# Contextual Analysis of the Use of Space at Two Near Eastern Bronze Age Sites

## Analysis of zooarchaeological data: Kilise Tepe 1995-1997

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### 1 Introduction

This report outlines the characteristics of the zooarchaeological data collected from 1995-1997 at Kilise Tepe, in the context of the Leverhulme research project, Contextual analysis of the use of space at two Near Eastern Bronze Age sites. The zooarchaeological study forms part of the much larger project, which combines analyses of plant remains, bones, pottery and micromorphology. The aim of the study was to "recover a statistical characterisation of context type, including household rooms of varying function, streets and open areas, so as to provide a new tool for understanding the anatomy of different settlements" (Postgate n.d.: 3). Preliminary analyses of the zooarchaeological data collected in 1995, 1996 and 1997 were presented in the project's archive reports (Baker 1995, 1997a, 1998).

The study of bone residues at Kilise Tepe stems from work undertaken at Abu Salabikh, Iraq (Matthews et al. 1994; Postgate n.d.). The sampling programme devised by Sebastian Payne (Payne 1986) for bone and pottery residues at this site was used in conjunction with methods developed by members of the Environmental Archaeology Unit (EAU) for the study of collections from York (O'Connor 1991) and applied to collections from Scara Brae and Bahrain (K. Dobney, pers. comm. 1995) and Lincoln (Dobney et al. 1996).

Previous work at Abu Salabikh focused on the quantitative analysis of various archaeological materials (pottery, bone, flint) recovered from a range of contexts, with the objective of defining the use of space and determining the intensity of occupation activities (Payne 1986). In particular, fragmentation and abundance of bone and pottery from private houses, rubbish dumps, craft areas, streets and corridors were quantified and compared, with the objective of identifying "norms" and "deviation from these norms" for the various assemblages (Matthews et al. 1994: 176). The results reveal patterns in fragmentation and abundance between closed and open spaces and between different types of open areas. These data were compared to the microstratigraphy of particular contexts in order to correlate, if possible, fragmentation and abundance with a more detailed picture of depositional events.

The work developed by the EAU in York was stimulated by the need to assess possible preservation biases between assemblages and to identify the presence of residual material in bone samples (O'Connor 1991: 234). Aspects of preservation, angularity and colour were recorded on a subjective scale and the qualitative categories were quantified in an attempt to distinguish between discrete collections and reworked materials.
The sampling strategy employed at Kilise Tepe is reviewed below followed by a detailed description of the method of study and recording procedures for the bone residues.

## 2 Methods

### 2.1 Collection of samples

Various methods were employed in the field for the recovery of zooarchaeological remains. These included recovery by hand, dry-sieving and wet-sieving. Samples for wet and dry-sieving were collected from as wide a horizontal and vertical distribution as possible in order to obtain a generalised representation of the refuse in each deposit class and level. Only the wet-sieved samples are analysed in the context of the Leverhulme-funded project. The volume of the soil samples was established before the field season and was continuously adapted to the range of context types and context size encountered during excavation, and according to logistics of time. In general, a volume of 60-70l was floated; the residue from 10 litres was sieved through a 1mm mesh and the remaining volume through a 3.5-4mm mesh. Only the latter fraction was studied for this research.

### 2.2 Criteria and recording procedure

In the following discussion, the terms bone, remains, fragment or specimen are used to denote both bone and tooth fragments. Various quantitative and qualitative aspects of the bones were recorded in the field on pro-forma sheets (see Appendix 2 to Preface). These included number and weight of fragments, preservation (appearance, angularity, colour), fragmentation and other modifications (e.g. burning, butchery, carnivore and rodent gnawing, modern breakage) of the total bone residues, as well as the zooarchaeological information for identified specimens (e.g. taxon, element, age, sex). The preservation and fragmentation of the remains are assumed to reflect the taphonomic processes that may have affected the material subsequent to deposition, including trampling and possible reuse of refuse and mixing of deposits, in addition to possible exposure to the natural elements (Table 1). An understanding of taphonomic histories of bone is important in any zooarchaeological study in order to avoid misinterpretation of chronological and spatial patterning of the data.

The number and weight of identified and unidentified remains were recorded separately. The identified remains were counted and weighed by taxon and the unidentified remains were quantified and weighed by class and animal size. The preservation and fragmentation variables and other aspects were recorded by animal class, and for mammal remains by size category also, including large mammal (LM; cattle/equid size), medium mammal I (MM1; pig/caprine size), medium mammal II (MM2; hare size) and small mammal (SM; squirrel-mouse size). Two procedures were followed in the analysis of the data. One was to examine the total contents of the samples and the second was to quantify the attributes by animal group. The latter step was performed in order to avoid possible biases due to differences in bone structure and robusticity between animal classes or size groups. In the 1995 and 1996 reports, observations were based on the total samples but possible biasing factors were mentioned, including the influence of body size on the preservation and fragmentation distributions (Baker, Archive report 1997a). In general, only the largest groups were considered, including MM1 and Unidentified mammal. Indeterminate fragments were also considered, as they constitute a large proportion of fragment counts, however their interpretative value is limited, as they may include remains from different taxonomic groups..

The data are analysed by deposit class and chronological level but analysis was not undertaken by horizontal space as defined for Tell Brak (Colledge 1998), nor by different trenches (excavation squares) (Colledge, this archive). It is important to note that the reliability of average values within deposit classes/levels with few samples is questionable, as one unusual sample may produce a marked effect on the average value, which may not be representative of the few other samples in that category. This was observed throughout the study for preservation and fragmentation indices. Multivariate analysis (as in Colledge, this archive; Dobney, this archive) is not used in this study.

2.2.1 Number of fragments, weight and density

The number and weight of bones were recorded for all animal class and size/unidentified groups. The numbers of fragments serve for all analyses of preservation and fragmentation and both numbers and weight are used in the calculation of bone densities by animal groups, deposit class and level. The density of bone in each sample was obtained by dividing the total bone weight or number of specimens by the total volume of soil from which the remains were obtained (g/l and n/l respectively) (Table 1).

2.2.2 Preservation

Different aspects of the bones were recorded in order to qualify and quantify preservation in the various assemblages. These include general appearance (preservation), angularity and colour (Table 1). The data are analysed by relative frequencies (%) of the different categories. Although assessment of these variables involves a certain degree of subjectivity, experiments prior to and after the field season indicated that assessment by two separate researchers was comparable.

- preservation: excellent, good, fair, poor. This aspect is assessed on the basis of the appearance of bone surface and sharpness of bone/tooth edges.
- angularity: battered, rounded, spiky, other (*e.*g. digested, eroded). Straight and sharp edges were recorded as spiky. Uneven, slightly jagged (but not sharp) edges were recorded as battered. Edges that were not sharp, with a slightly rounded rather than uneven edge were recorded as rounded. Erosion and semi-digestion were recorded as separate categories of angularity; although edges appear jagged or rounded in the respective cases, additional criteria suggest that the overall preservation results from distinct taphonomic processes.
- colour: white, fawn, light and dark brown, black, grey, green, ginger. Although fawn coloured fragments generally looked fresh and well preserved, the preservation of very dark fragments could be equally good. In addition, some very eroded bones were light coloured.

