

A method for recording archaeological animal bones: the use of diagnostic zones

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Summary

A system of recording bone fragments is reported here which has been developed over a number of years and successfully applied to numerous and diverse assemblages. It relies on the premise that whole bones can be divided into a number of readily identifiable morphological zones.

Its strength lies in its flexibility, enabling more accurate recording of bone fragmentation as well as, for example, the position of butchery marks and pathological conditions. It also facilitates the application of a wide variety of quantitative methods which can be employed in subsequent interpretation.

Introduction

The study of animal bones from archaeological sites has generated large quantities of data which have greatly improved and often radically changed our understanding of past economies. Enormous bone assemblages have been recovered and studied from sites of all types from throughout the world and, needless to say, there are still more awaiting analysis. Although zooarchaeology is still in its infancy, the discipline has made much progress in relatively few years. It is to the credit of those working in the field that the potential of such studies has been established and also that so much has been accomplished to date.

There are three basic premises that must be accepted when reading published bone reports. The first is that the initial identification of bone fragments is correct; the second is that the method of recording information is systematic and reproducible; and the third is that the quantitative methods used statistically to represent those fragments give an accurate impression of the material recovered from the ground.

The ways in which quantitative methods are used in subsequent economic interpretation are many and varied and depend entirely on the systems used to record the initial information. It is therefore imperative that the systems used take account of the numerous ante- and post-mortem processes which have shaped and moulded the archaeological bone record.

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Actual recording methods vary tremendously between individual zooarchaeologists and depend on a number of factors, in particular the nature of the assemblage, its archaeological importance, the experience of the zooarchaeologist and the time which is available for study. One common factor needed is systematic and rigorous recording, since no satisfactory collation of data may be achieved unless this has occurred in the first instance.

The problem that confronts us all is precisely how to record a single bone fragment accurately and to relate it to its counterparts and the rest of the assemblage. Fragments that are grouped as similar with respect to species and skeletal element, often show differences in fragmentation and preservation, typically as a direct result of factors such as animal selection, butchery practices and taphonomic processes. To proceed with interpretation on the basis of a naïve grouping of fragments by species and element will largely ignore these factors and may as a result bias information derived from statistical analyses.

It was with these fundamental problems in mind that we attempted to produce a systematic method for recording fragmented bones which would be detailed and rigorous as well as flexible, yet at the same time would be cost-effective and simple in its application.

Why diagnostic zones?

The idea of using diagnostic zones in recording animal bone assemblages was initially proposed by Watson (1979) who developed a system for recording comminuted animal bone fragments from Khirokitia, Cyprus. Rackham (1986) developed and used a similar system while recording animal bones from Piercebridge Roman Fort.

Using diagnostic zones relies on the premise that a skeletal element can be divided into a number of morphologically distinct zones that can be recorded merely as present or absent. These zones, when complete, are by definition non-repeatable elements; i.e. they can occur no more than once on a particular bone. Thus each archaeological bone fragment will consist of one or more of these zones in a variety of possible combinations. An extremely accurate record of each fragment can therefore be achieved which does not rely on subjective estimation of the proportion of whole bone which is represented in that fragment.

Obviously certain parts of bones (e.g. the shaft region of various long bones) are less susceptible to morphological subdivision than others, and in Rackham's method these areas remained largely ignored for that very reason. The system described here attempts to define these areas in order to incorporate the whole bone. This is made possible by the fact that these less diagnostic zones can often be recognised since they are frequently juxtaposed with highly diagnostic ones. Of course there will still be the ubiquitous pile of unidentifiable fragments, and thus a bias in the sample towards those which can be identified through anatomically direct association.

Method

The system reported here developed over a number of years and has been applied to several diverse archaeological bone assemblages from Europe and the Near East. The system was also updated constantly until virtually any bone fragment could be recorded with the described ease and precision.

The system was devised to include all the economically important domestic animals which commonly occur on archaeological sites, i.e. cattle, horse, pig and caprines. Obviously the general principles could and should be readily adapted to include carnivores, birds, and even fish, at locations where these may be of particular economic interest.

A series of drawings was prepared giving standard anatomical views of all major skeletal elements excluding the carpals and minor tarsals, patella, fibula, and sacrum. These drawings are reproduced here as Figs. 7-23. Additional illustrations are included where morphological coincidence of analogous zones of different species does not occur, e.g. in the metapodials.

Each zone is represented by a numerical code and is defined by a precise anatomical description (see captions to figures). All illustrated elements are shown from the left side (unless otherwise indicated) and with the zones usually numbered from the medial to the lateral surface. The lowest numbers usually represent the articular surfaces of the proximal and the distal ends of the bone.

The skull is not dealt with here. It may be divided into as many or few zones as desired, each zone representing a complete bone, for example: 1 - frontal; 2 - parietal; 3- occipital; 4 - petrous temporal, etc.

It was felt that an illustration or template of the zones was necessary to facilitate the speed and uniformity of application. These serve primarily as visual prompts to the recorder and allow only a limited number of recording options. These drawings are, of course, two-dimensional representations of three-dimensional objects; in other words, the zones being recorded are not completely flat surfaces. Therefore it should be remembered, for example, that where a particular zone is shown on the anterior aspect, it will also continue around to the corresponding part of the posterior aspect unless otherwise indicated. The zones on these various aspects could be further divided in order to accommodate detailed analysis of axially-based fracturing, but such subdivision would probably only add unnecessary complications for a small return of information.

The system explained

When initial sorting had been carried out, i.e. when the bone fragments had been assigned to species and element, each was then recorded using the new system. It was found to be simpler to deal with groups of homologous elements at the same time since in this way familiarity with zones was gained much more rapidly.

Each individual fragment was compared with the appropriate template to establish which particular zones were present. Each zone was then assessed individually in order to establish whether more than 50% of that zone was present on the specimen. The numerical code, i.e. the number by which that zone is labelled for each was then recorded in one of the two available columns of the pro-forma (i.e. less than 50% or greater than 50% - see Fig. 23).

Quantitative analysis

The crux of zooarchaeological interpretation relies on the accurate quantification of the original assemblage. It is of little value to calculate minimum numbers of individuals (MNI), or to establish epiphyseal fragment counts, or to apply whatever sophisticated statistics to the sample, if the original recording system does not accurately and consistently represent each bone fragment. Ideally a recording system is needed which can be applied to the majority of more commonly used quantitative methods.

