Both internal and external contexts are shown to have an abundance of the smaller sized bone fragments, with relatively less material as the size category increases. The assemblages differ in one important respect. The material from the internal areas shows a somewhat higher proportion of bone fragments between 0 and 1 cm in length while the most frequent fragment length from the external assemblage is 1-2 cm. Figure 9.19 clearly shows that the bone fragments recovered from external assemblages are notably larger than those from internal areas. In fact the fragments from the external assemblage are on average approximately 1 cm larger than those from the external assemblage.

This observation seems, at first, counterintuitive. The taphonomic profiles produced for the two assemblages so far have shown that the external assemblage has been subjected to a higher degree of taphonomic destruction than the internal assemblage. Consequently, it would be expected that the material recovered from external areas would be more fragmented. Figure 9.19 shows that the converse is true. This rather unexpected observation can be explained by the fact that it has been suggested that the occupants of Çatalhöyük kept the insides of the buildings on the site clean. This process would have had the effect of preferentially removing larger bone fragments from internal areas, since these would be more easily noticed while cleaning, and smaller-sized refuse would be more likely to be missed.

In this case, therefore, the size of the bone fragments is not representative of the varying degrees of bone fragmentation that has taken place across the site. It is in fact a reflection of human activity combined with the low visibility of the smallest bone fragments as they lay on the floors of the buildings.

9.5.8: Completeness indices

Bone fragmentation is not the only means of assessing taphonomic destruction without referring to the evidence of the processes themselves. The creation of "completeness indices" proposed by Marean (1991) produces a statistic that is intended to relate to the degree of post-depositional (or diagenetic) destruction that an assemblage has experienced. The method used to create this statistic has already been described in section 3.4.5. Marean's methodology requires that the completeness of each element being examined is individually recorded and summed. This figure is then divided by the number of elements in the assemblage and multiplied by 100, to produce an average percent completeness for the elements included in the analysis. This process was applied to all of the carpals and tarsals (except the calcanea) recovered from either internal or external assemblages. The results are displayed in table 9.10.

Completeness Category →	**< 0.25** ***(0.125)***	**0.25 - 0.5** ***(0.375)***	**0.5 - 0.75** ***(0.625)***	**>0.75** ***(0.875)***	**Whole** ***(1)***	**Total**	**Completeness Index**
Internal	1	6	2	3	51	63	**91**
External	14	30	17	10	218	289	**87**

Table 9.10: Showing the numbers of carpals and tarsals (except calcanea) in each of the five categories of completeness for both the internal and the external assemblages. The total number of these elements and the completeness indices derived from these data are also shown. The ranges used at the site are shown and the midpoint of each range is italicised.

The recording system at Çatalhöyük effectively estimates the completeness of each bone fragment by placing them into a completeness category. This means that each element included in that analysis was associated with a range, rather than an absolute completeness value and so summing the completeness values of the elements is impossible. This was overcome by summing the midpoint of each range, rather than the actual (unknown) completeness values.

The statistics returned are remarkable in their similarity. This suggests that each of the two assemblages have experienced similar degrees of post-depositional attrition.

Again, this result might be seen as being rather unexpected. Intuition suggests that the external assemblage, which otherwise appears to have experienced a higher level of taphonomic destruction, will have a lower completeness index than the internal assemblage. However, Marean’s completeness index is intended to assess the destructive effects of “post-depositional” processes only. His definition of this term excludes the effects of dogs, fire and weathering and is intended to relate solely to diagenetic destruction. The similarity of the completeness indices suggests that such “post-depositional” processes have not affected the two assemblages significantly differently. In other words, any differences observed between the bones from internal or external contexts are likely to be the result of carnivore action, weathering or burning.

This relatively crude calculation has been used to suggest that the effects of diagenesis are relatively constant across the site, and so any differences in element frequencies are the result of other destructive processes. Marean’s methodology is not intended to provide incontrovertible interpretations, but is useful in describing the more general nature of the assemblages.

9.5.9: Summary

This section has provided a "taphonomic profile" of the two assemblages, which offers a description of the various destructive taphonomic processes that may have acted on the material. The two taphonomic profiles can be summarised in the statement that the external material has been subjected to a higher degree of carnivore gnawing, digestion, butchery and burning. The proliferation of evidence of carnivores is especially notable.

It has not been possible to suggest where on the site different taphonomic processes (particularly burning or butchery) were active, since no evidence of how material may have moved around the site is available. It has only been possible to note where material has been deposited. This does not disadvantage the analysis, since it is concerned with the assemblages as they were found rather than their origins.

