Chapter 1 - Introduction

This chapter presents the archaeological research problem that is addressed by this project. It describes the broad aims and specific objectives of the project, before outlining how these aims and objectives will be met. Finally, a summary of the structure of this thesis is presented.

1.1: The Nature of the Archaeological Problem

One of the prime goals of archaeological enquiry is to reconstruct and understand the activities of past societies through the study of the material they left behind them. Zooarchaeologists in particular attempt to achieve this goal through the study of the animal remains (largely bones and teeth) left by ancient people. Since the 1960s zooarchaeology has become increasingly quantitative, whereby relative numbers of animals or skeletal parts have formed the basis for analysis (eg Davis 1987, O'Connor 2000, Reitz and Wing 1999). These methods, however, face the problem that archaeologically recovered animal bones are not necessarily a direct reflection of the material that was deposited by past societies (Lyman 1984). Natural processes (known as "taphonomic" processes), such as gnawing by dogs, weathering and trampling, alter the archaeological material and are capable of masking or obliterating any cultural information it may have once contained. One important way in which taphonomic processes can distort cultural information is by changing the element frequencies of assemblage.

A prerequisite of much archaeological interpretation is the identification of, and accounting for, any bias in bone assemblages that has been caused by taphonomic processes. This ensures that unbiased (cultural) information will form the basis of any analysis. One of the main tools used to this end is bone density data. It has long been noted that destructive processes tend preferentially to affect weaker (low density) bone before stronger (higher density) bone (for a definition of bone density see section 3.2). This fact enables researchers to assess which particular bones (or parts of bones) may be absent from a taphonomically ravaged assemblage and account for any resulting bias. It is clear that many taphonomic processes are mediated by bone density, and so bone density is indirectly related to our ability to interpret the cultural past of a site. The

theoretical framework by which taphonomic bias can be accounted for will be described in the next chapter.

The value of bone density data is reflected by the fact that there are large number of researchers who have attempted to establish the density values for a similarly wide range of animal species. The density data produced so far, however, has been based on small sample sizes or has been otherwise flawed. As a result, the taphonomic interpretations based on this information are also potentially flawed. One considerable shortcoming of the density data currently available is that it only describes the variation in density between different species and different skeletal elements (or parts of elements). Little effort has been made to explain how bone density might vary between animals of different ages, sexes or breeds. This means that it is currently impossible to identify or account for the biasing effects of taphonomy on the age or sex structure of an assemblage. Only the effects on element or species frequencies can presently be predicted.

This lack of high quality data has a potentially detrimental effect on the reliability of interpretations based on archaeological element frequencies. There is clearly scope for further work to explore the variables that affect animal bone density, as well as a need for high quality data.

1.2: Aims and Objectives

The central aim of this project is to explore the variables affecting bone density across the skeletons of animals of a wide variety of different ages. This will enable the value and use of bone density data in taphonomic interpretation to be reassessed.

This project will begin to overcome the lack of high quality bone density data by generating a large database of bone density values that can be used in taphonomic interpretation. These values will relate to the densities of a large number of well provenienced animals. A single species of mammal that is commonly found in Europe and Asia is most suitable for this type of analysis. Consequently, this project will focus on the bones of sheep. The parts of the skeleton that will be examined will be carefully defined. In order to produce such a large data set it will be necessary to develop a measurement method that is accurate, reliable and accessible. The value of the data produced will then be demonstrated by using it to undertake a taphonomic study of an archaeological bone assemblage.

This project will review both the data and the methods generally used in taphonomic interpretation. In doing so, it will be possible to suggest more appropriate methodologies than those currently in use.

The archaeological problem presented above poses a number of specific research questions that this project will endeavour to address. These questions are:

- To what extent is the destruction of animal bones by taphonomic processes mediated by bone density?
- How does bone density change according to factors other than skeletal element or species (eg age, sex, breed etc.)?
- How might this information be used to improve the ability of archaeologists to interpret archaeological assemblages?

