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Yeomans, Lisa Marie

Published in:
Inhabiting Çatalhöyük

Publication date:
2005

Document version
Early version, also known as pre-print

Citation for published version (APA):
Yeomans, L. M. (2005). Discard and disposal at Çatalhöyük: an investigation through the characterisation of faunal remains. In I. Hodder (Ed.), *Inhabiting Çatalhöyük: reports from the 1995-1999 seasons.* (pp. 573-585). Cambridge: Mcdonald Institute for Archaeological Research.

Chapter 23

Discard and Disposal Practices at Çatalhöyük: an Investigation through the Characterization of Faunal Remains

Lisa Yeomans

The purpose of this paper is to report on an initial investigation aimed at identifying patterns of discard and disposal practices at Çatalhöyük. In contrast to the paper by Cross (Volume 5, Chapter 2), this concentrates on faunal remains.

Background

Discarded artefacts, food processing waste and other types of refuse from past societies would have been widely scattered across the ancient landscape by humans during their daily routines. The presence of an archaeological site merely reflects a concentration of human activity where the increased quantity of debris, whether in the form of building remains or accumulations of consumption refuse and artefacts, makes an area visible archaeologically. As such, any investigation of the refuse and discard practices at an archaeological site will reflect just a limited aspect of the inhabitants' lives. Nevertheless, material recovered through the excavation of these accumulations provides an immensely rich body of data to investigate some facets of the discard process and its variations.

The deposition of refuse can be a complex process involving numerous mechanisms of discard each having a different impact on the formation of archaeological sites. Simplifying these actions, archaeologists have tended to label such processes so as primary, secondary and tertiary deposits to facilitate their recognition and interpretation. Artefacts and activity residues that were dropped or left in the area of use are often termed primary refuse deposits (Tani 1995). It is rare to encounter such accumulations on a site occupied by sedentary people (Murray 1980) since the build up of waste in these situations starts to become obtrusive and/or unhygienic. Secondary refuse deposits are therefore created removing the waste to areas of more limited activity. Tertiary deposits result from the inclusion of waste into new soil matrices — as when secondary refuse gets incorporated into brick or mortar, which then erodes leaving artefactual material of a long history. The frequency that the primary refuse is cleared and the effort employed in maintaining an area free of debris depends on a number of factors. Aside from differences in individuals views of what is considered to be clean or dirty, the intensity of use and the type of activities employed there (Needham & Spence 1997) will effect the effort in keeping an area clear of waste. Additional factors are the distance between the location of creation and the secondary deposit, any hazards caused by the presence of the rubbish (e.g. debitage from lithic production/maintenance; Clark 1991) and the potential for reuse of the waste. Gifford-Conzalez *et al.* (1985) also noted that surface type where waste is accumulated would alter the need or ability to clean an area. Only small fragments of waste will be left after a plaster floor has been cleaned, whereas a dirt surface will soak up a greater proportion of the waste. The composition of different matrices employed as a surface for the same activity is therefore a factor that needs to be examined in characterization of any microrefuse that was embedded in floor surfaces or from overlying occupational debris.

One approach to the study of refuse is to look at primary accumulations; since these are less acted upon by subsequent activities the actual processes that led to their formation may be more distinguishable. Although the identification of waste relating to an individual event is a rare occurrence at archaeological sites it has been argued (Kamp 1991; Meltcalfe

& Heath 1990; Schiffer 1983) that the microrefuse recovered from an area would be indicative of the tasks for which the location was used. The method of cleaning will, of course, affect what is left on a surface; hand collection of waste removes only the larger items whilst sweeping will remove almost all of the debris (Heath & Metcalfe 1984). Overtime, with trampling prior to cleaning, some of the debris will probably become embedded into floors reflecting, to a certain extent, the types of activity performed on them.

Secondary refuse deposits vary from large middens to what Needham & Spence (1997) term undirected refuse aggregations which are considered to be waste transported on a smaller-scale or in an unplanned manner. Given the derived nature of middens it can be difficult to isolate individual depositional events and even harder to associate them with specific activities. This does not mean, however, that middens will not yield information of the organization of refuse producing tasks; there may be broad differences between separate middens and their overall character could indicate the general tasks that produced the waste.

Not all the items that were discarded in middens may have been thought of as rubbish (Moore 1982). Loss or the intentional discard of usable artefacts could also have been practised. It is difficult to define middens entirely as accumulations of rubbish with useful items being placed or lost in these contexts and artefacts that are useless from a functional point of view that may have been retained. Waste itself can be useful product; for example at Beer-Sheba chemical analysis of the sediment from what appeared to be refuse pits suggested that pits were actually used in the creation of compost; material was not at the end of its use but merely in preparation for a new phase (Goffer *et al.* 1983). Martin & Russell (2000) have argued against the assumption that rubbish is material that no longer had a function unless it can be reused in some way and suggested that it may have had greater meaning to the people who created it.