2.2.3 Fragmentation

The study of fragmentation was undertaken in order to compare breakage between deposit classes and from this, the intensity of use of particular contexts or site area (Table 1). The size of the remains may be partly dependent on the type and intensity of predepositional activities (*e.g.* butchery) and it may reflect the method of discard also. Breakage patterns by level may also reflect residuality and the degree of disturbance/redeposition. Payne (1986: 8) has suggested that organised removal of particular classes or size groups of refuse may result in a skewed distribution of fragment sizes. Fragment size distributions also serve as a potential indicator of recovery bias between wet-sieved, dry-sieved and hand-collected remains; these data will be assessed in the wider study of zooarchaeological materials from Kilise Tepe.

All fragments under 2cm were grouped and fragments above this size were recorded by intervals of one cm. The data are analysed by relative frequencies of the <2cm group, subsequent intervals of 1cm and the 8cm/> group. This approach was chosen as the results provided by subdividing below two cm probably would not justify the extra time required. Identified and unidentified remains were studied together but the size of the identified elements was recorded separately also for additional analyses.

Although most of the remains consist of tiny fragments unidentified to taxon or element, where possible the elements represented in each animal size group were recorded in order to determine whether bone breakage could be related in part to element type (due to different bone structure and density). Fragmentation patterns (as reflected in length distributions) may reflect discard of different element types; for example, teeth and extremity elements are much smaller than the main limb bones. In addition, bone survival has been shown to be strongly linked to element type and part (differences in size and density) (e.g. Brain 1981; Lyman 1994). Consequently, fragmentation in different context types may reflect the elements discarded in those areas rather than, or in addition to, intensity of activity. MM1 remains are of most interest as they include a relatively high proportion of fragments larger than 2cm and a relatively high proportion of specimens identifiable to element or bodypart. The other animal groups either yielded too few fragments (e.g. LM) or mainly fragments under 2cm (eg. microfauna).

2.2.4 Other aspects

Other aspects including butchery, burning, dog and rodent gnawing and fresh breaks were recorded in order to assess potential predepositional and postdepositional attrition of bone refuse and to control for modern breakage within the fragmentation pattern (Table 1). The alterations are compared, where pertinent, to aspects of preservation and fragmentation discussed above. For example, the incidence of charring and/or calcination is compared to the relative frequency of dark brown/black and grey/white specimens respectively in the various deposit classes (as suggested by K. Dobney/N. Postgate, meeting 24/02/98). The relative frequency of carnivore gnawing and semi-digestion are compared and assessed for all bone and for various animal groups separately. These data may provide information about scavenging patterns and the possible presence of commensal animals (e.g. Davis 1985; Payne and Munson 1985). Rodent gnawing may also indicate exposure of waste and the presence of intrusive animals. Modern damage may influence colour and angularity distributions, with the presence of lighter coloured (fawn) surfaces and straight breaks/edges (spiky).

2.2.5 Recording of identified remains

For the purposes of this analysis, identification to class, and to size group for mammals, was deemed sufficient. A brief discussion of the taxonomic identifications of large mammal and medium mammal size fragments (and a few small mammal size specimens) is provided but these data, and the bird and fish identifications will be examined in much greater detail in a separate study of subsistence and animal use at Kilise Tepe (see also Baker, Archive report 1997b; Van Neer 2000 for fish). Crustacean and microfaunal remains (small mammals, reptiles, amphibia) will be analysed by other specialists at a future date. The information recorded for identifiable mammal remains include taxon, element, age, and where possible sex (and other aspects where present, for example measurements, pathology, butchery). Most of the mammal identifications were made in the field with the aid of reference material on loan from the Ancient Monuments Laboratory, English Heritage (now part of the Centre for Archaeology, Fort Cumberland, Portsmouth), while some specimens were identified in the UK, with the aid of additional reference collections in the Ancient Monuments Laboratory and the Museum of Natural History, London. The fish remains were identified by Wim van Neer (2000).

2.2.6 Presentation of the data: A list of individual samples is provided in Table 4 and sample data for each aspect discussed below may be obtained from Tables 24-26. The data are analysed by deposit class and level and presented in tables and figures for total bone and/or for the larger animal groups/unidentified fractions.

## 3 Samples, deposit class, chronological period

Faunal specimens were recovered from a total of 146 samples. Two of these were grouped with samples from the same contexts, one sample was considered of no value and two samples yielded only 1mm fractions. This report thus focuses on 141 samples, taken from 128 different contexts (in a few cases, more than one sample was taken from the same context) (Table 4). A breakdown by year and context type is provided in Table 2. The context types are presented by chronological period in Table 3. The samples are from five main context types, including structures (2, both of which are Fire Installations), In situ deposits (6) of which three consist of Fire Installation fills (but one may in fact be a structure) and three of room fills, construction materials (61), occupation sequences (27) and pit fills (37). A further eight samples are from miscellaneous undefined contexts (4) and mixed contexts (4). The latter two deposit types are presented in all data tables and graphs but are not discussed in detail. Thirteen samples are of Byzantine date, one is of Byzantine or possibly Late Iron Age date, 86 are from Iron Age contexts and 41 date to the Bronze Age. A total of 56211 faunal remains (c.8000 g.) were sorted and analysed. The volume of sieved soil is 8607.5 litres. Fragment counts and weight are quantified by deposit class and level in Figs. 1 and 2 respectively.

## 4 Relative frequencies of animal groups (including Indeterminate class)

The relative proportion of animal classes and unidentified groups is presented in Tables 5-8 and Figs. 3-4.

Mammal remains account for the largest proportion of bone in all samples (c.70% of total fragments and c.96% of total weight). The mammal remains were divided by size where possible, however the largest proportion of mammal remains is not identifiable to size group (Unidentifiable mammal, c.56% of total fragment counts; c.33% of total weight).

The largest group of mammal fragments identified to size is from mammals of medium artiodactyl size (Medium mammal 1 or MM1; 11% of total fragment counts; 49% of total weight), probably from sheep/goat (and possibly pig), as most of the taxonomic identifications are from these animals (see below, Tables 22-23). Large mammal (LM) remains represent a low proportion of bone counts (1% or less) but c. 16% of sample weight except in unusual samples (see below). Mammals the size of hare or small carnivore (Medium mammal 2 or MM2) and small mammals are rare

(0.3% and 2% of fragment counts). Both categories represent less than 0.5% of total weight.