By definition, a morphologically distinct zone occurs only once on each bone. If more than 50% of that zone is present then it may be regarded as a non-repeatable element. Thus by totalling the frequencies of each zone for each element per species, a MNI estimation can be made from the zone most frequently recorded as greater than 50% complete.

General fragmentation and bone survival patterns can be assessed by rank ordering the zone frequencies per bone (see Figs. 24 and 25), while more detailed information can be gained by computing the frequencies of combinations of zones which often occur together.

Obviously the more quantitative methods that are used, the more reliable and informative the interpretation of the relevant data. Since many zones are defined by fusion lines, epiphyseal fragments can readily be isolated from individual records for using the 'epiphyses only' method of quantification. Total numbers of fragments can also easily be calculated directly from the same recording pro-forma.

Recording butchery and pathology

When butchery marks, animal gnawing, pathology or other noticeable insults to the bone were located on fragments, a series of codes were used accurately to define each category of modification and its location. The zone or zones on which the modification to the bone occurred were recorded along with its aspect, orientation, type and frequency. The following coding: But/1,2/med/-k/x4, for example, indicates that butchery marks were present in zones 1 and 2 on the medial surface, and consisted of horizontal knife marks, there being four in each zone. GnC/1,4 or GnR/1,4 signifies that carnivore or rodent gnawing is present in zones 1 and 4. Pathological information was recorded in much the same way, e.g. Ar/1,2,3,4/med+lat/gd2 indicates the presence of an arthropathy in zones 1,2,3 and 4, on the medial + lateral surface, of grade 2 severity (on a scale of 0 to 4).

Positional information is particularly important when recording processes which directly affect the integrity of bone, for example damage due to butchery, preservation, trauma or disease. A system which subdivides individual skeletal elements into small identifiable portions defined on consistent anatomical criteria can also be used accurately to record the position and extent of butchery marks, pathological conditions, and so forth. Thus the understanding of general butchery patterns and the like can be undertaken by comparing total frequencies for each bone zone with more detailed information on the type, orientation and direction of the damage.

Conclusion

The system presented here was largely developed as a response to the need for detailed recording of fragmented bones. It is flexible enough to allow a variety of quantitative methods to be used without the need for a further category of recording and can also be used to record detailed information regarding preservation, butchery and pathology. It is simple to use and, once familiarity with the zonation scheme is achieved, information can be recorded rapidly.

It can be applied to any bone assemblage and is most useful where bone is heavily comminuted and preservation is poor, or where detailed recording of preservation, butchery practices or pathology is required. It is highly reproducible within and between individuals, and thus allows reliable data comparison.

The system is very flexible and can be adapted to suit changing priorities. More zones could, for example, be added, while existing ones could be subdivided or combined, depending entirely upon the material and research emphasis. It would, however, be imperative to illustrate fully and to describe precisely how this was done for the sake of others wishing to use the system or data derived from it.

This recording system can be seen as yet another method to add to the vast array of well-established and often highly personalised techniques with which zooarchaeologists attempt to bring some order and sense to bone assemblages. These are developed to suit particular needs and as such are constantly being updated as material and perspectives change. It would be absurd to assume that one rigid method alone could ever meet the inevitable diversity of requirements. However, problems arise when it is unclear just how bones have been dealt with, because all too often an inadequate description is given of the recording system used.

Further problems can arise when a particular recording system varies in its application between individuals as this inevitably reduces the validity of data comparisons. It is therefore imperative that a detailed description is given of whatever recording system is applied so that the relevant information can be confidently used by others.

Recording diagnostic zones has proved to be an extremely useful tool for general zooarchaeological needs and it is hoped that others may also find its application equally useful.

Acknowledgements

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Watson. J. P. N. (1979). The estimation of the relative frequencies of mammalian species: Khirokitia 1972. Journal of Archaeological Science 6, 127-37.

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Figures 7-22. Diagnostic zones.

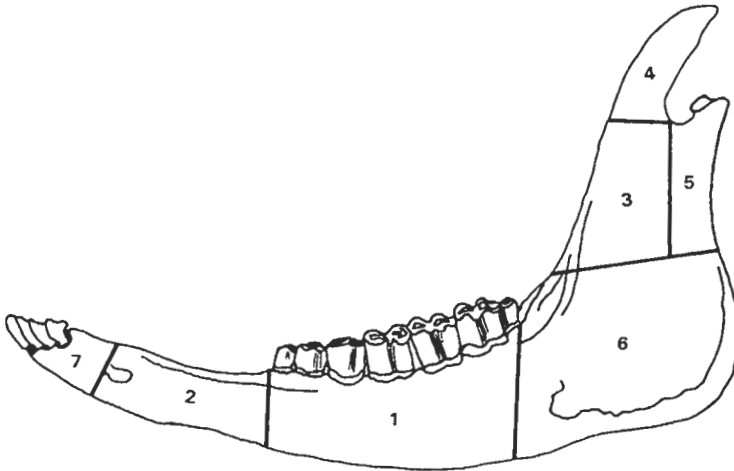


Figure 7. Mandible. 1 - tooth row; 2 - diastema including mental foramen; 3 - coronoid process (Processus coronoideus); 4 - anterior portion of ascending ramus; 5 - condyle and neck (Condylus mandibulae); 6 - ascending ramus (Collum manibulae); 7 - Corpus manibulae.