A number of ethnographic studies have highlighted the significance of spatial distribution in waste; underlying reasons can vary from cultural beliefs (Baer 1991; Deal 1985; Hodder 1987), the association of dumps with specific activity areas (Arnold 1990; O'Connell *et al.* 1991) and the need to separate certain hazardous or undesirable materials (Clark 1991). Distinguishing between the affects of these different factors and their influences on the archaeological record will often be difficult since the 'distribution of refuse types will always be the product of interaction between functional requirements and cognitive categories' (Moore 1982, 76). Despite this some archaeological studies have used the composition of waste associated with certain buildings to imply functions for the structures (e.g. Green 1993). Intrasite and between site comparisons should take into consideration the discard practices, as differences in the artefacts from various areas of a settlement or between different sites may relate to the intricacies of the specific deposit examined (Halstead *et al.* 1978). To understand the formation of midden deposits 'we must begin to ask how and why behaviour is organized as it is within sites, how that organization is reflected in the distribution of refuse, and whether our knowledge of relationships can be applied in the archaeological record' (O'Connell *et al.* 1991, 75). Once we have identified differences in the composition of different refuse deposits attempts can be made to explain why these accumulations vary considering the entire range of possibilities highlighted by the ethnographic and archaeological data discussed above.

Discard at Çatalhöyük

The object and significance of the study

Having defined some potential variables affecting rubbish disposal practices, it is necessary to try and assess the effect of these influences on the archaeological record at Çatalhöyük. The task of providing a convincing argument for the multitude of social, cultural and functional dynamics that left us with the archaeological record is extremely problematic. A preliminary step is to identify some common aspects to the discard practices at the site. Even this component is by no means a simple procedure since the intricacy of stratigraphic relationships and sheer complexity of deposits at Çatalhöyük makes defining comparable contexts impossible without subjecting the data to severe judgements of what we find similar. Reid Ferring (1984) has suggested that compositional patterning in spatially defined clusters of rubbish may inform on the activities involved in their production. This is the line of enquiry pursued below by the characterization of the faunal remains from individual contexts at Çatalhöyük.

A faunal case study

The influences of temporal and, to some extent, spatial variation on the faunal assemblage from Çatalhöyük have already been discussed (Chapter 2). This analysis observed that the bones deposited in various regions of the site could display significant differences. Whilst the economic importance of the various species remained relatively stable chronologically there was a conspicuous divergence between the animal bone recovered from the mound and that which derived from an off-site location (i.e. the KOPAL Area). Using information concerning area and stratigraphic level that individual excavation units were attributed to in the overall analysis of the animal bone may have obscured other aspects of internal variation. It is unlikely that remains of different animals would have been evenly scattered across the site; certain species, different ages of animal or particular regions of carcasses may have been associated with specific activities resulting in the formation of different aspects of the archaeological record.

Figure 23.1. *Frequency of digested bone and proportion of bone recovered that was under 3.5cm from individual excavation units.*

To test for correlations between the various deposit types and the faunal assemblage, groups of excavation units were created containing bones with similar characteristics. The grouping of the units was repeated a number of times using different variables to investigate the way that deposit type and location could effect these.

Characterization of faunal assemblages

A database system had been specifically created to record the animal bone from Çatalhöyük; it was designed to allow detailed taphonomic information to be included. In addition to the faunal remains that could be identified to taxonomic level, all bone recovered from the dry sieve was fully recorded involving registering aspects such as fragment size, location and degree of burning and evidence of being digested or gnawed for each individual bone fragment. As much detail as possible was recorded on the origin of the bone in terms of the skeletal element and approximate size of animal represented. Where the sample of bone recovered from an excavation unit by dry sieving was less than 100 fragments material from the 4 mm heavy residue of the flotation samples were also fully recorded. By the end of the 2000 season over 120,000 bones from the East Mound and the KOPAL Area had been studied to this level of detail providing a extremely useful data set that could be used to investigate contextual variation in animal bone.

Selection of the techniques employed

The faunal assemblages used in the following analysis are those from the sample of 355 contexts studied by all specialists; this could allow the results to be compared with other categories of remains. In total the number of bones from these 355 units that were fully recorded was 101,763 providing a large body of data on the taphonomic attributes of the bone from Çatalhöyük. An initial investigation based on a series of bivariate plots and histograms compared some of these attributes. They indicated that some distinctions could be made between material from excavation units with different interpretations or from different locations (such as internal, external, and between wall contexts). An example (Fig. 23.1) displays how attributes tended to be influenced by the location of final deposition. The three types of location shown are those that could be partially distinguished from each other on the basis of the proportion of bone that had been digested and the frequency that the bones were under 3.5 cm in length. Each point represents an individual excavation unit; units with a low number of bones were excluded. A general pattern is evident with units between walls containing a lower frequency of digested bone while greater fragmentation was displayed in bone from deposits within buildings compared to those recovered from external areas.

After plotting numerous attributes of faunal assemblages from separate units and comparing these to the data category and location of the unit it became clear that many of the attributes were partially dependent on these variables. A multivariate technique was needed that would investigate whether