Bird, reptile, amphibian and fish remains represent less than 0.1% respectively of sample contents (fragments and weight). Indeterminate fragments represent the second largest group of bone by fragment count (c.29%) but only a small proportion of sample weight (c.4%), as all of these consist of very small fragments under 2cm in length (see Fragmentation below).

**5 Bone density**

Bone density estimates may reveal differences in the amount and type of bone waste originally discarded in different deposit classes, or cleared from these areas, and/or in the intensity and type of use of different areas. Density by level may reveal differences in discard practices or preservation through time.

5.1 Bone density by deposit class: Density based on number of fragments (N/l) and weight (g/l) is presented in Tables 5-6 and illustrated in Figs. 5-8.

The average density of bone, based on number of specimens and weight, in structures, construction materials and occupation sequences is consistently below the total average (Fig. 5); correspondingly, the density of the more common groups, unidentifiable mammal, indeterminate and MM1, as well as large mammal, are invariably below the total average (Figs. 6-8; Tables 5-6). Fire installation fills yield densities (n/l and g/l) above the average values, due mainly to the presence of sample 96/01 (Tables 4, 24). Room fills show greater variability between the two values; while the density based on bone counts is high, density based on weight is just slightly higher than the total average, which is probably due to sample 97/34 and the high proportion of indeterminate fragments in it (Tables 4, 24). The bone density in pit fills (n/l and g/l) is slightly higher than the total average, and the density of unidentifiable mammal, MM1 and LM are above the average values. For the other less abundant classes, the following observations are of interest: the above average densities of bird, fish, amphibia and small mammals in pit fills, the above average densities of small mammals and reptiles in construction materials, and of crustacea in occupation sequences (Table 5).

5.2 Bone density by level: Density based on number of fragments (n/l) and weight (g/l) is listed in Tables 7-8. Density of fragment counts is illustrated in Figs. 9-12.

The density based on total fragment counts is highest in Bronze Age levels followed by Iron Age and Byzantine levels. Density based on weight is highest in Iron Age levels and lowest in Bronze Age levels (the densities in Iron Age and Byzantine samples are in fact very similar). The density (n/l) of the largest groups, including Unidentified mammal and Indeterminate class show a decrease from the Bronze Age to Iron Age (and a further decrease in the Byzantine period for Unidentified mammal and MM1) (Figs. 9-12; Table 7). The weight densities show a broadly similar pattern for Unidentified mammal and Indeterminate group but an increase for MM1 (Table 8; Figs. 9-12). The densities of bird and fish show a clear increase through time (n/l and g/l). There is no clear pattern of change in overall densities or densities of Unidentified mammal, MM1 or Indeterminate class (n/l or g/l) between levels within the Bronze Age and Iron Age. Within the Bronze Age, the density based on fragment counts and weight is highest in the Early Bronze Age levels (Level 8); the high proportion of Indeterminate fragments in Level 8 deposits is probably influenced by sample 97/34 (Tables 4, 24). Densities (n/l and g/l) within the Iron Age are highest in the Late Iron Age levels (Level 2f-h).

5.3 Summary and discussion: The total average for bone density based on number of fragments and weight is 6.4 fragments/l and 0.9g/l respectively. Pit fills, Fire installation fills and miscellaneous deposits consistently show higher than average densities for total bone counts and weight. Room fills yield the highest density for total bone, based on fragment counts, but a lower density based on weight. The fire installation structures, construction materials and occupation sequences have lower than average bone densities (n/l and g/l).

The relatively high density of bone in pits may be explained in various ways. More bone waste may have been disposed of in pits, as these would have constituted convenient rubbish disposal areas. Alternatively, bone may have been better protected in pits and consequently survived in greater numbers. It is also important to note that the density of large mammal remains is high in pit fills (see below), which influences the overall weight density value; however, the fact that pit fills also yield above average densities of MM1 and unidentified mammal remains suggests that a real difference exists between pit fills and other context types. The density of fish and bird remains in pit fills is above the average, perhaps reflecting deliberate discard of such waste (at least in the case of fish) away from living areas and/or to better preservation of these more fragile remains. The density of small mammal and amphibia remains is also higher than the average but that of reptiles is slightly lower than the average. Small mammals and amphibians may have become trapped in pits (as suggested by K. Dobney, meeting 24/02/98), while reptiles easily scale vertical surfaces.

Selection processes during the fabrication of building materials may explain the low densities in fire installation structures and construction materials. Large pieces of bone may have been deliberately selected out of the soil matrix; in fact, the density (n/l) of LM bone is lowest in these deposit classes and in room fills (see below and Table 5). Alternatively, or in addition, perhaps the process of making building materials further reduced fragment numbers and/or size, either deliberately through pounding or accidentally through reworking of fragments (see also Fragmentation below). It is interesting to note the much higher than average proportion of small mammal and reptile remains in construction materials. Some of these may be from animals which lived within or frequented buildings during their use, but it is also possible that they found refuge within abandoned or partially destroyed buildings; the remains of microfauna may have been present in the soil matrix used for building materials also.

The low densities of total bone and of most animal groups in occupation sequences may reflect "house cleaning". Intensity of occupation, use and cleaning may have reduced bone density in these areas compared to the more protected pit fills. Large waste may have been deliberately cleared away from living areas, as suggested by the below average density of LM (Table 5). It is interesting to note that although the density of MM1 is similar to the average, MM1 represents a higher than average proportion of total bone in occupation sequences; this may reflect the relative importance of medium artiodactyl in the settlement diet. Smelly waste, such as fish remains may have been cleared away from the living area also, or perhaps the finer fish bones were broken down by trampling or consumed by scavengers (see below for scavenging and evidence of semi-digested bone). In contrast, crustacean remains are noticeably more common in occupation sequences than in other deposit classes. These small remains are relatively robust and strong and may have survived trampling to become embedded into living floors. The relative scarcity of microfauna may reflect the more intense occupation activity and maintenance of the living area.

The small number of samples from both fire installation fills and room fills impedes a clear understanding of distributions in these deposit classes. Fire installation fills include a high proportion of LM remains, due mainly to sample 96/01, which includes many fragments of LM horncores. Room fills are characterised by an overwhelming presence of indeterminate fragments in comparison to all other deposit classes, due again to one unusual sample.

Analysis by level shows that total bone density (n/l) and density of Unidentified mammal and Indeterminate Class show a decrease through time, but neither n/l nor g/l show a clear pattern of change between individual levels. The LM and MM1 data (n/l) also show an overall decrease, although densities are highest in the Iron Age. The higher than average density of fish and bird remains in Byzantine samples may reflect their importance in the Christian diet or the effects of sample sizes and deposit classes. Three of the five Byzantine pit fills yielded the highest fish densities recorded for all samples in this study and two of these yielded high bird bone densities.

