJ13, WJ25, B27 and DH 2 suggests that groups visited the sites in spring/early summers, at least. Although mobility patterns are extremely difficult to gauge, and there is no evidence to suggest where people may have moved in the drier parts of the year, we might assume that the lakes at Azraq and Burqu made attractive summer locations since sheep and goats require frequent access to water. Contacts between eastern Jordan and the sown areas to the west are clearly strong in this period; but the character of steppic settlements and the observed continuity from the PPNB, plus the evidence of the chipped stone technology, tend to suggest that groups in eastern Jordan operated independently in the area, rather than being fully integrated with the systems further west.

Discussion

Full integration and contextualization of these faunal data with the results of other specialist studies of material from the eastern Jordanian sites is a future project, meaning that any interpretations presented here are both limited and tentative. Also, time has not permitted an exploration of the ethnographic literature which may stimulate some fleshing-out of the bone evidence, and allow suggestions about social organization; this too is a task for the future. I am aware that I have introduced many ideas which require following up and there are numerous interpretative frameworks which could be applied to the data presented here; however, the end of a thesis is not the place to start with new approaches.

Nevertheless, the results of this study which are summarized above do permit brief discussion of certain issues concerning subsistence activities in the eastern Jordan steppe in the Epipalaeolithic and Neolithic periods.

Mobility, storage and contacts

Almost all of the Epipalaeolithic and Neolithic sites discussed above appear to be those classed as longer-term or repeated use locations, as opposed to short-term, single use, or single task camps. The nature of the finds and architecture (where present), and the presumed constraints of the resources around the sites strongly suggests that the occupations are seasonal throughout the sequence; many of the sites (WJ6 A, KH4 A, B, C, D, WJ22 B and C, AZ18 DH 1 and 2, WJ13, WJ25, B27) have evidence for spring/early summer use, and general wet season occupation can probably be envisaged.

The question remains, therefore, as to where groups moved to and how they may have lived at other times of the year. One way of approaching this is to examine the limitations which the environment would place on the people who used it.

The whole of the study area can be classed as having a 'specialized ecosystem' (Gamble 1978) where relatively few animal and plant species are represented by many individuals. This is why I conclude in Chapter 7.2 that although gazelles dominate the faunal remains from many of the Epipalaeolithic, and some of the Neolithic sites, this does not necessarily imply that hunters selected this taxon above others, since they would probably have been the most common herd animals in the region. Diversity is generally low; apart from the areas of permanent standing water (Azraq, Burqu) there are few distinct niches which would support very different fauna. Grasslands are capable of supporting large numbers of grazing animals. Spring sees the peak availability of vegetation due to temperature and moisture conditions, and hence animals are also found in greater densities and in better condition at this time. One consequence of such a specialized and seasonal environment, however, is that resources are likely to fluctuate and be unpredictable, and dry summers will be times of sparse food availability. The rising temperatures and increased aridity of the Holocene is assumed to have made plant and animal life generally more unpredictable than in the Epipalaeolithic.

The ways in which groups cope with unpredictability, fluctuation and seasonal short-falls of food supplies is well explored (cf. Halstead and O'Shea 1989): movement, storage and exchange/reciprocal arrangements (i.e. access to others resources), or increased production/ diversification are the broad classes of options.

Mobility

Unlike other areas of the southern Levant, eastern Jordan is relatively flat, and comparatively lacking in diversity of vegetation and hence animal life. The models which have been proposed for the Negev, Sinai and areas of central Palestine (outlined in Chapters 1 and 2), which involve upland and lowland occupation in different seasons, are not applicable here. Instead, we might predict that hunter-gatherers in eastern Jordan moved relatively frequently, and used large areas or territories. It seems extremely unlikely that the area would support long-duration settlements or semi-sedentism, or even groups practicing radiating mobility (cf. Liebermann 1993): resources would be quickly depleted. In addition, the argument that whole carcasses (of both large and medium sized animals) were consistently returned to sites hints that hunting was done fairly nearby, rather than by groups who were hunting at some distance away. This might lend weight to an argument for circulating, or logistic mobility (cf. Binford 1980), rather than residential or radiating movement.

Predictions of where people were going in the summer, drier months are hazardous, since they could have either dispersed in the eastern Jordanian region, or moved elsewhere. In this respect, it is interesting to note that the early Epipalaeolithic chipped stone industry from Ein Gev IV on the Sea of Galilee is identical to that from WJ6 A (the triangle industry), and Nizzanian industries in the Negev show strong similarities to those from KH4 A (Fellner 1993). If stone tool forms - and particularly microlith shapes - are interpreted as representing groups of people (e.g. Fellner 1993:189), then these examples could signal that the groups in eastern Jordan were moving distances of up to c. 200km, and moving to lusher areas (maybe in drier months).

The Neolithic inhabitants of eastern Jordan (both PPNB hunter-gatherers and LN hunter-gatherer-herders) appear more 'local' in their movements, in that they seemed to have occupied the areas of eastern Jordan year-round (following the arguments forwarded in Chapter 9). Within this area, however, frequent and wide-ranging mobility could probably be envisaged, particularly since the periods of relative lushness and vegetation growth would have become more restricted in the Holocene. Kaufmann (1992) suggests a decrease in hunter-gatherer territory size through the Epipalaeolithic, culminating in sedentism/semi-sedentism in the Natufian in the more verdant areas of the Levant. Although eastern Jordan clearly does not show the same late Epipalaeolithic/Natufian pattern, the area may have seen more restricted Neolithic territories as a result of the settlement pattern changes elsewhere (ie. further west). One observation in support of this idea is that there are more Neolithic than Epipalaeolithic sites noted in the Basalt Desert, maybe indicating the more frequent use of a previously sparsely occupied area.

Storage

As described in Chapter 8, there is no direct evidence for the preservation and storage of meat (or indeed any foods) at the study sites. The sites and area, however, have many of the criteria which could have made storage an viable option at times (cf. Rowley-Conwy and Zvelebil 1989). Firstly, although I have argued that animals are **available** year-round and not seasonally, herd ungulates would be present in higher densities in winter/spring, meaning that larger numbers could be caught, and also that summers would constitute a 'lean season'. Secondly, as described above, mobility to other areas might have been practiced in some periods, but in the Neolithic, groups appear to have been restricted to eastern Jordan, where resource availability is likely to have been similar across the broad area. Seasonal shortfalls may also have been higher in the Neolithic. Thirdly, Witter states that "[t]he more strongly a subsistence strategy is oriented towards meat, the more necessary is preservation to compensate for the gaps in procurements." (Witter 1990:256). Although poor preservation of plant remains precludes a fair assessment of how subsistence strategies were oriented between plant and animal foods (Hillman's 'missing foods' 1989), it is possible to suggest that sites such as DH (both phases 1 and 2) were geared more towards hunting than plant food gathering, due to the nature of the occupation, the high animal bone densities and the resource expectations. At this site I have argued (Chapter 8) that meat processing and preservation is likely, and the idea that drive hunting allowed large numbers of animals to be harvested at one time would create a further reason to store.

Betts (1989) has reviewed accounts of the Solubba - nomadic hunters who inhabited parts of Arabia until the present century, hunting gazelle (amongst other animals), preserving the meat by salting and drying, and living in symbiosis with Bedouin herders. For DH 1 and 2, I have suggested that gazelle meat may have been smoked, from the evidence of numerous ash pits and ashy fills. Preserved meat could either have served these same groups or been exchanged (see below).

It is always possible that groups were preserving and storing animal products in the Epipalaeolithic in the region, and in fact at all sites, and supporting evidence is completely lacking. A slightly better case can be made for storage at Neolithic DH 1 and 2 in the Basalt Desert, based on circumstantial evidence, although this is still clearly tenuous.

It should be pointed out that the caprine herding in the PPNC/LN in the study area constitutes an example of storage 'on the hoof'.

Contacts

Contacts between the occupants of eastern Jordan and neighbouring groups (mainly to the west, and also probably to the north) are witnessed throughout the Epipalaeolithic and Neolithic sequence, and the movement of animals or their products may have been taking place much earlier than the first firm evidence for this in the PPNC/ELN (with the introduction of caprines into the steppe). As mentioned above, smoked/dried gazelle meat may have been exchanged with herders, farmers or even other hunters outside the area (cf. Byrd 1992; Bar-Yosef and Belfer-Cohen 1991:193); hare and fox skins may have been exported from the Epipalaeolithic sites of KH4 A and B, WJ6 A and PPNB WJ7 2; there are many possibilities for exchange.

The higher level of contact between eastern Jordan and the western plateau in the Neolithic (of which the movement of cultivated crops and herded animals are a part) may signal increased reciprocality, and perhaps increased inter-dependence between these two areas, which is interesting given the harsher conditions and maybe more restricted territories predicted.

Specialization and intensification

'Specialization' and 'intensification' in animal procurement is often taken to mean that hunting (in this case) is focused on particular animals, with the aim of increasing the yield, and maybe also by exerting some control or protection over the resource.

I have argued in Chapter 7.2 that none of the study assemblages which contain very 'high' frequencies of gazelle necessarily show particular selection of this animal, but rather that gazelles would have been the most common animals in the vicinity of the sites. There appear to be no other herd ungulates of a similar size which would constitute competitors. The dominance of one taxon, therefore, does not necessarily indicate 'specialization' of hunting. [Also, the late Epipalaeolithic (Natufian) assemblage of AZ18 provides some evidence for opportunistic hunting, in that the high percentage of cattle bones matches the ecological expectations of this distinctive oasis location. This observation does not support Henry's (1975) suggestion that Natufian sites have very high proportions of gazelle, regardless of site location].

It is clear that gazelle were a mainstay to both Epipalaeolithic and Neolithic hunters in eastern Jordan, even if the animal bones were converted into meat weights or calorific values which would decrease their relative importance compared to equids and cattle. Even if they were not being specifically selected above other taxa, were hunters manipulating them (intensifying their hunting) by selection of particular age or sex categories?

Whilst fully accepting that a range of relationships **can** exist between people and animals, I have concluded (Chapter 7.3) that no Epipalaeolithic assemblages show evidence for any intensification of gazelle hunting; in fact, encounter hunting, or stalking, of animals (including the weakest) appears to have been the pattern. In the Neolithic also, there is no evidence for selective practices in the Wadi el-Jilat area (although data are very poor), but in the Basalt Desert, both the PPNB and LN phases at DH seem to show a trend towards the culling of juveniles. I have argued that these patterns are likely to represent either the (intentional or not) killing of the more vulnerable young animals, or to be a result of increased hunting (pushing the animal population structure down); but it does not appear that the animals were under any form of management, whereby their breeding was being intentionally controlled. Intensification, therefore, may be at play in one respect, that of **increased** hunting, but none of the assemblages indicate that there was more control, or manipulation of gazelle herds, resulting from highly selective cull practices. It should be stressed here that this conclusion does not apply to other regions of the Levant; the gazelle behaviour model (Chapter 4) on which the arguments are based is intended for the study area alone.

A comment is needed here on the **kind** of hunting undertaken: I have rejected the concept of herd protection or management in the eastern Jordan area, but is it possible that hunters were herd following (cf. Ingold 1980)? Since I have argued that gazelle herds would not have undertaken large-scale movements in the area (Chapter 4), the idea that groups would have shaped their mobility around them seems unlikely, particularly since water constraints would not have allowed people to dispersed in drier months as herd animals would have done. Rather, the predictability of high densities of animals in certain locations in the wetter seasons may have influenced people's use of the area.

Long-term change in faunal assemblages

One difficulty in exploring variation through time is that none of the study areas provides complete archaeological sequences; in fact, most are represented by one or two sites, sampling a couple of time periods. The Wadi el-Jilat area has the best sequence, but even here there is a gap in occupation between WJ22 B (11,920±180) and WJ7 1 (c. 9,500-9,000bp). There is no evidence of continuity, therefore, between the Epipalaeolithic and

Neolithic in any part of eastern Jordan, and perhaps no continuity of occupation or use. Nevertheless, some observations can be made on variations between the two broad periods.

In the Wadi el-Jilat, gazelle generally decline in importance between the Epipalaeolithic and the PPNB (and PPNC/LN) assemblages. Equids and cattle virtually disappear in the Neolithic, and the frequency of hare increases greatly in the PPNB (see table 10.0). The trend, for this area at least, is a shift from larger to smaller animals, although this does not hold for some areas of the Basalt Desert (e.g. DH 1 and 2).

The role of environmental change (increasing temperatures and aridity), and a corresponding diminishing availability of large fauna has commonly been invoked to explain the shift from larger to smaller taxa in Near Eastern subsistence studies (see Chapter 2). Ideas of increasing population and 'over-hunting' are also common. I suggested in Chapter 7.1 that environmental changes may well have been partly responsible for the Holocene decline in large equids and cattle, but other factors should also be considered in explanation of the overall pattern. Firstly, equids constitute 9% of the LLN assemblage at B27 2 in the Basalt Desert, which suggests that they had not entirely disappeared from the region. Secondly, although gazelle decline in frequency in the PPNB and PPNC/LN in the Wadi el-Jilat, they are present in very high proportions (>90%) at PPNB and LN DH 1 and 2. Also, the proportions of hare at DH 1 and 2 are very low.

These observations do not suggest that gazelle and equids could not tolerate the early Holocene environment (they are both extremely well adapted to arid conditions). That they are less frequent in the Wadi el-Jilat Neolithic assemblages than Epipalaeolithic ones must be explained in other ways.

Firstly, it is possible that changing settlement patterns in the Neolithic actually altered faunal distributions; longer or more large-scale occupation in an area may have disturbed the fauna, or as O'Regan (1980) has noted, flocks of sheep and goats tend to disperse gazelle herds (although gazelle and equids 'decline' **prior** to the introduction of herded animals in the Wadi el-Jilat). Secondly, if there were lower densities of larger animals around the sites, the Neolithic inhabitants of the Wadi el-Jilat sites may have turned to hares for food in the absence of other (larger) animals. Thirdly, activities at Neolithic sites clearly had a different orientation to those at Epipalaeolithic occupations. The trapping of hares suggests a fairly intensive use of areas close to the sites (since hares have very small home ranges); groups, or parts of groups, may have focused their activities in relatively local areas. If crops were being cultivated near the sites (which is suggested, but far from clear), this idea would fit with a picture of Neolithic people doing a wider variety of things - hunting, trapping, crop cultivating and processing, and later herding - as opposed to the greater focus on hunting and carcass processing in the Epipalaeolithic. All of these suggestions, and combinations of them, could explain the variations observed in the assemblages.

relative proportions of equid and hare					
	equid		hare		sample size
assemblage	n	%	n	%	NISP (*MNB)
LLN					
B27 2	18	8.6	29	13.8	210
Jebel Naja	0	0.0	2	22.0	9
DH 2	58	0.7	138	1.6	8408
PPNC/ELN					
WJ13 3	1	0.1	283	29.1	971
WJ13 2	1	0.1	183	23.4	781
WJ13 1	2	0.1	522	22.0	2373
WJ25	0	0.0	27	17.0	159
PPNB					
DH 1	29	1.0	37	1.3	2786
Ibn el-G	0	0.0	2	10.0	20
WJ32	0	0.0	139	71.6	194
WJ26	0	0.0	7	58.0	12
WJ7 5	0	0.0	40	44.0	91
WJ7 4	0	0.0	168	46.7	360
WJ7 3	0	0.0	92	33.3	276
WJ7 2	0	0.0	102	14.5	704
WJ7 1	0	0.0	158	42.4	373
L EPAL					
Kh Anaza	3	9.0	3	9.0	34
AZ18	78	26.4	1	0.3	295
M EPAL					
AZ17	0	0.0	0	0.0	49
WJ22 B	45	7.4	37	6.1	611*
WJ22 C	36	14.8	9	3.7	243*
WJ10	36	53.7	0	0.0	67
WJ8	2	2.1	1	1.1	92
E EPAL					
UW18	49	8.9	4	0.7	553
UW14	1	9.0	2	18.2	11
KH4 D	194	2.6	220	3.0	7404
KH4 C	7	2.4	15	5.1	294
KH4 B	30	1.9	23	1.5	1572
KH4 A	193	10.5	38	2.1	1836
WJ6 B	25	22.3	0	0.0	112
WJ6 A	172	6.2	57	2.1	2753
L UPAL					
WJ9	11	10.9	1	0.9	101

Table 10.0. The relative proportions of equids and hare in each assemblage, shown by NISP (except for WJ22, which is shown by MNB).