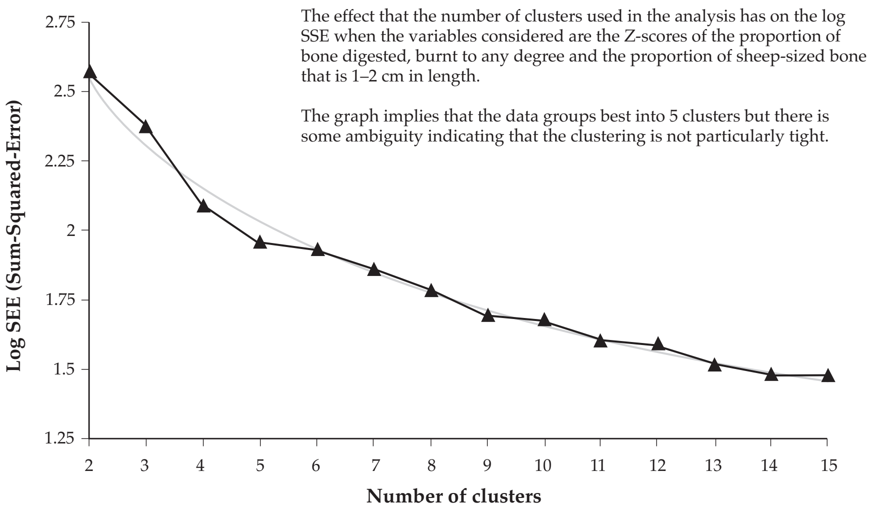

Figure 23.2. *Example of how the appropriate number of clusters was identified.*

sets of distinguishing characteristics could be defined for faunal assemblages from different types of context. As interpretation of an excavation unit is one of the aspects that taphonomic information from the faunal assemblage could provide a means of testing, discriminate analysis was avoided as it assumes that interpretations of the units are correct and then attempts to define the characteristics that separate these predetermined groups. Instead the approach chosen was cluster analysis; this technique does not presuppose any differences between units but groups the data into sets with similar attributes. From this it may be possible to test if the characteristics of a faunal assemblage relate to the interpretation of unit type and the method could also be used to highlight any units that are atypical for certain deposit types. The groups of units could also, in the future, be compared to other data sets to see if the faunal remains vary alongside other types of material and this could help to identify types of waste frequently disposed of together.

Cluster analysis

The technique used to produce groups of units with similar faunal characteristics was the k-means method of clustering and was performed on the 355 priority units that contained at least 20 fragments of bone providing the necessary information for the variables involved in each cluster analysis. Baxter (1994) notes that clustering techniques will produce spherical clusters since they work on the principle that each case is attributed to the nearest cluster centre using the variables defined and as such it will not recognize elliptical groups. If the variables are highly correlated the distribution of points will form non-spherical clusters and points that should be considered as one group may become separated. To avoid this problem the correlations between different attributes of the faunal assemblages were calculated and variables considered together in the same analysis are only used if the correlation between them is less than 0.5 (Baxter 1994). Additionally, some highly correlated variables, such as mass of bone per litre of excavated deposit and frequency of large fragments of bone from large mammals are measures of a similar quality. The presence of large fragments of bone will increase the mass of bone per litre and should not be included together anyway because this will inflate the importance of this aspect of the assemblage in the cluster analysis.

Individual analysis procedures were carried out using a limited number of attributes as some of these variables will probably cluster in a different manner to others. If all the variables were included at the same time they may blur any clustering that is present in fewer variables (Shennan 1997). In order to allow variables that display different ranges of values to have as much weight as each other in determining the clustering the method of using the Z-score was employed. This Z-score is a means of standardizing the data without affecting its distribution; the only factor that is altered is the scale so that all variables have equal weighting (Shennan 1997). For instance the proportion of digested bone varies within a small range of values whilst the frequency of burnt bone in a unit can vary within a much wider range of values. Without standardizing the values the clustering would be more heavily weighted to create groups based the proportion of burnt bone in a unit and the frequency of digested bone would be largely overlooked.

The cluster-analysis technique involves specifying the number of groups that the units will be divided into. Any number of clusters up to the number of samples present can be created and it is necessary to define the number of clusters required. In order to determine how many clusters the data naturally assumes the method of taking the log of the SSE (sum-squared-error) was employed (Gregg *et al.* 1991). This is a calculation of the degree of variation within a cluster; as the number of clusters specified increases the amount of variation displayed between the units in the cluster will decrease. If, however, the data group well into a certain number of clusters, then adding an additional cluster into the analysis will not reduce the amount of within-cluster variation to such an extent. On graphs that display the number of clusters used in the analysis plotted against the log SSE, points of negative inflection indicate the minimum number of clusters that should be used. Figure 23.2 is an example of a log SSE graph based on a cluster analysis involving the Z-scores of the proportion of bone that has been burnt and digested, and the frequency of bone from medium (sheep) sized animals that is 1 or 2 cm in length. The choice of the use of the proportion of bone from medium sized mammals that was 1 or 2 cm in length was based on natural divisions in the units with some assemblages dominated by bones of these lengths and others containing a lower frequency. An arbitrary figure of 15 was used as the maximum number of clusters for which the log SSE was calculated. Although the data could be grouped into more clusters, it is the broader patterns of characteristics in faunal assemblages that are sought, especially since the number of deposit categories was also reduced (see below). The graph in Figure 23.2 suggests that there are five groups of units that are relatively similar based on these three taphonomic attributes, reflecting how extensively the faunal material was affected by carnivore activity, by burning and had suffered from fragmentation.

The shapes of graphs displaying the number of clusters used in the analysis against the log SSE are useful in themselves as the lack of any clear points of negative inflection suggests that the data are evenly distributed according the variables used. In these cases there is a continuum of variability indicating that the units cannot be easily segregated into clusters based on the combination of variables used. Alternatively there may be an obvious number of clusters using a certain combination of variables but units from these clusters do not relate to any of the divisions of context based on the information provided by the excavators. These may imply that differences in the faunal assemblages do not equate to different types of depositional event but rather to previous events in the taphonomic history of the bone. From these points of view negative evidence is as informative as positive evidence would be for differences in the faunal assemblages from various contexts and locations. These could either suggest a more complicated depositional history with repeated episodes of deposition and deposit disturbance or limited correlation between deposition event and faunal assemblage. In the future comparison with patterning in the other types of remains recovered from the site could reveal which of these processes was the most important.