Similarly, the density of animal groups, including the unidentifiable material, in the Iron and Bronze Age deposits appears to be influenced by the relative frequency of the deposit classes and/or by a few unusual samples in each period or phase. The high density of LM in Iron Age samples is due mainly to the presence of sample 96/01, but it may also reflect the greater number of samples from pit fills and the high LM densities in three of these. The above average density of unidentifiable mammal and indeterminate fragments in Bronze Age levels is influenced by four samples with unusually high densities of these groups (Level 6: Construction materials, 96/17; Level 8: Occupation sequence, 97/29; Level 8: Room Fill, 97/34; Level 8: Miscellaneous deposit, 97/16).

## 6 Preservation, angularity and colour

### 6.1 Preservation and angularity

The preservation and angularity data are summarised in Tables 9-10 and illustrated in Figs. 13-28. In most samples, the highest proportion of bones shows fair to poor preservation. These categories make up an average of 21% and 68% respectively of total bone preservation. The pattern of preservation categories is borne out by the study of bone angularity. A high proportion of the bone residues are battered and rounded (average values of 66% and 17% respectively of total bone). The average relative proportion of spiky fragments is 17%; less common conditions include semi-digestion (0.4%) and erosion (0.1%). Preservation and angularity characteristics vary widely between animal groups and are discussed first; variation by animal group (including Unidentified mammal and Indeterminate remains) is also considered in the analysis by deposit class and level.

6.1.1 By animal group: The total average of poor preservation for Unidentified mammal remains is c.80%, while 16% of specimens show fair preservation. Consequently, over 95% of unidentifiable mammal remains shows poor to fair preservation, very few show good preservation (4%) and less than 1% show excellent preservation. Indeterminate fragments also constitute a high proportion of samples and include a relatively high proportion of remains showing poor and fair preservation (69% and 22% respectively of total bone) (Figs. 15, 16; 23-24).

The preservation of remains identified to animal Class or size group is generally better, with a lower proportion of poorly preserved remains and higher proportions of fair to excellent preservation. Microfaunal remains generally show a high proportion of good to excellent preservation. Bird and fish remains also show relatively high proportions of good to fair preservation. Medium mammal 1 remains include a relatively high proportion of bones showing fair (40%) and poor preservation (29%) while specimens showing good or excellent preservation account for c.22% and 9% respectively of preservation states (Figs. 14, 22).

The relative frequency of the angularity categories varies between animal groups also. Unidentified mammal remains show a high proportion of battered and rounded specimens (average proportion of 68% and 23% respectively), which consist in large part of small fragments of cancellous bone. Indeterminate fragments also include a high proportion of battered fragments (73%) and also spiky fragments (20%), possibly from small mammals, birds, and other microfauna, as well as mollusca and crustacea. Rounded fragments are much less common (6%) in the Indeterminate category (Figs. 19, 20, 27, 28). The remains of microfauna, bird, fish and crustacea include high proportions of spiky fragments. The MM1 remains show high proportions of battered fragments (53%). MM1 and MM2 remains show the highest proportion of partially digested fragments, while these modifications are absent on bones of other Classes (Figs. 18, 26).

6.1.2 By deposit class: Pit fills and room fills include above average proportions of excellent and/or good preservation, but also above average proportions of poorly preserved remains. Occupation sequences yielded a higher than average proportion of specimens showing good and fair preservation while poor preservation is similar to the average. The relative frequency of excellent and/or good preservation in construction materials and fire installation fills is below average (Figs. 13-16). The fire installation fills were particularly badly preserved, due again to the large sample size and poor preservation of 96/ 01 (Tables 6, 25).

The relative frequency of angularity for total specimens closely mirrors the preservation values (this is not surprising as preservation is assessed in part by the state of the bone edges) (Fig. 17). Pit fills and room fills include higher than average proportions of spiky fragments, while structures, construction materials and fire installation fills include below average proportions of spiky specimens. The data for occupation sequences compare to the average value. The proportion of rounded specimens is particularly high in fire installation structures but this deposit class only includes two samples with few specimens in each, thus the distribution may not be as reliable as in larger classes. The fire installation fills include a high proportion of battered specimens. Interestingly, in addition to the high proportion of spiky fragments, pit fills include an above average proportion of rounded fragments.

These patterns may reflect, to some degree, the relative proportion of different animal classes in each (see above), however, the more common groups, Medium mammal 1, Unidentified mammal and indeterminate fragments, closely mirror the overall preservation and angularity patterns, except in the smallest deposit classes (e.g. structures) (Figs. 18-20).

Additional categories of angularity include erosion and semi-digestion. The relative proportion of eroded fragments in construction materials and pit fills is higher than the average, while occupation sequences have a lower proportion of eroded fragments. Erosion is absent in other deposit classes. The presence of semi-digestion was observed in all deposit classes except fire installation fills and structures. The relative frequency of this modification is highest and above average in pit fills and occupation sequences, and below average in all other deposit classes (Figs. 17-20).

6.1.3 By level: The data for total bone suggests that preservation is poorest in the Bronze Age samples, and improves slightly in the Iron Age and Byzantine levels; this pattern is reflected somewhat by the Unidentified mammal fragments, while MM1 shows the opposite pattern (Table 10; Figs. 21-24).

The Byzantine samples include a higher than average proportion of fair preservation, below average proportion of poor preservation and proportions of good and excellent preservation similar to the average. The large individual groups of Unidentified mammal and Indeterminate fragments show a broadly similar distribution, with above average proportions of fair preservation but some variation between the other preservation states.

In Iron Age samples, the relative frequency of poor, fair and good preservation is similar to the average (excellent preservation is below the average). The unidentified mammal and MM1 fragments show a similar distribution, while the Indeterminate group shows slightly better preservation. The variation between Early, Middle and Late Iron Age levels suggests that preservation improves in the more recent levels; this is evident in the total bone data and with some variation for MM1, Unidentified mammal and Indeterminate groups (when only distinct levels are considered, i.e. Levels 2, 3 and 4).

In Bronze Age levels, the relative proportion of poor and excellent preservation is above average and higher than in Byzantine or Iron Age levels. The Indeterminate Class and Unidentified mammal groups include above average proportions of poorly preserved remains and below average proportions of good preservation (and fair preservation for Unidentified mammal). MM1 includes higher than average proportions of good and excellent preservation and lower than average fair and poor preservation. There is considerable variation between Bronze Age levels, although there appears to be an overall increase in excellent, good and fair preservation for total bone and the larger groups, from the Early to Late Bronze Age. MM1 shows a less clear trend.

The angularity data show that Byzantine samples (Table 10; Figs. 25-28) include a below average proportion of battered remains, and higher than average proportions of rounded and spiky fragments. The large groups of Unidentified mammal and Indeterminate fragments yield a broadly similar pattern while MM1 shows the opposite distribution. The proportion of eroded specimens of MM1 and Unidentified mammal is much higher in Byzantine samples than in other levels.