The introduction of domesticates

In Chapter 9 I have argued, in agreement with Byrd (1992), that the first domestic animals (sheep and goat) seen in eastern Jordan were adopted by local hunter-gatherer groups, and integrated into an economy of hunting, trapping, herding and perhaps crop cultivation (cf.

arguments about the spread of farming in Eurasia; see Zvelebil 1986). The continuity in material culture across the period of sheep and goat introduction (cf. Baird 1993), plus the continuity in the wild fauna used are the keys to this argument. Strong contacts are evidenced between eastern Jordan and the better watered areas to the west, and the latter is seen to be a likely location from which elements of agricultural life were adopted. Domestic type barley and wheat are first seen in the PPNB in the Wadi el-Jilat; herded sheep and goat follow in the PPNC/LN.

For eastern Jordan, I would suggest that the presence of domestic sheep and goat does not signal the beginnings of specialized pastoralism in the area - whereby groups are reliant primarily on the products of herded animals. That sheep and goats constitute c. 20% of assemblages where present (except for WJ25, which could be explained in other ways, see above) indicates that other forms of animal procurement (hunting, trapping) remain important, and that sheep and goat are not the mainstays of subsistence. The same applies to the evidence for domestic cereals at Wadi el-Jilat Neolithic sites: groups had access to, and perhaps cultivated, crops, but this does make them full-scale agriculturalists. It may be implied rather that certain elements of agricultural life were adopted in eastern Jordan, but from the animal bone evidence, these did not dominate subsistence activities.

This point is highlighted by a comparison of the faunal assemblage from PPNC Ain Ghazal on the western Jordanian Plateau with the broadly coeval study assemblages from WJ13. At Ain Ghazal Köhler-Rollefson *et al.* (1988:426) observe a decrease in the diversity of taxa compared to the PPNB levels at the site, with 68% of the remains belonging to caprines. This heavy reliance on domesticates is probably to be expected at a sedentary agricultural site. Whilst accurate quantifications of faunal diversity are impossible due to the interference of different sample sizes (Chapter 6, table 6.44), it is evident that WJ13 has the highest number of taxa from any of the eastern Jordanian assemblages; this suggests that people were not narrowing down on the variety of animals they exploited, but using a diverse array.

It is notable that the integration of caprines and wild fauna seen in the PPNC/LN Wadi el-Jilat site is not the trend across all areas of eastern Jordan. DH 2 (LN) in the Basalt Desert has only a few caprine bones which are of ambiguous status, but even if from domestic animals, their low proportions are not suggestive of the mixed economy seen in the Wadi el-Jilat, or at B27 2. Rather, these primarily gazelle hunters highlight the variability of activities undertaken in the Neolithic in the region.

Evidence points to sheep and goats being introduced into eastern Jordan simultaneously (possibly also with domestic dogs). The question arises as to why goats were not adopted earlier in the region, in the middle or middle/late PPNB, for example. Köhler-Rollefson has argued for goats being "... well on their way to domestication ..." in the middle PPNB of nearby Ain Ghazal (1989:145); there is evidence for strong contacts between the regions in the PPNB (see Chapter 3); and from the earliest PPNB, there is evidence of cultivated cereals in the steppe, suggesting that either the cultigens, or at least the techniques of cultivation, were imported. The omission of goats is an intriguing issue, which future research might hope to address.

Summary conclusions

1) None of the faunal assemblages used in this study, whether Epipalaeolithic or Neolithic, provides evidence for the intentional highly selective culling of gazelles associated with ideas of herd maintenance, 'intensification' or 'specialization'. Two Neolithic assemblages - DH 1 and 2 (PPNB and LN) - show biases towards the culling of juvenile gazelles, which could result from either intentional or unintentional targetting of this age category (i.e. the young may be most vulnerable), or from persistent hunting of certain gazelle populations.

Eastern Jordan provides an interesting example of an area where there is potentially at least seasonal imbalance between people and their ability to obtain food, but this does not appear to lead to intensification or specialization of hunting.

2) The original research goals of much of the fieldwork in the eastern Jordanian steppe (Azraq Basin project) was to investigate the role of a semi-arid region in the origins of food production. The results of the present study agree with those already posited elsewhere (Garrard *et al.* 1988; 1994; Baird *et al.* 1992), that eastern Jordan is a **recipient** of innovations in animal domestication and cereal cultivation.

3) Apparently 'domestic' sheep and goats seem to be integrated into a hunting/foraging economy in the PPNC/LN, as are domestic type cereals slightly earlier (PPNB). Steppic hunter-gatherers are not replaced by agriculturalists; wild animals continue to constitute high proportions of faunal assemblages after the introduction of herded caprines, and some sites demonstrate predominantly hunting occupation throughout the Neolithic in the area.

4) All the above suggests that eastern Jordan must be seen as an area of interest in its own right. The region does not have to be considered only in relation to others, or as 'marginal' to the lusher areas of the southern Levant, but it has its own history and traditions of hunting and land use.

APPENDIX ONE

POTENTIAL FOOD RESOURCES

The principle edible animal and plant resources that would probably have been available in the Levant from 22,000-7,500bp are reviewed here. What makes a resource 'edible' is clearly culturally determined, and may also depend on knowledge of appropriate processing: for example, acorns are 'edible' if they have had much of their tannin removed.

The following lists are based primarily on archaeozoological and archaeobotanical data. What has been identified is laden with the biases of both archaeological researchers and prehistoric communities, and therefore does not pretend to be comprehensive list of 'what was there'. Other problems exist in that archaeological floral and faunal remains can sometimes be difficult to identify, but can only be described with reference to surviving known species. For animal taxa, some are included in the review even if they have not been identified archaeologically, if it is considered that they may have been present.

There is, obviously, no evidence that the species listed below were eaten; their presence in archaeological deposits may indicate activities other than subsistence, or even may reflect deposition by non-human agencies.

Animal Resources

Mammals

The following discussion is based heavily on Garrard's review of the distribution, ecology and ethology of Levantine animal species (Garrard 1980: table 3A and 3B), supplemented with data from Uerpmann (1987), and other authors where indicated.

Order Artiodactyla

Bovidae

Of the large bovids, the aurochs (*Bos primigenius*) is known to have inhabited the Levant well into historic times. These animals occupy open woodland or dense grassland, and live in a mixture of herd types or as solitary males. Clutton-Brock and Grigson stress that wild cattle would be mixed feeders, both grazers and browsers, and highly adaptable (in Uerpmann 1982a). The range of the steppe wisent (*Bison bison*) may have included the Levant - its' habitat is open grassland - but so far, remains have been identified only from Jarmo in Iraq and parts of Turkey. The addax (*Addax nasomasculatus*) also has not been recorded from Levantine fossil remains, but might possibly have inhabited the stony or sandy deserts. The Arabian oryx (*Oryx leucoryx*) is known to have inhabited stony/sandy deserts in the post-Neolithic Levant, and might have been present earlier also, although no positive identifications attest to this. The open grassland Bubal hartebeest (*Alcelaphus buselaphus*), now extinct in the area, was a Levantine inhabitant from the Upper Palaeolithic until earlier this century. Of the above animals, only the last species has territorial males and only the wisent is believed to have been migratory, although the addax and oryx move with erratic rainfall.

The three species of gazelle (*Gazella gazella*, *Gazella subgutturosa* and *Gazella dorcas*) all survive today, although *G. subgutturosa* only in very small numbers. The Dorcas gazelle is believed by some to have entered the Levant later in the Holocene (Tchernov *et al.* 1986/87), whilst the other two species are evidenced from late Pleistocene deposits. The ecology and ethology of the gazelles is considered in detail in Chapter 4.

Capra ibex, the ibex, is known from the Pleistocene and still survives today in its preferred habitat of high altitude cliffs and mountain crags. The ibex is both a browser and grazer, but prefers the former; it requires some surface water, can go for long periods without drinking. Ibeces live in small troops, in fairly restricted home ranges (Harrison 1968:335-6). The wild Bezoar goat (*Capra aegagrus*), known in the area until this century, has a similar habitat to the ibex, but favours slightly better watered areas and lower altitudes. They also both browse and graze. Both species of wild goat are present at Beidha (PPNB) in southern Jordan (Hecker 1975), showing that their habitats probably overlapped in the past.

Wild sheep (*Ovis orientalis*) prefer gently rolling steppic hills; they predominantly graze but will also browse; and they run better than goats. They are known from the northern Levant from the Middle Palaeolithic (e.g. Payne 1983). Davis *et al.* (1982) have also found wild sheep bones from Epipalaeolithic contexts in the Negev, suggesting that the distribution of these extended to the semi-arid steppe of the southern Levant. None of the wild goat or sheep species is territorial; they move in mixed herds generally in restricted home ranges; they have social systems based on dominance hierarchies which probably made them very suitable for herding, and domestication (Clutton-Brock 1981; Garrard 1984).

The Arabian tahr (*Hemitragus jayakeri*) and the Barbary sheep (*Ammotragus lervia*) have distributions which may only possibly have included the Levant, since they are unknown from any sites there. Elsewhere today they are found on arid mountain cliffs and rocky arid mountains respectively.

Cervidae

Red deer (*Cervus elaphus*) existed in the Pleistocene and early Holocene, but is believed to have become extinct in the late Neolithic in the Levant. They generally prefer open forest and adjacent steppe, and need access to water. The Persian fallow deer (*Dama mesopotamica*) is well known from the fossil record, becoming extinct in the region earlier this century; it is adapted to riverine forest and its adjacent steppe, and probably deciduous woodland alongside open grassland. Roe deer (*Capreolus capreolus*) has survived until today only in northern Syria; its habitat preference is for deciduous or mixed forest providing shelter and browse. All three species of deer are likely to move seasonally in search of food, and all have territorial males for at least part of the year.

Suidae

Sus scrofa, the wild boar, survives in parts of the Levant today, in riverine thickets and open woodland (Dar 1976), as it has done since the Middle Paleolithic. The warthog (*Phacocoerus aethiopicus*) prefers open grassland with available water, and has been noted only for the Lower Palaeolithic in the Levant (Bate 1937). Both species are fairly sedentary.

Hippopotamidae

The hippopotamus (*Hippopotamus amphibius*) has been found in Middle Palaeolithic deposits and from others dating to the Bronze Age, suggesting it may have also been present in-between, although no finds are known. It requires a habitat of shallow water with gently shelving banks and grassland nearby, is sedentary and has a small home range (grazes within 1.5km of river).

Camelidae

The dromedary (*Camelus dromedarius*) is known in its wild state from the Middle Palaeolithic until the Bronze Age when it is believed to have been domesticated. It is non-territorial, can move over large distances when grazing, and has a desert habitat.

PERISSODACTYLA

Equidae

The wild horse (*Equus ferus/caballus*) has fossil remains from the Lower Palaeolithic to the Epipalaeolithic in the Levant. The exact species which existed in the Near East is uncertain, but the habitat of a probable close relative, *Equus ferus przewalskii* known from Mongolia, is saline steppe. Feral horses can have large home ranges (up to 200km^2), and tend to live in family groups.

Bones of the Asiatic wild ass (*Equus hemionus*), possibly of the subspecies *E. hemionus hemippus*, *E. hemionus onager* and *E. hemionus hemionus*, have also been found from Lower Palaeolithic deposits. The first subspecies was still present in Syria in the 19th century. It lived in steppe and bare rocky hills. *Equus africanus*, the African wild ass, it now seems had a distribution including parts of the Near East (see Tchernov and Bar-Yosef 1982:29-31): it has recently been identified from PPNB levels at Basta in southern Jordan (Becker 1991:70-71). The habitat of this species is known to be steppe/desert plains and mountains. In contrast, the European wild ass (*Equus hydruntinus*) had a preferred habitat of cold steppe. It is known from fossil evidence from the Palaeolithic and Epipalaeolithic. Very little is known about the mobility of the European wild ass, while the Asiatic form can be forced to migrate for grazing, often in large herds (up to 400), and the African wild ass makes small localised movements in smaller herds (c.30).

Rhinoceratinae

Two species of rhinocerus were present in the Levant in the prior to the Upper Palaeolithic, Merck's rhinocerus (*Dicerorhinus mercki*) and the steppe rhinocerus (*Dicerorhinus hemitoechus*). The former is likely to have been found in grassland with a preference for woodland, and the latter would probably have had a preference for steppe. Little is known about their group dynamics; some species of the same genus have territorial males, live in groups of 2 to 6, have home ranges of up to 12kms^2, and need water every few days.

PROBISCIDAE

Elephas maximus, the Indian elephant, has been recorded for the Levant from Upper Palaeolithic to historic times, when there was a colony in the mid-Euphrates valley. It is currently found in forest areas, but an African species also inhabits sub-desert areas. African elephant populations are divided into resident and nomadic members, with the latter moving in an area of 3200km^2. Today, herds are of 2 to 20 individuals, but herds of 150 have been recorded historically.

HYRACOIDEAE

The rock hyrax (*Procavia capensis*), in evidence from the Palaeolithic until today, lives in rocky areas which provide browse and graze, in groups of up to 60 individuals, and is residential.

LAGOMORPHA

Hare (*Lepus* spp.) has also been continuously present in the region from the Palaeolithic until the present day. There is confusion as to the species represented in the region today (mostly believed to be *Lepus capensis* but some *Lepus europaeus*) (Angermann 1983), and this debate will apply to prehistoric material also. The hare's habitat range is very broad; they are able to live anywhere from the sand deserts to mountains, as long as there is sufficient minimal vegetation. They are mainly solitary and always residential.

RODENTIA

Only the larger rodents are considered here; smaller rodents are included under 'other' below.

Beaver (*Castor fiber*) remains have been found from late Pleistocene sites in Anatolia, Iraq and Iran, and more recently from Syria (see Legge and Rowley-Conwy's review 1986b). Legge and Rowley-Conwy suggest that it may have existed earlier in the Near East but there is as yet no archaeological evidence. Its habitat is in perennial rivers, adjacent to woodland, where it resides alone or in small groups. Taking into account other means by which beaver bones may have arrived at the site (e.g. on furs), Legge and Rowley-Conwy argue that the presence of beaver at Abu Hureyra in Syria extends its habitat range to include steppe.

Hystrix indica, the Indian crested porcupine, survives today living in small groups in the more fertile areas of the Levant, and is first observed in Palaeolithic deposits.

CARNIVORA

Felidae

Lion (*Panthera leo*) and leopard (*Panthera pardus*) were both identified in Palaeolithic faunas, and leopard still survives today, while the latest record of lion is from c.1300AD. The lion prefers an open woodland habitat, which the leopard will also be found in, as well as in mountains, hilly steppe and riverine thicket. The cheetah (*Acinomyx jubatus*) is known from the Upper Palaeolithic, and would have preferred the open territory of the steppe and desert. Lions live in prides, while leopards and cheetahs are generally solitary. All three of these large carnivores are generally residential, although nomadism is reported amongst lions and cheetahs, and home ranges can be large (400km^2 for lion; up to c. 60km^2 for leopard and cheetah).

One species of lynx, the European lynx (*Lynx lynx*), has been reported from the Upper Palaeolithic (the other, the Caracal lynx (*Caracal caracal*) is first seen after the Neolithic). The Lynx is solitary and territorial, inhabits rocky wooded country, and males have the largest home ranges of up to 300km^2.

Two species of wild cat are known from the Levant from the late Pleistocene; these are *Felis sylvestris/libyca*, the wild cat, and *Felis chaus*, the jungle cat. Another, *Felis margarita*, the sand cat, possibly inhabited the area in prehistory. The habitat of the wild cat is generally rocky wooded country, while the jungle cat favours riverine thickets. Both are solitary and territorial.