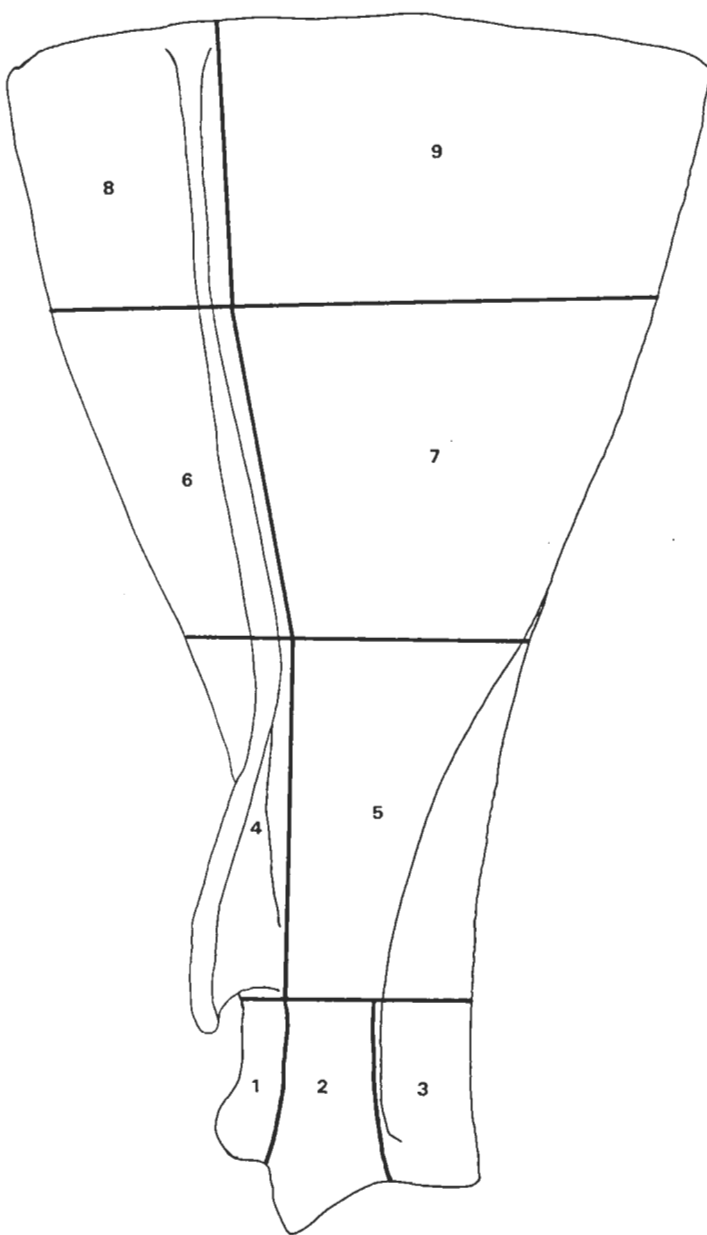


Figure 8. Scapula. 1 - Tuber scapulae; 2 - anterior half of glenoid cavity; 3 - posterior half of glenoid cavity; 4 - portion of blade including acromion and tuber spine; 5 - portion of blade including nutrient foramen; 6 - mid portion of blade including spine and suprascapular fossa; 7 - mid portion of blade including infraspinous fossa; 8 - portion of blade including spine and anterior angle; 9 - portion of blade including posterior angle.

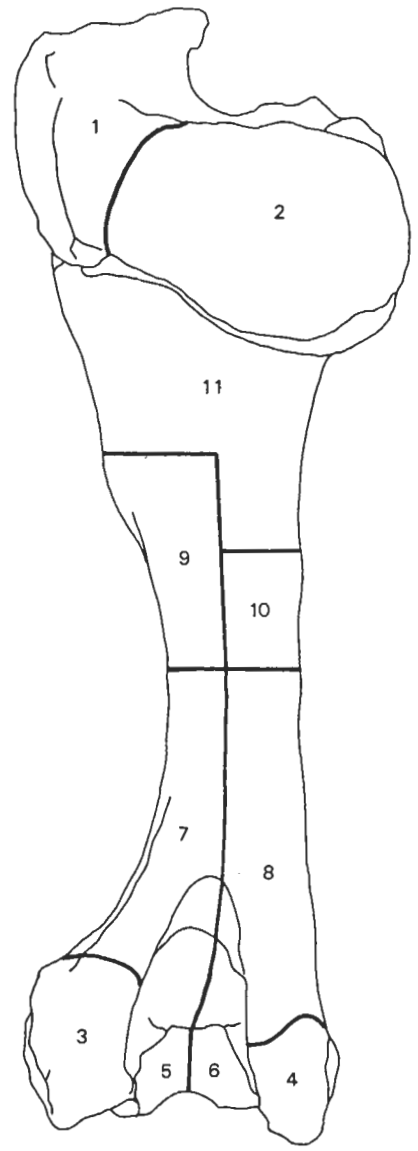
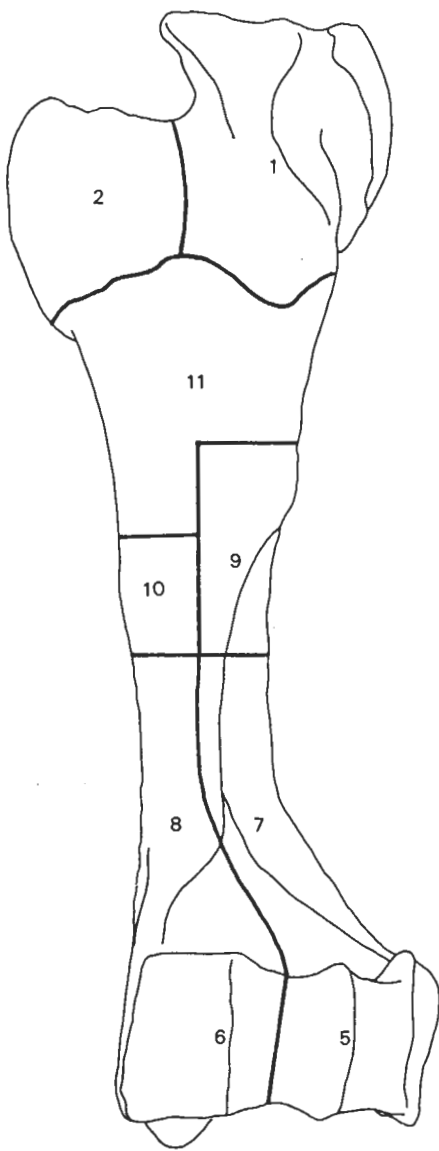


Figure 9. Humerus. 1 - lateral tuberosity; 2 - head including medial tuberosity and intertuberal groove; 3 - lateral epicondyle; 4 - medial epicondyle; 5 - lateral condyle; 6 - medial condyle; 7 - lateral distal half of shaft including musculospiral groove and coronoid and olecranon fossae; 8 - medial distal half of shaft including nutrient foramen and coronoid fossa; 9 - deltoid tuberosity; 10 - Tuberculum teres; 11 - proximal portion of shaft.