Comparison of cluster results grouping of deposit types

The clustering process was repeated a number of times involving different variables and combinations of variables. Membership of units to different clusters was then compared to the excavation data base. Units had already been assigned to different data categories based on the interpretation of the deposit during excavation. However, the location of the unit in addition to other factors also needed to be considered and it was decided to subdivide the units further to take account of these variables. The following groups were used as a compromise between variability in contexts encountered and the number of recorded units: construction materials, external midden, midden in abandoned buildings, fill between walls, fill in buildings, burial fill, fill in cuts other than burial pits, fills and use of features, internal floors, internal occupation debris, external occupation debris, fire spots, lime burning, penning deposits and KOPAL Area deposits.

Analysis was separated into two parts. First, those attributes that primarily deal with the taphonomic history of the assemblage and include aspects such as fragmentation, burning and digestion were considered. The second section involves comparison of species representation and skeletal frequency to determine if and how these varied according to deposit type.

Results

Differences in taphonomic attributes

Figure 23.3 Had displays the log SSE (sum-squared-error) against the number of clusters for a variety of different characteristics calculated for the faunal assemblages and in different combinations. More pronounced points of negative inflection on this graph suggest the attributes and number of clusters that best define groups of units and these are the variables that will be considered further. The number of units where there is sufficient data to allow the faunal assemblage to be clustered was not great enough for tests of statistical significance to be accurate; instead the raw counts of the number units, by type of deposit, were calculated for each cluster.

It is interesting to note that in Figure 23.3 points of negative inflection and therefore a natural group-

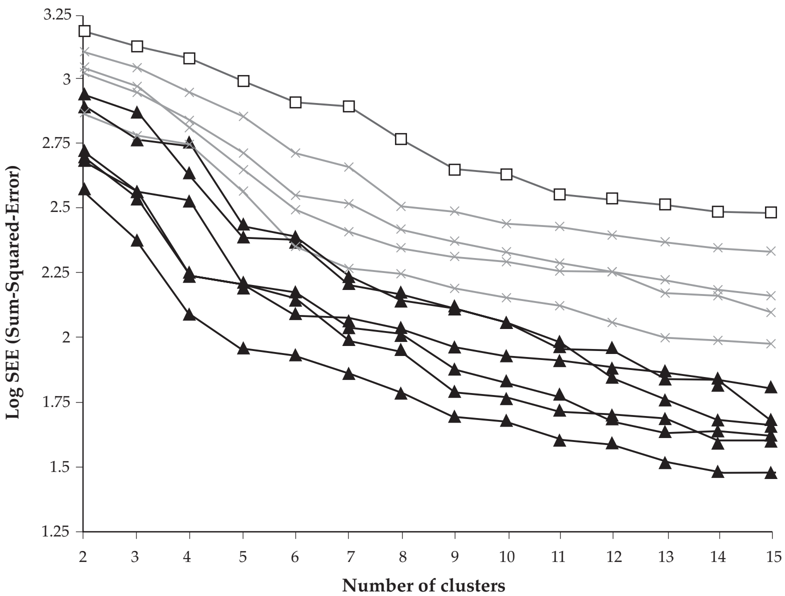

Figure 23.3. *Graph displaying the log sum-squared-error for different clusters analyses performed on the characteristics of the faunal assemblages. Black triangle indicates that three variables were used, the cross denotes cases where four of the attributes were used and using five characteristics generated the case defined by the open square.*

ing of the units are clearer when limited numbers of attributes are used in the analysis. As additional characteristics are included it becomes harder to identify a specific number of clusters that would represent a meaningful division of the faunal assemblages. This implies that animal bone recovered from different units that are similar in terms of certain characteristics may well differ in other attributes and highlights the overall variability of the material in terms of the taphonomic processes that have affected each excavation unit. Nevertheless it is worth comparing how the clusters of units to the excavation data to attempt to define with a greater degree of confidence how taphonomic processes have altered the bone from different types of context.

Four relatively clearly defined groups of units existed in the data when variables used in the cluster analysis were the mass of bone per litre of excavated deposit, the proportion of the bone that displayed evidence of being worked and the frequency of burnt bone in an assemblage. The values defining the centre of each cluster were compared to the average across the site to provide a benchmark for describing the attributes of the cluster. Table 23.1 shows units from different types of deposit and their occurrence in each cluster. Division of the units according to these three equally rated variables highlights few differences between deposit types. Unsurprisingly the assemblages recovered from fire spots and lime-burning episodes often contained enough burnt bone for them to be separated from the majority of the units. Internal floors and occupation debris tend to be characterized by units with a higher proportion of worked bone which maybe a reflection of where implements were used. Although there were four distinct types of faunal assemblage according to the variables discussed,

Table 23.1. *Occurrences of unit membership to different clusters based on the mass of bone per litre of excavated deposit, the frequency of worked bone and proportion of bone that has been worked.*

Deposit type	Mass – average worked - average burning - low	Mass - average worked – low burning - high	Mass – very high worked - low burning - high	Mass – low worked – high burning - average
Midden (external)	33	2		
Midden (in abandoned building)	9		1	
Fill (within building)	42	13		2
Fill (between building walls)	6	4	2	
Internal floors	18	2		1
Occupation debris (internal)	22			2
Occupation debris (external)	2	2		
Lime burning	1	3		
Fire spots	1	2		
Penning deposits	8			
Features (fills and use of)	8	3		
Construction deposits	10	3		
Fill in burial cuts	5			
Fill in other cuts	23			
KOPAL Area deposits	7			

within these four types the class of deposit they were obtained from did not have a major impact on faunal characterization.