The Iron Age data are broadly similar to the average values. The individual groups of Indeterminate, Unidentified mammal and MM1 fragments also compare to the average values for each group. It is interesting to note the higher than average proportion of semi-digested specimens in these samples. There is no clear variation between levels of the Iron Age, for the larger groups.

In the Bronze Age deposits, the proportion of battered, rounded, semi-digested and eroded specimens is below or similar to the average and that of spiky specimens is above average. For the largest groups (MM1, Unidentified mammal, Indeterminate), the pattern is similar. The relative proportion of rounded MM1 and Unidentified mammal specimens is similar to the average, but higher than in Iron Age samples. The Bronze Age deposits do not show a clear pattern of change in angularity of total bone or individual animal groups between phases, although there is an overall increase in rounded specimens (for MM1, Unidentified mammal, Indeterminate), and an increase in spiky fragments and decrease in battered specimens for Unidentified mammal and MM1, in the later levels.

6.1.4 Summary and discussion: Differences in preservation were noted between animal groups. Some of these differences may be due to differences in bone structure as well as to taphonomic pathways. For example, the good preservation of microfaunal remains may reflect the intrusive nature of at least some of these or protection from trampling, scavenging and reworking. The preservation and angularity states of bird and fish remains may reflect bone structure of these classes (e.g. Nicholson 1996: 526; Jones and Wheeler 1989: 63). For example, when fish bone degrades, it may split or crack and crumble (Nicholson 1996: 527); attrition strong enough to "round" larger mammal bone, may result in increased splitting of fish bone into spiky or jagged pieces, or complete destruction, but the bones would not become rounded, unless perhaps those of very large fish. Remains of LM and MM1 were probably exposed to trampling, cleaning and clearance to open areas and scavenging by dogs and show high proportions of battered fragments. The presence of semi-digested bone fragments of MM1 and MM2 but not of other animals may be explained by the fact that bones of birds and smaller animals (squirrel size) and fish may be completely destroyed by chewing or digestion while bones of larger mammals survive these processes in greater numbers (Payne and Munson 1985; Jones 1984; Davis 1985).

The data suggest that differences in preservation exist between deposit classes, however there is considerable variation within and overlap between these. The good preservation in pits may reflect regular discard of fresh waste into these convenient spaces. The presence of an above average proportion of rounded specimens is also noteworthy and suggests that old, possibly reworked waste may have been discarded in pits also. The presence of a relatively high proportion of semi-digested fragments suggests that faeces were cleared away from living areas and dumped into these spaces. The bone waste in occupation sequences was probably exposed to a high incidence of weathering, trampling or other attritional activity, resulting in a high incidence of battering. Perhaps also, old waste was used to form new occupation surfaces. Spiky fragments are relatively common in occupation sequences and perhaps result from freshly broken bone. The presence of semi-digested remains in occupation sequences suggests that faeces became incorporated into the occupation build-up layers. The presence of well-preserved and spiky fragments in room fills is intriguing. Perhaps this reflects the use of fresh or undisturbed waste material as fill, upon which new "occupation" surfaces formed. The poor preservation of construction materials (including fire installation structures) suggests that these include redeposited waste (reworking, re: K. Dobney, meeting 24/2/98); alternatively, or in addition, the bone inclusions may have been battered repeatedly during retrieval of soil and preparation of mud bricks. In the case of fire installation fills, the hearth contents may not have been trampled or reworked and the incidence of battering may reflect the uneven broken edges of calcined and charred bone rather than attritional process. In addition, the severe or prolonged attrition which might result in rounding of bone may have destroyed the burnt remains, perhaps due to differences in fragility between non-burnt and highly burnt bone, for example. In the case of sample 96/01, the burnt remains were very friable.

The distribution of preservation categories is broadly similar between levels. The most striking difference is the relatively high proportion of eroded specimens in the Byzantine levels. Erosion is most common in the 1995 bone residues (see also Baker, Archive report 1995), suggesting that the modification may be related to proximity to the ground surface and possibly water percolation or root action. Battering and rounding of total bone are relatively more common in Iron Age samples than in Bronze Age deposits, but the pattern for different animal groups varies from this and the differences between the two periods are slight. K. Dobney suggested (meeting 24/02/98) that the poorer preservation (and higher frequency of battering?) of later materials at Tell Brak may result, in part, from the reworking of earlier materials.

**6.2 Colour**

The colour data are presented in Tables 9-10 and illustrated in Figs. 29-32. Only the distributions for total bone and MM1 are illustrated, as the patterns are broadly similar for total bone and the larger groups. In general, the highest proportion of bone residues is of a light orange-brown colour. This category makes up 65% of colour in the total residues. Fawn coloured specimens and black specimens are the next most common colours (7% and 9% respectively), while other colours are less frequent. Very rare colours include ginger and green; the latter is present only in one sample from a deposit of construction materials (Bronze Age).

6.2.1 By deposit class: It is interesting to note the higher than average proportion of fawn coloured specimens in pit fills and room fills (and more variably for Occupation sequences), for total bone and the larger animal/size groups. Perhaps the higher proportion of light coloured specimens in pit fills is related to better preservation of the remains in general, to the incorporation of fresh waste and/or possibly to a lack of reworking.

The fills of fire installation fills are distinctive by the high proportion of black, grey and white specimens. This reflects, for most animal groups, the high frequency of burnt specimens in these deposits (see Burning below). The fire installation structures themselves also include a relatively high proportion of white specimens, perhaps consisting of small calcined fragments, which were caught in recesses or were part of the structures themselves. Other deposit classes show a broadly similar distribution of grey (4%-5%), black (7%-8%) and white specimens (c.2-4%). Burnt waste from hearths may have been incorporated into occupation surfaces through trampling (or deliberate spreading?), dumped into pits to cover noxious waste and perhaps used in construction materials.

6.2.2 By level: The colour distribution by level shows that fawn coloured specimens are much more common in Byzantine levels than in earlier deposits, for total bone residues and for the larger animal/size groups. Perhaps this reflects a lack of reworking, or differences in depositional environment. The data also show that light colours, including fawn and light orange brown, are relatively more common in Bronze Age deposits than in Iron Age deposits. The latter, in contrast, include a higher proportion of black, grey and white specimens, reflecting the presence of all but one (Byzantine) of the fire installation fills or structures, and the high frequency of burnt remains in these deposits (see Alterations below). This reduces the relative proportion of the other categories. Ginger specimens, although rare, are also more common in Iron Age deposits while green specimens are present in one Bronze Age sample only.

**7 Fragmentation**

The fragmentation data are presented in Tables 11-19 and illustrated in Figs. 33-38. Fragment length and average weight/fragment, of total bone and of MM1 were used as indices of fragmentation. Fragment length of MM1 remains was also analysed by element groups.