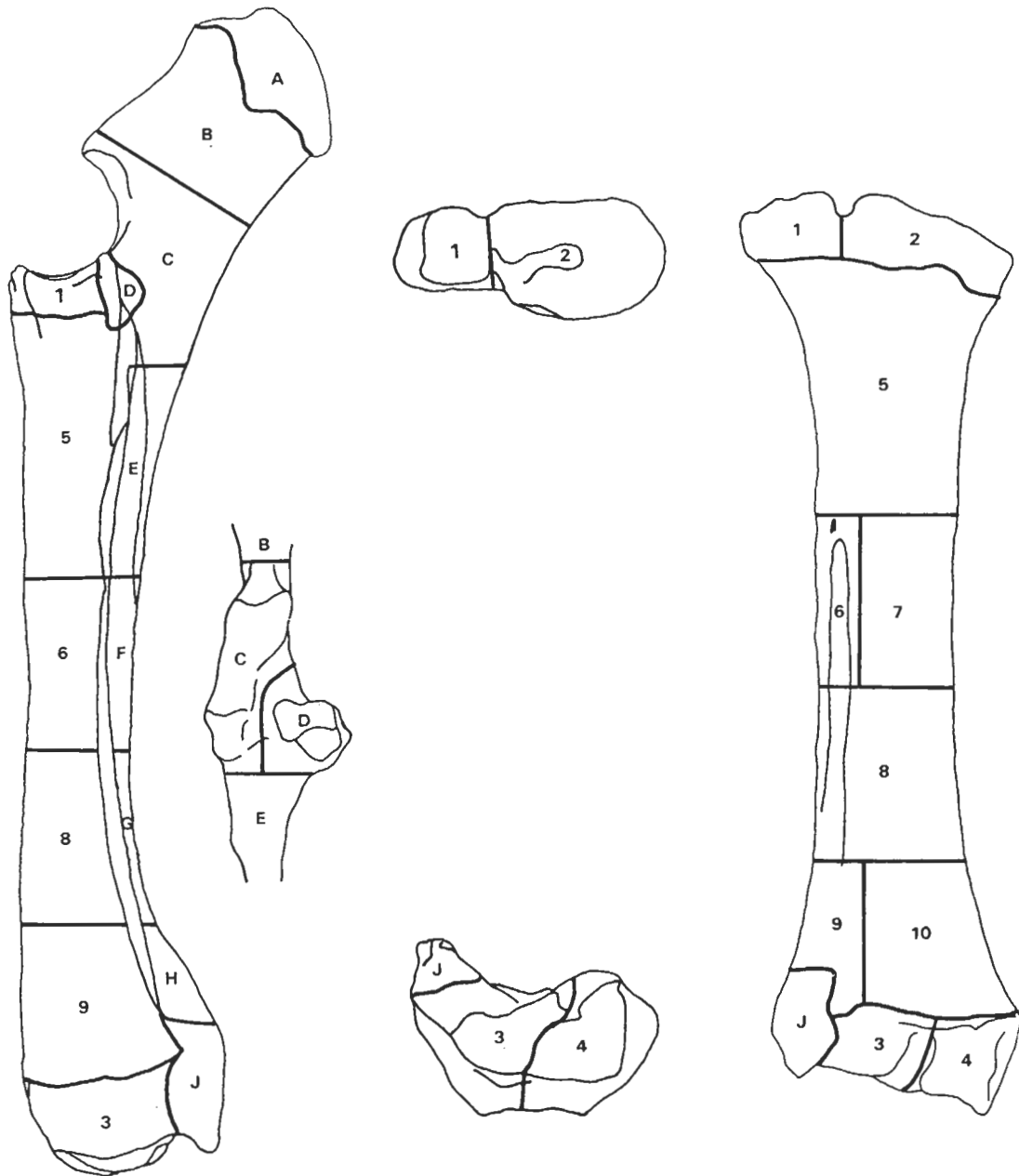


Figure 10. Radius/Ulna. 1 - lateral portion of humeral articular surface including coronoid process and radial tuberosity; 2 - medial portion of humeral articular surface including glenoid cavity and radial tuberosity; 3 - lateral portion of distal articulation; 4 - medial portion of distal articulation; 5 - proximal portion of shaft incorporating proximal inter-osseous space; 6 - lateral portion of shaft including proximal portion of ulna scar below nutrient foramen; 7 - medial portion of shaft; 8 - shaft including remaining ulna scar; 9 - distal shaft incorporating distal inter-osseous space; 10 - medial portion of distal shaft; A - olecranon; B - portion of ulna between the olecranon and Processus anconaeus; C - Processus anconaeus, semilunar notch and posterior portion; D - lateral articular surface; E - Portion of shaft inferior to articular surfaces including inter-osseous space; F - mid portion of shaft; G, H - distal portions of shaft; J - styloid process.

