ARCHAEOZOOLOGY OF THE NEAR EAST VI

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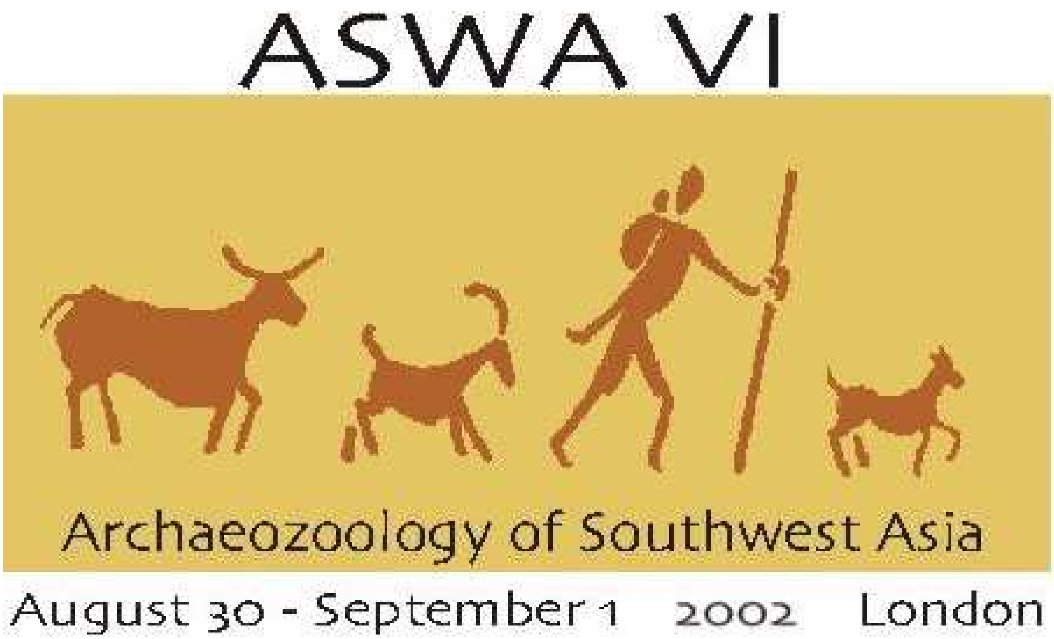