The same basic method for distinguishing the differences between groups was used in all cluster analyses performed on the faunal assemblages. Variables considered in Table 23.2 were the mass of bone per litre of excavated deposit, the frequency of potentially articulating bone and the degree of fragmentation based on the calculation of sheep sized animal bone that was only 1 or 2 cm in length.

Some interesting patterns start to emerge from the results of this cluster analysis; a major difference occurs in the grouping of fills deposited in buildings and the external middens. In some respects the attributes of the two groups were consistent; both were found to have an average frequency of potentially articulating bone and fragmentation between the groups was similar. However, fills in the buildings has a lower mass of bone recovered per litre of excavated deposit; this could be a result of using collapsed portions of mudbrick walling to raise the level of the room to the required height before the next building phase. Middens on the other hand are more likely to have accumulated at a slower rate with bone forming a greater portion of the matrix.

It is also noteworthy that the fills deposited between the walls of adjacent buildings were very variable in the terms of the attributes of the bone contained within them. Three of these deposits had

Table 23.2. *Occurrences of unit membership to different clusters based on the mass of bone per litre of excavated deposit, the frequency of potentially articulating bone and proportion of bone from sheep sized mammals that was 1 or 2 cm in length.*

Deposit type	**Mass - high articulation - very high fragmentation - very low**	**Mass - low articulation – average fragmentation - low**	**Mass - very high articulation - low fragmentation - low**	**Mass - high articulation - average fragmentation - low**	**Mass - average articulation - average fragmentation - low**	**Mass - average articulation - very high fragmentation - average**
Midden (external)		4			31	
Midden (in abandoned building)		4		1	5	
Fill (within building)		46			9	1
Fill (between building walls)	1	5	1	1	4	
Internal floors		18			3	
Occupation debris (internal)		17			6	
Occupation debris (external)		2			2	
Lime burning		3			1	
Fire spots		3				
Penning deposits		3			5	
Features (fills and use of)		8			3	
Construction deposits		12			1	
Fill in burial cuts		4			1	
Fill in other cuts		15			8	
KOPAL Area deposits		3			2	2

Table 23.3. *Occurrences of unit membership to different clusters based on the mass of bone per litre of excavated deposit, the frequency of worked bone and proportion of bone from sheep sized animals that is 1 or 2 cm in length.*

Deposit type	**Mass - low worked - very high fragmentation - high**	**Mass - average worked - average fragmentation - low**	**Mass - very high worked - low fragmentation - low**	**Mass - low worked - low fragmentation - high**
Midden (external)		30		5
Midden (in abandoned building)		5	1	4
Fill (within building)	2	7		47
Fill (between building walls)		5	2	5
Internal floors	1	3		17
Occupation debris (internal)	2	4		17
Occupation debris (external)		2		2
Lime burning		1		3
Fire spots				3
Penning deposits		5		3
Features (fills and use of)		3		8
Construction deposits		1		12
Fill in burial cuts		1		4
Fill in other cuts		8		15
KOPAL Area deposits		3		4

the highest density of bone and it will be useful to see how the other characteristics of these deposits are different since it has been postulated that some of the fill between walls could represent waste from feasting events.

A couple of units from the KOPAL Area have exceptionally high frequencies of articulating bone; the faunal assemblages from the KOPAL Area have been distinguished as unique for the frequency of cattle bone they contain.

The third clustering process that seemed to provide fairly distinct groups of clusters was based on the mass of bone per litre of excavated deposit, the frequency of articulating bone and the proportion of bone that had been digested (Table 23.3). The majority of the units fell into two clusters; the characteristics did not allow the definition of significant differences between most deposit types but again the fill between walls showed greater variability.

The data in Table 23.4 add to our knowledge of the variance displayed in the bone deposited in external midden deposits and building fills. Table 23.2 had already highlighted the fact that bone was more dense in midden deposits and this is confirmed by the data in Table 23.4; added detail is provided by the fact that worked bone was also consistently found in higher proportions in the external midden deposits. Although two building fill deposits did have an exceptionally high frequency of worked bone, in the majority of cases worked bone was better represented in external midden deposits.

The data in Table 23.5 indicate a further difference highlighting the variability in frequency of digested bone. Middens that accumulated in an abandoned building differ from those found in external areas and are typified by a high frequency of digested bone perhaps suggesting that these areas provided suitable, undisturbed locations for dogs to use. The presence of moderately high frequencies of digested bone in some building fills and deposits in cut features is more difficult to explain. Perhaps material from uninhabited parts of the settlement was brought in to build up room levels and these may have included locations where dogs tended to gather. The clusters displayed in Table 23.6 are based on the proportion of digested bone, the frequency of burnt bone and a measure of the extent of fragmentation. Although there is a greater separation of the units across different clusters a similar pattern is seen as in the previous analysis with external midden deposits displaying characteristics, which whilst not totally distinctive, are broadly different to the general pattern.

