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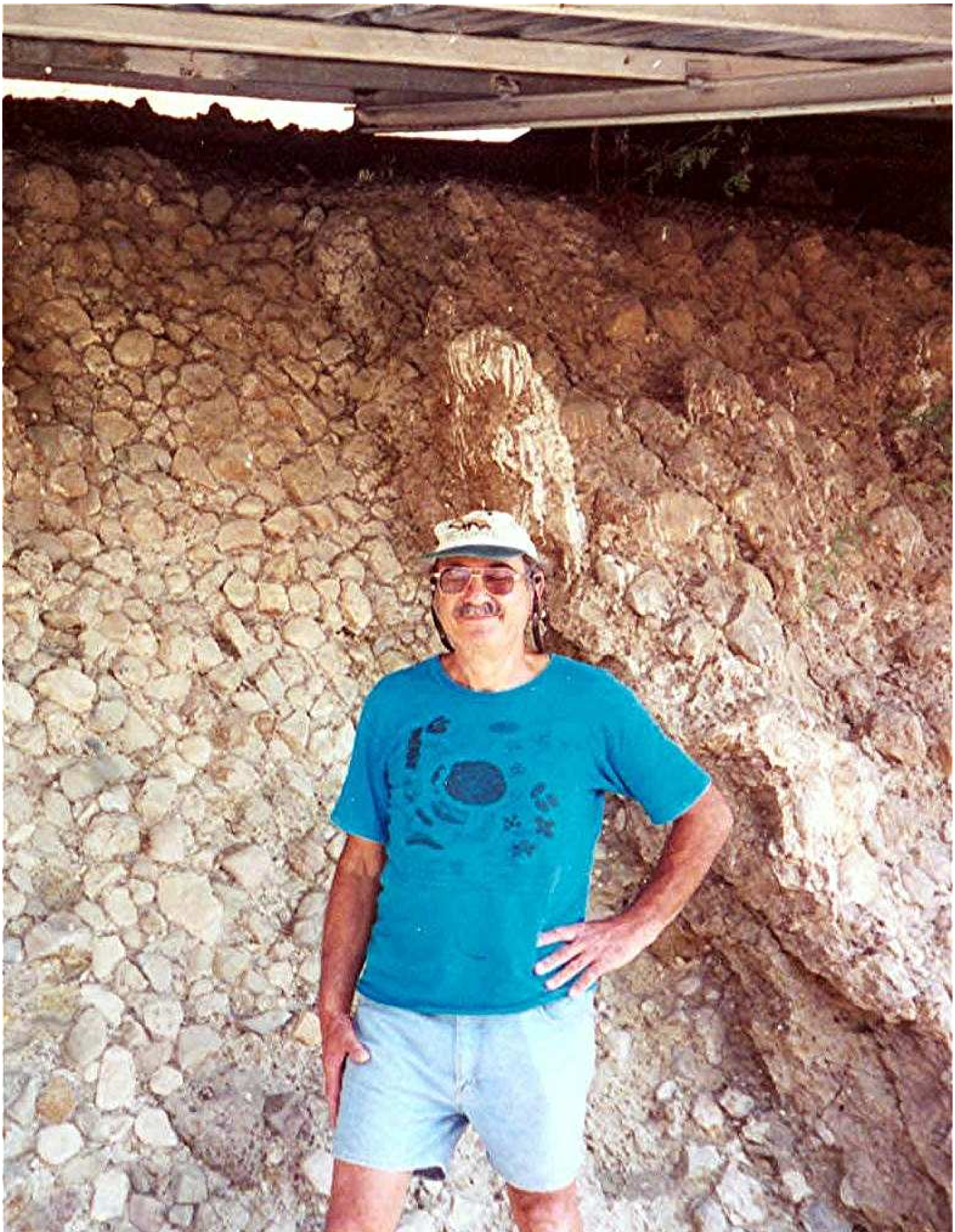

Prof.Dr. Eitan Tchernov

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

Preface

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

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

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

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

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

Louise Martin
London 2005

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

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TAPHONOMY AND ÇATALHÖYÜK: HOW ANIMAL BONE TAPHONOMY CAN ENHANCE OUR INTERPRETATIVE POWERS

Robert Symmons[1]

Abstract

Interest in the faunal material from the Neolithic site of Çatalhöyük, Turkey has been considerable. This study attempts to understand aspects of the taphonomic history of the site. It focuses on how spatial variation in taphonomic destruction can complement other interpretations based on faunal material.