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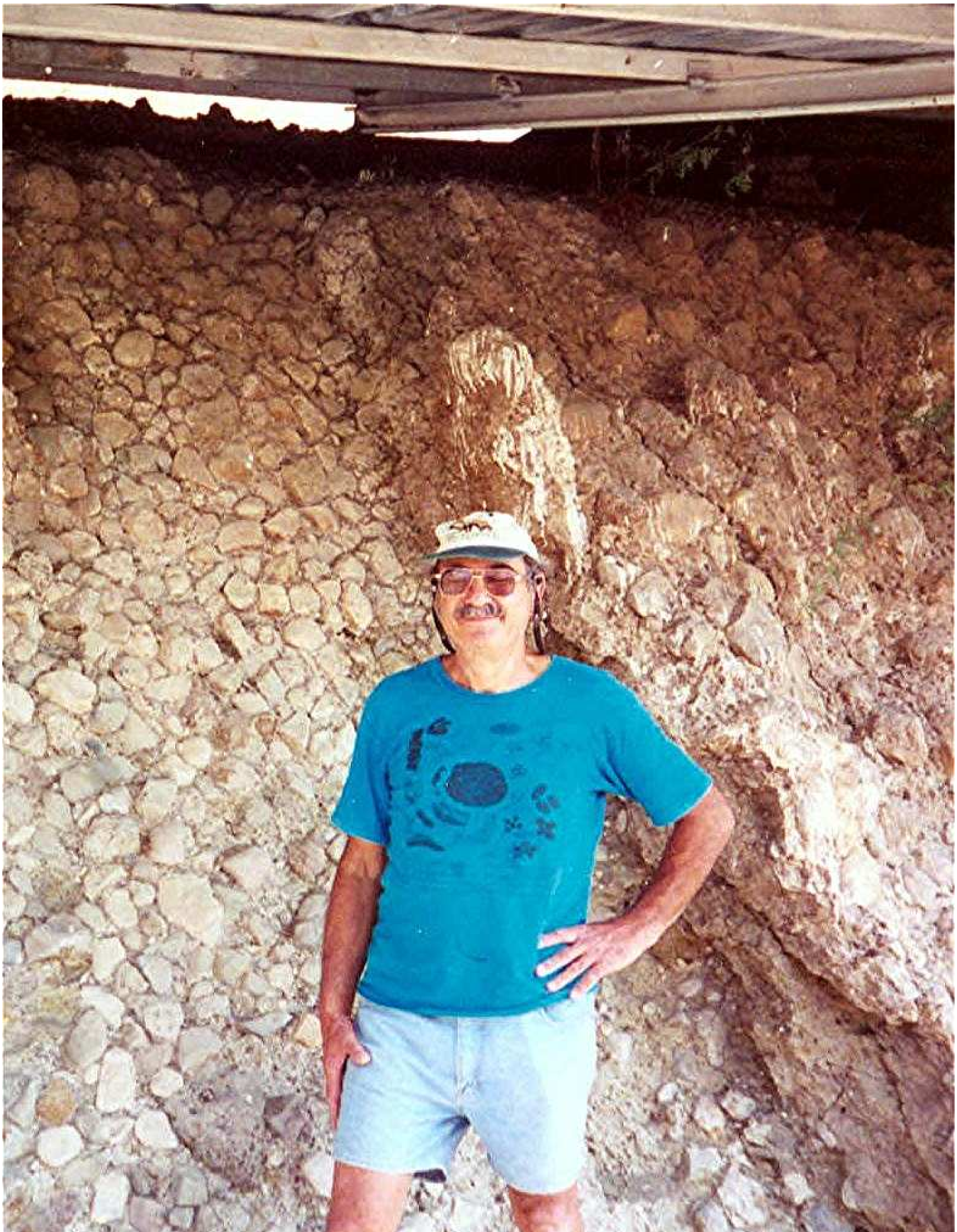

Prof.Dr. Eitan Tchernov

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 post-graduate 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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Preface

CHARACTERISING DEPOSITS ON THE BASIS OF FAUNAL ASSEMBLAGES: THE USE OF CLUSTER ANALYSIS AND ITS POTENTIAL FOR ANALYSING CORRELATIONS ACROSS FAUNAL DATA CATEGORIES.

Lisa Yeomans[1]

Abstract

This paper describes how cluster analysis can be used to identify depositional contexts containing faunal remains displaying similar characteristics. The method can be applied to either taphonomic modifications or taxonomic and skeletal part representations to provide a means of designating contexts that may have undergone similar taphonomic histories or comprise of similar types of waste. The technique is particularly useful for large faunal assemblages, or where the recording of the bone occurred over extended periods, helping identify patterns within the data. Results can also be compared to other forms of archaeological remains aiding in the identification of deposition patterns occurring across artefact classes.

Résumé

Cet article décrit comment l'analyse de faisceau peut être employée pour identifier les contextes dépositionnels contenant le faunal demeure montrant les caractéristiques semblables. La méthode peut être appliquée ou aux modifications taphonomic ou taxonomique et squelettique pièce les représentations pour fournir des moyens d'indiquer les contextes qui ont pu avoir subi les histoires taphonomic semblables ou comportent des types semblables de perte. La technique est particulièrement utile pour de grands assemblages de faunal, ou où l'enregistrement du l'os s'est produit des périodes étendues, aidant identifient des modèles dans les données. Des résultats peuvent également être comparés à d'autres formes des restes archéologiques facilitant dedans l'identification du dépôt a modelé l'occurrence à travers des classes d'objet façonné.

Key Words: cluster analysis, faunal characterisation, Çatalhöyük

Mots Clés: faisceau analyse, caractérisation de fauna, Çatalhöyük

Introduction

Archaeological deposits tend to be composites of numerous categories of material including human artefacts, biological remains and re-deposited sediments. Processes affecting the formation, survival, recognition and excavation of an archaeological context will alter the characteristics of all these constituent elements. Material remains from a specific context are interrelated in terms of how and why they became deposited together, yet they become separated purely on the basis of which specialist will study them. There are various levels at which reintegration of the data can be attempted with the most basic involving phasing so that finds can be assigned to broadly contemporary groups and chronological trends can be observed. Spatial concentrations and similar features are also frequently considered, but identifying associations with other artefact classes can be difficult, time-consuming and problematic to quantify. The aim of this paper is to highlight the potential of cluster analysis to define groups of contexts with similar faunal assemblages that can then be compared to groupings in other datasets or aspects of the stratigraphic record.