Differences in animal bone deposition

Analysis was also performed on the relative proportions of species as indicated by the faunal remains as the results might provide additional information on the selection and deposition of bones in certain contexts. Cluster analysis used the Z-scores of species representation based on the number of identified elements. The majority of the units, regardless of the type of deposit that they derive from, fall into clusters with a high percentage of caprine bones. Exceptions to this are KOPAL Area units, some fill between-wall contexts and a limited number of the

Table 23.4. *Occurrences of unit membership to different clusters based on the mass of bone per litre of excavated deposit, the frequency of worked bone and proportion of bone from sheep sized animals that is 1 or 2 cm in length.*

Deposit type	Mass - low worked - very high fragmentation - high	Mass - average worked - average fragmentation – low	Mass - very high worked - low fragmentation - low	Mass - low worked - low fragmentation - high
Midden (external)		30		5
Midden (in abandoned building)		5	1	4
Fill (within building)	2	7		47
Fill (between building walls)		5	2	5
Internal floors	1	3		17
Occupation debris (internal)	2	4		17
Occupation debris (external)		2		2
Lime burning		1		3
Fire spots				3
Penning deposits		5		3
Features (fills and use of)		3		8
Construction deposits		1		12
Fill in burial cuts		1		4
Fill in other cuts		8		15
KOPAL Area deposits		3		4

midden deposits especially those that were from abandoned buildings. The clusters are characterized compared to the average for all units so clusters are defined in relation to the representation of the five main taxonomic groups found.

Membership in the separate clusters is show in Table 23.7; sample size is small, as few units were large enough to contain a sufficient sample of bones that were identifiable to taxonomic level. Overall, there were eight clusters of units but the majority of units belonged to the two clusters that contained a very high representation of caprines. Despite the small sample size KOPAL Area material was clearly different in that in none of the units had the same domination of caprines that is seen in the majority of the material. With the small sample available at present it is difficult to see any patterning of species proportions compared to context type. In future, when there is a greater quantity of data it may be possible to see the effects of context type on species representation.

Body part representation

During the butchery of a carcass parts of the skeleton are discarded at different times. At Çatalhöyük there is also evidence that some parts of skeletons

Table 23.5. *Occurrences of unit membership to different clusters based on the mass of bone per litre excavated deposit, the frequency of digested bone and proportion of bone from sheep sized animals that is 1 or 2cm in length.*

Deposit type	Mass - average digestion - very high fragmentation - high	Mass - average digestion - high fragmentation - average	Mass - very high digestion - very high fragmentation - average	Mass - very high digestion - very low fragmentation - low	Mass - average digestion - very low fragmentation - average
Midden (external)		6			29
Midden (in abandoned building)	3	5	1		1
Fill (within building)	3	18			35
Fill (between building walls)		1		2	9
Internal floors		1			20
Occupation debris (internal)		2			21
Occupation debris (external)	1	1			2
Lime burning		2			2
Fire spots					3
Penning deposits		1			7
Features (fills and use of)		3			8
Construction deposits		3			10
Fill in burial cuts		3			2
Fill in other cuts	1	9			13
KOPAL Area deposits					7

Table 23.6. *Occurrences of unit membership to different clusters based on the frequency of digested bone, burnt bone and proportion of bone from sheep sized animals that is 1 or 2 cm in length.*

Deposit type	Digestion - low burning - very high fragmentation - very high	Digestion - low burning - low fragmentation - very low	Digestion - very high burning - low fragmentation - high	Digestion - high burning - high fragmentation - very high	Digestion - low burning - high fragmentation - very high
Midden (external)	1	24			2
Midden (in abandoned building)		3	1	3	
Fill (within building)	1	1		4	17
Fill (between building walls)	2	1			2
Internal floors		1			4
Occupation debris (internal)		1		1	9
Occupation debris (external)	1	2		1	
Lime burning	1				1
Fire spots	2				1
Penning deposits					2
Features (fills and use of)	2	2		1	2
Construction deposits	1	1		2	4
Fill in burial cuts				1	1
Fill in other cuts		4		1	4
KOPAL Area deposits		1			1

are retained for use in installations. In order to look for any patterning in the disposal of skeletal portions a cluster analysis was performed using the mass of bone from different anatomical regions on all bones from sheep sized animals (Table 23.8). The portions of the body considered were the skull, axial skeleton, girdle, upper limb bones and lower limb bones. The units grouped into eight clusters and these are characterized compared to the mass of bone from different skeletal regions in a complete modern reference skeleton.

With the mass of bone from sheep sized animals it is worth noting that external midden units frequently contained bone in roughly similar proportions to that present in complete skeletons suggesting that the waste deposited represents all stages in the butchery process. Room fills are more variable but a number of units of this type contained a high representation of the axial skeleton; the bones of the vertebra and ribs are not those discarded in the initial phase of butchery neither would they be kept for extensive processing. Although there is a notable

Table 23.7. *Membership of units of different types to clusters based on the proportion of the number of elements identified to the five main food animals. The symbols after the animal type denote their relative representation with +++ symbolizing that bones from a certain species group are considerably better represented than the average for the site, though 0 indicating that a species is approximate to the average for the site, to - - - which suggests that the animals are particularly underrepresented.*

Deposit type	**Caprine - cattle 0 cervid - pig +++ equid +**	**Caprine - - cattle ++ cervid 0 pig + equid +**	**Caprine - - - cattle ++ cervid - pig - - equid +++**	**Caprine + cattle 0 cervid - pig + equid +**	**Caprine - cattle - - cervid +++ pig 0 equid 0**	**Caprine - - - cattle +++ cervid 0 pig 0 equid 0**	**Caprine - - cattle - - cervid - pig ++ quid +++**	**Caprine +++ cattle - - - cervid - pig - equid - -**
Midden (external)	4	2	2	9	1	1	1	12
Midden (in abandoned building)	3	2		2				
Fill (within building)							1	3
Fill (between building walls)		2	1					3
Internal floors								1
Occupation debris (internal)								2
Occupation debris (external)								2
Lime burning				1				
Fire spots				1				1
Penning deposits								1
Features (fills and use of)								1
Construction deposits		1						
Fill in burial cuts		1		2				2
Fill in other cuts		2			1	2		
KOPAL Area deposits								