Canidae

Wolf (*Canis lupus*) and jackal (*Canis aureus*) have been identified from the Upper Palaeolithic and earlier periods respectively. The wolf tolerates varied habitats excepting the sandy desert, is possibly territorial (being both residential and nomadic) and is known to move in packs of up to 12 individuals. The jackal also survives in habitats throughout the

Levant, except extreme desert. Jackals live solitarily or in small packs; they are territorial and residential.

Vulpes vulpes, the red fox, is known since the Palaeolithic; the smaller fox, *Vulpes rupelli,* is evidenced only after the Neolithic, but *Fennecus zerda* has been found from late Pleistocene deposits in the southern Sinai (Tchernov and Bar-Yosef 1982:23). The red fox will live in most Levantine habitats except the sand deserts. Males are territorial, females are largely residential and they wander in small home ranges.

Hyaenidae

Both the spotted and striped hyaena (*Crocuta crocuta* and *Hyaena hyaena*) have pre-Upper Palaeolithic remains. The spotted hyaena is commonest in open savannah, where it lives in often large groups (up to 100), and is territorial. Some are known to be residential, other migratory. The striped hyaena occupies drier areas than *Crocuta,* and lives singly or in small residential groups.

Ursidae

The brown bear (*Ursus arctos*) inhabited the Levant from Middle Palaeolithic times until the present century. This animal lives generally solitarily in woods, especially on well-watered hills and mountains, wanders extensively (up to 100km^2), and hibernates in areas of abundant vegetable food.

Mustelidae

The badger (*Meles meles*) and the honey badger (*Melivora capensis*) are represented from Upper Palaeolithic and Epipalaeolithic deposits respectively. They both live solitarily in residential territories, with the former preferring a wooded habitat, and the latter showing tolerance of most areas in the Levant except sandy deserts.

The common otter (*Lutra lutra*) has been found only after the Neolithic. It is generally solitary and has a distribution confined to perennial rivers, marshes and lakes. The bones of the stone marten (*Martes foina*) have been retrieved from Upper Palaeolithic deposits; it prefers rocky, wooded areas. The marbled polecat (*Vormela peregusna*) favours slightly drier areas than the stone marten; it is known from the Palaeolithic. The weasel (*Mustela nivalis*) has a wide variety of habitats, generally in the more fertile areas, but bones of this animal are not known from pre-Neolithic deposits. Like the otter, all these mustelids tend to be solitary unless they live with their cubs; family groups have territories; they are mainly nocturnal and may hibernate.

Viverridae

The Egyptian mongoose (*Herpestes ichneumon*) was probably a Middle Palaeolithic inhabitant of well-watered and wooded Levantine regions. It may form family groups, but is often single, and feeds mainly nocturnally. The European civet (*Genetta genetta*) tends to adhere to wooded ravines and in the Levant favours hilly or mountainous areas. Bone remains are of post-Neolithic date.

PINNIPEDIA

The Mediterranean monk seal (*Monachus monachus*), known from post-Neolithic deposits, would probably have lived in colonies along the Mediterranean coast, preferring offshore rocks, sandbars and islands. They spend time on land, particularly to give birth.

Other

Many species of small rodents (Tchernov 1968; 1982; Bar-Yosef and Tchernov 1966) and bats appear in deposits from Levantine prehistoric sites. They will not be discussed here in any detail, however, because it is probable that they do not represent the remains of human food procurement activities. From his study of the Douara Cave faunal remains, Payne concluded that most of the small rodent bones came from owl pellets, as often did small bird bones and lizard bones. Bat bones were seen to reflect the accumulation of dead animals below a bat-roost in the cave roof. Hedgehog bones, however, are interpreted as human food remains (Payne 1983:65).

Non-mammals

Birds

Residential game birds are still fairly rich in the Levant and include the black partridge, the chuckar, sandgrouse, coursers and Houbara bustard, with the Arabian bustard and Arabian ostrich being present until recently (Garrard 1980 quoting Meinertzhagen 1954). The large residential raptors include three species of vulture, the golden eagle, kestrel and several species of owl.

The better watered areas of the Levant receive winter visitors such as ducks and flamingos, which today arrive between September and December and leave between February and May. The permanent residents of these watered areas include teals, moorhens, coots, kingfishers and several species of bittern in the summer.

Migratory birds which are flying south from northern Eurasia to sub-Saharan Africa, stop over in the Levant in the spring (today from late March to mid-May), but are richest on their return (from late August to late October today). Such migrants commonly include herons, spoonbills, ibises, storks, cranes, osprey, buzzards, eagles and harriers. Garrard notes that the Levant probably acted as a summer breeding ground for many more species during the glacial when conditions were less favourable in northern Eurasia, and also that early Holocene conditions, before gradual habitat destruction, would have seen more migrating birds (Garrard 1980:93).

Reptiles and Amphibians

There are two species of land tortoise which inhabit the Levantine region (*Testudo graeca* and *Testudo leithii*), three small species of freshwater turtle (*Emys orbicularis, Clemmys caspica* and *Trionyx triungius*), and two marine turtles which reach over a metre in length and are found on the sandy beaches along the Levantine coast (*Chelonia mydas* and *Chelonia caretta*) (Garrard 1980:93). The Nile crocodile (*Crocodilus vulgaris*) was last sighted earlier this century; its tolerance of salt water would presumably have enabled it to inhabit Levantine coastal rivers.

A whole host of frogs, newts and toads would have been found around fresh water sources (e.g. *Rana* sp., *Bufo* sp.), and lizards, snakes and other reptiles would have had a varied distribution throughout the area.

Fish, Molluscs and Crustaceans

Freshwater fish would have been abundant in the Huleh Lake, Lake Tiberias and the Jordan River (Byrd 1989:171). Marine fish would have also been available, but, as Garrard points out, the steeply shelving continental shelf and the general lack of nutrient enrichment from the eastern Mediterranean would have made resources along this coastline very poor (Garrard 1980:94).

Edwards (1989) notes the many kinds of marine, freshwater and terrestrial gastropods, and marine and freshwater bivalves which have been retrieved from prehistoric deposits in the Levant (Edwards 1989:229-230). These, however, along with any crustaceans, would probably only form a supplementary part of any diet (Garrard 1980). Alternatively, as Edwards notes

> Many of the marine shells collected in the Levant during the later Pleistocene are more properly explicable as items procured for ornamentation than for food.
>
> Edwards (1989:236)

Plant resources

In describing the present native flora, Zohary states that despite disppearance of plants through over-exploitation and, in particular, over-grazing, the local vegetation still supports hundreds of edible species (M. Zohary 1973:612). Some of the main species with their habitat preferences (taken from M. Zohary 1973; Garrard 1980: table 3C) are listed here under Zohary's category headings:

Pot herbs and salad plants

These leafy or herbaceous stemmed plants are numerous and widespead through different habitats in the Levant. Examples are knotweed (*Polygonum* spp.), goosefoot (*Chenopodium* spp.), docks (*Rumex* spp.), nettles (*Urtica* spp.) and samphire (*Crithmum maritimum*), the last of which is restricted to rocky coasts.

Bulbs and roots

Of the many plants in this category, arums (*Arum* spp.) and black bryony (*Tamus communis*) adhere to the Mediterranean woodland area. Bulbous barley (*Hordeum bulbosum*) has a widespread distribution, being found also in the steppe, as is tuberous cranesbill (*Geranium tuberosum*). Crocus bulbs (*Crocus* spp.) are edible and are found in the cool humid coastal mountains, and cow parsnips (*Zozima absinthifolia*) prefer a steppe/desert habitat.

Fruits

Grape (*Vitis vinifera*), fig (*Ficus carica*), pear (*Pyrus syriaca*), hackberry (*Celtis australis*) and carob (*Ceratonia siliqua*) are amongst the many fruit trees found in the Mediterranean woodland, and hawthorn (*Crataegus* spp.) also spreads into steppe/forest areas. Date palms (*Phoenix dactylifera*) tend to adhere to the Sudanian belt, where they grow near springs. Buckthorn (*Ziziphus* spp.) prefers a hot desert habitat.

Oil plants

The olive (*Olea oleaster*) is typical of Mediterranean woodland regions, and stone pine (*Pinus pinea*) inhabits the more mountainous regions.

Nut plants

The most commonly found nut in the Mediterranean vegetation zone is the acorn since oak trees (*Quercus* spp.) form the basis of the woodland zone here. Pistachio trees (*Pistacia* spp.) are also widespread in Mediterranean oak woodland, but in addition are found in the steppe. Almond trees (*Amygdalus* spp.) will grow in semi-steppic regions but also extend into fairly dry areas. In contrast, the hazel (*Corylus* spp.) prefers cool, mountainous habitats.

Pulses

The Middle East is one of the richest centres of legumes in the northern hemisphere; the number of native leguminous species being over 2000 (M. Zohary 1973:625-626). To take just a few examples, the wild pea (*Pisum* spp.) is widespread on loess and alluvial soil; broad bean (*Vicia faba*) and chickpea (*Cicer pinnatifidum*) inhabit oak woodland areas; the distribution of the lentil (*Lens* spp.) is from woodland to steppic regions, and lupins (*Lupinus* spp.) are widespread in sandy areas.

Cereals

The natural habitats of Near Eastern wild cereals have been investigated more thoroughly than any of the other plants because research has tended to focus on the wild progenitors of cereal cultivation (Harlan and Zohary 1966). Emmer wheat (*Triticum dicoccoides*) has a limited distribution in primary niches of oak woodland, due to its exact requirements for growth. It is found in the upper Jordan Valley, northern Jordan and Palestine, Lebanon and small areas of southwestern Syria. Outside of the Levant, wild wheat has limited distribution in the Zagros and south eastern Anatolia.

Einkorn wheat (*Triticum boeoticum*) also inhabits the open oak woodland, but is more tolerant of cold, giving this species a distribution in altitudes of over 2000m asl. Wild einkorn would probably have been abundant across the Near Eastern arc, from the Zagros to south eastern Anatolia, as well as in some parts of western Anatolia, with niches in northern Syria (Zohary and Hopf 1988:30).

The distribution of wild barley (*Hordeum spontaneum*) is more widespread since it can tolerate hot steppes as well as the Mediterranean woodland. The wild habitat of barley would probably have included most of the Levant, extending into the Negev and Sinai, but Harlan and Zohary's distribution maps do not show it inhabiting the eastern Jordanian steppe (1966).

Other wild cereals would have included rye (*Secale* spp.) in cool or mountainous habitats, oats (*Avena* spp.) which grow amongst the dwarf-shrub communities in the Mediterranean zone, and feather grass (*Stipa* spp.) which prefers more steppic environments.

APPENDIX TWO

GAZELLE CASE STUDY POPULATIONS - RAW DATA

Case Study No 1
G. gazella UG

Sources: Baharav 1983a and 1983b.

STUDY AREA

Ramat Qedesh, Upper Galilee, Israel; 6km²

Animals Protected?

gazelles are in protected area; hunting forbidden

BODY SIZE

no data

Sexual dimorphism:

no data

ENVIRONMENT

Climate:

ranges from Mediterranean to Irano-Turanian
cold winters; not below 0°C.
warm summers; 28-35°C.

Rainfall:

500-700mm; rainy season ends April

Vegetation:

ranges from Quercus-Ceratonia woodland to maquis to grassland to open steppe

Water availability:

from mid-May until winter rains, daily access to free standing water through irrigation system

Topography:

ranges from 70m asl to 800m asl
steep mountain slopes

BEHAVIOUR

Feeding habits:

winter and spring - grasses and forbs eaten
late spring and summer - browse (including leaves and twigs)

Browse or graze:

tendency towards grazing, turning to browse in late spring, summer and autumn after annual grasses and forbs have wilted

Patch desription:

no data

Minimization of water loss:

suggestion that the gazelles select plants with higher water content at the expense of protein during summer

Shade:

shades beneath *Zizyphus lotus*

Predators:

no data

Competitors:

cattle grazing at lower elevations

Concealment strategy:
uses *Z. lotus*

MATING STRATEGY

Polygamous:
yes
Territorial:
yes
Mating time:
Dec-Jan
Timing of births:
peak in June

GROUPING/MOVEMENT

Home range:
2.2 km^2 in winter/spring
Population density:
(averages)
1974-75 12.97+/-2.60 individuals/km^2
1975-76 18.10+/-2.74 individuals/km^2
1976-77 13.05+/-0.78 individuals/km^2
highest recorded
54 individuals/km^2
Biomass:
no data
Social organization:
bachelor groups of i) adults and subadults ii) yearlings
females move freely, solitary at fawning time
average of 6.49+/-1.26 males/10 mature females
Jan-June - 5.43+/-1.73 males/10 mature females.
Population structure:
1975 0.68 yearlings/mature females
1976 0.49 yearlings/mature females
1977 0.42 yearlings/mature females
Aggressive behaviour:
no data
Nomadism/Migration:
winter and spring - concentration in lower elevations
May - move to grassland or even woodland
late summer - a few go to woodland

BIRTHING

Age of 1st conception:
18 months
Lactation period:
75 days
Post-partum oestrus:
150-160 days
Spacing between births:
1yr
Fawns per birth:
1

Case Study No 2
G gazella LG

Sources: Baharav 1974a, 1974b, 1981, 1983a and 1983b.

STUDY AREA

Ramot Yissakhar, Lower Galilee, Israel
10.2km²

Animals Protected?

hunting prohibited (*G gazella* here was almost extinct 30 yrs ago but has now become an agricultural pest)

BODY SIZE

adult males: 25.200 kg
adult females: 18.335 kg
yearling males: 14.950 kg
yearling females: 16.125 kg

Sexual dimorphism:

males have larger thicker horns and thicker necks

ENVIRONMENT

Climate:

Transition between Mediterranean and Irano-Turanian; woodland to semi-arid
Mild winters; daily temp of 10-15°C; occassional frost
wet season: Oct-May (rain mostly in Jan and Feb)
summer: hot and dry, av. 32°C.

Rainfall:

200-350mm
seasonal rains, heaviest in late December

Vegetation:

dwarf shrub communities, dominated by *Zizyphus lotus*

Water availability:

springs are affected in dry years, but there is normally water throughout the year

Topography:

valleys at 200m bsl, and plateaux reaching 312m asl.

BEHAVIOUR

Feeding habitats:

available food can be separated into three categories:
i) grasses
ii) forbs an dwarf shrubs
iii) shrubs and trees
year round, grasses and forbs constitute a major part of the diet; also feed on shrubs, their leaves and fruit, and centre on *Z. lotus*;
Rumen contents (during growing season) - 73% grasses, 23% herbs, 4% browse species

Browse or graze:
during the growing season (Dec-March) *G. gazella* is almost exclusively a grazer; in the drying off season (April-June) and the dry season (July-Nov) browsing constituted 32% of the diet

Patch description:
no data

Minimization of water loss:
shades beneath *Z. lotus*

Shade:
shades beneath Z. *lotus* in dry season

Predators:
no data

Competitors:
some grazing cattle in valleys

Concealment strategy:
the young shelter from both intruders and the sun under *Z. lotus*

MATING STRATEGY

Polygamous:
yes

Territorial:
during the mating season the males held 14 territories in the area, with 2-5 females in each

Mating time:
all year round with peaks in Oct and May

Timing of births:
all year round but two main fawning seasons in late spring (April highest peak) and late autumn (lower peak in Nov)

GROUPING/MOVEMENT

Home range:
no data

Population density:
(mean) 23 individuals/km^2
(wet season - Jan) 37 individuals/km^2

Biomass:
(mean) - 389kg/km^2
(wet season - Jan) - 604kg/km^2

Social organization:
Female groups
bachelor groups (consisting of 1-3 older bucks and the rest young)
territorial males

Population structure:
81 males/100 adult females
20 reproducing males/100 adult females
summer: 53 fawns/100 females
winter: 32 fawns/100 females
74 yearlings/100 females

Aggressive behaviour:
yearling males expelled from a territorial male group

Nomadism/Migration:
sedentary

BIRTHING
Age of 1st conception:
6 months
Lactation period:
100 days
Post-Partum Oestrus:
15-60 days
Spacing between births:
6 months
Fawns per birth:
1

Case Study No 3
G. dorcas SN

Sources: Baharav 1982, 1983b; Baharav and Mendelssohn 1976.