Cluster Analysis

Cluster analysis is a multivariate technique allowing numerous different characteristics to define groups with similar attributes without any prior assumptions about the data. The method described below is K-means cluster analysis performed in the computer program SPSS.

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In the case of faunal material, examples of characteristics that could be used include the proportion of bone that has been burnt, the proportion of bone from different skeletal regions, the frequency of different fragmentation sizes or the representation of worked bone. These are just a few aspects that can be investigated with the potential list of attributes limited only by the detail in which the faunal assemblage was recorded. Even so it is better to perform a number of analyses using a few different criteria so that any clustering that is evident on the basis of a few characteristics is not obscured by greater variation created when an excessive number is used.

One limitation to the attributes used is that none of the criteria should be highly correlated. This is because each case is attributed to the nearest cluster centre and therefore spherical clusters are produced; elliptical groups will not be recognised and cases that should probably be considered as a group may become separated. To avoid this problem Baxter (1994) suggests that any two characteristics with a correlation greater than 0.5 should not be used in the same analysis. Although the characteristics should not be highly correlated, choosing attributes that may infer on the same set of processes will probably produce more meaningful results.

To ensure the variables used in the analysis contribute equally to the clustering process it is necessary to use the Z-score values, which standardise the data without affecting its distribution; Shennan (1997) describes this transformation of the data in more detail. Without using the transformed data, one aspect may be largely overlooked. For instance, if two of the variables used were the proportion of bone that had been digested and the proportion of bone that measured under 3cm in length, the first attribute varies within a limited range whilst the second tends to be much more variable and will therefore weigh much more heavily in the clustering process, with the proportion of digested bone having little impact on defining clusters of similar type.

A disadvantage of the clustering technique is that it groups cases into however many clusters are indicated at the outset, regardless of the degree of variability in the cluster. It is therefore necessary to be certain that the clusters given actually refer to groupings and are not merely the data divided into a random number of groups with limited internal cohesion. In order to overcome this problem the clustering process is repeated a number of times and each time the number of clusters is increased until it is deemed that the data would be separated over too many grouping to be of use. After every analysis the degree of separation between each case and its cluster centre is calculated. Adding these values together and taking the log of the value (using the formula Log Sum-Squared-Error or log SSE) provides an indication of the overall inaccuracy in the clustering (Gregg *et al* 1991 also describe this process). As the number of clusters increases, the error decreases because the data is divided into more groups and there are more cluster centres so the values of the case will be closer to one of them. The error value is plotted against the number of clusters used in the analysis; ideally this would show a clear change from a high decrease in log SEE value to a considerably lower one showing as a point of negative inflection. This would indicate relatively tight grouping into a specific number of clusters. Being unable to clearly define the number of clusters assumed by the data can be as informative as the positive identification of clusters as it indicates that the data, with regard to the attributes under investigation, consists of characteristics more or less variable along a continuum. Figures 1 and 2 show a hypothetical case of cluster analysis based on two variables for ease of visualisation and with obvious clusters.

Case study

The approach is ideally suited to faunal assemblages from sites were there was an emphasis on recovery and detailed recording of the animal bone. Çatalhöyük, located on the Turkish Konya Plain, is a Neolithic Tell formation; background information concerning the site is available in numerous reports (Mellaart 1967; Hodder 1996; 2000). Çatalhöyük is an ideal site to implement the clustering approach since at the time of the analysis over 100,000 fragments of bone had been recorded onto a database that was designed specifically to register numerous quantitative and qualitative attributes of each specimen. Additionally the complicated stratigraphy provides a wide range of depositional circumstances allowing comparison of faunal assemblages characteristics from numerous different context types.