**7.1 By deposit class**

7.1.1 Weight/fragment: Fragment weight (g/fragment) is highest in fire installation fills, due to the presence of sample 96/01, which has a high proportion of large LM fragments (Table 11; Fig. 33). Structures and pit fills also yield higher than average weight/fragment values. Room fills and construction materials yield lower than average values. Weight/fragment in occupation sequences is similar to the average. The pattern appears to reflect, in part, the relative proportions of Indeterminate and Unidentifiable mammal remains in the different deposit classes, i.e. as the proportion of total unidentified remains increases, the overall weight/fragment decreases (e.g. as in construction materials and room fills, Fig. 3). These variables behave in an unusual fashion in fire installation fills, which despite having a high proportion of unidentified remains (and fragments under 2cm), also give the heaviest weight/fragment; this is due to the presence of a relatively high proportion of heavy LM fragments, which markedly increase the overall weight/fragment.

The pattern of fragment weight of MM1 follows a roughly similar pattern to that of all bone. Fire installation fills and pit fills yield the heaviest fragments, while structures and construction materials yield the lowest values. Room fills and occupation sequences give values similar to the average. The behaviour of structure fragments is unusual; in this case, the weight/fragment is low but the relative proportion of fragments over 2cm is higher than in all other deposit classes. The sample size is very small and the data may be less reliable than for other deposit classes.

7.1.2 Fragment length (cm): The proportion of fragments under 2cm is highest, and above average, in room fills, followed by construction materials (Table 13; Figs. 35-36). Fire installation structures and fills yield the lowest values, and pit fills and occupation sequences yield slightly lower than average values also. The proportion of fragments under 2cm is related closely to the proportion of Unidentified mammal and Indeterminate fragments in the various deposit classes (see above). The Indeterminate category is particularly high in room fills, fire installation fills and construction materials. The distribution of fragment length of MM1 is similar to the above pattern. Construction materials and occupation sequences have above average proportions of fragments under 2cm, while the other deposit classes include below average proportions of these small fragments.

7.1.3 Element type: Fragmentation of MM1 elements shows that 91% of teeth or tooth fragments and c. 80% of carpals, tarsals and phalanges (or fragments of these) are under 2cm in length (Table 15). Rib and vertebral fragments also include high proportions of fragments under 2cm (64% and 77% respectively), while longbone and cranial remains include 58% and 55% respectively (Table 8). The distribution of MM1 elements by deposit class shows little variation (1-3%) and it is unlikely that this has a bearing on overall fragmentation patterns (Table 16). Fragmentation of the more common element groups shows some interesting variations by deposit class. Pit fills consistently include lower proportions of fragments under 2cm for almost all element groups than in most other deposit classes. In contrast, construction materials and occupation sequences tend to include above average proportions of fragments under 2cm for the same element groups. The data from the deposit classes with low MM1 counts (e.g. Room fills, Fire installation fills) do not show clear patterns (Table 18).

**7.2 By level**

7.2.1 Weight/fragment: The overall fragment weight and that of LM, MM1 and Unidentified mammal is lowest in Bronze Age samples followed by Byzantine and Iron Age levels (Table 12). In contrast, Indeterminate fragments have the lowest fragment weight in Iron Age samples followed by Byzantine and Bronze Age samples. The distinct Iron Age phases (2, 3, and 4) reveal an increase in fragment weight for total bone and MM1 separately. There is no clear trend between Bronze Age phases.

7.2.2 Fragment length (cm): The proportion of fragments under 2cm for total bone and MM1 is highest in Bronze Age samples and lowest in the Byzantine samples (Table 14; Figs. 37-38). There is considerable variation between levels however. The Early and Late Bronze Age levels (Levels 8-9, 6) yielded a higher proportion of small fragments than the Middle Bronze Age level (Level 7), for all bone, although the pattern for MM1 varies from this. For Iron Age deposits, there is no clear pattern although the MM1 fragments show a decrease in size in the later levels (2 and 2/3).

7.2.3 By element type: There are relatively more cranial, horn, limb and rib fragments in the Byzantine levels than in Iron or Bronze Age samples, which might influence fragmentation patterns (Tables 15, 17). However, for most MM1 element types, the proportion of fragments under 2cm decreases from the Bronze Age to Byzantine levels, reflecting the overall pattern described above for MM1 (Table 19).

7.3 Summary and discussion: The fragmentation study shows that fragments are generally larger in pit fills and structures and smaller in construction materials, occupation sequences and room fills. The relative proportions of the different bone groups influence fragmentation patterns. In particular, as the proportion of small unidentified remains (Unidentified mammal and Indeterminate) increases, so does the relative frequency of the 0-2cm fragment category. Fragmentation of total MM1 remains and of the MM1 specimens divided by element type shows broadly the same pattern as total samples however, suggesting that fragmentation reflects differential attrition and not only sample composition (i.e. animal groups and MM1 elements).

The presence of a higher proportion of small fragments in general, and of MM1 elements in particular, in construction materials, may reflect inclusion of finer materials, whether deliberately or accidentally and removal of large bone scrap from soil used in mudbricks. The presence of a high proportion of small MM1 fragments in occupation sequences may reflect the effects of trampling on earth-beaten floors, weathering (and increased fragility) in open areas and clearance of larger waste to border areas or away from the living area. In contrast, fragments in pits would have been less exposed to attrition and weathering and pits may have been filled with the larger waste cleared from living areas. Fire installation fills show a much lower proportion of small fragments than in room fills and other deposit classes, perhaps reflecting survival of many larger specimens (in particular horncore fragments).

The data for total bone residues by level suggests decreasing fragmentation from the Bronze Age to Byzantine levels. This may be influenced by the relative frequency of different animal groups, in particular of unidentified (including mammal and indeterminate class) remains, which constitute a higher proportion of samples from Bronze Age deposits, followed by Iron Age or Byzantine deposits. However, the MM1 fragments identified to element also show greater fragmentation in the early deposits. It is possible that distribution of samples by deposit class, within levels, influences these trends. Bronze Age levels, in particular Late and Middle Bronze Age levels, include a higher proportion of samples from construction fills and occupation sequences than Iron Age or Byzantine levels, while the high fragmentation of MM1 in Late Iron Age deposits may be influenced by sample 95/06 (pit fill), which is highly fragmented.

## 8 Other Alterations

In addition to preservation and fragmentation, other alterations observed on the faunal specimens, including butchery marks, burning (charring and calcination), carnivore and rodent gnawing, were recorded (Tables 20-21; Figs. 39-52). These data provide additional information about the taphonomic history of the bone residues.