STUDY AREA
Yotvata region, Southern Negev; 11 km²
Animals Protected?
hunting prohibited?

BODY SIZE
no data
Sexual dimorphism:
no data

ENVIRONMENT
Climate:
Extreme desert; intense solar radiation
temps for Aug: 28-34°C.
low relative humidity; almost no dew
Rainfall:
25mm; unpredictable and sporadic
Vegetation:
best developed in the wadis where *Acacia* sp. shrub and woodland is relatively dense
Water availability:
scarce
Topography:
alluvial fan; flat

BEHAVIOUR
Feeding habits:
throught the year acacia is the most important food source; selection for green acacia pods
Browse or graze:
mainly browse for acacias, and for other leaves and twigs; grazing occassionally in winter
Patch description:
acacia stands and areas under acacia trees
Minimization of water loss:
shading under acacias

Shade:
canopy of acacias to protect from sun
Predators:
no data
Competitors:
no data
Concealment stragegy:
no data

MATING STRATEGY
Polygamous:
yes
Territorial:
yes
Mating time:
September
Timing of births:
March

GROUPING/MOVEMENT
Home range:
no data
Population density:
5-6 individuals/km^2
Biomass:
no data
Social Organization:
territorial males
female groups
bachelor males
Population structure:
1 fawn/3 females (1974-78)
Aggressive behaviour:
no data
Nomadism/Migration:
movement very limited; activity highest around *Acacia* trees

BIRTHING
Age of 1st conception:
18 months
Lactation period:
90 days
Post-partum oestrus:
150-160 days
Spacing between births:
1 yr
Fawns per birth:
1

Case Study No 4
G. dorcas HWW + HOT

Sources: Baharav 1982, 1983b.

STUDY AREA

Hiyyon Region in the South Negev Desert; 550km²
Two different areas under study:
HWW - Hiyyon wide wadi
HOT - Hiyyon open terrain

Animals Protected?
no data

BODY SIZE

no data

Sexual dimorphism:
no data

ENVIRONMENT

Climate:
extreme desert; august temps 28-34°C.
low relative humidity; intense solar radiation
almost no dew

Rainfall:
25mm; unpredictable, sporadic and rainstorms in winter

Vegetation:
best developed in wadis; single shrubs/plants exist, but otherwise barren; acacias in wadis; annuals during rainy season, but wilt in less than a month

Water availability:
HWW: scarce other than wet season
HOT: v scarce

Topography:

BEHAVIOUR

Feeding habitats:
acacia is the preferred food but due to competition from other animals, gazelle rely on *Zilla spinosa* and *Ochradenus* spp. which grows in the wadi beds in all seasons; HOT is less productive and more browse, twigs and flowers are eaten

Browse or graze:
animals are primarily browsers, but graze when grass and forbs are available

Patch description:
large acacia stands
HWW: animals forage from patch to patch along wadi bed
HOT: animals stay in large patches to minimize energy loss through movement

Minimization of water loss:
restricted movement and shade

Shade:
canopy of acacia

Predators:
no data
Competitors:
Bedouin herds of sheep, goats and camels
Concealment strategy:
no data

MATING STRATEGY

Polygamous:
yes
Territorial:
HWW: yes
HOT: no
Mating time:
september
Timing of births:
march

GROUPING/MOVEMENT

Home range:
HWW: 1-2 km^2
HOT: 25 km^2
Population density:
HOT: 0.09/km^2
Biomass:
no data
Social organization:
HWW: high densities, female herds (5-22 adults and young males), and groups of bachelor males (2-5)
HOT: low densities, harem-like social structure of 1 adult male and 1-4 female and young
Population structure:
HWW: 1 fawn/4 females (1974-75)
HOT: 1 fawn/8 females (1974-75)
Aggressive behaviour:
gazelles using HOT are probably those expelled from better habitats through competition
Nomadism/Migration:
HOT: roaming

BIRTHING

Age of 1st conception:
18 months
Lactation period:
75 days
Post-partum oestrus:
180 days
Spacing between births:
1 yr
Fawns per birth:
1

Case Study No 5
G. gazelle KKWRC + FI

Sources: Habibi *et al.* 1993

STUDY AREA

King Khaled Wildlife Research Centre, Thummah, Saudi Arabia; 680km^2; some observations also taken from wild populations on Farasan Islands (Red Sea)

Animals Protected?

KKWRC: yes; hunters and predators barred; enclosed
FI: in wild

BODY SIZE

shoulder height av. 64.5cm

Sexual dimorphism:

male horns longer and thicker than females

ENVIRONMENT

Climate:

hot, dry summers; midday temps 45°C.
winters cooler 25°C;

Rainfall:

rains in winter; 50-100mm/year; infrequent showers

Vegetation:

sand dune desert type

Water availability:

no data

Topography:

plains and low hills

BEHAVIOUR

Feeding habitats:

animals have supplementary feeding

Browse or graze:

no data

Patch description:

no data

Minimization of water loss:

no data

Shade:

no data

Predators:

yes; response=stotting

Competitors:

no data

Concealment strategy:

no data

MATING STRATEGY

Polygamous:
yes

Territorial:
yes; territories held throughout the year; less herding and chasing of females than *G. subgutturosa* in same location

Mating time:
throughout year with peaks in Oct-Nov and April-May

Timing of births:
throughout year with peaks in March-April and Sept-Oct

GROUPING/MOVEMENT

Home range:
territories (?): KKWRC: 170x170m; FI: 54-74km^2

Population density:
FI: 4/km^2

Biomass:
no data

Social organization:
FI: single males (38%); females alone (21%); females with young (24%); mixed sex groups (9%); male groups (up to 4); 2 females and young; largest group=5

Population structure:
no data

Aggressive behaviour:
male agonistic behaviour described

Nomadism/Migration:
sedentary

BIRTHING

Age of 1st conception:
no data

Lactation period:
no data

Post-partum oestrus:
appears to be soon after birthing

Spacing between births:
6 months

Fawns per birth:
1

Case Study No 6
G. subgutturosa KKWRC/Gh/Al-H

Sources: Habibi *et al.* 1993

STUDY AREA

King Khaled Wildlife Research Centre, Thummah, Saudi Arabia; 680km^2; with additional observations from Ghurrub, northern Saudi Arabia and Al Harrah Reserve near Jordanian border

Animals Protected?

KKWRC: yes; hunters and predators barred; enclosed
Gh: wild
Al Harrah: protected and enclosed

BODY SIZE

shoulder height av. 63.5cm and thickset

Sexual dimorphism:

males horned, but horns generally absent in females (except *G. s. marica* subspecies)

ENVIRONMENT

Climate:

hot, dry summers; midday temps 45°C.
winters cooler 25°C;

Rainfall:

rains in winter; 50-100mm/year; infrequent showers

Vegetation:

sand dune desert type

Water availability:

no data

Topography:

KKWRC: plains and low hills
Ghurrub: barren and low hills
Al Harrah: basalt plain

BEHAVIOUR

Feeding habitats:

animals have supplementary feeding; travel long distances in search of food

Browse or graze:

no data

Patch description:

no data

Minimization of water loss:

no data

Shade:

no data

Predators:

yes; response=fast trot

Competitors:

no data

Concealment strategy:

no data

MATING STRATEGY

Polygamous:

yes

Territorial:

yes; strongly territorial; males attempt to herd females into territory, as many as possible, but probably don't hold territories for long

Mating time:

Sept-Oct

Timing of births:

KKWRC: March/April

GROUPING/MOVEMENT

Home range:

territories (?): KKWRC:70x70m
no firm evidence for territoriality in wild?

Population density:

Gh: 0.2/km^2

Biomass:

no data

Social organization:

Gh: groups of up to 56 animals
commonest groups = single male or mixed-sex group with a single male; mixed-sex groups common outside breeding season; harems during breeding season
single males=22% of all groups during rut
single males=29% of groups at other times of year
male/female/young groups common
bachelor 'groups' (of only 2 males) very rare
female and young groups usually with a male
large groups with >1 adult male are frequent
in winters, large mixed groups with several males
neonates form creches of c.20 after c.1 week

Population structure:

no data

Aggressive behaviour:

territorial males highly aggressive; rigorously defend territories

Nomadism/Migration:

may have been migratory and/or nomadic in the past; in KKWRC travel long distances in search of food; behaviour seems adapted for mobility (e.g. short holding of territories).

BIRTHING

Age of 1st conception:

1 year

Lactation period:

no data

Post-partum oestrus:

no data

Spacing between births:

1 year

Fawns per birth:

KKWRC: a third of females have 2; two thirds have 1

Case Study No 7
Gazella dorcas KNP/TPA

Source: O'Regan 1980

STUDY AREA

Dasht e Kavir area, Iran. Two main areas censused: i) Kavir National Park (KNP), left wild. ii) Turan Protected Area (TPA) where herding and cultivation continue.

Animals Protected?

yes

BODY SIZE

males: 30kg; 70cm shoulder height
females: 20kg; 65cm shoulder height

Sexual dimorphism:

females have long thin horns, thinner than males

ENVIRONMENT

Climate:

markedly seasonal: July temp max 38°C.; January 13°C.

Rainfall:

100mm/year, most of which falls in winter and spring

Vegetation:

dominant vegetation is perennial shrubs; Tamaricaceae on moister soils and Chenopodiaceae on drier. Alluvial plains dominated by *Artemisia herba-alba*. Generally sparse with spring annuals

Water availability:

springs throughout the park; dorcas gazelle are free from standing water, but visit springs anyway (for social interaction)

Topography:

rocky mountain outcops (altitude up to 1,608m asl), broad alluvial plains (c. 1,000m asl), low salt and mud-flats and sand dunes.

BEHAVIOUR

Feeding habitats:

KNP: gazelle selecting *Haloxylon* and *Artemisia* and avoiding *Seidlitzia*
TPA: gazelle selecting *Haloxylon*
they visit springs daily in summer, not neccessarily because they need to drink

Browse or graze:

predominantly browsers; graze on spring annuals, but when these die they turn to browsing esp on *Artemisia*

Patch description:

no data

Minimization of water loss:

feed in early morning and late evening; rest in foothills in middle of day

Shade:
shade beneath *Haloxylon* in summers
Predators:
cheetah, lynx
Competitors:
grazing flocks of domestic sheep and goat (in TPA); feral camels; goitred gazelle (in wetter, more steppic areas), wild ass, wild sheep and goat occur on mountain outcrops
Concealment strategy:
birthing in foothills - more concealed

MATING STRATEGY
Polygamous:
yes
Territorial:
yes; male territory size is 35-60 hectares; in summers they are more concentrated around springs; females move through territories
Mating time:
late Oct-mid Nov
Timing of births:
April-May

GROUPING/MOVEMENT
Home range:
no data
Population density:
TPA: max of 0.7/km^2 (influenced by human habitation and domestic flocks)
KNP: 0.03-1.5/km^2; a more even distribution of animals seen here in summers than TPA
Biomass:
TPA: 2.7kg/km^2
KNP: 4.13kg/km^2
Social organization:
groups:
i) male only (adult = >15 months)
ii) female only (adult = >15 months); at birth
iii) fawn (up to 1 yr), with or without females (fawns lie out for c.1 month)
iv) harem groups peak in Nov (at rut); max sizes are 6 in KNP and 3 in TPA
v) mixed; group sizes are generally small, max of 9 in KNP and 5 in TPA
smallest groups in May and largest in January; group size larger in winter in KNP than TPA; smaller proportion of males and fawns in TPA than KNP
Population structure:
KNP July: 31% adult male; 36% adult female; 33% fawn (although "male category includes adult and yearling", O'Regan 1980:116)
Aggressive behaviour:
no data

Nomadism/Migration:

seasonal movements only: in summer, gazelle are close (c 5km) to springs in foothills (KNP) and 7.5-12.5km distant in TPA, BUT on the plains (KNP) they select the *Haloxylon* habitat rather than sites close to springs. This selection does not occur in winter/spring (no water stress)

BIRTHING

Age of 1st conception:

no data

Lactation period:

no data

Post-partum oestrus:

no data, but not soon after birthing

Spacing between births:

1 year

Fawns per birth:

1

Case Study No 8
Gazella granti NC

Sources: Estes 1967

STUDY AREA

Ngorongoro Crater, Tanzania; 311km^2

Animals Protected?

no data

BODY SIZE

adult male:68-81kg

Sexual dimorphism:

males have large lyre-shaped horns; females have thin shorter horns

ENVIRONMENT

Climate:

equatorial; humid

Rainfall:

abundant; probably >760mm

Vegetation:

open grassland; fertile volcano soil

Water availability:

no data

Topography:

hilly; altitude ranges from 5,800-7,000feet

BEHAVIOUR

Feeding habitats:

mixed feeding; feeds on grass (red oat grass); inhabits range from tall grassland to light bush to desert regions; feeding also on legumes and shrubs

Browse or graze:

40% graze;60% browse

Patch description:
no data
Minimization of water loss:
no data
Shade:
no data
Predators:
cheetah, leopard, hyaena, jackals (gazelles fight off latter)
Competitors:
wildebeest, Burchell's zebra, eland, topi, waterbuck; more like commensals; may feed together; gazelle feeds on pasture which is poor for others
Concealment strategy:
grouping of mothers together for protection; hiding places; mothers clean scent

MATING STRATEGY

Polygamous:
yes
Territorial:
yes; males defend a large territory; spaced c. half mile apart
Mating time:
throughout year but peak in Aug-Sept
Timing of births:
throughout year but peak in Jan-Feb

GROUPING/MOVEMENT

Home range:
290km^2
Population density:
no data
Biomass:
no data
Social organization:
groups of c.100 individuals
territorial males
bachelor herds
nursery herds
Population structure:
no data
Aggressive behaviour:
males defend territories; intimidation; display
Nomadism/Migration:
no data but probably move with commensals at onset of rains

BIRTHING

Age of 1st conception:
no data
Lactation period:
no data
Post-partum oestrus:
no data
Spacing between births:
no data
Fawns per birth:
no data

Case Study No 9
Gazella granti SNP

Sources: Walther 1972

STUDY AREA
Serengeti National Park, Tanzania
Animals Protected?
no data

BODY SIZE
no data, but probably as above
Sexual dimorphism:
no data, but probably as above

ENVIRONMENT
Climate:
equatorial; hot; dry
Rainfall:
abundant; probably >760mm; 'small rains' in Nov; 'long rains' end in May
Vegetation:
area includes bush and woodlands/clearings (mbuga), as well as open plains and semi-arid areas; bush=*Acacia-Commiphora*
Water availability:
creeks which fill with water only during the rainy seasons
Topography:
no data

BEHAVIOUR
Feeding habitats:
no data
Browse or graze:
Talbot (1962, quoted in O'Regan 1980): predominantly browser (60% of diet)
Patch description:
no data
Minimization of water loss:
no data
Shade:
no data

Predators:
cheetah, leopard, hyaena, jackal
Competitors:
wildebeest, zebra etc. (as above); movements of these all influence gazelle population density
Concealment strategy:
fawns lie out

MATING STRATEGY
Polygamous:
yes
Territorial:
yes; males hold territories for 8 months of year (Dec-June/July); territory size=500-2,000m^2; male territory coincides approx. with home range of female group
Mating time:
throughout year but peaks in July-Aug and March-April
Timing of births:
throughout year but peaks in Dec-Feb (after small rains) and Aug-Sept (dry season)