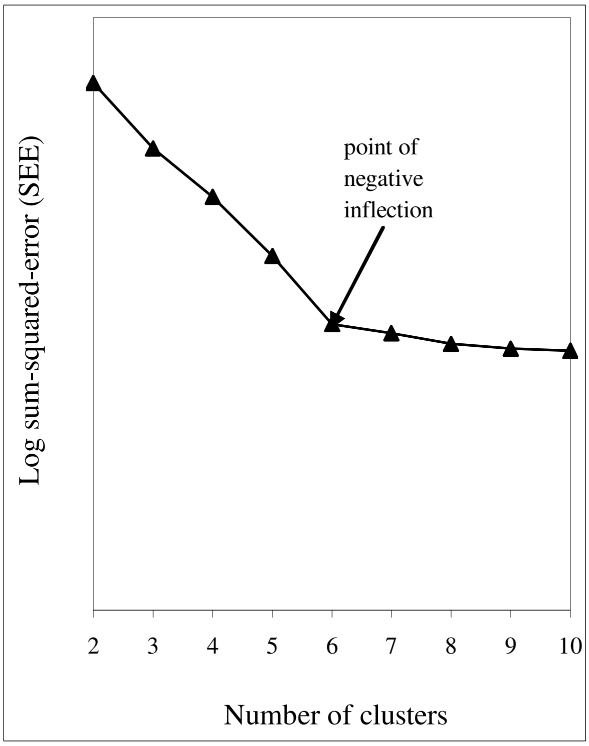

Fig. 1. Example of a log SSE graph created from the data in figure 2 and showing a clear point of negative inflection indicating that the data assumes six clusters.

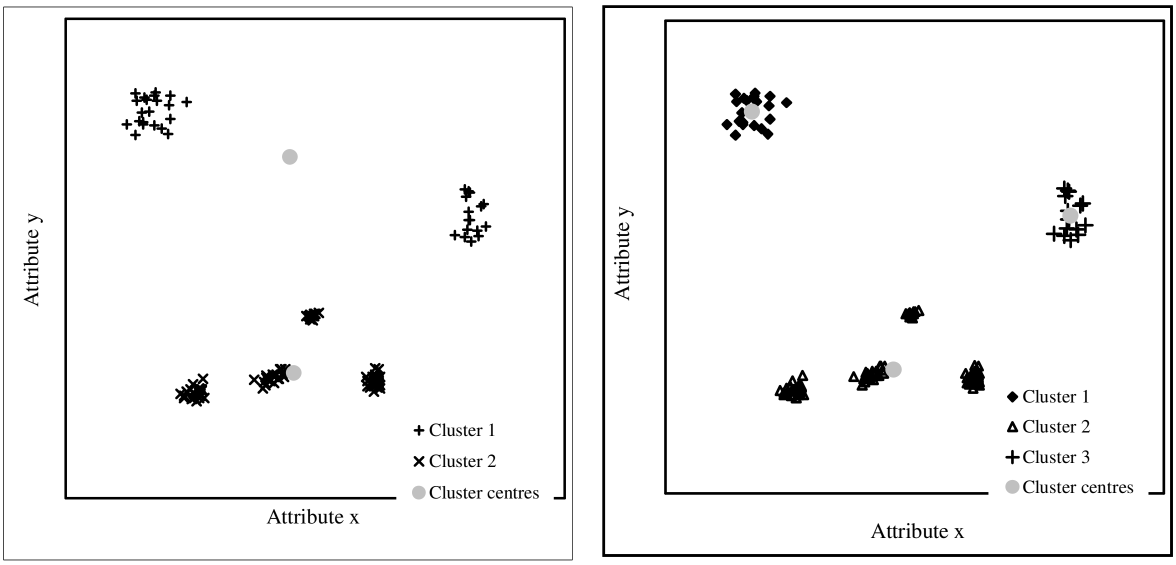

Fig. 2. Graphs showing distribution of a hypothetical data set with clear clustering and the cluster membership of each cluster when two and three groups are designated. It shows the effect of increasing the number of clusters, as the number of clusters increases the total of the distances between each point and their cluster centre is reduced.

Further results of the current analysis are to be published elsewhere with the aim of addressing some aspects of the discard and disposal practices at the site. Trends are only summarised here.