### 8.1 Butchery

Evidence of butchery was observed on few specimens overall (0.1%), probably due to the small size of most of these. Large mammal specimens show the highest incidence of butchery (c.1.6%) which probably reflects carcass size and intensity of processing, as well as perhaps larger fragment size. MM1 remains show traces of butchery on 0.5% of remains. In all other groups, such modification was observed on less than 0.5% of fragments. The small mammal remains, which may include squirrel, show few marks.

Butchery traces are most common on MM1 specimens from pit fills (Table 20; Fig. 39). This may reflect better preservation of bone surfaces and/or greater specimen size in these deposits. If fresh waste was discarded in pits and subsequently protected from scavenging, weathering and reworking, traces of butchery, if present, would be more readily identifiable. Room fills and occupation sequences show the next highest frequency of butchered MM1 remains. Structures and construction fills show the lowest frequencies, perhaps reflecting poor preservation and smaller size of specimens in these deposits.

The total bone and MM1 distributions show a decrease in butchery from the Bronze Age to Byzantine period, although for MM1, butchery traces are most common in Iron Age samples. Perhaps the greater overall frequency of butchery traces in Iron Age deposits reflects the greater proportion of bone residues from pit fills in the later levels and their corresponding characteristics of better preservation and greater fragment size.

Butchery may also vary by element type but distribution of MM1 element types does not vary markedly by deposit class, suggesting that this would not account for differences in butchery frequency. There does not appear to be a clear pattern of element distribution and butchery frequency by individual level either.

**8.2 Burning**

Burning was observed on c. 14% of the total assemblage (Tables 20-21). The mammal remains (LM, MM1, Unidentified mammal) show a much higher relative proportion of burnt remains than microfauna, fish or bird remains. This may reflect the disposal and burning of larger waste in fires, the use of larger bone as fuel or the greater survival of the more robust mammal remains. It may also reflect the greater frequency of cooking by roasting, although this would result in the burning of exposed ends of bone and not of the entire specimens; only a few specimens show such modification. The relative frequency of burning, however, probably does reflect the greater overall consumption of mammals and resulting amount of MM1 and LM bone waste, which was deliberately or accidentally burnt. The presence of a few burnt remains of microfauna suggests that the carcasses of such animals may have been occasionally disposed of in fires or possibly that some animals were trapped and burnt during house fires.

The relative frequency of burnt specimens (charred and/or calcined) is highest in fire installation fills and above average in the fire installation structures themselves (Table 20; Figs. 41-42). It is above average in occupation sequences also, perhaps reflecting the spread and incorporation of burnt remains from fire installation fills into occupation surfaces. Evidence of burning is rarer in pit fills, construction materials and room fills. The presence of a few burnt small mammal, reptile and amphibian remains in construction materials may indicate burning *in situ* of intrusive animals.

Burning is most common in Iron Age levels (17.4%) and lowest in Bronze Age levels (8.2%) (Table 21; Figs. 43-44). The Iron Age data are probably influenced by sample 96/01 from a Fire Installation, which is almost entirely burnt. There is no clear pattern of variation between phases of the Bronze or Iron Age.

Comparison of the incidence of burning with colour distribution shows a very clear correspondence between the frequencies of charred/calcined fragments and black, dark brown, grey or white coloured fragments for all animal groups. The higher the incidence of burning, the higher the frequency of these colours. This is most striking for fire installation fills and structures (Tables 9, 20; Figs. 41-42).

**8.3 Carnivore gnawing**

Carnivore gnawing was observed on a low proportion of LM, MM1, MM2 and Unidentified mammal remains. The bones of smaller taxa, such as birds, fish or small vermin, if scavenged by dogs, may have been completely destroyed (e.g. Payne and Munson 1985) (Tables 20-21; Figs. 45-46).

The incidence of carnivore gnawing is infrequent in all deposit classes (average 0.1%). Pit fills yielded the highest relative frequency of carnivore gnawed specimens (0.3%), followed by occupation sequences and construction materials (0.09% respectively). MM1 and Unidentified mammal specimens vary slightly from this. The greater incidence of carnivore gnawing in pit deposits may be related to the presence of larger fragments and to better preservation of bone surfaces on which such traces might be visible.

Carnivore gnawing is most common in bone residues from Iron Age deposits (0.12%) and least common in Bronze Age deposits (0.06%) (Table 21; Fig. 46). The MM1 specimens show a similar pattern. Semi-digested remains are also relatively more common in Iron Age deposits (total bone and MM1 specimens, see above). Perhaps more bone waste was exposed to scavengers during Iron Age occupation; or perhaps dogs were more common in the Iron Age. The relative proportion of *Canis sp*. specimens is much higher in Iron Age deposits than in Bronze Age ones but the relative frequencies are based on very low bone counts (N=6/26.7% and N=2/1.7% respectively; see Taxonomy below). Davis (1985) discusses how the greater incidence of digested specimens may reflect an increase in dog keeping from the Natufian period in Israel. Perhaps the variation reflects deposit classes, as a greater proportion of the Iron Age samples are from pit fills and other deposit classes, while Bronze Age samples are largely from construction materials. There is no clear variation for total bone between phases within the Bronze Age, while the Iron Age samples show a decrease from the earliest to latest levels. MM1 does not show a clear pattern.

### 8.4 Rodent gnawing

Rodent gnawing is extremely rare (average 0.02%) and is most common in room fills (0.06%) followed by construction materials (0.04%) (Table 20; Fig. 47). Traces are present on few MM1 specimens in room fills, pit fills and construction materials and on a few Unidentifiable mammal remains from construction materials only. Rodent gnawing is most common in Bronze Age deposits (0.04%) and absent in Byzantine samples. Small mammal remains are also relatively more common in Bronze Age than Iron Age deposits (Table 21; Fig. 48).

### 8.5 Fresh breaks

Approximately 14% of total bone shows fresh breaks. Fire installation fills (18.8%), structures (16.7%), and occupation sequences 17.4%) show the highest incidence of recent damage followed by construction materials (13.5%), pit fills (12.2%) and room fills (8.6%). Individual groups (e.g. MM1, Unidentifiable mammal Indeterminate) differ slightly from this pattern. Miscellaneous and mixed deposits both show a relatively high occurrence of fresh damage, suggesting perhaps that these were less carefully excavated than well preserved or more readily identifiable deposits. Alternatively, the material in these deposits may have been more fragile due to poorer preservation and thus more easily broken; fresh damage and preservation, however, do not show an obvious correlation for all deposit classes. There is no obvious correlation between the relative frequency of fawn coloured specimens and fresh breaks in the samples.

The Iron Age levels show the highest frequency of fresh breakage (15.2%) and Bronze Age deposits the lowest (12%). The relative frequency of breakage in Byzantine levels compares to the average.

