THE UNIVERSITY OF MANITOBA

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PRODUCTION, DISTRIBUTION AND CONSUMPTION OF ANIMALS AT EARLY BRONZE AGE TITIŞ HÖYÜK, SOUTHEASTERN TURKEY: A ZOOARCHAEOLOGICAL APPROACH

BY

ADAM ALLENTUCK

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirement of the degree

of

MASTER OF ARTS

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Department of Anthropology
University of Manitoba
Winnipeg, Manitoba

ABSTRACT

Archaeological research on the subsistence activities of non-elite residents living in peripheral areas of the ancient city can be used to address several important questions. As examples, how were early urban societies spatially organized at the levels of the settlement, neighbourhood, and household? What was the nature of economic relations between different sectors of society? To what degree was the early city internally differentiated relative to the urban layout? To what degree was production specialized and/or centralized? Though these and other questions pertaining to early urban life are of central importance, their answers are largely unknown in the cultural context of Northern Mesopotamia during the Early Bronze Age (EBA), the period of urban origins and early florescence.

In an effort to tackle these issues, the focus of this research is on the animal economy of Titriş Höyük, an early urban settlement in southeastern Turkey. The faunal remains of the herd animals from the EBA levels of Titriş Höyük are analyzed in an effort to address specific hypotheses. These deal with post-depositional taphonomy, the mode of animal production and consumption, productive specialization, animal product distribution, and differential access to animal products. These hypotheses are evaluated with the use of specific zooarchaeological, spatial analytical, and statistical methods and techniques.

The results of the faunal analysis indicate that sheep, goats and cattle were of primary importance in the subsistence economy. Low frequencies of wild animal remains reflect the secondary importance of hunted fauna in the economy. Pigs are only anomalously represented, indicating that they played almost no role in the economy.

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CHAPTER 1: INTRODUCTION

Introduction: research agenda

Since the birth of Near Eastern archaeology in the 19th century, most excavation efforts were focused on recovering the remains of palace, temple and administrative contexts (Lloyd 1955). Since the tells (built mounds) of Mesopotamia were the most visible monuments on its flat terrain, these features were obvious places to dig for 19th century antiquarians and for early 20th century workers using crude excavations methods. The scholarly and popular appeal of cuneiform tablets, monumental architecture and splendidly carved monuments is evidenced by their residence in the great museums of the world. The excavation of the glamorized contents of tells alone have the potential to yield information regarding the political, social and economic life of the elite. However, since the non-elite typically resided outside of the city's core (Trigger 2003: 122), these excavations do little to provide information about the domestic activities of the populace.

The study of non-elite residents living in peripheral areas of the ancient city has the potential to provide information about a different, yet equally important aspect of past lifeways. Research into the archaeology of the non-elite leads to many important questions. As examples, how were early urban societies spatially organized at the levels of the settlement, neighbourhood, and household? What was the nature of economic relations between different sectors of society? To what degree was the early city internally differentiated relative to the urban layout? To what degree was production specialized and/or centralized?

Unfortunately, research into this less glamorous aspect of Near Eastern urban archaeology has only been pursued in recent decades. Though these and other questions pertaining to early urban life are of central importance, their answers are largely unknown for the Near East in the period of urban origins and early florescence, i.e., the Early Bronze Age (hereafter EBA). This gap in our knowledge is the impetus for the current research and for the long-term goals of the larger Titriş Höyük project (Algaze *et al.* 1995: 14; Matney *et al.* 1997: 61-62; Matney *et al.* 1999: 186; Algaze *et al.* 2001: 24-25).

This research will investigate how the pastoral economy contributed to urban processes during the EBA of northern Mesopotamia. Most generally, this research project will explore the economic relations within the urban community of Titriş Höyük in southeastern Turkey. Titriş Höyük was located on an important trade route and was the capital in the regional settlement hierarchy. An analysis of the faunal assemblage from Titriş Höyük will identify the economic uses of domestic herd animals, which is an important part of the domestic economy.

Focus of research

An economically focused examination of the faunal remains from Titriş Höyük is appropriate in light of the sampling strategy, spatial controls and cultural context. These characteristics also provide a rare opportunity to examine the horizontal distribution of the faunal remains. Several specific issues related to the pastoral economy at Titriş Höyük can be addressed from zooarchaeological and spatial perspectives. These include post-depositional processes that contributed to the assemblage, the types of animal products that were emphasized (meat, milk and wool), animal product distribution mechanisms, and differential access to animal products. Specific hypotheses are elaborated in Chapter 5.