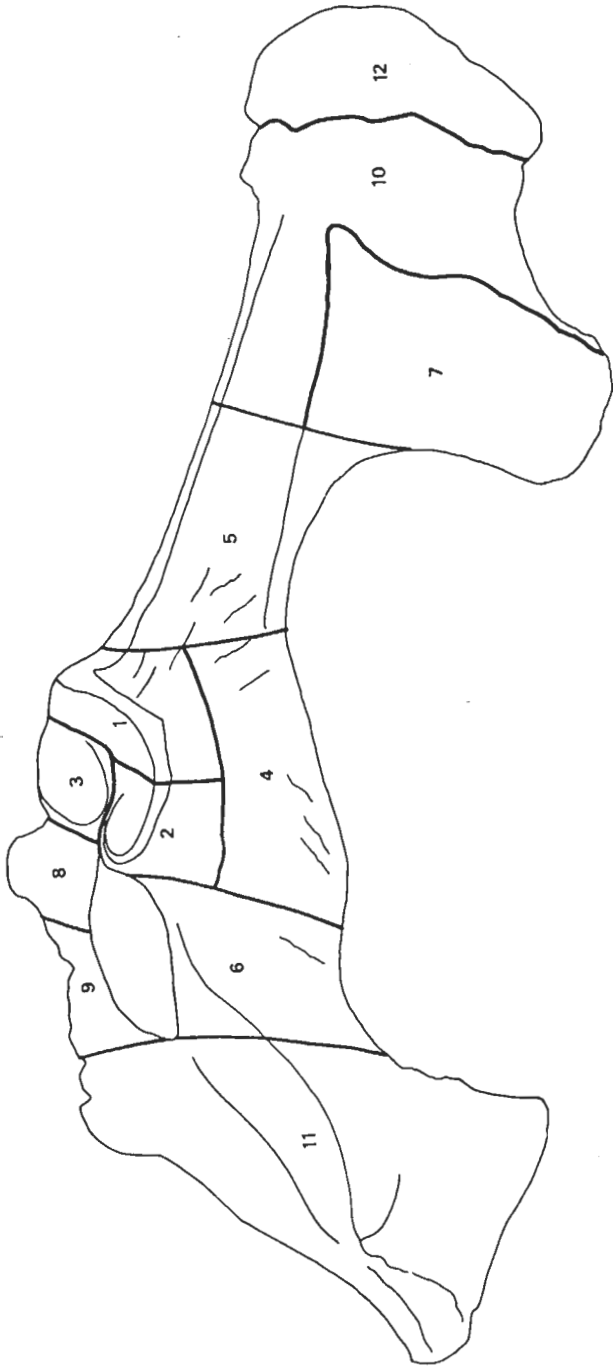


Figure 11. Innominate. 1 - Cranial portion of acetabular articulation; 2, 3 - acetabular articulation divided by acetabular fossa; 4 - ischial spine; 5 - shaft of ilium including greater sciatic notch; 6 - portion of ischium opposite obturator foramen; 7 - portion of ilium which articulates with sacral wing; 8 - portion of pubis including ilio-pectineal eminence and pubic tubercle; 9 - remaining portion of pubis including acetabular and symphyseal branch; 10 - remaining portion of ilium; 11 - remaining portion of ischium; 12 - Tuber coxae.

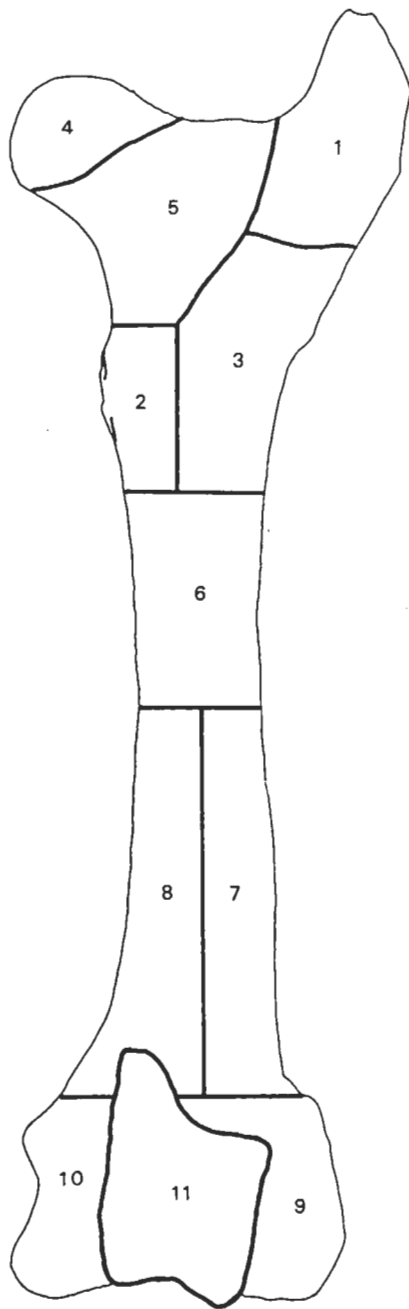
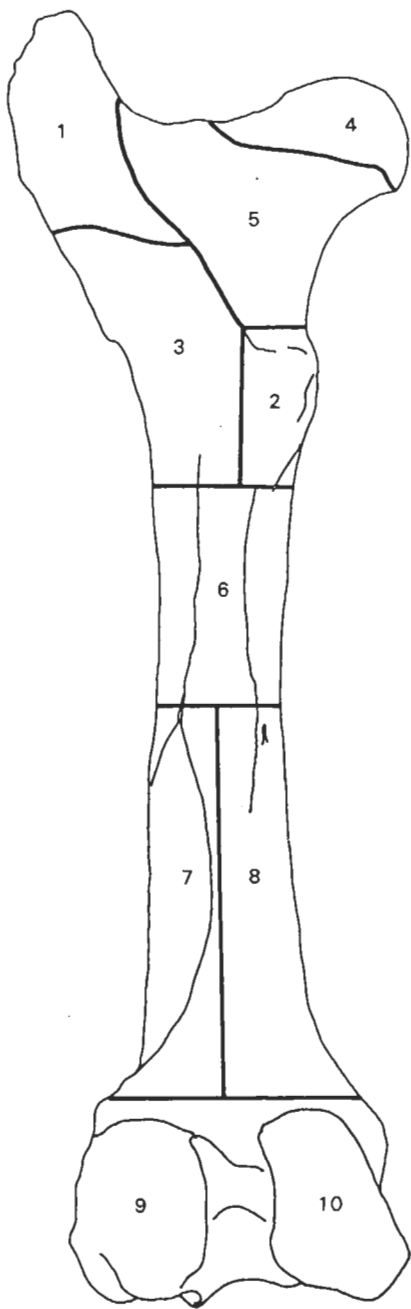


Figure 12. Femur. 1 - Trochanter major; 2 - Trochanter minor; 3 - Trochanter tertius (present in perissodactyles); 4 - head; 5 - trochanteric fossa and neck; 6 - mid portion of shaft; 7 - lateral portion of shaft including nutrient foramen and vascular groove; 8 - medial portion of shaft including supracondylar crest and supracondylar fossa; 9 - medial condyle and epicondyle; 10 - lateral condyle and epicondyle; 11 - trochlea.