Table 23.8. *Membership of different unit types to clusters of assemblages that contain different proportions of skeletal regions of sheep sized animals based on mass. Body part representation is given in comparison to the actual representation of the bone mass in a complete sheep skeleton.*

Deposit type	**Skeletally complete**	**Dominated by skull bones**	**Axial skeleton well represented**	**Skull and axial skeleton well represented**	**Dominated by axial skeleton**	**Lower-limb bones well represented**	**Upper-lime well represented**	**Dominated by girdle bones**
Midden (external)	26	2	4	2				
Midden (in abandoned building)	3		3	4				
Fill (within building)	8	3	16	5	2	3	2	2
Fill (between building walls)		3	3	4			1	
Internal floors		1	8	5	2	1	1	
Occupation debris (internal)	1		8	1	1	1	1	
Occupation debris (external)	2		1				1	
Lime burning	2			2				
Fire spots	2		1					
Penning deposits	3					1	1	
Features (fills and use of)	2	1	2		1	2	1	
Construction deposits	2	2	3	3				
Fill in burial cuts	1		3		1			
Fill in other cuts	6	1	10	2			2	1
KOPAL Area deposits	1	1		1	2		2	

overlap between unit types, some types do contain more units dominated by specific body parts. There is similarity between internal floors and internal occupation debris, both of which tend to contain units dominated by a specific body region rather than representing complete carcasses and this may reflect the activities that produced these deposits.

Since the representation of cattle bones is low at Çatalhöyük, units that contained a suitable sample of data concerning the body part representation of bones from cattle sized animals are rarely encountered. An attempt was made to identify differences in the body part representation of cattle by deposit type (Table 23.9) but with the exception of the fact that the axial skeleton seems over-represented in midden deposits at the expense of the upper limb bones, no specific patterns could be observed. In the future an analysis of this type may provide particularly useful in identifying the varied ways that cattle bones were used at the site.

Summary of results

Patterns in contextual variability

Certain taphonomic characteristics, such as the mass of bone per litre of excavated deposit were found to consistently occur in the variables that created groups of units suggesting that the data conformed to a few ranges of bone density rather than being completely variable. Other attributes only provided meaningful clustering of the data when studied in combination with additional factors. The advantage of using cluster analysis over bivariate techniques is that it allows subtle differences to be combined to provide a more useful separation of the units into groups.

The cluster analysis approach to identifying the characteristics of the faunal assemblages from different deposits has highlighted certain patterns in the data that need to be investigated further. Almost all of the analyses tended to group the external midden deposits as distinct from room fills. Despite this, none of the clusters alone could be used to distinguish a type of deposit; there was significant and often considerable overlap between categories. Whilst the characteristics of bone from different deposit types displayed lower internal variation than external variability it did not occur to the extent that it was possible to define a mutually exclusive set of characteristics for the faunal assemblages from a specific deposit type.

The taphonomic attributes of an assemblage will be dependent on all the processes that have acted upon the bone, not just the final use or depositional episode. Therefore using the characteristics of a bone assemblage as a means of ascertaining the accuracy

Table 23.9. *Membership of different unit types to clusters of assemblages that contain different proportions of skeletal regions of cattle sized animals based on mass.*

Deposit type	Skull bones only	Dominated by skull bones	Skull, girdle and axial skeleton over-represented at expense of limb-bones	Upper-Limb bones well represented	Lower-limb bones over-represented at expense of upper-limb bones	Axial skeleton well represented	Lower-limb bones well represented	Axial skeleton over-represented at expense of upper-limb elements	Dominated by lower-limb bones	Axial and upper-limb bones well represented	Dominated by girdle elements	Dominated by bones of the axial skeleton
Midden (external)			5		1	3	1	15	2		1	
Midden (in abandoned building)				1	2	2	2		1			
Fill (within building)			1		2	2			1			
Fill (between building walls)			1				2					1
Internal floors	1	2										
Occupation debris (internal)								1		1		
Occupation debris (external)					1							
Lime burning						1		1	1			
Fire spots			1	1				1				
Penning deposits					1							
Features (fills and use of)			1			1						
Construction deposits								1				
Fill in burial cuts												
Fill in other cuts				2	1		2				1	
KOPAL Area deposits						1	2			2		

of the stratigraphic interpretations would be highly problematic. Not only does this assume that the bone has not been redeposited from elsewhere, it also assumes that a deposit of a certain type would always have been formed through a similar set of processes. This is exactly the added information about the formation of deposits and use of material by the inhabitants of Çatalhöyük which studying the taphonomic aspects of the bone can provide. Whilst stratigraphic evidence provides information on the final deposition of material; aspects relating to the history, use life and reworking of material is obtained by studying the characteristics of material within units. When more samples of bone are studied and with integration of results from other data sets it should be possible to get a better picture of the taphonomic history of deposits from a site that has been the function of a complex series of formation processes.