## 9 Taxonomic identifications

The identified specimens are listed in Tables 27-28. The distribution shows that caprine and caprine size specimens make up over 89% of identified remains. Cattle and large mammals constitute c. 2% and pigs c. 7%. Other taxa account for less than 2% of the samples. Quantification of just the main taxa, caprines, cattle and pigs varies little from the above. Goat remains are more common than sheep in a 1.3:1 ratio (56% and 44% respectively of total identified sheep and goat specimens). This is reflected in the ratios determined for the much larger assemblage of non-sieved remains (Baker Archive report 1997b).

There is little variation between the more common deposit classes (and larger samples) (Table 27). Pig remains are most common in pit fills, followed by occupation sequences and construction materials. Distribution by level also reveals little variation. Caprine and caprine size specimens make up c. 90-91%, cattle/large mammal constitute 0-2% and pigs 7-9% of total Bronze Age, Iron Age and Byzantine samples (Table 28). Other taxa make up a very low proportion of the samples. A few dog specimens were recovered but these make up a low proportion of the identified samples (6% and 2% of Iron Age and Bronze Age remains respectively). The large felid metapodial from an Iron Age pit fill is of interest. The specimen is similar in size and shape to that of modern lion and slightly less so to that of tiger (comparison to reference collections at the Natural History Museum, London and Ancient Monuments Laboratory, English Heritage, Fort Cumberland).

## 10. Summary and Discussion

The aim of the wider project regarding the "use of space" was to devise and test various measures that might inform on the density, type and degree of attrition of bone (and plant remains) in different deposits, as a means to understanding site activity in different chronological periods. The data presented and discussed in this report will be integrated with the plant and ceramic remains from the same site, and compared to data from Tell Brak, in a second stage of project publication.

The data suggest that broad differences exist between the types and modifications of waste in different deposit classes, which may be attributable to original discard practices but more probably to post-depositional processes. The most marked differences may be observed for well-defined contexts such as pit fills or fire installation fills. The data for deposits which represent a palimpsest of materials, such as occupation sequences, or deposits of possibly reused waste (construction materials) show less distinct patterns, while data for categories of deposit class with few samples are difficult to interpret. It is improbable that the data reflect the original activities undertaken in various context types; certain aspects are suggestive of house cleaning rather than distinct pre-depositional activity. The main observations for each of the variables are reviewed briefly below and interpretation of the data, already explored in each sub-section (see above), is summarised.

Bone density is above average in pit fills, fire installation fills and room fills. Construction materials and fire installation structures yield the lowest deposits while occupation sequences place between these values. The high density of bone in pit fills may reflect greater discard or protection of waste in pits; the greater density of fish and bird bones in pit fills would support preferential discard (e.g. smelly waste) and differential preservation. Conversely, bone may have been selected out of construction materials or removed from occupation floors, or broken down and destroyed through trampling, pounding or reworking.

The distribution of animal groups also varies by deposit class and appears to reflect a combination of discard practice and other formation processes. For example, the above average frequency of MM1 (and LM) in pit fills, and of MM1 in occupation sequences, may reflect the preponderance of this size group in site diet; the above average density of reptile and small mammal remains in construction materials, may result in part from intrusive animals or animals which inhabited abandoned structures/rubble.

The analysis of preservation based on general appearance and angularity indices has shown that pit fills and room fills include a high incidence of good and excellent preservation while construction materials and occupation sequences show lower levels of good preservation, perhaps indicating that these were subject to greater attrition, and perhaps reworking. Preservation of fire installation fills is poor, due probably to the influence of one large sample.

Colour shows few clear patterns. In a few cases, the colour variation (e.g. white, grey, black, dark brown) is clearly correlated with burning (FI structures and fills). Different animal classes show some distinct differences such as the greater relative frequency of light coloured specimens of microfauna, which may reflect the intrusive nature of some of these. Fawn coloured specimens, which are most common in pit fills and room fills, may reflect better preservation.

Fragmentation, based on fragment weight and fragment length, shows differences which may reflect intensity of attrition but also the relative proportions of different animal groups in the deposit classes. In particular, the proportion of very small unidentified mammal and indeterminate fragments in the different deposits influences fragmentation distributions. However, analysis of MM1 fragments (and MM1 element types) indicates that pit fills yield a lower proportion of small fragments than other deposit classes, suggesting better protection or discard of larger pieces in these spaces. Construction materials and occupation sequences show more pronounced fragmentation which may be due, in the former case to the selecting out of large fragments, reworking and/or reduction processes (e.g. pounding) and in the latter to trampling or to clearance of large waste.

The study of other preservation characteristics and various alterations shows that semi-digested bone and bone with carnivore gnawing marks are most common in pit fills and occupation sequences. This may indicate that pits were used for discard of offensive waste (faeces), probably cleared from occupation areas. Alternatively better preservation in pit fills may have allowed more ready identification of these modifications. Not surprisingly, burning is most common in fire installation structures and fills. Occupation sequences also show incorporation of burnt waste. Burning probably does not reflect the importance of cooking by roasting but rather the general importance of particular size groups in subsistence (e.g. MM1) and accidental or deliberate burning of bone in hearths. The greater frequency of butchery in pit fills followed by occupation sequences may be related to more frequent discard of LM and MM1 in pits, the greater size of the remains or better preservation which allows more ready identification of such traces. In the case of occupation sequences, it may reflect food preparation and the build-up of burnt waste in the living area.

Variation by chronological level shows few distinct patterns, and within the Bronze and Iron Age, often no clear patterns were observed. It is difficult also to disentangle the effects of deposit class from chronological variation.

The most distinct preservation pattern is the greater level of erosion in Byzantine levels, due probably to proximity to the ground surface. Iron Age levels show a higher frequency of battering than Bronze Age levels, however variation between phases within the broad periods is marked.

Fragmentation is most marked in Bronze Age levels, which may be due to the greater relative proportion of samples from construction materials and occupation sequences; however this does not correlate with the lower frequency of battering.

Other alterations, including butchery, burning, carnivore gnawing (and semi-digestion) were relatively more common in Iron Age samples, which may reflect differences in deposit class distributions by period or the presence of a few unusual samples. In the case of carnivore gnawing and semi-digestion, this may reflect the greater frequency of residues from pit fills, which yield a higher frequency of bones with these modifications; the data may also reflect a more common presence of dogs, longer exposure of bone, or perhaps different disposal/house cleaning activities.

The data collected for this research were not analysed by horizontal space or trench. As such, the study regarding use of space is limited to distinct deposit types and not wider issues of "intensity" of use of space. Some of the data indicate what we might expect; i.e. that bone is better protected in enclosed spaces, such as pits and/or that such spaces provide ideal waste disposal areas. Contexts such as occupation surfaces, exposed to trampling and other occupation activity, and deposits which reuse waste, show poorer preservation and greater fragmentation. Nonetheless, the data have revealed evidence for particular processes of "house-cleaning" and pathways of waste disposal. No doubt wider site activities and formation processes will be elucidated when all data are combined and when the data from Kilise Tepe and Tell Brak are compared.

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