The assemblages recovered from outside buildings at Çatalhöyük (courtyards, penning areas etc) consisted mainly of the most robust parts of the skeleton, suggesting that this material had been subjected to taphonomic processes that destroyed the more fragile elements. The reverse is true of material excavated from within the buildings and so can be said to be a more direct result of human decision-making. An analysis of the faunal material itself suggests that this difference is largely the result of domestic dogs gnawing bones outside the dwellings.

Age profiles for the material excavated from both the internal and external areas at Çatalhöyük were compared. No significant difference between the two profiles could be identified. Therefore, although differences in the taphonomic histories exist across the site, these differences seem not to have affected the age structure represented by the faunal material.

Résumé

L'intérêt pour le matériel faunique du site néolithique de Çatalhöyük en Turquie a été considérable. Cependant aucune tentative n'a été fait pour comprendre jusqu'à quelle limite la les processus de destruction taphonomique ont pu introduire un biais dans cet assemblage. Cette étude examine l'histoire taphonomique des restes de moutons découverts sur le site. A ce point les densités de structure de différente partie de 95 moutons modernes ont été examinés, offrant une indication de la résistance relative de ces parties dans le squelette.

L'assemblage recueillis en dehors du bâtiments à Çatalhöyük (la cour, aire d'enclos, etc.) est composé essentiellement des parties les plus robustes du squelette, indiquant que cet assemblage a été exposé aux processus taphonomiques qui ont détruits les parties les plus fragiles. Le contraire est vrai pour le matériel exhumé à l'intérieur du bâtiment et donc reflétant plus directement les conséquences de l'action humaine. Une analyse du matériel faunique lui même suggère qu'une destruction importante est due aux machouillages des chiens en dehors des habitations.

Les courbes d'abattage, du matériel fouillé dans les espaces intérieurs et extérieurs ont été comparées. Aucune différence significative n'a pu être relevée entre les deux. Donc, même si différentes histoires taphonomiques existent sur le site, ces différences ne semblent pas avoir affectées les structures d'abattages.

Keywords: Çatalhöyük, bone density, age, taphonomy, sheep, carnivore gnawing.

Mots Clés: Çatalhöyük, densité des os, âge, taphonomie mouton, machouillage par les carnivores.

Introduction

In its infancy, the study of animal bone from archaeological sites typically entailed the identification and listing of animal taxa and (in the more thorough analyses) skeletal elements that could be identified from excavated bone material. Although there were of course exceptions to this, it is true to say that zooarchaeologists were primarily concerned with the animals whose remains had been recovered. In recent years, this focus has undergone something of a shift and it is now clear that faunal remains can offer more information than simply taxa and elements. Close examination of a bone can yield information regarding butchery, burning, gnawing by other animals, rapidity of burial, trampling and much more.

This type of analysis (termed *taphonomy* – literally "the laws of burial" (Efremov 1940)) relies on both the examination of the bones themselves (e.g. colour change associated with certain types of heating) and the structure of the assemblage as a whole (i.e. the relative frequencies of different parts of the skeleton).

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Systematic attempts to understand the effects of destructive taphonomic processes on the structure of faunal assemblages began in 1969 with the work of Brain. In this work, Brain noted that taphonomic processes, principally gnawing, tend to remove material from an assemblage by destroying weaker bones more readily than stronger bones. By measuring the strength of different parts of the skeleton (in fact "specific gravity" was used as a proxy for strength), he was able to predict which bones were most likely to survive taphonomic destruction. Where the observed element frequencies matched his prediction, it was considered reasonable to conclude that destructive taphonomic (rather than purely cultural) processes were at least partially responsible for the structure of the assemblage.

Although not without its critics, Brain's work formed the foundation of a considerable body of work by numerous authors (e.g. Lyman 1982; Kreutzer 1992; Willey *et al* 1997; Lam *et al* 1999; Pavao and Stahl 1999; Dirrigl 2001; Ioannidou 2003). These and other authors have measured a variety of physical attributes of bone, all of which are more or less related to Brain's original specific gravity. Although there is little standardisation between the measurements, the property of interest is frequently called "structural density" (Lyman 1984) and will be referred to here simply as "density" or "bone density" (see Lyman 1984 for a critique of the various terminologies and measurement methods used).