GROUPING/MOVEMENT
Home range:
1-2km diameter
Population density:
varies greatly across areas; linked to rains and movements of other animals
Biomass:
no data
Social organization:
max size of mixed herds: 428
other groups (male, female, harem)=30-40
small group size favoured in the bush/clearings;
territorial males
harems
bachelor herds
mother-offspring groups
solitary adult
changes in sizes and structure of groups are linked to seasons: split into smaller groups in rainy seasons; large mixed herds in dry season and at time of migration (especially at beginning and end)
Oct: peak of drought, small groups
Nov: rains; mixed herds
Jan-Feb: mixed herds splitting, peak of fawning
March-June: large harem herds
July: beg of dry season, lg harems break up
Aug-Sept: small harem groups, peak of mating
Oct-Dec: mixed herds decline, migration

Population structure:

adolescent females: adolescent males=1:1.3 (not sig diff)
subadult females: subadult males=1:1 (1-2 years)
adult females: adult males=2:1 (5038:2658)
subadults:adults=1:2.5
female subadults: female adults=1:4.5
i.e. mortality rate higher in males than females; and adult female lifespan is longer than adult male
adults:juveniles=62%:38%

Aggressive behaviour:

threat/dominance display with other males

Nomadism/Migration:

seasonal migrations; animals leave bush in Nov at beginning of small rains and migrate to open plains for the rainy season; in July-Sept they go deeper into bush; some animals won't migrate if they don't need the graze; extent of movement depends on drought, distribution of grass, degree of burning and rainfall

BIRTHING

Age of 1st conception:

no data

Lactation period:

no data

Post-partum oestrus:

no data

Spacing between births:

1 year

Fawns per birth:

1

Case Study No 10
Gazella thomsoni NC

Sources: Estes 1967

STUDY AREA

Ngorongoro Crater, Tanzania; 311km^2

Animals Protected?

no data

BODY SIZE

adult male:21-27kg

Sexual dimorphism:

males have large straight horns, whilst females have thin horns

ENVIRONMENT

Climate:

no data

Rainfall:

abundant; probably range between 250-760mm

Vegetation:

open grasslands; fertile volcanic soil

Water availability:

no data

Topography:

ranges in altitude 5,800-7,000feet

BEHAVIOUR

Feeding habitats:

feeds on short green grass, and also legumes, herbs and shrubs; likes dry ground (more restricted in range than *G. granti*)

Browse or graze:

predominantly a grazer

Patch description:

no data

Minimization of water loss:

can go without drinking if on green pasture

Shade:

no data

Predators:

cheetah, leopard, hyaena, jackals, wild dogs (does will fight off smaller predators)

Competitors:

commensals: wildebeest, Burchell's zebra, eland, topi, waterbuck, other gazelles

Concealment strategy:

mothers associate together as anti-predator behaviour; use hiding places; clean patches before moving to obliterate scent

MATING STRATEGY

Polygamous:
yes

Territorial:
males vigorously territorial (more than *G. granti*); males spaced 200-300yards apart

Mating time:
throughout year but peak in Aug-Sept

Timing of births:
throughout year but peak in Jan-Feb (between rains)

GROUPING/MOVEMENT

Home range:
wet season: 42-65km^2
dry season:142.5km^2

Population density:
no data

Biomass:
no data

Social organization:
territorial males
bachelor herds
nursery herds

Population structure:
no data

Aggressive behaviour:
males use intimidation and fighting; aggressive

Nomadism/Migration:
no data, but see below

BIRTHING

Age of 1st conception:
no data

Lactation period:
no data

Post-partum oestrus:
no data

Spacing between births:
1 year

Fawns per birth:
no data

Case Study No 11
Gazella thomsoni T

Sources: Brooks 1961

STUDY AREA
much of Tanzania, including Serengeti National Park; the study area varies with migrations

Animals Protected?
no data

BODY SIZE
no data, but see above

Sexual dimorphism:
no data, but see above

ENVIRONMENT

Climate:
equatorial; ranges from hot humid coastlands to hot dry plains; temperatures can exceed 32°F

Rainfall:
abundant; probably ranges between 250-760mm; short rains in Nov; long rains in April-May

Vegetation:
scattered tree- grasslands (Acacia-Themeda); generally low tree/high grass areas; mainly grasslands in highlands; also semi-deserts. Firing for vegetation growth/animal control

Water availability:
probably abundant temporary water sources in rainy seasons; more limited permanent bodies

Topography:
altitude ranges from 2,500-7,000feet

BEHAVIOUR

Feeding habitats:
only likes specific conditions: fresh, short grass; will avoid long rank grass of the plains; also feeds on green foliage of acacia, leaves, twigs and fruit. Grasses form c90% of diet, but feeding is very varied and other 10% constitutes trees, shrubs and herbs

Browse or graze:
both but predominantly grazer

Patch description:
scattered tree-woodlands and short grass clearings

Minimization of water loss:
they frequent watering places; in dry season they water at least once a day (observed travelling up to 10 miles for water); shading for hottest part of day reduces water loss; most activity in early morning and late afternoon

Shade:
shade beneath trees, or seek high ground

Predators:
cheetah, leopard, lion, spotted hyaena, black-backed jackal, golden jackal, huntingdog, eagle (+baboon and other birds)

Competitors:
shares range with hartebeest, zebra, topi, giraffe, dik-didk, common duiker, stenbuck, oribi, oryx, roan antelope, eland, gerenuk, bushbuck, waterbuck, Bohor, mountain reedbuck, buffalo and warthog; integrates socially with Grant's gazelle and impala. Movements of all these animals influence gazelle

Concealment strategy:
press themselves into ground; colouring of young acts as camoflage

MATING STRATEGY

Polygamous:
yes

Territorial:
males have marked territories; probably return to same territories repeatedly

Mating time:
throughout year but peaks in Aug-Sept and Jan-Feb

Timing of births:
throughout year but peaks in Jan-March (after short rains) and June-late July (after long rains)

GROUPING/MOVEMENT

Home range:
no data

Population density:
54/km^2

Biomass:
no data

Social organization:
i) harem herd: 4-60 females + 1 adult male, some young
ii) scattered females: either in advanced pregnancy or with fawn
iii) bachelor herds: males 8 months-2.5 years; groups of 6-300 animals
iv) solitary males: >2 years old; maintain territories over all seasons, or as long as grazing permits

Population structure:
no data

Aggressive behaviour:
males fight and display

Nomadism/Migration:
2 migrations/year i) eastwards to plains before rainy season (in Oct/early Nov before Nov short rains). ii) westwards migration at onset of dry season (June-July); distances vary from 30-100miles; in dry season, Thomson's gazelle follow in path of wildebeest and zebra; but at onset of rains, they lead them. They migrate in anticipation of fresh grazing, but also to find refuge areas of drained ground. Pregnant females may also be seeking breeding grounds. Migrations intimately connected with firing.

BIRTHING

Age of 1st conception:
1 year

Lactation period:
6 months (weaning)

Post-partum oestrus:
no data but short because they can breed twice a year

Spacing between births:
c.6 months

Fawns per birth:
no data

APPENDIX THREE

BIRD BONE

UW18 - bird bone	
species/taxa (common name)	no. of frags
Rallus aquaticus (water rail)	1

KH4 A - bird bone	
species/taxa (common name)	no. of frags
Struthio camelus (ostrich)	2
Neophron percnopterus (Egyptian vulture)	5
Mergus merganser (Goosander)	1

KH4 B - bird bone	
species/taxa (common name)	no. of frags
Struthio camelus (ostrich)	2

KH4 D - bird bone	
species/taxa (common name)	no. of frags
Struthio camelus (ostrich)	4
Pterocles orientalis (black-bellied sandgrouse)	3
Bubo bubo (eagle owl)	1

WJ6 B - bird bone	
species/taxa (common name)	no. of frags
cf. *Pterocles alchata* (pin-tailed sandgrouse)	1

Table 13.0 List of identifiable bird bone from each assemblage.

WJ6 A - bird bone	
species/taxa (common name)	no. of frags
Struthio camelus (ostrich)	2
Francolinus/Alectoris (partridge)	1
Syrrhaptes paradoxus (Pallas' sandgrouse)	13
cf. *Syrrhaptes paradoxus* (cf. Pallas' sandgrouse)	3
cf. *Pterocles alchata* (cf. pintailed sandgrouse	12
cf. *Pterocles orientalis* (cf. black-bellied sandgrouse	1
Syrrhaptes/Pterocles (sandgrouse)	5
Galderida cristata (crested lark)	1

WJ22 C - bird bone	
species/taxa (common name)	no. of frags
Syrrhaptes paradoxus (Pallas' sandgrouse)	1
Syrrhaptes paradoxus/Pterocles alchata (sandgrouse)	8
cf. *Buteo rufinus* (long-legged buzzard)	15
cf. *Buteo* sp. (buzzard)	4
Anas platyrhynchos (mallard)	1
Milvus milvus (red kite)	1
Turdus sp.(thrush)	1
Aquila nipalensis (steppe eagle)	4
A. nipalensis/A. chrysaetos (steppe/ golden eagle)	2
A. nipalensis/A. heliaca (steppe/ imperial eagle)	2
A. nipalensis/A. heliaca/A. clanga (steppe/imperial/spotted eagle)	1
Eagle	28

Table 13.0 (cont.). List of identifiable bird bone from each assemblage.

WJ22 B - bird bone	
species/taxa (common name)	no. of frags
Syrrhaptes paradoxus/Pterocles alchata (sandgrouse)	2
cf. *Buteo rufinus* (long-legged buzzard)	3
Buteo sp. (buzzard)	3
Anas platyrhynchos (mallard)	1
Anas acuta/platyrhynchos (pintail/ mallard)	1
Aquila nipalensis (steppe eagle)	2
cf. *Aquila chrysaetos* (cf. golden eagle)	1
A. nipalensis/A. heliaca/A. chrysaetos (steppe/imperial/golden eagle)	12
A. nipalensis/A. heliaca/A. clanga/ Hieraeetus fasciatus (steppe/imperial spotted/Bonelli's eagle)	1
A. nipalensis/A. heliaca/A. chrysaetos Hieraeetus fasciatus (steppe/imperial/ golden/Bonelli's eagle)	6
Eagle	10

AZ18 - bird bone	
species/taxa (common name)	no. of frags
Struthio camelus (ostrich)	1
Anas acuta (pintail duck)	1
Anas querquedula (garganey)	1
Anas sp. (duck)	1

WJ7 2 - bird bone	
species/taxa (common name)	no. of frags
cf. *Neophron percnopterus* (Egyptian vulture	2
Syrrhaptes paradoxus (Pallas' sandgrouse)	1
Pterocles alchata (pin-tailed sandgrouse)	1
Syrrhaptes/Pterocles (sandgrouse)	2
cf. *Ketupa zeylonensis* (brown fishing owl)	2
Ciconia ciconia/nigra (white or black stork)	2

Table 13.0 (cont.). List of identifiable bird bone from each assemblage.

DH 1 - bird bone	
species/taxa (common name)	no. of frags
Pterocles orientalis (black-bellied sandgrouse)	1
Chlamydotis undulata (Houbara bustard)	1
cf. *Chlamydotis undulata* (cf. Houbara bustard)	1
cf. *Perdix perdix* (partridge)	1

DH 2 - bird bone	
species/taxa (common name)	no. of frags
Pterocles alchata (pin-tailed sandgrouse)	5
cf. *Pterocles alchata* (cf. pin-tailed sandgrouse)	1
Syrrhaptes paradoxus (Pallas' sandgrouse)	1
Pterocles/Syrrhaptes (sandgrouse)	2
Coturnix coturnix (quail)	5
cf. *Athene noctua* (little owl)	3
Ixobrycus minuta (little bittern)	1

Table 13.0 (cont.). List of identifiable bird bone from each assemblage.

Period	Site/Phase	No. of bird taxa	NISP %	MNE/B %
LN	DH 2	5	0.2	0.3
LN	WJ13 3	not id.	1.4?	1.8?
LN	WJ13 2	not id.	1.8?	2.2?
LN	WJ13 1	not id.	3.0?	3.3?
LN	WJ25	not id.	1.3?	1.8?
PPNB	DH 1	3	0.1	0.2
PPNB	WJ7 4	not id.	0.6?	0.8?
PPNB	WJ7 3	not id.	0.4?	0.5?
PPNB	WJ7 2	5	1.4	2.1
L EPAL	AZ18	3	1.4	3.8
M EPAL	WJ22 C	6	2.2	28.0
M EPAL	WJ22 B	4	0.8	6.9
M EPAL	KH D	3	0.1	0.2
E EPAL	UW18	1	0.2	0.6
E EPAL	KH B	3	0.1	0.2
E EPAL	KH A	3	0.5	0.8
E EPAL	WJ6 B	1	0.9	2.2
E EPAL	WJ6 A	5	1.4	4.5

Table 13.1. The NISP% and MNE/B% of bird bone for each assemblage.

Bird bones

Although most of the bird species shown in this Appendix could have been permanent residents of eastern Jordan in the late Pleistocene/early Holocene, some are only seasonal visitors. Table 13.2 lists these species and shows the seasons when they would probably visit the area, based on present distributions and migration patterns (Heinzel *et al.* 1972). The assemblages where these species occur are also shown in Table 13.0.

Seasonal presence of birds in eastern Jordan

season of presence	species	assemblage (n=MNE)
spring/autumn migrants	*Anas querquedula* (garganey)	AZ18 (1)
	Ciconia ciconia (white stork)	?WJ7 2 (1) or
	Ciconia nigra (black stork)	?WJ7 2 (1)
	Ixobrycus minuta (little bittern)	DH 2 (1)
summer	*Neophron percnopterus* (Egyptian vulture)	KH4 A (5) WJ7 2 (2)
winter	*Mergus merganser* (goosander)	KH4 A (1)
	Syrrhaptes paradoxus (Pallas' sandgrouse)	WJ6 A (3) WJ22 C (1) WJ7 2 (1) DH 2 (1)
	Anas acuta (pintail)	AZ18 (1)
autumn/winter spring	*Turdus* sp. (thrush)	WJ22 C (1)
	Aquila nipalensis (steppe eagle)	WJ22 C (4) WJ22 B (2)

Table 13.2. The bird species which visit eastern Jordan on a seasonal basis are shown, and the occurrence of these species in assemblages.

The difficulties with using the information in table 13.2 are that the seasonal movements of modern birds may not be similar to those in prehistory (e.g. Jenkinson and Sutherland 1984), and even if they were, the reflected seasons of hunting are rather broad. An additional problem is that bird bones may be curated, and their presence in a different context would lead to false inferences (although none of the bird bones appeared worked).

Nevertheless, it is noteworthy that for most of the assemblages, the bird data are in accordance with the hunting times suggested by the gazelle cull patterns. The birds from WJ6 A, WJ22 B and C, AZ18 and DH 2 are all either spring/autumn migrants or winter visitors. The presence of the summer visitor, *Neophron percnopterus* (Egyptian vulture) at KH4 A and WJ7 2, however, raises more questions. This species inhabits much hotter, drier regions on a year-round basis, and presently only moves north (Middle East, southern Europe) in the warmer summer months (Heinzel *et al.* 1972). At the time of occupation of KH4 A (Glacial Maximum/early post-glacial) and WJ7 2 (early Holocene), winters would have not have been warmer than present-day, but in both cases would have been presumably cooler, therefore suggesting that the Egyptian vulture would have been a summer visitor then too. When this is viewed in relation to the gazelle cull patterns from the two assemblages, KH4 A, shows no evidence for summer culls, but WJ7 2 interestingly sees the greatest increase in cull between June and December.

APPENDIX FOUR

BODY PART DATA

The following pages present the body part data for all animals discussed in Chapter 8 (gazelle, equids, cattle, hare and fox). Tables 8.0-8.10 show gazelle body part data; Tables 8.17-8.26 show that for equids; Tables 8.29-8.45 are for hare, and Tables 8.46-8.49 show data for fox.