The previous section highlighted that differences in bone frequencies between the two assemblages undoubtedly exist. Specifically, the element frequencies from the external assemblage appear to be partly the result of the action of destructive taphonomic processes. Conversely, the internal assemblage has been less subjected to these processes. This section has identified gnawing and digestion as being the main factors responsible for these differences. Weathering can be largely discounted as a factor because the differences in the degree of weathering between the internal and external assemblages are minimal. The contribution of butchery and burning to the differences between the assemblages is also suggested as being slight. This is because the incidence of butchery is low and the ability for both of these processes to produce a density mediated assemblage is not great. Marean's completeness indices have shown that the contribution of diagenetic processes to these differences is also minimal.

9.5.10: The ability for density to shape the element profiles of archaeological assemblages

Although it has been possible to indicate that taphonomic processes have been involved in the formation of the element profiles of the external and (less so) internal assemblages from Çatalhöyük, it is notable that the relationship between bone survival and bone density is a weak one. There are two reasons for this. Firstly, it is almost certain that density is not the only factor to mediate bone survival and destruction. This project has already noted numerous factors that control the ability for a bone to withstand destructive forces (see chapter 4). For example, it is likely that a very dense bone would be less liable to survive mechanical forces if it were very thin. To this extent, the assumption that density is solely responsible for bone survival (inherent in the vast majority of investigations of this type) is untrue. This fact alone could account for the apparently poor relationship between density and bone survival.

Secondly, the nature of the bone assemblage before taphonomic attrition took place is unknown. Consequently, it is necessary to assume that the original assemblage consisted of whole animals. Human decision making means that the original assemblage consists of elements that have been selected by humans, and so will contain certain biases. Only in extreme or unusual cases will taphonomic processes be capable of completely obscuring such bias. Consequently, the faunal material from Çatalhöyük almost certainly represents a combination of biases associated with both bone survival and human activity (although it is suggested that the extent of bias associated with bone survival is greater in the external assemblage). This is a further reason why the relationship between bone survival and density is not a perfect one.

It is important to note that this analysis has simply identified a specific difference between the two assemblages and provided an indication as to the causes of this difference. It would be inappropriate to extrapolate this observation to other sites or situations, because the situation discussed here is the result of a number of complex interactions of a variety of processes (not all of which have been able to be discussed here). A slight alteration in any one of these processes will potentially have an effect on the assemblage that cannot be predicted.

9.6: The Impact of Density Mediated Destruction on the Age Profiles of the Two Assemblages

Now that the impact of destructive taphonomic processes on the element frequencies of archaeological assemblages has been explored, the effect of these processes on age profiles will be discussed. This section will set out a model that, drawing on the density data produced by this project, will predict the biases likely to be encountered in each of the two assemblages. This model will then be tested through observation and discussion of the data. Any deviation of the proposed model from the observed data will be explored and finally this analysis will be placed in its broader archaeological context.

It has already been established that age profiles derived from fusion data can be invaluable when interpreting the animal management strategies used by people in the past (Munson 2000, Payne 1973). It has also been made clear that the bones of an animal undergo changes in their density as it matures. This section will attempt to assess how these density changes are likely to be translated into age related bias in the archaeological record and whether this bias will be likely to result in misinterpretation of an assemblage.

This analysis will again make use of the electronic database of the excavated faunal material from the recent excavations at Çatalhöyük, Turkey. As before, the contexts from the site will be split into "internal" and "external", using the same criteria as for the previous analysis (section 9.4.3). Fusing and neonatal material will be excluded from this analysis, because the density data produced for this material have shown it to be either anomalous or erratic in its density.

9.6.1: Building an archaeological model for the age profiles

Section 9.2 has already explored the potential for age related density changes to distort archaeological age profiles. The following paragraphs will build upon this exploration in order to provide a model of how the two assemblages from Çatalhöyük will differ.

It is necessary for the model to rely on the assumption that the faunal material from the two Çatalhöyük assemblages is essentially the same and differs only in the degree of taphonomic destruction that it has experienced. Consequently, the two assemblages derive from bodies of material that would once have produced identical age profiles. Any differences between the age profiles of the two assemblages are therefore the result of destructive taphonomic processes. The implications of this assumption will be given further attention later (section 9.6.4). The previous section demonstrated that, of the two assemblages under investigation, the external assemblage has been more affected by destructive taphonomic processes than the internal assemblages.