A central aim of the work cited above and, indeed, of taphonomic analysis itself, is to establish whether a particular faunal assemblage is primarily the result of either human decision-making or taphonomic destruction. In other words, has the assemblage been shaped only by cultural factors or is it partly the result of the properties of the bones themselves? Implicit in much research is the idea that bias associated with taphonomic destruction will distort or mask what element frequencies can reveal about past human activities. If the structure of an assemblage reflects the strength of the bones within it, how can it inform us about more extrinsic cultural factors? The assumption is therefore that distortion of element frequencies associated with taphonomic bias impedes our ability to learn about human behaviour in the past.

Much of the remainder of this paper intends to revise this assumption. By selectively examining material from different spaces within the Neolithic site of Çatalhöyük, Turkey, variation in taphonomic bias within these spaces will *enhance* the interpretation of the site.

The types of space that will be compared are the interiors of buildings on the site (termed `internal' here) and the courtyards, middens, working areas and thoroughfares that are found outside the buildings (`external" areas'). The extent to which the bone material from each of these two types of space has been affected by destructive taphonomic processes will be examined. Particular attention will be given to the effects of these processes on element frequencies. Next, the specific causes of the observed differences will be explored. Finally, some attention will be given to the assumption that taphonomic destruction tends to act preferentially on unfused bone, and the potential for this to skew age profiles that are derived from fusion data.

The archaeological material: Çatalhöyük

Çatalhöyük is a well-known site that is situated on the Konya plain in Central Anatolia, Turkey. The site occupies two mounds. The main (eastern) mound covers 13.5 hectares and has a maximum height of approximately 20 m. It is largely Neolithic in date, with some later levels. It is the Neolithic levels, dated as being from the late ninth to the eighth millennia bp (uncalibrated radiocarbon dates), from the eastern mound for which the site is best known. These are the strata that will be the focus of this paper.

The site was first discovered and excavated by James Mellaart in the 1960s. These early excavations are described by Mellaart (1967, 1998) and reports on the archaeofauna are provided by Perkins (1969) and Ducos (1988). Recent excavations at the site, under the directorship of Professor Ian Hodder, have uncovered numerous buildings and produced vast quantities of archaeological material, including approximately 400,000 fragments of animal bone. This paper will examine only the material from 355 specially selected contexts, which have been subjected to particularly thorough analysis and recording (approximately 300,000 fragments in total). Of these, 9473 fragments were identified as being from `sheep sized' animals, 1037 of which contained more than 50% of a diagnostic zone (Watson 1972). Being the most commonly recovered taxon, sheep will be the focus of this investigation.

Table 1. Grouping of internal and external contexts at Çatalhöyük

Internal/External	Group for analysis
Internal	Burial fills
	Fills between walls
	Fills or use of features (e.g. bins, hearths ovens)
	Internal floors and raised platforms
	Internal occupation debris (from floors)
External	External middens
	External occupation debris (floors)
	Fills in buildings
	Lime burning areas
	Middens in abandoned buildings
	Penning areas
	(Non-structured) Fire spots
	Fills in other cuts (e.g.. postholes, scoops, pits)

For the purposes of analysis, each of the 355 contexts in question have been assigned an "analytical grouping". Each of these groupings can be classified as being either "internal" or "external" in nature. Table 1 describes how the contexts were categorised.

Internal contexts are those associated with human activity within the mud brick buildings on the site. It should be noted that all burials on the site were found beneath the plaster floors within the buildings and can therefore be classed as being internal. "Fills between walls" includes all material recovered from the narrow spaces between adjacent buildings. In fact, this often consists of debris from inside the buildings that has been dumped outside. This debris has been protected from subsequent alteration and so, regardless of its physical location, most closely represents waste from within the buildings. The categorisation of "fills in buildings" as being external contexts also warrants a brief explanation. These contexts consist of material that has been dumped in abandoned buildings in order to gradually build up a level platform on which new structures could be built. Therefore, this material is not associated with the interior of *extant* buildings and so can be classed as being external.