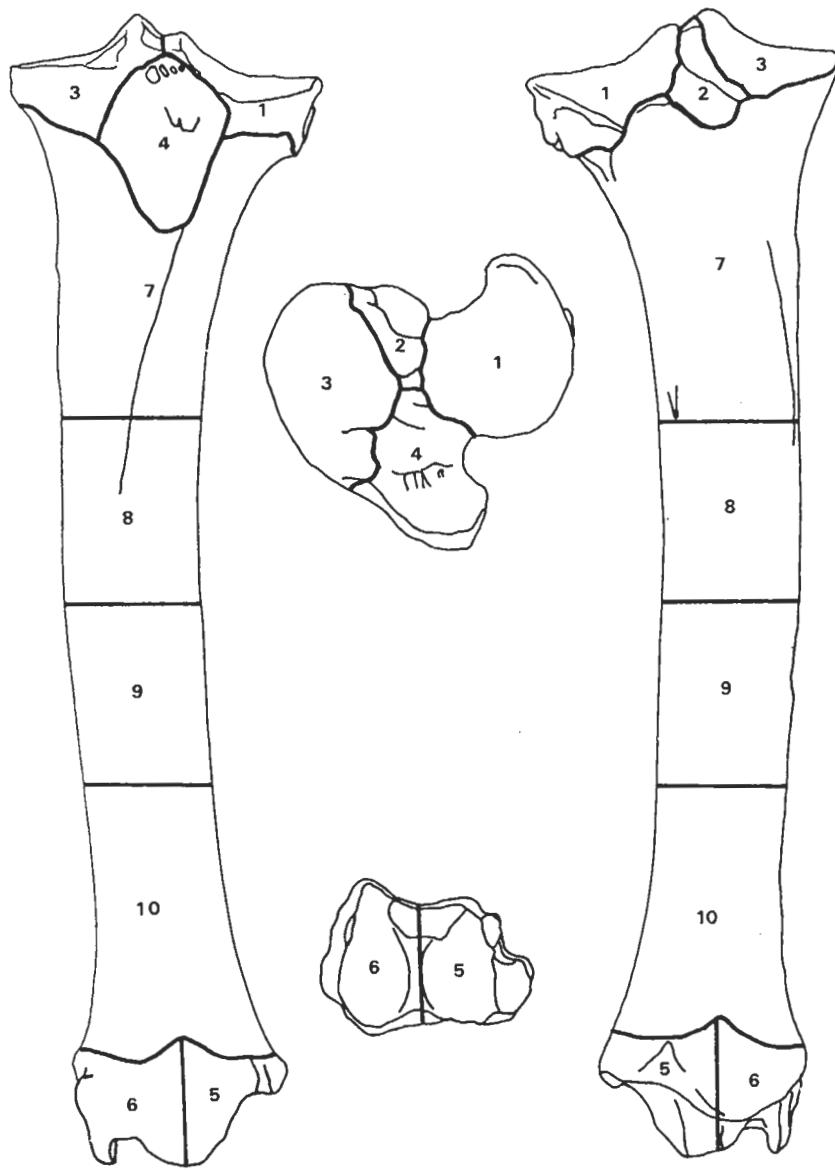


Figure 13. Tibia. 1 - medial condyle; 2 - intercondylar fossa; 3 - lateral condyle; 4 - proximal tuberosity and area between tubercles of spine; 5 - medial malleolus; 6 - lateral malleolus; 7 - proximal portion of shaft including nutrient foramen, most of crest and muscle attachment lines; 8, 9 - mid portions of shaft (8 includes distal end of anterior crest); 10 - distal portion of shaft.

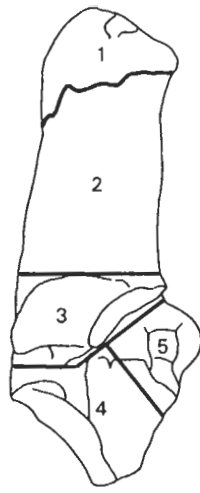


Figure 14. Calcaneum. 1 - Tuber calcis; 2 - body; 3 - Sustentaculum; 4 - distal tuberosity and articulation; 5 - Processus cochlearis.

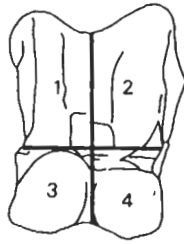


Figure 15. Astragalus. 1 - medial half of trochlea; 2 - lateral half of trochlea; 3 - medial half of distal articulation; 4 - lateral half of distal articulation.

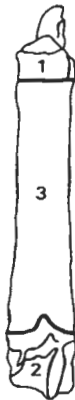


Figure 16. Metapodial (pig). 1 - proximal articulation; 2 - distal condyle; 3 - shaft region. N.B. for horse metapodials follow the same scheme as for pig but further dividing the shaft into two halves.

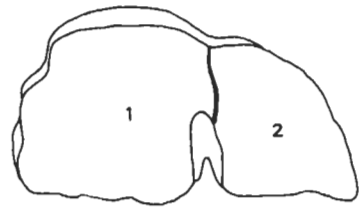
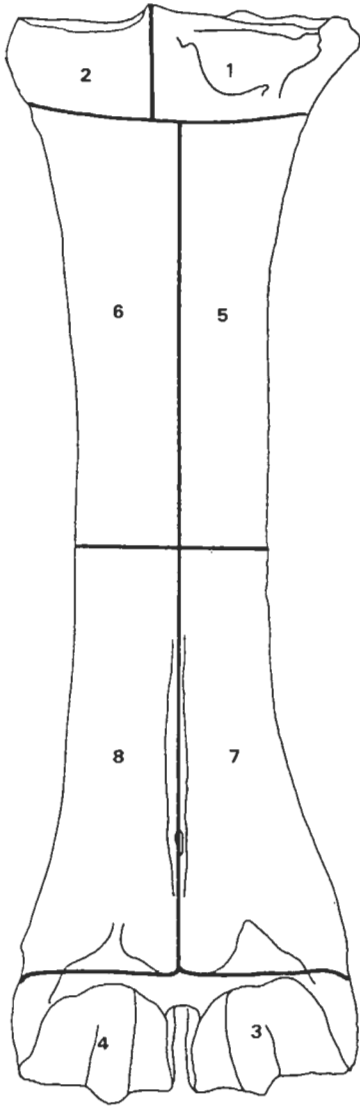


Figure 17. Metapodial (artiodactyles excluding pig). 1 - lateral portion of proximal articulation; 2 - medial portion of proximal articulation; 3 - lateral condyle; 4 - medial condyle; 5, 6 - proximal half of shaft divided by vascular groove; 7, 8 - distal half of shaft divided by vascular groove.

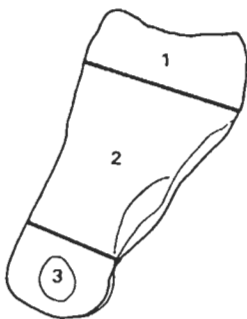


Figure 18. Phalanges. 1 - proximal articulation; 2 - distal articulation (for 3rd phalanx this is remaining portion of bone); 3 - shaft region.

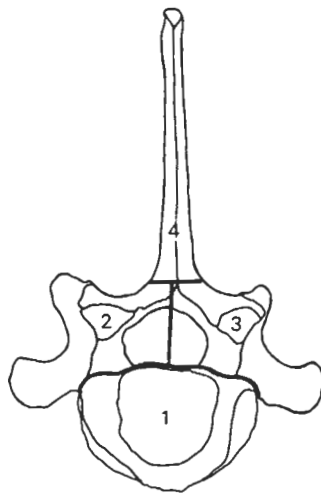


Figure 19. Vertebrae (excluding atlas and axis) (cranial aspect). 1 - head and body; 2 - right articular and transverse process; 3 - left articular and transverse process; 4 - spinous process.