GAZELLE BODY PART DATA

Assemblage: WJ6 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		4		62	6
PETROUS (SKULL)		0		62	0
OCCIPITAL COND		6		62	10
MANDIBLE	22	98		62	35/158
MANDIBULAR COND	22	70		62	35/113
ATLAS		6		31	19
AXIS		1		31	3
SCAPULA		32		62	52
HUMERUS PROX		4		62	6
HUMERUS DIST		34		62	55
RADIUS PROX		57		62	92
RADIUS DIST		37		62	60
ULNA		49		62	79
CARPALS		55		62	89
METACARPAL PROX		25		62	40
METACARPAL DIST		63		62	102
PELVIS		42		62	68
FEMUR PROX		24		62	39
FEMUR DIST		30		62	48
TIBIA PROX		7		62	11
TIBIA DIST		63		62	102
ASTRAGALUS		69	31	62	111
CALCANEUM		62		62	100
NAVICULO CUBOID		50		62	81
METATARSAL PROX		74		62	119
METATARSAL DIST		61		62	98
PHALANX 1		172		248	69
PHALANX 2		151		248	61
PHALANX 3		158		248	64
TOTAL		1380			

Table 8.0. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: KH4 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		47	31	62	76
PETROUS (SKULL)		0		62	0
OCCIPITAL COND		0		62	0
MANDIBLE		81		62	131
MANDIBULAR COND		29		62	47
ATLAS		2		31	6
AXIS		6		31	19
SCAPULA		24		62	39
HUMERUS PROX		17		62	27
HUMERUS DIST		61		62	98
RADIUS PROX		39		62	63
RADIUS DIST		38		62	61
ULNA		36		62	58
CARPALS		8		62	13
METACARPAL PROX		15		62	24
METACARPAL DIST		29		62	47
PELVIS		40		62	65
FEMUR PROX		17		62	27
FEMUR DIST		33		62	53
TIBIA PROX		16		62	26
TIBIA DIST		50		62	81
ASTRAGALUS		82		62	132
CALCANEUM		84		62	135
NAVICULO CUBOID		35		62	56
METATARSAL PROX		48		62	77
METATARSAL DIST		12		62	19
PHALANX 1		117		248	47
PHALANX 2		96		248	39
PHALANX 3		75		248	30
TOTAL		1347			

Table 8.1. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: KH4 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		14		48	29
PETROUS (SKULL)		2		48	4
OCCIPITAL COND		4		48	8
MANDIBLE		63		48	131
MANDIBULAR COND		31		48	65
ATLAS		5		24	21
AXIS		6		24	25
SCAPULA		24		48	50
HUMERUS PROX		21		48	44
HUMERUS DIST		44		48	92
RADIUS PROX		70		48	146
RADIUS DIST		30		48	63
ULNA		26		48	54
CARPALS		7		48	15
METACARPAL PROX		25		48	52
METACARPAL DIST		19		48	40
PELVIS		51		48	106
FEMUR PROX		19		48	40
FEMUR DIST		19		48	40
TIBIA PROX		7		48	15
TIBIA DIST		44		48	92
ASTRAGALUS		66	24	48	138
CALCANEUM		58		48	121
NAVICULO CUBOID		31		48	65
METATARSAL PROX		51		48	106
METATARSAL DIST		15		48	31
PHALANX 1		133		192	69
PHALANX 2		124		192	65
PHALANX 3		120		192	63
TOTAL		1428			

Table 8.2. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: KH4 C

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		2		12	17
PETROUS (SKULL)		0		12	0
OCCIPITAL COND		0		12	0
MANDIBLE		4		12	33
MANDIBULAR COND		1		12	8
ATLAS		0		6	0
AXIS		0		6	0
SCAPULA		2		12	17
HUMERUS PROX		1		12	8
HUMERUS DIST		9		12	75
RADIUS PROX		9		12	75
RADIUS DIST		3		12	25
ULNA		3		12	25
CARPALS		7		12	58
METACARPAL PROX		3		12	25
METACARPAL DIST		1		12	8
PELVIS		4		12	33
FEMUR PROX		1		12	8
FEMUR DIST		2		12	17
TIBIA PROX		0		12	0
TIBIA DIST		8		12	67
ASTRAGALUS		8	6	12	67
CALCANEUM		8		12	67
NAVICULO CUBOID		8		12	67
METATARSAL PROX		1		12	8
METATARSAL DIST		2		12	17
PHALANX 1		27		48	56
PHALANX 2		29		48	60
PHALANX 3		30		48	63
TOTAL		258			

Table 8.3. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: KH4 D

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		53		158	34
PETROUS (SKULL)		18		158	11
OCCIPITAL COND		20		158	13
MANDIBLE		200		158	127
MANDIBULAR COND		138		158	87
ATLAS		27		79	34
AXIS		40		79	51
SCAPULA		105		158	66
HUMERUS PROX		33		158	21
HUMERUS DIST		97		158	61
RADIUS PROX		198		158	125
RADIUS DIST		137		158	87
ULNA		106		158	67
CARPALS		54		158	34
METACARPAL PROX		143		158	91
METACARPAL DIST		90		158	57
PELVIS		179		158	113
FEMUR PROX		43		158	27
FEMUR DIST		39		158	25
TIBIA PROX		33		158	21
TIBIA DIST		46		158	29
ASTRAGALUS		200	79	158	127
CALCANEUM		268		158	170
NAVICULO CUBOID		132		158	84
METATARSAL PROX		241		158	153
METATARSAL DIST		72		158	46
PHALANX 1		668		1264	53
PHALANX 2		624		1264	49
PHALANX 3		524		1264	41
TOTAL		7404			

Table 8.4. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: UW18

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		10		16	63
PETROUS (SKULL)		0		16	0
OCCIPITAL COND		1		16	6
MANDIBLE		9		16	56
MANDIBULAR COND		4		16	25
ATLAS		0		8	0
AXIS		0		8	0
SCAPULA		1		16	6
HUMERUS PROX		0		16	0
HUMERUS DIST		2		16	13
RADIUS PROX		5		16	31
RADIUS DIST		2		16	13
ULNA		7		16	44
CARPALS		3		16	19
METACARPAL PROX		9		16	56
METACARPAL DIST		16		16	100
PELVIS		1		16	6
FEMUR PROX		1		16	6
FEMUR DIST		1		16	6
TIBIA PROX		2		16	13
TIBIA DIST		3		16	19
ASTRAGALUS		12	8	16	75
CALCANEUM		13		16	81
NAVICULO CUBOID		8		16	50
METATARSAL PROX		11		16	69
METATARSAL DIST		11		16	69
PHALANX 1		50		64	78
PHALANX 2		62		64	97
PHALANX 3		56		64	88
TOTAL		207			

Table 8.5. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: WJ22 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	1	1		32	3/ 3
PETROUS (SKULL)	2	2		32	6/ 6
OCCIPITAL COND	0	0		32	0/ 0
MANDIBLE	0	0		32	0/ 0
MANDIBULAR COND	25	25		32	78/ 78
ATLAS	0	0		16	0/ 0
AXIS	0	0		16	0/ 0
SCAPULA	10	11		32	31/ 34
HUMERUS PROX	1	4		32	3/ 13
HUMERUS DIST	9	19		32	28/ 59
RADIUS PROX	30	66		32	94/206
RADIUS DIST	6	9		32	19/ 28
ULNA	5	5		32	16/ 16
CARPALS	5	5		32	16/ 16
METACARPAL PROX	26	44		32	81/138
METACARPAL DIST	12	19		32	38/ 59
PELVIS	11	20		32	34/ 63
FEMUR PROX	3	5		32	9/ 16
FEMUR DIST	10	25		32	31/ 78
TIBIA PROX	3	10		32	9/ 31
TIBIA DIST	26	46		32	81/143
ASTRAGALUS	20	24		32	63/ 75
CALCANEUM	3	3		32	9/ 9
NAVICULO CUBOID	5	12		32	16/ 38
METATARSAL PROX	31	98	16	32	97/306
METATARSAL DIST	12	23		32	38/ 72
PHALANX 1	5	9		128	4/ 7
PHALANX 2	14	16		128	11/ 13
PHALANX 3	4	4		128	3/ 3
TOTAL	279				

Table 8.6. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: WJ7 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	6	8		20	30/ 40
PETROUS (SKULL)	1	1		20	5/ 5
OCCIPITAL COND	1	1		20	5/ 5
MANDIBLE	15	15		20	75/ 75
MANDIBULAR COND	13	15		20	65/ 75
ATLAS	0	0		10	0/ 0
AXIS	4	4		10	40/ 40
SCAPULA	13	14		20	65/ 70
HUMERUS PROX	0	0		20	0/ 0
HUMERUS DIST	11	12		20	55/ 60
RADIUS PROX	9	11		20	45/ 55
RADIUS DIST	19	21	10	20	95/105
ULNA	1	1		20	5/ 5
CARPALS	3	3		20	15/ 15
METACARPAL PROX	3	3		20	15/ 15
METACARPAL DIST	6	9		20	30/ 45
PELVIS	9	11		20	30/ 55
FEMUR PROX	8	9		20	40/ 45
FEMUR DIST	2	2		20	10/ 10
TIBIA PROX	10	12		20	50/ 60
TIBIA DIST	8	9		20	40/ 45
ASTRAGALUS	12	12		20	60/ 60
CALCANEUM	6	7		20	30/ 35
NAVICULO CUBOID	5	5		20	25/ 25
METATARSAL PROX	11	16		20	55/ 80
METATARSAL DIST	6	8		20	30/ 40
PHALANX 1	22	23		80	28/ 29
PHALANX 2	23	24		80	29/ 30
PHALANX 3	23	23		80	29/ 29
TOTAL	250				

Table 8.7. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: DH 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	11	16		134	8/ 12
PETROUS (SKULL)	49	49		134	37/ 37
OCCIPITAL COND	3	3		134	2/ 2
MANDIBLE	31	48		134	23/ 36
MANDIBULAR COND	22	22		134	16/ 16
ATLAS	8	14		67	12/ 21
AXIS	20	25		67	30/ 37
SCAPULA	73	102		134	54/ 76
HUMERUS PROX	11	14		134	8/ 10
HUMERUS DIST	108	144		134	81/107
RADIUS PROX	47	65		134	35/ 49
RADIUS DIST	50	63		134	37/ 47
ULNA	55	58		134	41/ 43
CARPALS	20	20		134	15/ 20
METACARPAL PROX	29	37		134	22/ 28
METACARPAL DIST	74	124		134	55/ 93
PELVIS	60	115		134	45/ 86
FEMUR PROX	51	62		134	38/ 46
FEMUR DIST	44	80		134	33/ 60
TIBIA PROX	51	65		134	38/ 49
TIBIA DIST	81	94		134	60/ 70
ASTRAGALUS	133	147	67	134	99/110
CALCANEUM	100	114		134	75/ 85
NAVICULO CUBOID	36	43		134	27/ 32
METATARSAL PROX	59	92		134	44/ 69
METATARSAL DIST	63	106		134	47/ 79
PHALANX 1	104	117		536	19/ 22
PHALANX 2	115	115		536	21/ 21
PHALANX 3	88	88		536	16/ 16
TOTAL	1596				

Table 8.8. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: WJ13 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	3	3		32	9/ 9
PETROUS (SKULL)	0	0		32	0/ 0
OCCIPITAL COND	1	1		32	3/ 3
MANDIBLE	8	8		32	25/ 25
MANDIBULAR COND	20	20		32	63/ 63
ATLAS	3	3		16	19/ 19
AXIS	1	1		16	6/ 6
SCAPULA	5	9		32	16/ 28
HUMERUS PROX	1	3		32	3/ 9
HUMERUS DIST	23	26	16	32	72/ 81
RADIUS PROX	15	18		32	47/ 56
RADIUS DIST	15	18		32	47/ 56
ULNA	6	6		32	19/ 19
CARPALS	10	10		32	31/ 31
METACARPAL PROX	2	4		32	6/ 13
METACARPAL DIST	11	14		32	34/ 44
PELVIS	9	11		32	28/ 34
FEMUR PROX	9	14		32	28/ 44
FEMUR DIST	8	13		32	25/ 41
TIBIA PROX	7	11		32	22/ 34
TIBIA DIST	12	12		32	38/ 38
ASTRAGALUS	10	11		32	31/ 34
CALCANEUM	12	14		32	38/ 44
NAVICULO CUBOID	1	1		32	3/ 3
METATARSAL PROX	6	10		32	19/ 31
METATARSAL DIST	13	13		32	41/ 41
PHALANX 1	44	58		128	34/ 45
PHALANX 2	41	42		128	32/ 33
PHALANX 3	57	57		128	45/ 45
TOTAL	353				

Table 8.9. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

GAZELLE BODY PART DATA

Assemblage: DH 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE	16	16		304	5/ 5
PETROUS (SKULL)	149	149		304	49/ 49
OCCIPITAL COND	24	26		304	8/ 9
MANDIBLE	51	76		304	17/ 25
MANDIBULAR COND	61	61		304	20/ 20
ATLAS	11	20		152	7/ 13
AXIS	31	46		152	20/ 30
SCAPULA	69	82		304	23/ 27
HUMERUS PROX	23	36		304	8/ 12
HUMERUS DIST	213	343		304	70/113
RADIUS PROX	156	241		304	51/ 79
RADIUS DIST	130	166		304	43/ 55
ULNA	122	152		304	40/ 50
CARPALS	125	129		304	41/ 42
METACARPAL PROX	68	89		304	22/ 29
METACARPAL DIST	151	268		304	50/ 88
PELVIS	129	295		304	42/ 97
FEMUR PROX	170	216		304	56/ 71
FEMUR DIST	101	251		304	33/ 83
TIBIA PROX	93	165		304	31/ 54
TIBIA DIST	213	290		304	70/ 95
ASTRAGALUS	303	407	152	304	100/134
CALCANEUM	157	210		304	52/ 69
NAVICULO CUBOID	168	235		304	55/ 77
METATARSAL PROX	108	219		304	36/ 72
METATARSAL DIST	198	365		304	65/120
PHALANX 1	331	401		1216	27/ 33
PHALANX 2	404	407		1216	33/ 33
PHALANX 3	322	323		1216	26/ 27
TOTAL	4097				

Table 8.10. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: WJ6 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		5		6	83
PETROUS (SKULL)		0		6	0
OCCIPITAL COND		0		6	0
MANDIBULAR TEETH		4		6	67
MANDIBULAR COND		1		6	17
ATLAS		0		3	0
AXIS		0		3	0
SCAPULA		1		6	17
HUMERUS PROX		0		6	0
HUMERUS DIST		1		6	17
RADIUS PROX		1		6	17
RADIUS DIST		4		6	67
ULNA		0		6	0
CARPALS		3		6	50
METACARPAL PROX		2		6	33
METACARPAL DIST		2		6	33
PELVIS		6	3	6	100
FEMUR PROX		1		6	17
FEMUR DIST		0		6	0
TIBIA PROX		3		6	50
TIBIA DIST		8		6	133
ASTRAGALUS		4		6	67
CALCANEUM		5		6	83
NAVICULO CUBOID		0		6	0
METATARSAL PROX		0		6	0
METATARSAL DIST		1		6	17
PHALANX 1		19		12	158
PHALANX 2		11		12	92
PHALANX 3		7		12	58
TOTAL		99			

Table 8.17. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: KH4 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		8		12	67
PETROUS (SKULL)		0		12	0
OCCIPITAL COND		0		12	0
MANDIBULAR TEETH		8		12	67
MANDIBULAR COND		0		12	12
ATLAS		0		6	0
AXIS		0		6	0
SCAPULA		2		12	17
HUMERUS PROX		0		12	0
HUMERUS DIST		0		12	0
RADIUS PROX		2		12	17
RADIUS DIST		2		12	17
ULNA		1		12	8
CARPALS		2		12	17
METACARPAL PROX		1		12	8
METACARPAL DIST		6		12	50
PELVIS		2		12	17
FEMUR PROX		2		12	17
FEMUR DIST		2		12	17
TIBIA PROX		2		12	17
TIBIA DIST		9		12	75
ASTRAGALUS		3		12	25
CALCANEUM		3		12	25
NAVICULO CUBOID		0		12	0
METATARSAL PROX		4		12	33
METATARSAL DIST		8		12	67
PHALANX 1		31	6	24	129
PHALANX 2		28		24	117
PHALANX 3		32		24	133
TOTAL		196			