A comparison of the internal and external material

It has been suggested that the Neolithic inhabitants of Çatalhöyük had different perceptions of different types of space (Last 1994; Martin 1995; Martin and Russell 2000). This is apparent in that internal areas seem to have been rigorously cleaned, while external areas tend to have been reserved for "dirty" activities (animal penning, lime production, waste disposal etc.). If this were the case, then this differentiation might be expected to be reflected in the taphonomic histories of the two types of space. To test this assertion, it is necessary to describe and compare the taphonomic profiles of the internal and external spaces (below).

One method of establishing the impact of destructive taphonomic processes on a bone assemblage is to correlate the number of bones (or bone parts) recovered with the density of that bone (or bone part) (Brain 1976; Binford and Bertram 1977; Lyman 1984; Kreutzer 1992; Butler and Chatters 1994; Elkin 1995; Willey *et al* 1997). Taphonomic destruction will produce an assemblage that is dominated by high-density material. The greater the extent of this destruction, the stronger the density-abundance relationship will be.

In order to enable comparison of bone density with bone abundance, it was necessary to establish the density of the material in question. Bone density measurements were taken from 95 modern sheep skeletons. Twentyone standardised measurements were taken across each skeleton. These measurements have been shown to provide reliable proxy density values for the archaeological material (Symmons, 2004). The methods used to take these measurements and the precise skeletal location of each are available elsewhere (Symmons 2002, 2004).

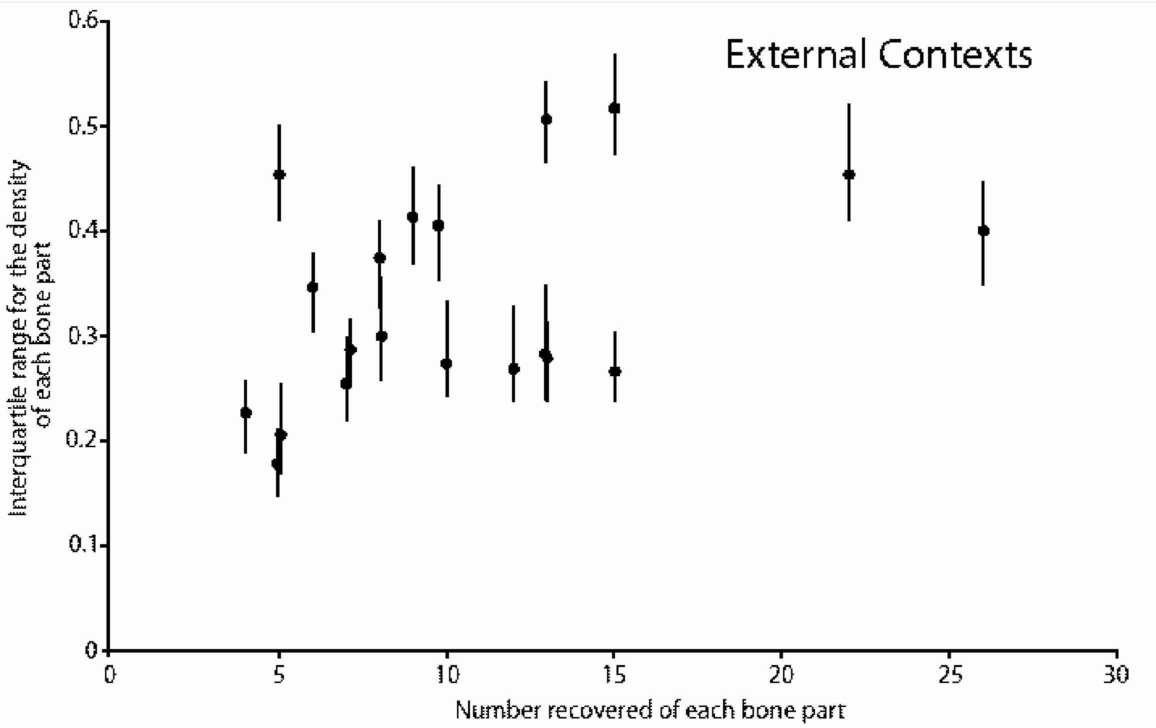

Fig 1. Bone density of different skeletal parts compared with the number of each part from external contexts.
Each vertical line represents the interquartile density range measured from a sample of 95 modern sheep. The black dots show the median value of the total density range.