The clustering process was repeated a number of times involving different variables and combinations of variables. Membership of contexts to different clusters was then compared the interpretation of the deposit and type of location. To a certain extent the level of variety recorded in the deposits had to be limited so that relationships between the faunal assemblage characteristics and deposit type could be assessed. Dispersing the data over too many categories using deposit types, location, and other descriptions would mean that it would be difficult to determine patterns were more than just random variation as the number of fully analysed contexts is not sufficient to justify an overly detailed sub-division of contexts.

The following groups were used as a compromise between variability in contexts encountered and the number recorded:

1. Construction materials
2. External midden
3. Midden in abandoned buildings
4. Fill between walls
5. Fill in buildings
6. Burial Fill
7. Fill in cuts other than burial pits
8. Fills and use of features
9. Internal floors
10. Internal occupation debris
11. External occupation debris
12. Fire spots
13. Lime burning
14. Penning deposits
15. Kopal (offsite) deposits

The tables 1, 2 and 3 display some results of the analysis using taphonomic variables, frequencies of main species and skeletal body part representation of bones from sheep sized animals as examples of patterns produced during the analysis of the data from Çatalhöyük and to show how different aspects of faunal assemblages can be used. Many attempts at clustering failed to produce clear positive correlations between deposit types and faunal characteristics. This highlights the high degree of variability in contexts and the lack of defining characteristics suggests that the categories used to group the deposit types were insufficiently detailed given the complicated depositional and taphonomic processes that lead to the formation of the archaeological record.

Table 1. Occurrences of contest membership to different clusters based on the mass of bone per litre excavated deposit, the frequency of worked bone and proportion of bone from sheep sized animals that is 1 or 2 cm in length. All tables only include contexts where over 20 fragments of bone provided the information relevant to the analysis.

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 buildings)		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 deposits		3		4

Table 2. Membership of contexts 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 +++ symbolising 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 ++ Equid +++	Caprine +++ Cattle --- Cervid - Pig - Equid --
Midden (external)	4	2	2	9	1	1	1	12
Midden (in abandoned buildings)	3	2		2				
Fill (within building)							1	3
Fill (between buildingwalls)		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 deposits								

Table 3. Membership of different context 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 buildings)	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 deposits	1	1		1	2		2	

However, there were some indications of the potential for this type of analysis; the data in Table 1 shows how bone deposited in external midden deposits and building fills differed significantly. Worked bone was consistently found in higher proportions in the external midden deposits which also tended to have a greater mass of bone per litre of deposit and lower fragmentation 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 they derive from, fall into clusters with a high percentage of caprine bones. Exceptions to this are KOPAL units, some fill between-wall contexts and a limited number of the midden deposits, especially those that were from abandoned buildings. The clusters are characterised compared to the average for all units so clusters are defined in relation to the representation of the five main taxonomic groups found. This suggested that midden deposits accumulating in different locations might have been used for discarding the bones of species in proportions that were not consistent and further, underlying, causes may have been responsible.

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 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. The portions of the body considered were the skull, axial skeleton, girdle, upper limb bones and lower limb bones. The units grouped into 8 clusters and these are characterised compared to the mass of bone from different skeletal regions in complete modern reference skeleton (Table 3). Midden deposits 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 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.

The Potential of Cluster Analysis in Integrating Data

The capability to group data into clusters based on its attributes, whether dealing with the characteristics of a faunal assemblage or those of the lithic, botanial, ceramic or other finds categories, could certainly be of great advantage in understanding how external variables affect each type of find. For example, the depositional circumstances that created a faunal assemblage with similar attributes may have also have affected the lithics. Once such patterns have been highlighted it is possible to attempt interpretation and determine the cultural and/or taphonomic actions that generated specific types of assemblages. The stratigrapahic record can also be compared to clusters to verify if there is an association between a certain depositional circumstance and the characteristics of remains recovered. There would seem to be a huge potential for this type of analysis to add to the understanding of an archaeological site and the processes that resulted in its formation. The application of the cluster analysis approach at Çatalhöyük has just begun and hopefully future work will progress revealing the full potential of this technique to a site with an immensely complicated stratigraphic record resulting from numerous cultural and taphonomic variations.

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