Table 8.18. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: KH4 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		1		4	25
PETROUS (SKULL)		0		4	0
OCCIPITAL COND		0		4	0
MANDIBULAR TEETH		1		4	25
MANDIBULAR COND		0		4	0
ATLAS		1		2	50
AXIS		0		2	0
SCAPULA		1		4	25
HUMERUS PROX		0		4	0
HUMERUS DIST		0		4	0
RADIUS PROX		0		4	0
RADIUS DIST		1		4	25
ULNA		0		4	0
CARPALS		1		4	25
METACARPAL PROX		3		4	75
METACARPAL DIST		1		4	25
PELVIS		1		4	25
FEMUR PROX		2		4	50
FEMUR DIST		0		4	0
TIBIA PROX		0		4	0
TIBIA DIST		0		4	0
ASTRAGALUS		1		4	25
CALCANEUM		2		4	50
NAVICULO CUBOID		0		4	0
METATARSAL PROX		1		4	25
METATARSAL DIST		0		4	0
PHALANX 1		5	2	8	63
PHALANX 2		0		8	0
PHALANX 3		4		8	50
TOTAL		26			

Table 8.19. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: KH4 D

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		4		10	40
PETROUS (SKULL)		0		10	0
OCCIPITAL COND		1		10	10
MANDIBULAR TEETH		3		10	30
MANDIBULAR COND		12		10	120
ATLAS		0		5	0
AXIS		0		5	0
SCAPULA		6		10	60
HUMERUS PROX		1		10	10
HUMERUS DIST		1		10	10
RADIUS PROX		3		10	30
RADIUS DIST		2		10	20
ULNA		1		10	10
CARPALS		4		10	40
METACARPAL PROX		3		10	30
METACARPAL DIST		2		10	20
PELVIS		8		10	80
FEMUR PROX		1		10	10
FEMUR DIST		4		10	40
TIBIA PROX		6		10	60
TIBIA DIST		6	5	10	60
ASTRAGALUS		2		10	20
CALCANEUM		3		10	30
NAVICULO CUBOID		0		10	0
METATARSAL PROX		3		10	30
METATARSAL DIST		3		10	30
PHALANX 1		28		20	140
PHALANX 2		20		20	100
PHALANX 3		7		20	35
TOTAL		134			

Table 8.20. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: UW18

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			8	0
PETROUS (SKULL)	0			8	0
OCCIPITAL COND	0			8	0
MANDIBULAR TEETH	1			8	13
MANDIBULAR COND	0			8	0
ATLAS	0			4	0
AXIS	0			4	0
SCAPULA	0			8	0
HUMERUS PROX	0			8	0
HUMERUS DIST	0			8	0
RADIUS PROX	0			8	0
RADIUS DIST	0			8	0
ULNA	0			8	0
CARPALS	2			8	25
METACARPAL PROX	1			8	13
METACARPAL DIST	3			8	38
PELVIS	0			8	0
FEMUR PROX	0			8	0
FEMUR DIST	0			8	0
TIBIA PROX	0			8	0
TIBIA DIST	0			8	0
ASTRAGALUS	1			8	13
CALCANEUM	2			8	25
NAVICULO CUBOID	0			8	0
METATARSAL PROX	0			8	0
METATARSAL DIST	2			8	25
PHALANX 1	8			16	50
PHALANX 2	17		4	16	106
PHALANX 3	4			16	25
TOTAL	41				

Table 8.21. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: WJ22 C

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	2			6	33
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	1			6	17
MANDIBULAR COND	0			6	0
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	2			6	33
HUMERUS PROX	0			6	0
HUMERUS DIST	0			6	0
RADIUS PROX	1			6	17
RADIUS DIST	0			6	0
ULNA	1			6	17
CARPALS	2			6	33
METACARPAL PROX	2			6	33
METACARPAL DIST	3			6	50
PELVIS	0			6	0
FEMUR PROX	1			6	17
FEMUR DIST	0			6	0
TIBIA PROX	0			6	0
TIBIA DIST	1			6	17
ASTRAGALUS	1			6	17
CALCANEUM	2			6	33
NAVICULO CUBOID	0			6	0
METATARSAL PROX	2			6	33
METATARSAL DIST	3			6	50
PHALANX 1	3		3	12	25
PHALANX 2	0			12	0
PHALANX 3	0			12	0
TOTAL	27				

Table 8.22. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: WJ22 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	2			4	50
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	1			4	25
MANDIBULAR COND	0			4	0
ATLAS	1			2	50
AXIS	0			2	0
SCAPULA	0			4	0
HUMERUS PROX	2			4	50
HUMERUS DIST	3			4	75
RADIUS PROX	1			4	25
RADIUS DIST	0			4	0
ULNA	1			4	25
CARPALS	1			4	25
METACARPAL PROX	2			4	50
METACARPAL DIST	2			4	50
PELVIS	3			4	75
FEMUR PROX	0			4	0
FEMUR DIST	1			4	25
TIBIA PROX	0			4	0
TIBIA DIST	0			4	0
ASTRAGALUS	3		2	4	75
CALCANEUM	1			4	25
NAVICULO CUBOID	1			4	25
METATARSAL PROX	2			4	50
METATARSAL DIST	2			4	50
PHALANX 1	4			8	50
PHALANX 2	4			8	50
PHALANX 3	3			8	38
TOTAL	40				

Table 8.23. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: AZ18

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		4		8	50
PETROUS (SKULL)		0		8	0
OCCIPITAL COND		0		8	0
MANDIBULAR TEETH		5	4	8	63
MANDIBULAR COND		2		8	25
ATLAS		0		4	0
AXIS		0		4	0
SCAPULA		0		8	0
HUMERUS PROX		0		8	0
HUMERUS DIST		0		8	0
RADIUS PROX		0		8	0
RADIUS DIST		0		8	0
ULNA		0		8	0
CARPALS		1		8	13
METACARPAL PROX		0		8	0
METACARPAL DIST		5		8	63
PELVIS		0		8	0
FEMUR PROX		1		8	13
FEMUR DIST		0		8	0
TIBIA PROX		0		8	0
TIBIA DIST		2		8	25
ASTRAGALUS		2		8	25
CALCANEUM		1		8	13
NAVICULO CUBOID		0		8	0
METATARSAL PROX		0		8	0
METATARSAL DIST		2		8	25
PHALANX 1		10		16	63
PHALANX 2		4		16	25
PHALANX 3		6		16	38
TOTAL		45			

Table 8.24. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: DH 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	3			4	75
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	2			4	50
MANDIBULAR COND	0			4	0
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	2		2	4	50
HUMERUS PROX	0			4	0
HUMERUS DIST	0			4	0
RADIUS PROX	0			4	0
RADIUS DIST	0			4	0
ULNA	0			4	0
CARPALS	1			4	25
METACARPAL PROX	0			4	0
METACARPAL DIST	2			4	50
PELVIS	0			4	0
FEMUR PROX	0			4	0
FEMUR DIST	0			4	0
TIBIA PROX	1			4	25
TIBIA DIST	1			4	25
ASTRAGALUS	1			4	25
CALCANEUM	0			4	0
NAVICULO CUBOID	0			4	0
METATARSAL PROX	0			4	0
METATARSAL DIST	1			4	25
PHALANX 1	2			8	25
PHALANX 2	0			8	0
PHALANX 3	0			8	0
TOTAL	16				

Table 8.25. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

EQUID BODY PART DATA

Assemblage: DH 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			6	0
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	3		3	6	50
MANDIBULAR COND	0			6	0
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	1			6	17
HUMERUS PROX	0			6	0
HUMERUS DIST	0			6	0
RADIUS PROX	1			6	17
RADIUS DIST	0			6	0
ULNA	0			6	0
CARPALS	0			6	0
METACARPAL PROX	0			6	0
METACARPAL DIST	3			6	50
PELVIS	1			6	17
FEMUR PROX	1			6	17
FEMUR DIST	0			6	0
TIBIA PROX	0			6	0
TIBIA DIST	1			6	17
ASTRAGALUS	1			6	17
CALCANEUM	0			6	0
NAVICULO CUBOID	1			6	17
METATARSAL PROX	2			6	33
METATARSAL DIST	2			6	33
PHALANX 1	3			12	25
PHALANX 2	2			12	17
PHALANX 3	2			12	17
TOTAL	24				

Table 8.26. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

BOS BODY PART DATA

Assemblage: AZ18

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
HORN CORE		4	3	6	67
MAXILLARY TEETH		4		6	67
PETROUS (SKULL)		0		6	0
OCCIPITAL COND		0		6	0
MANDIBULAR TEETH		4		6	67
MANDIBULAR COND		1		6	17
ATLAS		0		3	0
AXIS		0		3	0
SCAPULA		0		6	0
HUMERUS PROX		0		6	0
HUMERUS DIST		0		6	0
RADIUS PROX		0		6	0
RADIUS DIST		0		6	0
ULNA		0		6	0
CARPALS		1		6	17
METACARPAL PROX		1		6	17
METACARPAL DIST		1		6	17
PELVIS		1		6	17
FEMUR PROX		1		6	17
FEMUR DIST		0		6	0
TIBIA PROX		0		6	0
TIBIA DIST		1		6	17
ASTRAGALUS		1		6	17
CALCANEUM		1		6	17
NAVICULO CUBOID		1		6	17
METATARSAL PROX		0		6	0
METATARSAL DIST		1		6	17
PHALANX 1		9		24	38
PHALANX 2		2		24	8
PHALANX 3		1		24	4
TOTAL		35			

Table 8.28. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ6 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		1		8	13
PETROUS (SKULL)		0		8	0
OCCIPITAL COND		0		8	0
MANDIBULAR TEETH		1		8	13
MANDIBULAR COND		0		8	0
ATLAS		0		4	0
AXIS		0		4	0
SCAPULA		4	4	8	50
HUMERUS PROX		1		8	13
HUMERUS DIST		7		8	88
RADIUS PROX		2		8	25
RADIUS DIST		1		8	13
ULNA		4		8	50
CARPALS		0		8	0
METACARPAL PROX		0		40	0
METACARPAL DIST		0		40	0
PELVIS		1		8	13
FEMUR PROX		3		8	38
FEMUR DIST		2		8	25
TIBIA PROX		7		8	88
TIBIA DIST		5		8	63
ASTRAGALUS		2		8	25
CALCANEUM		5		8	63
NAVICULO CUBOID		0		8	0
METATARSAL PROX		0		40	0
METATARSAL DIST		0		40	0
PHALANX 1		0		80	0
PHALANX 2		0		80	0
PHALANX 3		0		80	0
TOTAL		46			

Table 8.29. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: KH4 A

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		1		8	13
PETROUS (SKULL)		0		8	0
OCCIPITAL COND		0		8	0
MANDIBULAR TEETH		2		8	25
MANDIBULAR COND		0		8	0
ATLAS		0		4	0
AXIS		0		4	0
SCAPULA		3		8	38
HUMERUS PROX		1		8	13
HUMERUS DIST		7	4	8	88
RADIUS PROX		1		8	13
RADIUS DIST		0		8	0
ULNA		2		8	25
CARPALS		0		8	0
METACARPAL PROX		0		40	0
METACARPAL DIST		0		40	0
PELVIS		10		8	125
FEMUR PROX		0		8	0
FEMUR DIST		0		8	0
TIBIA PROX		0		8	0
TIBIA DIST		2		8	25
ASTRAGALUS		0		8	0
CALCANEUM		9		8	113
NAVICULO CUBOID		0		8	0
METATARSAL PROX		0		40	0
METATARSAL DIST		0		40	0
PHALANX 1		0		80	0
PHALANX 2		0		80	0
PHALANX 3		0		80	0
TOTAL		38			

Table 8.30. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: KH4 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH		0		6	0
PETROUS (SKULL)		0		6	0
OCCIPITAL COND		0		6	0
MANDIBULAR TEETH		2		6	33
MANDIBULAR COND		0		6	0
ATLAS		0		3	0
AXIS		0		3	0
SCAPULA		2		6	33
HUMERUS PROX		2		6	33
HUMERUS DIST		1		6	17
RADIUS PROX		2		6	33
RADIUS DIST		0		6	0
ULNA		1		6	17
CARPALS		0		6	0
METACARPAL PROX		0		30	0
METACARPAL DIST		0		30	0
PELVIS		7	3	6	117
FEMUR PROX		2		6	33
FEMUR DIST		0		6	0
TIBIA PROX		0		6	0
TIBIA DIST		0		6	0
ASTRAGALUS		0		6	0
CALCANEUM		4		6	67
NAVICULO CUBOID		0		6	0
METATARSAL PROX		0		30	0
METATARSAL DIST		0		30	0
PHALANX 1		0		60	0
PHALANX 2		0		60	0
PHALANX 3		0		60	0
TOTAL		23			

Table 8.31. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: KH4 D

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	6	10		16	38
PETROUS (SKULL)		2		16	13
OCCIPITAL COND		0		16	0
MANDIBULAR TEETH	6	16		16	38
MANDIBULAR COND		4		16	25
ATLAS		0		8	0
AXIS		0		8	0
SCAPULA		18		16	113
HUMERUS PROX		6	8	16	38
HUMERUS DIST		12		16	75
RADIUS PROX		8		16	50
RADIUS DIST		4		16	25
ULNA		9		16	56
CARPALS		0		16	0
METACARPAL PROX		3		80	4
METACARPAL DIST		11		80	14
PELVIS		12		16	75
FEMUR PROX		14		16	88
FEMUR DIST		4		16	25
TIBIA PROX		1		16	6
TIBIA DIST		9		16	56
ASTRAGALUS		2		16	13
CALCANEUM		12		16	75
NAVICULO CUBOID		0		16	0
METATARSAL PROX		7		80	9
METATARSAL DIST		10		80	13
PHALANX 1		25		160	16
PHALANX 2		9		160	6
PHALANX 3		1		160	1
TOTAL		204			

Table 8.32. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ22 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	1			4	25
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	1			4	25
MANDIBULAR COND	0			4	0
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	1			4	25
HUMERUS PROX	0			4	0
HUMERUS DIST	1			4	25
RADIUS PROX	0			4	0
RADIUS DIST	1			4	25
ULNA	0			4	0
CARPALS	0			4	0
METACARPAL PROX	1			20	5
METACARPAL DIST	3			20	15
PELVIS	0			4	0
FEMUR PROX	0			4	0
FEMUR DIST	2			4	50
TIBIA PROX	1			4	25
TIBIA DIST	2		2	4	50
ASTRAGALUS	2			4	50
CALCANEUM	1			4	25
NAVICULO CUBOID	0			4	0
METATARSAL PROX	1			20	5
METATARSAL DIST	2			20	10
PHALANX 1	14			40	35
PHALANX 2	2			40	5
PHALANX 3	0			40	0
TOTAL	36				

Table 8.33. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ7 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	1			6	17
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	1			6	17
MANDIBULAR COND	0			6	0
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	2			6	33
HUMERUS PROX	0			6	0
HUMERUS DIST	3			6	50
RADIUS PROX	4			6	67
RADIUS DIST	2			6	33
ULNA	3			6	50
CARPALS	0			6	0
METACARPAL PROX	10			30	33
METACARPAL DIST	12			30	40
PELVIS	3			6	50
FEMUR PROX	1			6	17
FEMUR DIST	5		3	6	83
TIBIA PROX	1			6	17
TIBIA DIST	3			6	50
ASTRAGALUS	2			6	33
CALCANEUM	0			6	0
NAVICULO CUBOID	0			6	0
METATARSAL PROX	11			30	37
METATARSAL DIST	12			30	40
PHALANX 1	22			60	37
PHALANX 2	18			60	30
PHALANX 3	0			60	0
TOTAL	116				