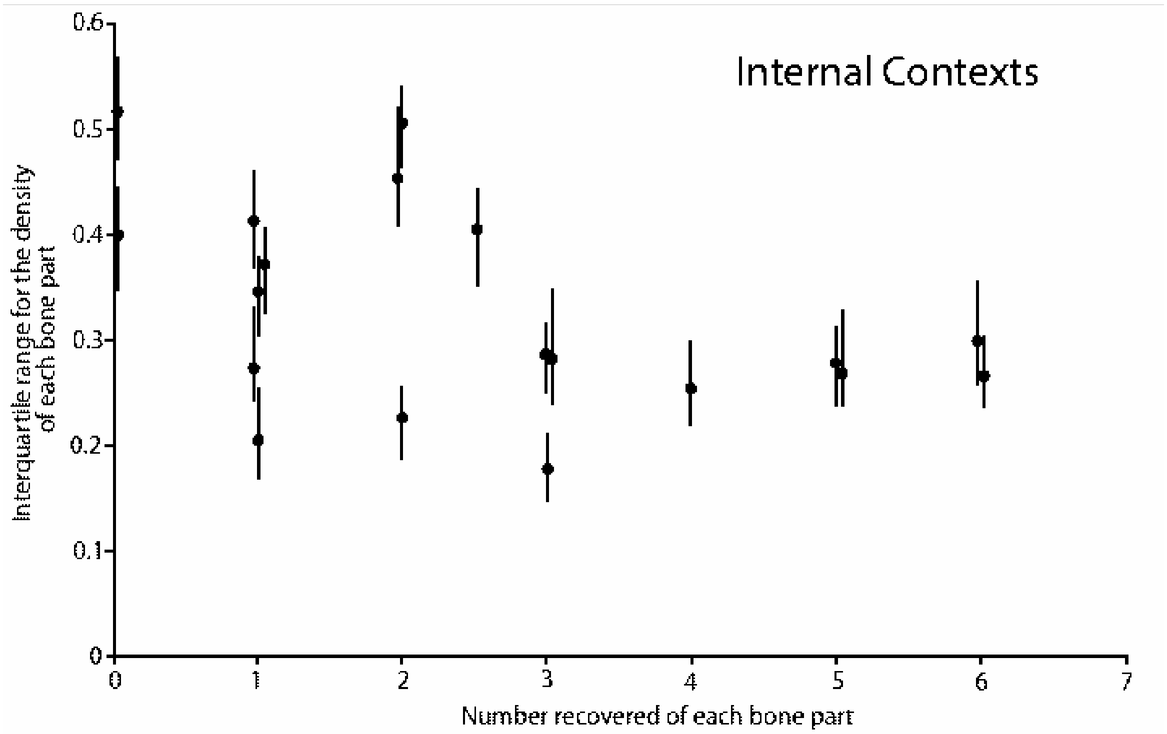

Fig 2. Bone density of different skeletal parts compared with the number of each part from internal contexts.
Each vertical line represents the interquartile density range measured from a sample of 95 modern sheep. The black dots show the median value of the total density range.

Figures 1 and 2 show the relationship between bone density and bone survival for both the internal and external assemblages. These figures have been produced in the same way as the scatter plots used by Lyman (1984), Lyman *et al* (1992) and Elkin (1995), but with one important difference. Previous studies have assumed that the bone density of a skeletal part is fixed and, therefore, predictable. Consequently, scatter plots have used *points* to describe the density-abundance relationship for each skeletal part. It has recently been demonstrated (Symmons in press) that density is a very variable attribute of bone and so cannot be reliably predicted. In order to emphasise this, each point in Figures 1 and 2 is represented by a vertical line, the length of which relates to the range in which a bone density value is most likely to fall (the line, in fact relates to the interquartile range of the total range described by Symmons (2004)). This is intended to provide a better representation of the variable nature of animal bone density.

Despite this variability in bone density, patterns within the two figures can still be identified. The material from external areas shows a positive correlation with bone density, the densest skeletal parts being the most frequently recovered. This is indicative of an assemblage that is, at least partly, the result of destructive taphonomic processes. The material from the internal spaces shows no such relationship.

Rogers (2000) and Orton and Rennie (unpublished) have suggested that certain statistical tests, including Spearman's rank, may not be suitable for this type of analysis. However, to facilitate comparison with other studies, Spearman's rank correlation coefficients have been calculated for both the internal and external assemblages at Çatalhöyük. In each case, the density values used to calculate the statistics were the median values for each of the 21 standardized skeletal areas from the 95 modern individuals mentioned above. The correlation between bone density and bone recovery for the external assemblage is positive and moderate (r=0.466, p=0.038). This is comparable to the results of other authors (Lyman 1984; Kreutzer 1992; Butler and Chatters 1994; Ioannidou 2003). For the internal material, no such correlation exists (r=0.073, p=0.758).