Given these parameters, it is possible to predict some of the ways in which age profiles of the two assemblages will differ. It has been established that unfused bones are generally less dense than their fused counterparts. Consequently, it can be predicted that the (external) assemblage that has suffered a higher degree of taphonomic destruction will have experienced the preferential removal of unfused bone. The resulting under-representation will be apparent in the age profiles as a higher percentage representation of fused bone in the external material. Furthermore, section 9.2.4 has noted that, contrary to popular expectations, the under-representation of unfused material in the external assemblage will not affect the earliest fusing bones disproportionately. Instead, an under-representation of the earliest and latest fusing elements (groups 2 and 4, respectively - see table 9.3 for definition of the groups) would more realistically be expected. It would therefore be expected that the external assemblage would contain fewer unfused group 2 and 4 elements compared with the internal material. This would be apparent in the age profiles as an over representation of fused groups 2 and 4 elements for the external assemblage. No prediction as to the difference between the assemblages for the group 1 elements can be provided. This is because inadequacies in the experimental material meant that sufficient density data were not available to be incorporated into the model.

It is possible to summarise the predictions of this model as follows. The external assemblage will exhibit some degree of under-representation of all unfused material, as compared with the internal material. This under-representation will be especially acute in the groups 2 and 4 elements. Consequently each column of the age profile for the external assemblage will show a higher percentage of fused material than the internal assemblage. This feature will be greatest in the groups 2 and 4 columns.

9.6.2: Testing the age model

In order to test the above model, it is necessary to construct an age profile from each of the two assemblages. The method used to achieve this is the one outlined by Chaplin (1971 p128). The fusion groups used are those adopted by Halstead (1992 p36) (see section 9.2.3).

The age profiles for both the internal and the external material from Çatalhöyük are represented by figures 9.20 and 9.21.

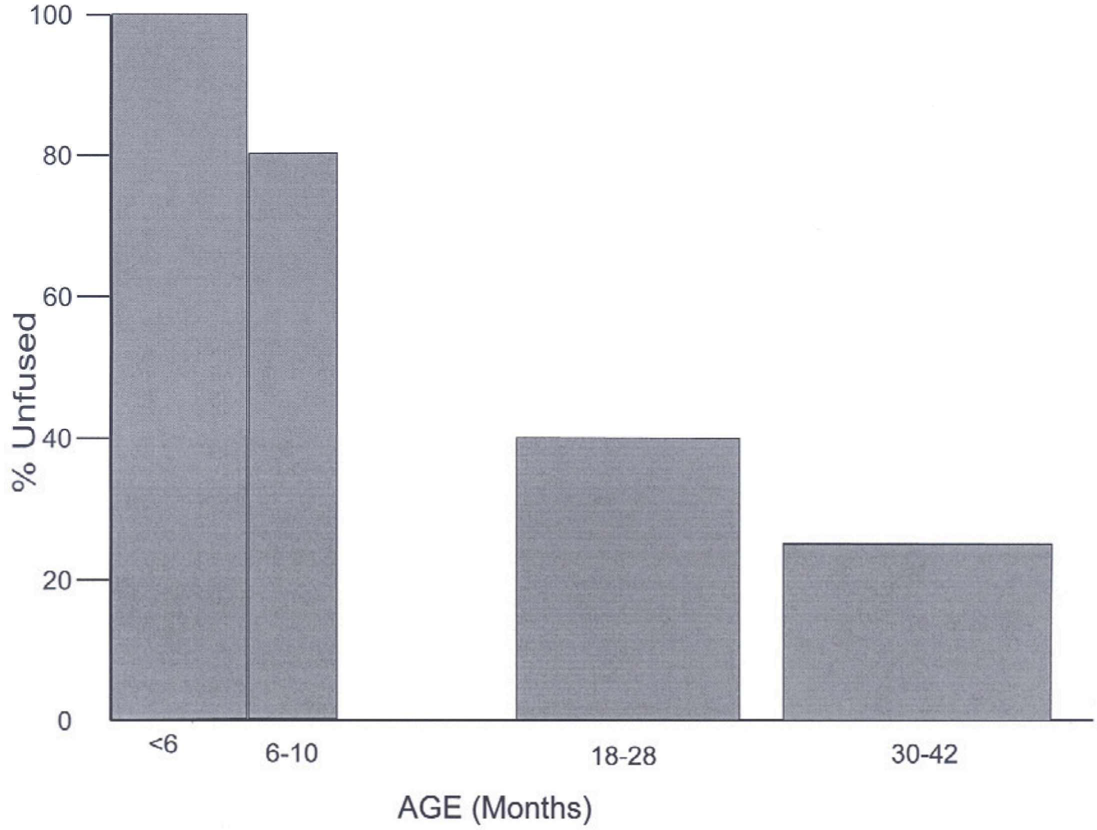

Figure 9.20: Showing the age profile of the material recovered from the internal contexts. The age data are derived from fusion data.