Table 8.34. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. *Actual* representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ7 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	8			14	57
PETROUS (SKULL)	0			14	0
OCCIPITAL COND	0			14	0
MANDIBULAR TEETH	11			14	79
MANDIBULAR COND	0			14	0
ATLAS	0			7	0
AXIS	0			7	0
SCAPULA	3			14	21
HUMERUS PROX	2			14	14
HUMERUS DIST	13		7	14	93
RADIUS PROX	9			14	64
RADIUS DIST	3			14	21
ULNA	4			14	29
CARPALS	0			14	0
METACARPAL PROX	0			70	0
METACARPAL DIST	0			70	0
PELVIS	7			14	50
FEMUR PROX	3			14	21
FEMUR DIST	3			14	21
TIBIA PROX	4			14	29
TIBIA DIST	6			14	43
ASTRAGALUS	6			14	43
CALCANEUM	3			14	21
NAVICULO CUBOID	0			14	0
METATARSAL PROX	0			70	0
METATARSAL DIST	0			70	0
PHALANX 1	0			140	0
PHALANX 2	0			140	0
PHALANX 3	0			140	0
TOTAL	85				

Table 8.35. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ7 3

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			6	0
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	0			6	0
MANDIBULAR COND	0			6	0
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	3			6	50
HUMERUS PROX	0			6	0
HUMERUS DIST	6		3	6	100
RADIUS PROX	2			6	33
RADIUS DIST	0			6	0
ULNA	1			6	17
CARPALS	0			6	0
METACARPAL PROX	6			30	20
METACARPAL DIST	6			30	20
PELVIS	2			6	33
FEMUR PROX	2			6	33
FEMUR DIST	0			6	0
TIBIA PROX	1			6	17
TIBIA DIST	4			6	67
ASTRAGALUS	0			6	0
CALCANEUM	3			6	50
NAVICULO CUBOID	0			6	0
METATARSAL PROX	7			30	23
METATARSAL DIST	6			30	20
PHALANX 1	21			60	35
PHALANX 2	2			60	3
PHALANX 3	0			60	0
TOTAL	72				

Table 8.36. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ7 4

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	6			6	100
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	2			6	33
MANDIBULAR COND	2			6	33
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	2			6	33
HUMERUS PROX	1			6	17
HUMERUS DIST	6		3	6	100
RADIUS PROX	5			6	83
RADIUS DIST	0			6	0
ULNA	1			6	17
CARPALS	0			6	0
METACARPAL PROX	10			30	33
METACARPAL DIST	18			30	60
PELVIS	2			6	33
FEMUR PROX	1			6	17
FEMUR DIST	1			6	17
TIBIA PROX	1			6	17
TIBIA DIST	0			6	0
ASTRAGALUS	2			6	33
CALCANEUM	3			6	50
NAVICULO CUBOID	0			6	0
METATARSAL PROX	11			30	37
METATARSAL DIST	18			30	60
PHALANX 1	33			60	55
PHALANX 2	3			60	5
PHALANX 3	0			60	0
TOTAL	128				

Table 8.37. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ7 5

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			4	0
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	0			4	0
MANDIBULAR COND	0			4	0
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	2			4	50
HUMERUS PROX	0			4	0
HUMERUS DIST	3		2	4	75
RADIUS PROX	1			4	25
RADIUS DIST	0			4	0
ULNA	1			4	25
CARPALS	0			4	0
METACARPAL PROX	4			20	20
METACARPAL DIST	4			20	20
PELVIS	0			4	0
FEMUR PROX	0			4	0
FEMUR DIST	0			4	0
TIBIA PROX	1			4	25
TIBIA DIST	2			4	50
ASTRAGALUS	0			4	0
CALCANEUM	3			4	75
NAVICULO CUBOID	0			4	0
METATARSAL PROX	5			20	25
METATARSAL DIST	3			20	15
PHALANX 1	5			40	13
PHALANX 2	0			40	0
PHALANX 3	0			40	0
TOTAL	34				

Table 8.38. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ32

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	7			14	50
PETROUS (SKULL)	0			14	0
OCCIPITAL COND	0			14	0
MANDIBULAR TEETH	9			14	64
MANDIBULAR COND	0			14	0
ATLAS	0			7	0
AXIS	0			7	0
SCAPULA	6			14	43
HUMERUS PROX	1			14	7
HUMERUS DIST	12		7	14	86
RADIUS PROX	4			14	29
RADIUS DIST	5			14	36
ULNA	5			14	36
CARPALS	0			14	0
METACARPAL PROX	7			70	10
METACARPAL DIST	7			70	10
PELVIS	6			14	43
FEMUR PROX	4			14	29
FEMUR DIST	3			14	21
TIBIA PROX	0			14	0
TIBIA DIST	8			14	57
ASTRAGALUS	2			14	14
CALCANEUM	7			14	50
NAVICULO CUBOID	0			14	0
METATARSAL PROX	7			70	10
METATARSAL DIST	8			70	11
PHALANX 1	30			140	21
PHALANX 2	4			140	3
PHALANX 3	1			140	1
TOTAL	143				

Table 8.39. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: DH 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	1			6	17
PETROUS (SKULL)	0			6	0
OCCIPITAL COND	0			6	0
MANDIBULAR TEETH	2			6	33
MANDIBULAR COND	0			6	0
ATLAS	0			3	0
AXIS	0			3	0
SCAPULA	2			6	33
HUMERUS PROX	0			6	0
HUMERUS DIST	5		3	6	83
RADIUS PROX	1			6	17
RADIUS DIST	0			6	0
ULNA	3			6	50
CARPALS	0			6	0
METACARPAL PROX	1			30	3
METACARPAL DIST	2			30	7
PELVIS	5			6	83
FEMUR PROX	1			6	17
FEMUR DIST	2			6	33
TIBIA PROX	1			6	17
TIBIA DIST	1			6	17
ASTRAGALUS	0			6	0
CALCANEUM	4			6	67
NAVICULO CUBOID	0			6	0
METATARSAL PROX	3			30	10
METATARSAL DIST	1			30	3
PHALANX 1	0			60	0
PHALANX 2	0			60	0
PHALANX 3	0			60	0
TOTAL	35				

Table 8.40. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ25

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			4	0
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	0			4	0
MANDIBULAR COND	0			4	0
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	1			4	25
HUMERUS PROX	0			4	0
HUMERUS DIST	3		2	4	75
RADIUS PROX	1			4	25
RADIUS DIST	1			4	25
ULNA	0			4	0
CARPALS	0			4	0
METACARPAL PROX	3			20	15
METACARPAL DIST	3			20	15
PELVIS	1			4	25
FEMUR PROX	1			4	25
FEMUR DIST	0			4	0
TIBIA PROX	0			4	0
TIBIA DIST	0			4	0
ASTRAGALUS	0			4	0
CALCANEUM	2			4	50
NAVICULO CUBOID	0			4	0
METATARSAL PROX	2			20	10
METATARSAL DIST	3			20	15
PHALANX 1	4			40	10
PHALANX 2	0			40	0
PHALANX 3	0			40	0
TOTAL	25				

Table 8.41. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ13 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			30	0
PETROUS (SKULL)	2			30	7
OCCIPITAL COND	0			30	0
MANDIBULAR TEETH	8			30	27
MANDIBULAR COND	0			30	0
ATLAS	0			15	0
AXIS	1			15	7
SCAPULA	13			30	43
HUMERUS PROX	12			30	40
HUMERUS DIST	29		15	30	97
RADIUS PROX	13			30	43
RADIUS DIST	10			30	33
ULNA	21			30	70
CARPALS	0			30	0
METACARPAL PROX	42			150	28
METACARPAL DIST	39			150	26
PELVIS	14			30	47
FEMUR PROX	23			30	77
FEMUR DIST	8			30	27
TIBIA PROX	13			30	43
TIBIA DIST	14			30	47
ASTRAGALUS	20			30	67
CALCANEUM	23			30	77
NAVICULO CUBOID	0			30	0
METATARSAL PROX	47			150	31
METATARSAL DIST	37			150	25
PHALANX 1	60			300	20
PHALANX 2	20			300	7
PHALANX 3	3			300	1
TOTAL	472				

Table 8.42. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ13 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			16	0
PETROUS (SKULL)	0			16	0
OCCIPITAL COND	0			16	0
MANDIBULAR TEETH	0			16	0
MANDIBULAR COND	0			16	0
ATLAS	0			8	0
AXIS	0			8	0
SCAPULA	16		8	16	100
HUMERUS PROX	1			16	6
HUMERUS DIST	9			16	56
RADIUS PROX	3			16	19
RADIUS DIST	2			16	13
ULNA	5			16	31
CARPALS	0			16	0
METACARPAL PROX	12			80	15
METACARPAL DIST	12			80	15
PELVIS	7			16	44
FEMUR PROX	3			16	19
FEMUR DIST	4			16	25
TIBIA PROX	2			16	13
TIBIA DIST	2			16	13
ASTRAGALUS	3			16	19
CALCANEUM	3			16	19
NAVICULO CUBOID	0			16	0
METATARSAL PROX	30			80	38
METATARSAL DIST	24			80	30
PHALANX 1	31			160	19
PHALANX 2	9			160	6
PHALANX 3	2			160	1
TOTAL	180				

Table 8.43. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: WJ13 3

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			16	0
PETROUS (SKULL)	0			16	0
OCCIPITAL COND	0			16	0
MANDIBULAR TEETH	1			16	6
MANDIBULAR COND	0			16	0
ATLAS	0			8	0
AXIS	0			8	0
SCAPULA	6			16	38
HUMERUS PROX	0			16	0
HUMERUS DIST	16		8	16	100
RADIUS PROX	8			16	50
RADIUS DIST	6			16	38
ULNA	6			16	38
CARPALS	0			16	0
METACARPAL PROX	31			80	39
METACARPAL DIST	29			80	36
PELVIS	5			16	31
FEMUR PROX	5			16	31
FEMUR DIST	1			16	6
TIBIA PROX	1			16	6
TIBIA DIST	4			16	25
ASTRAGALUS	7			16	44
CALCANEUM	14			16	88
NAVICULO CUBOID	0			16	0
METATARSAL PROX	40			80	50
METATARSAL DIST	31			80	39
PHALANX 1	48			160	30
PHALANX 2	14			160	9
PHALANX 3	1			160	1
TOTAL	274				

Table 8.44. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

HARE BODY PART DATA

Assemblage: DH 2

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	5			16	31
PETROUS (SKULL)	0			16	0
OCCIPITAL COND	0			16	0
MANDIBULAR TEETH	10			16	63
MANDIBULAR COND	0			16	0
ATLAS	0			8	0
AXIS	0			8	0
SCAPULA	1			16	6
HUMERUS PROX	2			16	13
HUMERUS DIST	16		8	16	100
RADIUS PROX	6			16	38
RADIUS DIST	2			16	13
ULNA	4			16	25
CARPALS	0			16	0
METACARPAL PROX	11			80	14
METACARPAL DIST	8			80	10
PELVIS	13			16	81
FEMUR PROX	0			16	0
FEMUR DIST	1			16	6
TIBIA PROX	2			16	13
TIBIA DIST	8			16	50
ASTRAGALUS	3			16	19
CALCANEUM	16			16	100
NAVICULO CUBOID	0			16	0
METATARSAL PROX	11			80	14
METATARSAL DIST	7			80	9
PHALANX 1	8			160	5
PHALANX 2	0			160	0
PHALANX 3	0			160	0
TOTAL	134				

Table 8.45. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

FOX BODY PART DATA

Assemblage: KH4 B

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	6	8		8	75
PETROUS (SKULL)		0		8	0
OCCIPITAL COND		1		8	13
MANDIBULAR TEETH	12	14		8	150
MANDIBULAR COND		2		8	25
ATLAS		1		4	25
AXIS		2		4	50
SCAPULA		5		8	63
HUMERUS PROX		7	4	8	88
HUMERUS DIST		6		8	75
RADIUS PROX		6		8	75
RADIUS DIST		2		8	25
ULNA		5		8	63
CARPALS		0		8	0
METACARPAL PROX		1		40	3
METACARPAL DIST		1		40	3
PELVIS		3		8	38
FEMUR PROX		2		8	25
FEMUR DIST		4		8	50
TIBIA PROX		3		8	38
TIBIA DIST		3		8	38
ASTRAGALUS		2		8	25
CALCANEUM		6		8	75
NAVICULO CUBOID		0		8	0
METATARSAL PROX		0		40	0
METATARSAL DIST		0		40	0
PHALANX 1		0		80	0
PHALANX 2		0		80	0
PHALANX 3		0		80	0
TOTAL		84			

Table 8.46. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

FOX BODY PART DATA

Assemblage: KH4 D

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	2	4		6	33
PETROUS (SKULL)		0		6	0
OCCIPITAL COND		1		6	17
MANDIBULAR TEETH	8	16		6	133
MANDIBULAR COND		3		6	50
ATLAS		0		3	0
AXIS		0		3	0
SCAPULA		3		6	50
HUMERUS PROX		1		6	17
HUMERUS DIST		2		6	33
RADIUS PROX		2		6	33
RADIUS DIST		2		6	33
ULNA		8		6	133
CARPALS		0		6	0
METACARPAL PROX		6		30	20
METACARPAL DIST		16		30	53
PELVIS		5	3	6	83
FEMUR PROX		3		6	50
FEMUR DIST		6		6	100
TIBIA PROX		1		6	17
TIBIA DIST		1		6	17
ASTRAGALUS		1		6	17
CALCANEUM		6		6	100
NAVICULO CUBOID		0		6	0
METATARSAL PROX		6		30	20
METATARSAL DIST		15		30	50
PHALANX 1		28		60	47
PHALANX 2		8		60	13
PHALANX 3		0		60	0
TOTAL		144			

Table 8.47. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

FOX BODY PART DATA

Assemblage: WJ13 1

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	1			4	25
PETROUS (SKULL)	0			4	0
OCCIPITAL COND	0			4	0
MANDIBULAR TEETH	1			4	25
MANDIBULAR COND	2			4	50
ATLAS	0			2	0
AXIS	0			2	0
SCAPULA	2			4	50
HUMERUS PROX	2			4	50
HUMERUS DIST	2			4	50
RADIUS PROX	0			4	0
RADIUS DIST	0			4	0
ULNA	0			4	0
CARPALS	0			4	0
METACARPAL PROX	10			20	50
METACARPAL DIST	6			20	30
PELVIS	0			4	0
FEMUR PROX	2			4	50
FEMUR DIST	4	2		4	100
TIBIA PROX	0			4	0
TIBIA DIST	1			4	25
ASTRAGALUS	2			4	50
CALCANEUM	0			4	0
NAVICULO CUBOID	0			4	0
METATARSAL PROX	5			20	25
METATARSAL DIST	1			20	5
PHALANX 1	23			40	58
PHALANX 2	11			40	28
PHALANX 3	7			40	18
TOTAL	82				

Table 8.48. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

FOX BODY PART DATA

Assemblage: WJ13 3

ELEMENT	MNEND	NISP	HIGHEST MNI	EXPECTED REP.	ACTUAL REP. % MNEND/ NISP
MAXILLARY TEETH	0			2	0
PETROUS (SKULL)	0			2	0
OCCIPITAL COND	0			2	0
MANDIBULAR TEETH	0			2	0
MANDIBULAR COND	0			2	0
ATLAS	0			1	0
AXIS	0			1	0
SCAPULA	0			2	0
HUMERUS PROX	0			2	0
HUMERUS DIST	0			2	0
RADIUS PROX	1		1	2	50
RADIUS DIST	0			2	0
ULNA	0			2	0
CARPALS	0			2	0
METACARPAL PROX	1			10	10
METACARPAL DIST	2			10	20
PELVIS	0			2	0
FEMUR PROX	0			2	0
FEMUR DIST	0			2	0
TIBIA PROX	1			2	50
TIBIA DIST	0			2	0
ASTRAGALUS	0			2	0
CALCANEUM	1			2	50
NAVICULO CUBOID	0			2	0
METATARSAL PROX	5			10	50
METATARSAL DIST	1			10	10
PHALANX 1	14			20	70
PHALANX 2	10			20	50
PHALANX 3	0			20	0
TOTAL	36				

Table 8.49. The data used for body part representation. The MNI is the highest of either the left or right MNENDs/NISPs. The expected representation is the highest MNI multiplied by the frequency with which each body part occurs in the skeleton. Actual representation is the MNEND/NISP expressed as a percentage of the expected representation.

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