When these correlation coefficients are calculated separately for trabecular and cortical bone, the result for trabecular bone increases, while that of cortical bone decreases (see Table 2). This might suggest that bone density mediates the survival of trabecular bone to a greater extent than it does cortical bone. Although there is scope for development of this observation, this is not within the remit of this paper.

Table 2. Spearman's rank correlation coefficient for the density and number of bone parts.

	All skeletal parts		Cortical bone only		Trabecular bone only	
	r=	p=	r=	p=	r=	p=
External	0.466	0.038	0.811	0.002	0.209	0.589
Internal	0.073	0.758	-0.500	0.170	0.605	0.049

Discussion

Closer examination of the bone material itself provides some indication of the actual processes that are responsible for this difference. Table 3 compares various lines of taphonomic evidence from each of the two assemblages.

The two assemblages have the same average weathering stage and fragment length. Their completeness indices are also comparable (the completeness index is a score between 1 and 100 that is intended to indicate the level of diagenetic destruction that has been experienced by an assemblage (Marean 1991)). However, it appears that the external material has been subjected to a greater degree of carnivore gnawing, digestion, butchery, and burning than the internal material. These processes are all likely to be partly responsible for the difference between the internal and external material described above. The difference between the levels of gnawing and digestion of the two assemblages is especially great and it is reasonable to conclude that carnivore action is the main cause of the observed pattern. It should also be noted that the prevalence of burnt material in the external areas is due

Table 3. Number of measurable indicators of taphonomic destruction from the internal and external assemblages.

	Average weathering stage	Average fragment length	Completeness index	% Butchered	% Burnt	% Digested	% Gnawed
External	2.4	3.0 cm	91	0.4	15.0	6.8	2.5
Internal	2.4	3.0 cm	87	0.1	6.2	1.1	0.5

to a small number of features (recorded on site as being "lime burning" areas) that contained a very high incidence of burnt bone. To this end, the overall pattern of burning is due to a limited range of features and is not representative of the external area as a whole.

Although certain processes can be identified as being responsible for the differences observed in the element frequencies of the two spaces, no conclusions can be drawn about where these processes were carried out. It is impossible to be sure that butchery, for example, took place either inside or outside the buildings (or even on the now-collapsed roofs). However, it is possible to conclude that the internal areas were almost certainly *perceived* by the ancient inhabitants of Çatalhöyük as being different to the external areas. It is difficult to be sure where bone material was processed and how it moved around the site. However, what is certain is that only the material that was finally deposited in the external areas had been (or was subsequently) subjected to significant taphonomic destruction. Agents of taphonomic destruction, appear to have been excluded from within the buildings. It does not seem unreasonable to suggest that the primary agents of taphonomic destruction on the site, namely carnivores (probably domestic dogs), were confined to the external areas.

The Impact of Taphonomic Destruction on Age Profiles

It has been noted that unfused bone is generally less robust than fused bone (Mueller *et al* 1966; Currey 1969; Trotter and Hixon 1974; Binford and Bertram 1977; Thomas *et al* 1991) and so will be more susceptible to taphonomic destruction. This is probably due to variation both in bone density and the relative levels of mineral and collagen as a bone develops.

It is remarkable that the impact of any resulting age related bias on age profiles and their interpretation has yet to be systematically explored (with the notable exception of recent work by Munson and Garniewicz (2003) – although this work did not examine the postcranial skeleton). It is generally assumed that the susceptibility of immature bone to taphonomic destruction will result in an under-representation of the earliest fusing bones in an age profile (Grant 1975; Halstead 1992). An alternative model, based on density data, is given by Symmons (2002) in which taphonomic bias is apparent as an under-representation of *all* unfused bones, especially the earliest and latest fusing bones.

A means of testing these models is to compare the age profiles from both the internal and the external assemblages at Çatalhöyük. It is necessary to assume that the only significant difference between the two assemblages is the degree of taphonomic destruction to which they have been subjected. It is difficult to imagine a scenario in which animals of different ages were deposited in different parts of the site, and so this assumption is not an unreasonable one. In this case, any difference between the age profiles may be the result of increased taphonomic bias in the external assemblage.