These specific questions and the general research aims will be addressed with reference to both the available literature and new experimentally produced data. It will be necessary to design a measurement method that is capable of producing a large number of high quality density values. These must be derived from a suitable body of well provenienced reference material. Drawing upon the methods employed by previous researchers will ensure that the methods employed here are appropriate. It will also be necessary to test the method so that its precision can be assured.

The data produced will be used to assess how bone density is liable to vary according to the preparation method used to deflesh the material, as well as the sex, month of death, breed and the age of the animals. This will contribute to a fuller understanding of the interpretative power of bone density in taphonomic studies.

The value of the data produced by this project will be demonstrated by applying them to an archaeological assemblage. The large Neolithic tell site of Çatalhöyük, in Turkey, is especially well suited to this kind of analysis. Again, the results produced will highlight the value (and the shortcomings) of bone density data as an interpretative tool. An assessment of the impact of taphonomy on the bone frequencies from the site will be made. The density data produced by this project will also enable a considered assessment of the impact of bone density on age profiles to be undertaken. This will be the first time bone density data has been used to this end.

The application of the data produced by this project to the material from Çatalhöyük raises three further research objectives that can be addressed:

- What impact have taphonomic processes had on the animal remains recovered from Çatalhöyük, Turkey?
- Which taphonomic processes are responsible?
- How are taphonomic processes capable of distorting archaeological age profiles (particularly those from Çatalhöyük)?

Finally, this project will be placed in its overall context in the field of archaeology and suggestions will be made for further work.

1.3: The Structure of the Thesis

The thesis is split into three main sections. The first reviews the available literature and places this project in its research context. The literature is later drawn upon to establish the importance of taphonomy and density to archaeology and is also referred to in the methodology section.

The second section consists of a description of the materials used in this project, the methods employed and the results achieved. Each set of results is presented and discussed in turn.

Thirdly, the data is applied to the faunal assemblage at Çatalhöyük. This has the dual effect of contributing to a much needed understanding of the site formation processes at the site as well as demonstrating the applicability of the results on a general level.

Specifically, the chapters will take the following form:

- Chapter 1: Introduction. To present the archaeological problem. To state the aims of this project and describe its structure.

- Chapter 2: To define the terms central to the understanding of this project. To describe a theoretical framework around which this project can be structured.

- Chapter 3: To introduce bone density and establish its importance in controlling the impact of taphonomic processes. A wide range of destructive processes will be addressed in turn and the relative importance of bone density in controlling each one will be discussed.

- Chapter 4: To establish that bone density controls bone destruction through a variety of mechanical pathways. To introduce a number of factors other than bone density that are known to influence bone strength.

- Chapter 5: To establish the variables (age, sex, breed etc.) that are known to result in bone density variation. This will enable the definition of the variables to be discussed later (chapter 9).

- Chapter 6: To describe the range of density measurement techniques that are available and have previously been used. Each method will be described and its relative advantages and disadvantages will be discussed. Chapter 8 (Materials and Methods) will draw on these discussions to ensure that the methods used by this project are appropriate.

- Chapter 7: To describe and justify the choice of experimental material and the methods used to measure it. The methods will be subjected to a suite of tests to ensure that they will produce reliable results.

- Chapter 8: Presentation of the density data obtained using the materials and methods described in the previous chapter. The data will be analysed in such a way that the variation in bone density according to a suite of variables (defined with reference to chapter 4) can be assessed. Results for each variable will be presented and discussed in turn.

- Chapter 9: To apply the results to the material excavated from the site of Çatalhöyük, Turkey. The use of archaeological models will enable an assessment of the impact of taphonomy on the element frequencies of two distinct assemblages from the site. The root cause of any differences between

these assemblages will be suggested. An analysis of the effects of taphonomic processes on the age profiles of this material will also be presented.

- Chapter 10: Conclusion. To present an overall summary of the findings of the project. Also to place the project in its wider archaeological context and to offer suggestions for profitable avenues of further work.

The research questions that this thesis intends to answer, the manner in which they will be addressed and the overall aims and objectives have now been briefly outlined. A summary of the chapters that follow has also been provided. It would now be appropriate to define the term "taphonomy" and emphasise its importance in archaeological analysis.