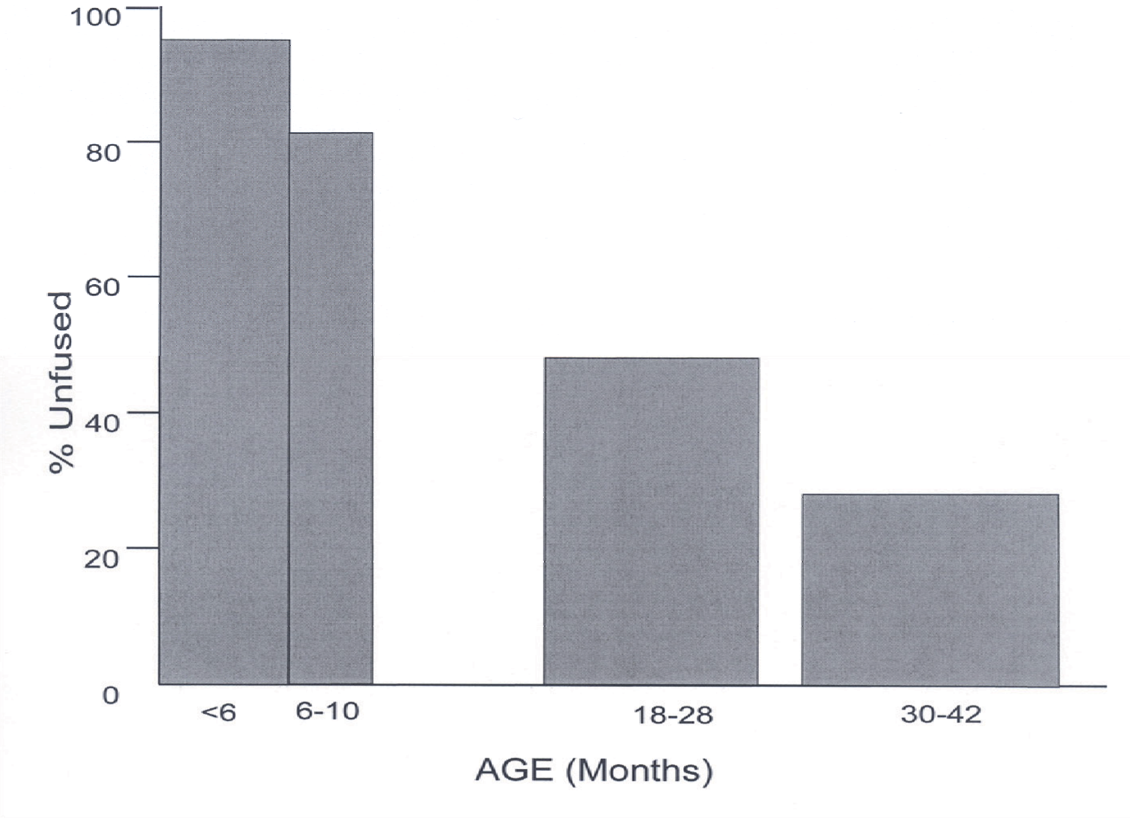

Figure 9.21: Showing the age profile of the material recovered from the external contexts. The age data are derived from fusion data.

Figures 9.20 and 9.21 are remarkable in their similarity. Both figures show an abundance of the youngest aged animals with progressively fewer individuals as the age category increases. The main kill-off in both cases is between groups 2 and 3 (6 and 28 months) although some animals survive to a greater age.

Some minor differences between the two assemblages do exist. Compared with the internal material, the external assemblage contains fewer less than 6 month old animals, but relatively more of the older individuals. These differences are small (especially in the case of the 6 - 10 month old animals) but nonetheless notable.

Below are an interpretation of the age profiles and a discussion of the differences between them.