A brief comparison of the age profiles (derived from bone fusion data) of the internal and external assemblages from Çatalhöyük reveals that little difference can be seen between them (see Fig. 3). In each case the profile is indicative of a meat-based herd management strategy (Munson 2000). Although a higher degree of density-mediated bias has been shown to exist within the external assemblage, this has not be translated into a significant bias in the age structure of the material. This could be because density variation associated with age at death is insignificant when compared with inter-element or inter-individual density variation. Also, the models outlined above rely on the notion that bone density is the main factor that mediates bone destruction. It is quite possible that other factors, such as bone size and histology, have influenced bone destruction in a manner that was not predicted by either model.

It seems that variation in the taphonomic histories of the two assemblages has not resulted in any significant variation in their age profiles. The idea that levels of taphonomic bias such as those apparent at Çatalhöyük might not result in significant distortion of age profiles is encouraging. However, this conclusion should be presented with two caveats: firstly, it should be stressed that the age profiles referred to here were created using very small samples; secondly, it should also be repeated that this test was based on an assumption that the two assemblages were comparable prior to the introduction of taphonomic bias. Nevertheless, this promising avenue of investigation warrants further attention when possible.

Summary

This analysis has used a new set of bone density data to compare different types of space at Çatalhöyük. The data themselves are presented and discussed in full by Symmons (2002).

Zooarchaeological analysis often relies on the comparison of butchery patterns, age profiles, fragmentation patterns etc. from different sites, areas or levels. It also often compares element profiles from contrasting context types. However, element profiles in relation to the bone density of the different skeletal parts are infrequently compared. It has been shown here that such an analytical approach is not without merit. At Çatalhöyük, it has been possible to identify two separate assemblages from different parts of the site. Each of these assemblages exhibited contrasting element profiles: one indicating taphonomic bias, and the other more a reflection of the original deposited assemblage. This difference between the two assemblages is suggested to reflect differences in the perceptions or treatment of space by the ancient inhabitants of the site. In this case, these conclusions confirmed other artefactual evidence and were supplemented by other taphonomic signatures. In other such analyses, however, it is quite possible that the comparison of taphonomic histories might alert the analyst to variation within a site that might otherwise be invisible.

It is encouraging that, even though taphonomic destruction can be seen to have had an effect on the element profiles from the external areas of Çatalhöyük, this bias is not apparent in the age profiles of the two assemblages. More work with larger samples is required here. One reason for the failure of destructive taphonomic processes to produce significant bias in age profiles is probably that the density difference between fused and unfused bone is much less than has previously been assumed.

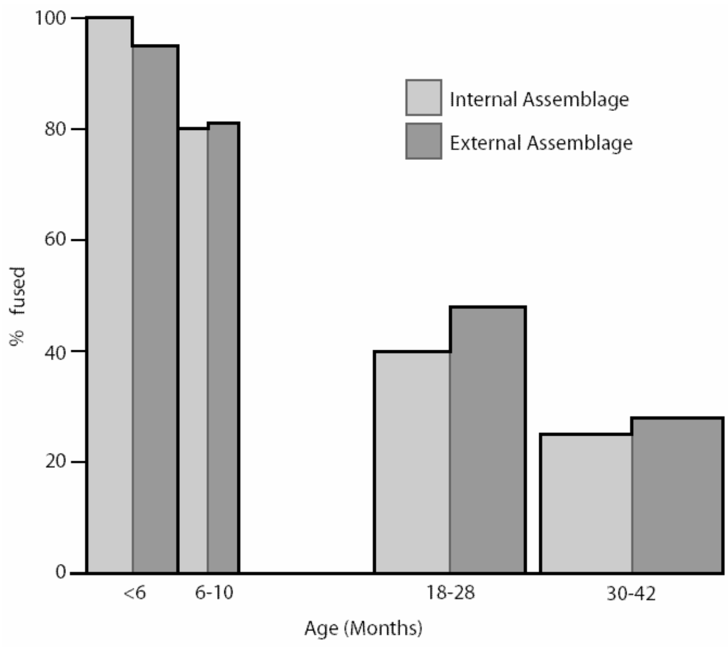

Fig 3. Graph comparing the age profiles of the internal and external assemblages.

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