The previous sections have shown that the attributes of faunal assemblages found inside the buildings differed from those recovered from midden deposits and other supposed accumulations of refuse. This suggests that not all the latter material originated from internal contexts; the difference in the fragment size was probably caused by the removal of the larger fragments whilst smaller bones tended to remain at the use-location. High fragmentation within buildings may also result from the presence of tertiary refuse in floor make-up and construction material. There are other differences that need to be explained if middens and between-wall fills were to be seen as deposits from waste created inside the buildings. Dogs scavenging on the secondary deposits and defecating within the vicinity could create the higher proportion of digested bone. However, the difference in the proportion of bone that has been burnt, with units from internal contexts frequently characterized by a relatively high amount of burnt bone compared to the middens, is unlikely to be a function of the cleaning process or post-depositional disturbances. Skeletal element representation of bones from sheep-sized animals also shows a notable dissimilarity in the units from inside buildings. Both the bone that had been incorporated into the floors and the internal occupation debris frequently consisted of units dominated by the axial skeleton; secondary deposits often contained bones in the approximate proportions that they are found in complete skeletons. This suggests that much of the bone from the secondary deposits derived from another source and not entirely from the activities that were carried out inside the buildings.

Conclusions and requirements of further analysis

The formation of tell sites, such as Çatalhöyük, occurred through the massive build-up of human occupational refuse on a considerable scale (Davidson 1976). Of paramount importance in understanding this process is considering why material, with the majority of it apparently being waste, was permitted to remain in the vicinity of buildings that were actually in use as these accumulations were forming. At Çatalhöyük much of the waste accumulated in open areas of the site, in abandoned buildings and between the walls of adjacent houses. These locations were not segregated from the rest of the site that were inhabited and there is no evidence to suggest that episodes of occupation and waste accumulation were alternated. Therefore, the proximity between living areas and the decaying residues of inhabitation must have created odorous and unhygienic conditions. Although remains of commensal pests were found in relatively low frequencies they were present in all types of deposit and throughout the temporal sequence (Chapter 4). This would also seem to imply that discard processes were not actively designed to avoid propinquity between waste and occupied areas of the site. Allowing rubbish to accumulate so close to buildings may have been either intentional or an unintentional consequence caused by a large population living within a restricted space where the rules or social customs did not require discard of material away from living areas. Perhaps midden deposits were a symbol of wealth or the right of ownership over the land and surrounding areas through the longevity and continuity of occupation implied by its formation. Raising the level of houses above the marshy plain may have also been advantageous.

In the initial stages of settlement it would have been impossible to predict the growth of the mound without something to emulate. Although A?ıklı Höyük was probably abandoned between 100 and 400 years prior to the earliest occupation of Çatalhöyük (Volume 5, Chapter 4) it seems doubtful that settlers would have envisaged their foundations to eventually form a similar creation. Buildings of the original occupation of Çatalhöyük have not yet been revealed in the coarse of the excavations and it is therefore impossible to consider how the first layers of the mound were generated.

Is it reasonable to assume that later occupants comprehended that the mound they were living on was an artificial creation of their antecedents in the otherwise flat expanse of the Konya plain? Though

digging features and foundations they would have encountered the dense remains of the preceding occupation. However, it has been estimated that the use life of a single building would range between 50 and 80 years on the basis of dendrochronological and micromorphological data (Chapter 21 & Volume 5, Chapter 2). Given the lifespan of individuals (Chapter 11) perhaps the population would not really considered the gradual aggregation of deposits into the makeup of the mound, though there is obviously potential for oral histories and stories to convey these changes down through the generations.
Cluster analysis of the attributes of bone from different types of context revealed broad differences between building fill midden to imply that building fill was not just used as an additional area for dumping and that the act of room filling was intentional. The lower mass of bone in building fills may suggest a faster rate of accumulation with the quantity of bone generated for discard unable to form such a high proportion of the deposit. The purpose of building new structures higher could have been to keep up with the level of outside midden areas (cf. Keene 1982).

It is difficult to determine what were the causal factors in the accumulation and placement of the midden deposits around the various parts of Çatalhöyük. The presence of distinctive tip lines show where gathering of primary material, mixed during the collection process, were dumped on the middens. In this respect the material might appear to be rubbish with little or no connotations attached to its discard and there are many incidences of material from specific activity being deposited close by. Other aspects of the discard processes reveal further considerations that affected people's judgements on what was viewed as waste or no longer required. This is highlighted by the recovery of complete bone tools from some midden contexts. Potential reasons for this discard may include the removal of personal articles at the time of someone's death, replacement of items by new pieces or part of the belief system involving deposition of personal items. Other situations also arise where used or broken items were kept perhaps because of symbolic importance placed upon the object. An example may be seen in the way that 'clusters of clay balls and geometric objects were not removed before new features were constructed, or building infilling took place' (Volume 5, Chapter 6). Other examples include the frequency that bone points were resharpened rather than new ones been made (Russell 2001) and or the recovery of rounded 'potdiscs' made from broken vessels (Volume 5, Chapter 5).

Considerably more work is required on the integration of the various datasets but hopefully this example on the cluster analysis of the faunal attributes shows one potential method of investigating the characteristics of different deposits and how it could be used to further our understanding of discard practices. Extending this study to include other classes of material will greatly add to the appreciation of how they were used and disposed of. Different clusters of units generated using a wider range of variables could then be compared with one another to inform us how archaeological remains separated by specialists actually functioned together during their use and disposal.

Acknowledgements

Many members of the Çatalhöyük project have provided help but I would particularly like to thank Louise Martin, Nerissa Russell and Shahina Farid; also Clive Orton who provided assistance with the statistical aspects this study.