Figure 20. Axis (lateral view).
Zones as Figure 19.

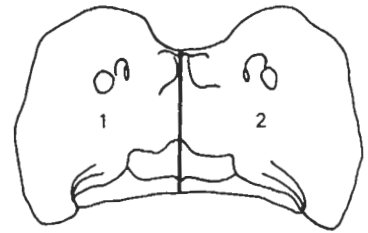


Figure 21. Atlas.
1 - left half; 2 - right half.

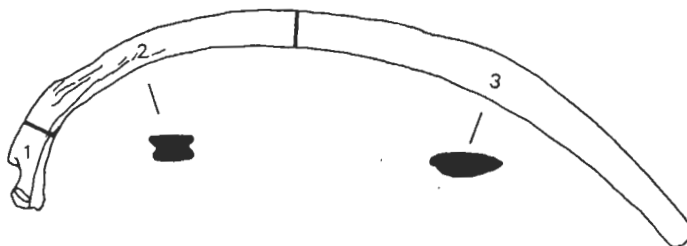


Figure 22. Rib. 1 - head, neck and tubercle; 2 - portion of blade with square section; 3 - portion of blade with flattened section.

Record Identifier	Bone No	Trench	Unit Context	Period	Context Descrip	Species	Element	Left Right	Measure
663	455		09		Hellenistic pit	Ovi	aph	L	Glpe: 37.09 / Bp: 12.88
664	455		09		"	Ovi	aph	L	Glpe: 39.38 / Bp: 13.52
665	455		09		"	Ovi	aph	R	Glpe: 40.85 / Bp: 14.68
666	455		09		"	O/c	aph	L	Glpe: 42.66 / Bp: 15.30
667	455		09		"	O/c	aph	L	Bp: 17.77
668	455		09		"	Cap	aph	L	Glpe: 35.59 / Bp: 12
669	455		09		"	Cap	aph	R	Glpe: 41.13 / Bp: 14
670	455		09		"	Cap	aph	R	Glpe: 39.37 / Bp:
671	455		09		"	Cap	aph.	R	Glpe: 43.82 / Bp:
672	455		09		"	Cap	aph	R	Glpe: 38.24 / Bp
673	455		09		"	Cap	baph	L	Glpe: 24.14 / Bp
674	455		09		"	Cap	bph	L	Glpe: 25.65 / Bp:
675	455		09		"	Cap	bph	L	Glpe: 25.30 / Bp
676	455		09		"	Cap	bph	L	Bd: 13.11
677	455		09		"	Cap	Cph	L	Ld: 30.39 / 2L2
678	455		09		"	Odi	Mc	L	Gl: 15.49 / Bp: 26.50
679	455		09		"	Cap	Ht	?	Sp: 24.65 / a: 9.83 / b: 6
679	455		09		"	Cap	Hp	?	a: 9.51 / b: 16.65
680	455		09		"	O/c	Horn	L	68: 32.26 / 6T: 30.88
681	455		09		"	O/c	Horn	R	68: 33.67 / 6T: 31.68
	455		09		"	O/c/g	Mc	?	---
682	455		09		"	Ovi	Rad	L	---
	455		09		"	O/c	Rad	R	---
683	455		09		"	Cap	Tib	L	Bd: 28.81
684	455		09		"	O/c/g	Tib	L	---
	455		09		"	O/c/g	Tib	R	---
685	455		09		"	O/c/g	Tib	R	---
	455		09		"	O/c/g	Tib	R	---
	455		09		"	O/c	Tib	R	---
686	455		09		"	O/c/g	Tib	R	---
687	455		09		"	Cap	Cal	L	66: 22.31 / LF: 0.41 / 12.2
688	455		09		"	Ovi	Pist	L	64: 33.60 / 6LM: 31.22
689	455		09		"	O/c/g	Fem	L	---
	455		09		"	Cap	horn	B	---
	455		09		"	Cap	horn	B	---
	455		09		"	O/c/g	pel	L	---
	455		09		"	O/c/g	pel	L	---
	455		09		"	O/c/g	pel	L	---
690	455		09		"	O/c	pel	L	---
	455		09		"	O/c	Uln	L	---
	455		09		"	O/c	Uln	L	---
	455		09		"	O/c	Uln	R	---
691	455		09		"	Ovi	Scap	L	---
692	455		09		"	O/c	Scap	L	---
	455		09		"	O/c	Scap	L	---
	455		09		"	O/c/g	Scap	L	---
	455		09		"	O/c	Rad	R	---
	455		09		"	O/c	hmm	R	---

Figure 23. Example of a recording pro-forma used in the field. Columns 11 and 12 are used to record the morphological zones, while columns 15 and 16 record butchery and pathology.