9.6.3: Discussion

The pattern described by both figures 9.20 and 9.21 is reminiscent of the meat-based herd management strategy described by Munson (2000 pp397 - 398). This involves the culling of most of the males at between 6 and 15 months of age and the retention of females as breeding stock. Without data relating to the sex of the material, it is impossible to conclude that it was, in fact, the males that were being culled, while the females were retained. Munson's interpretation, however, is reasonable given the available data. What is central to this analysis is that, despite any minor differences between the two assemblages, the interpretation of both is identical. To this extent the impact of destructive taphonomic processes on the age profiles is negligible.

The slight differences between the two assemblages, as described above, do not entirely support the proposed model. Figures 9.20 and 9.21 show the prediction that there will be a general under-representation of unfused material in the external assemblage (because it has been subjected to a higher level of taphonomic attrition) to be valid. It was also predicted that the external assemblage would show an even higher proportion of fused group 2 and 4 elements. This cannot be said to be the case. The over representation of fused group 2 and 4 elements is slight and, in fact, not as great as that displayed by the group 3 elements. This is contrary to the predictions of the model.

Overall, the archaeological data show an under-representation of unfused bone from the more intensively taphonomically ravaged assemblage. This was predicted, since unfused bone is generally less dense than fused bone and so would be expected to be preferentially removed from the assemblage that has suffered a higher degree of taphonomic destruction. However, the earliest and latest fusing bones are notably less dense than their fused counterparts (compared with group 3 elements, which have reasonably similar densities in their fused and unfused states). It is for this reason that the model predicted that the earliest and latest fusing elements for which data are available (groups 2 and 4) would be more notably scarce in the external assemblage. This prediction has not been reflected in the observed archaeological material. Possible reasons for this discrepancy between the expected and observed assemblages will be discussed below.

9.6.4: Why the archaeological data were not fully predicted by the model

There are a number of possible reasons why the unfused elements from groups 2 and 4 do not seem to have been preferentially removed from the external assemblage.

Firstly, the assumption on which the model was dependent (outlined above) may have been flawed. This assumption proposed that the internal and external assemblages were essentially the same and that the only differences between them were the result of taphonomic bias. It might be argued that, for some culturally determined reason, the external assemblage contained more unfused group 2 and 4 elements (see table 9.3) than the internal material before the taphonomic bias was introduced. The preferential removal of unfused group 2 and 4 material from the external areas would produce an age profile not dissimilar to that shown in figure 9.21. Groups 2 and 4 consist largely of meat-bearing elements and so it is not beyond reason that such a culturally determined discrimination could have been at work. If so, the reasoning behind this discrimination remains obscure and this explanation must remain hypothetical.

Another methodological reason for the failure of the model to predict the archaeological assemblage relates to the size of the sample used to create the age profiles. Table 9.11 shows that, although a total of 33514 bone fragments have been recovered from Çatalhöyük, a much smaller number were appropriate for use in this analysis.

	Total bone fragments	Total sheep/goat/roe deer fragments	Total sheep/goat/roe deer DZs	Total sheep/goat/roe deer DZs from relevant skeletal locations
Internal Contexts	5405	448	162.5	38
External Contexts	28109	3633	1410	161

Table 9.11: Showing the total numbers of bone fragments recovered from Çatalhöyük and how only a small proportion of these was suitable for fusion-based age analysis. The data presented are derived from internal and external priority contexts only.

It is apparent from table 9.11 that although the faunal assemblage from Çatalhöyük is very large, only a total of 161 bone fragments were used to create the age profile for the external assemblage while only 38 were available from the internal assemblage. Although a larger number of specimens would be preferable at this stage, it is not possible to increase the size of the sample without compromising its integrity or suitability for this analysis. The small number of bones available for this analysis means that a single additional bone fragment in the internal assemblage would have a disproportionately large effect on the age profile. The small sample size on which figure 9.20 is based means that any small discrepancies between it and the age profile for the external material (figure 9.21) must be treated with caution.

It is also necessary to consider the extent to which bone density is capable of altering the structure of a bone assemblage. The only variable considered by the model is that of bone density. Implicit in the model, therefore, is the assumption that bone density is the only variable that controls taphonomic bias. It has already been noted that this assumption is probably incorrect (see section 9.5.10). If, as is likely, taphonomic bias is controlled by a complex interaction of numerous factors, it is not surprising that a model relying on density as its only variable has been unable to predict taphonomic bias. This is even less surprising, considering predictions of the model were of a high resolution (ie they related to slight changes in bone frequencies for specific ranges of elements). Had the model been attempting to predict broader trends in the data, it is likely to have been more successful.