Comments	Zones 75%+	Zones < 50%	Fusion Ageing	Teeth Present	Bone Alteration	Pathology	Preservation	Fresh Br spiral line Root etch etc	Photo x-ray removed Drawn
Bd: 11-47	1/2/3	—	Pf Df	—	—	—	Fair	—	—
Bd: 11-92	1/2/3	—	Pf Df	—	—	—	Fair	—	—
Bd: 13-89	1/2/3	—	Pf Df	—	—	—	Fair	—	—
Bd: 13-12	1/2/3	—	Pf Df	—	—	—	Fair	—	—
12/Bd: 11-87	1/2/3	—	Pf Df	—	—	Am/3/Normal	Good	—	R/P
10/Bd: 13-48	1/2/3	—	Pf Df	—	—	—	Good	—	—
14-53/Bd: 12-76	1/2/3	—	Pf Df	—	—	—	Fair	—	—
13-43/Bd: 12-18	1/2/3	—	Pf Df	—	—	—	Fair	—	—
38-24/Bd: 13-01	1/2/3	—	Pf Df	—	—	—	Good	—	—
B-84/Bd: 10-88	1/2/3	—	Pf Df	—	—	—	Good	—	—
12-04/Bd: 10-54	1/2/3	—	Pf Df	—	—	—	Fair	—	—
13-82/Bd: 11-36	1/2/3	—	Pf Df	—	—	—	Fair	—	—
6	2/3	—	Df	—	—	—	Fair	—	—
37-17	1/2/3	—	Pf	—	—	—	Good	—	—
(Bd 31-44-a-12-53-b-10)	1/2/3/4/5/6/7/8	—	Pf Df	—	—	—	Fair	FB (small)	—
3-6	3/4	—	Dn	—	—	—	Fair	—	—
	3or4	—	Dn	—	—	—	Fair	—	—
GD: 16-20	5/6/7/8	9 mm	Dg	—	—	—	Fair	FB	—
GS: 16-10	5/6/7/8	—	Dg	—	Band/ All	—	Fair	FB	—
	7/8	—	Dn/Ju	—	—	—	Poor	FB	—
	5/6/7/8/9	—	Dn/Ju	—	—	—	Poor	—	—
	8/9/10	7	Dn	—	—	—	Fair	—	—
	7/8/9	6	Dg	—	—	—	Fair	FB/SF	—
	5/6/7/8	—	Dn	—	(But 5/Red - c/f)	—	Fair	—	—
	6/7	—	Dn	—	Bone/ all	—	Fair	—	—
	4/5/	6	Pn	—	But 4/5/6/7/8	—	Fair	—	—
	5	6	—	—	—	—	Fair	FB	—
	1/2/3	—	Pn	—	—	—	Poor	—	—
	1/2	3	Pn	—	But 3/4/5 - c/f	—	Poor	FB	—
110/GD: 14-74	2/3	—	Pn	—	—	—	Fair	—	—
16-20-4/Bd: 17-54	1/2/3/4	—	Ma	—	—	—	Fair	Wenth	—
	8/9/10	6/7	Dn	—	—	—	Poor	—	—
	1/2	3	—	—	—	—	Fair	FB	—
	1	2	—	—	—	—	Fair	FB	—
	1/4/5/6	2	Ma	—	—	—	Fair	FB	—
	1/6/11	4/3	In	—	—	—	Poor	—	—
	1/6	4/11	In	—	—	—	Poor	—	—
	5/7/10	—	Ma	—	But 5/6/7/8 - c/f	—	Fair	—	—
	2/3	4	Pn	—	—	—	Poor	—	—
	2/3	—	Pn	—	—	—	Poor	—	—
	2/3	4	Pn	—	—	—	Poor	FB	—
	1/2/3/4/5	—	Pf	—	—	epithelial form	Fair	FB	—
	4/5/6/7	8/9	—	—	But 4/5/6/7 - c/f	—	Fair	FB/Wenth	—
	4/5/6/9	—	—	—	—	—	Poor	—	—
	9/6	10	Bn	—	—	—	Fair	Wenth	—
	1	5/6	Pf	—	—	—	Fair	—	—
	2/3	10	Pn	—	—	—	Fair	—	—

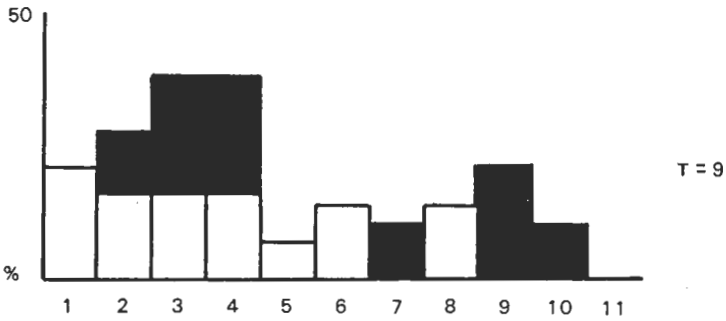
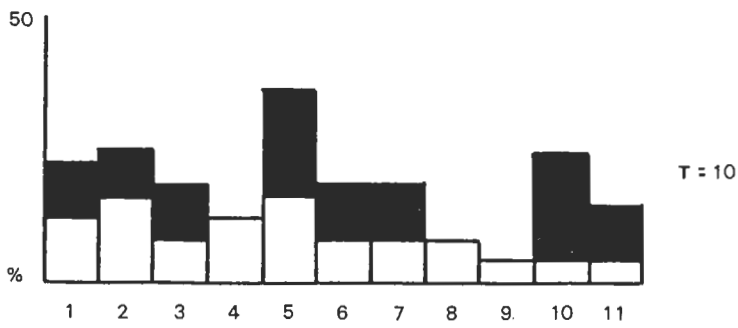


Figure 24. Histograms showing frequencies of morphological zones in caprovid pelvis fragments from Uruk-period deposits at two sites in north and south Iraq - above: Mohammed Arab; below: Abu Salabikh. Zone 12 was not recorded in these two instances. T - total number of bone specimens; percentages are calculated from the total number of zones recorded as > 50% present (25 for site Mohammed Arab and 14 for Abu Salabikh) or < 50% present (10 and 9 respectively).

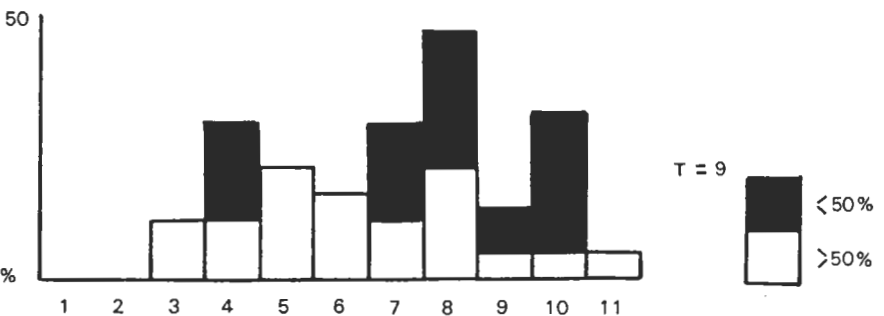
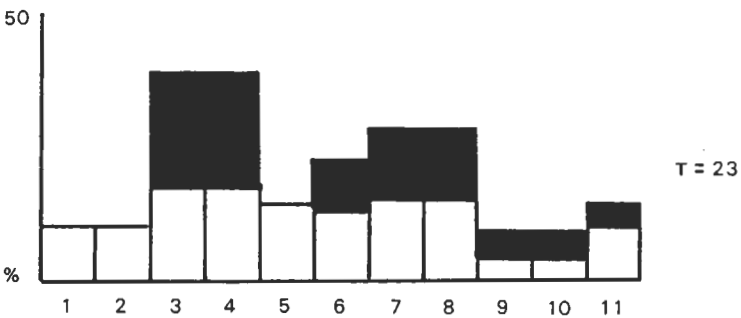


Figure 25. As Figure 24, for caprovid humerus fragments; total numbers of zones recorded as > 50% present are 101 for Mohammed Arab (above) and 19 for Abu Salabikh (below); total numbers recorded as < 50% present are 21 and 11 respectively.