The inability of the model to make such high resolution prediction may have been a function of the magnitude of the differences in density of fused and unfused material. The extent of these differences is shown in figure 9.7 (section 9.2.1). It is apparent in this figure that the variability in density between fused and unfused material is generally small. On the whole, the inter-element variation exceeds the variation between material at different developmental stages. It is arguable that the magnitude of the differences between unfused and fused material will not be reflected in the bone assemblages to any degree that is either measurable or meaningful. Also, factors other than density that mediate taphonomic destruction will produce a degree of background "noise" that may have the effect of masking any patterns caused by density variation.

The model is partly reliant on the observation that the difference in density between fused and unfused material was greater in groups 2 and 4 than it was in group 3. Overall, this observation is well founded. However, within some of the groups, anomalous elements can be seen. For example, group 4 has been characterised as containing elements that are notably less dense when unfused than they are when they have fused. This characterisation is generally sound, although exceptions to this rule do exist. The difference between the fused and unfused proximal femur is small, while the unfused distal radius is in fact shown to be denser than its fused counterpart.

These anomalous scan-sites are especially important when it is considered that the majority of the group 4 elements recovered from the external assemblage are either proximal femora or distal radii. In light of this observation, the characterisation of the group 4 unfused elements as being markedly less dense than the fused elements is ill founded. This single observation is capable of explaining why the under-representation of unfused group 4 elements is not as marked as predicted by the model: in the case of the external assemblage, the group 4 unfused material is not significantly less dense than the fused material.

9.6.5: Summary

A model that aimed to predict the differences between the age profiles of the internal and external animal bone assemblages from Çatalhöyük was proposed. This was based on the assumption that the external assemblage has been subject to a higher degree of taphonomic destruction than the internal material. Consequently, the external material was expected to show a comparative absence of the less dense (unfused) material. The predicted pattern was reflected in the archaeological material and so, to this extent, this aspect of the model was confirmed. However, the model also predicted that the under-representation of unfused material would be more apparent in fusion groups 2 and 4. The archaeological material did not support this prediction. This failure of the model was due to either the small size of the archaeological sample, the assumptions inherent in the model being incorrect, or the analysis not having sufficient resolution to identify the relevant patterns. It is not improbable that more than one of these suggestions is responsible for this failure of the model.

It has been supposed that taphonomic destruction will result in an absence of very young (groups 1 and 2) animals from an archaeological assemblage (Grant 1975 pp394 - 5, Halstead 1992 p37). This would be manifest in an age profile by increasing the height of the first and second columns. This analysis has shed some doubt on the validity of this assumption. It has done so by demonstrating that (in the case of Çatalhöyük, at least) the removal of unfused material by taphonomic destruction results in an overall reduction of the numbers of all unfused bones, no matter which fusion group they are from.

It is of prime importance that although some density mediated bias in the age profiles was identified (as represented by the lower proportion of unfused material in the external assemblage), the archaeological interpretation of the two age profiles was the same. It is therefore possible to conclude that, in the case of these two assemblages at Çatalhöyük, the impact of taphonomic bias on the age profiles is negligible.

The apparent failure of the model to predict the archaeological data by no means invalidates the results of this test. By casting doubt on some of the assumptions commonly employed when interpreting archaeological age profiles, this test has contributed to the ability for archaeologists to interpret age data reliably. What is now required is an assessment of which of the reasons proposed in this section are actually responsible for the failure of the model. If the sample size or cultural factors are implicated, then the failure of the model is specific to this study. If this is the case, then lessons can be learnt concerning the universal application of interpretative models to sites, regardless of their suitability. However, the predictions of the model may not have been met simply because bone density is not a sufficiently accurate predictor of bone destruction. If this is the case, then the implications will be relevant for the vast majority of interpretations of archaeological bone fusion data and a reassessment of traditional interpretative assumptions might be called for. Assessing which of the proposed explanations is responsible for the failure of the model is therefore bound to be a valuable avenue for further work.

This chapter has provided a set of density data that is suitable for the production of archaeological element frequencies and age profiles. After discussing the potential of these data to improve the interpretative power of the archaeologist, it has been possible to use the density data to create hypothetical models predicting the impact of destructive taphonomic processes on both archaeological element frequencies and age profiles. Whether the models were successful in predicting the archaeological data or not, it was possible to use them as a means to explore the nature of destructive taphonomic processes and their relationship with bone density. Taphonomic signatures were used to explore the taphonomic processes responsible for the observed bias.