The substantive issues of this thesis – production, distribution, and consumption of animals – are presented in the order in which they occurred. In other words, the events in the pastoral economy "chaîne opératoire" are discussed in sequential order. One may think of the living animals as the raw materials that are continually reduced through the stages of exploitation, culling, preparation, butchering, distribution, consumption, and discard. They are further reduced as deposited materials through various natural deteriorative processes until they are finally excavated, and then analyzed in the laboratory as a small sample of the original living animal population(s).

General theoretical approach

The general theoretical approach taken throughout this thesis is materialist. The materialist school of thought posits that material conditions, which include technology, demography and economics, have a primary role in shaping culture (Harris 1979). In this approach, the relative costs and benefits of human decisions are measured in terms of these material conditions (Trigger 1989: 292). Following the materialist school, this thesis incorporates empirical testing of hypotheses and, moreover, is explicitly scientific in its research strategy, methodology, and presentation of results.

However, my approach breaks from the fundamentalist materialist approach. The hypotheses that are outlined in Chapter 5 are deduced from a rich knowledge base that has been substantially gained from iconographic and literary research. These sources offer as close to an emic perspective as is possible in archaeology, given that our human subjects have long been extinct. Near Eastern archaeologists are fortunate to have at their disposal not only the food remains from its settlements, but also a wide array of texts and art that inform us on of the economic, political, environmental, technological *and* ideological nature of domestic animals (see Chapters 3 and 5).

Materialist archaeology has been extensively criticized for its myopic view of culture. Critics condemn materialism's particularly dogmatic proponents, i.e., Binford (1968), who hold the view that one can predict past human behaviour because it is determined by certain strict, universal laws of cultural evolution (Kohl 1981: 100). Materialist studies have been criticized for using too few and/or inappropriate variables, and questionable empirical measures to predict human decisions. Moreover, human behaviour is dynamic; it is far too complex to appreciate in a simple input-output model. However, to argue that human behaviour is impossible to accurately model, and therefore should not be attempted, is fatalistic, and would impede the advancement of knowledge. Instead, a careful materialist should construct a model that is as comprehensive as possible. This can be achieved by integrating multiple material correlates into the model (Taylor 1948).

The analytical approach taken in this thesis is synchronic, rather than diachronic. Instead of examining change through time, as a diachronic approach would prescribe, the synchronic approach emphasizes a culture-specific theme in a single time period. In the synchronic study of early states, common themes that are investigated include exchange, urban organization, and pastoral economies (Stein 2001).

General methodological approach

The methodological approach taken in this research is grounded in two general methods: the analysis of faunal remains and the analysis of the spatial distribution of faunal remains. All of the research hypotheses employ faunal analysis, but only some of the hypotheses are addressed with the spatial analysis method. The specific methods that are used in this research are elaborated upon in Chapter 5.

A running theme throughout this work is the concept of taphonomy, which, in the most general of terms, is the study of the life history of a bone assemblage. Taphonomic process continuously impacts bone assemblages. Hesse and Wapnish (1985: 18-31) describe a popular model of taphonomic process. Their taphonomic trajectory begins with the environmental, ecological and other conditions that affect the living animal population (biotic process). This leads to the human decisions that contribute to the death of an animal (thanatic process), which is then followed by weathering and scavenging processes (perthotaxic process), post-burial geochemical changes (taphic process), the archaeological sampling strategy (sullegic process), and curatorial and research decisions of the faunal analyst (trephic process). The model used in the present study employs a simplified, less divisive model of taphonomy, following Reitz and Wing (1999: 110-112). For heuristic purposes, taphonomic process is divided at the point that a bone is deposited (discarded). Pre-depositional process includes biotic and thanatic events, while post-depositional process includes perthotaxic, taphic and sullegic events (Figure 1).

The site

Excavations at Titriş Höyük were conducted between 1991 and 1999. The project was co-directed by G. Algaze (University of California at San Diego) and T. Matney (University of Akron). Titriş Höyük was excavated for the purpose of broadly exposing portions of non-elite domestic and productive components of an early urban settlement. The tell at the city's centre, which would have contained the remains of elite and administrative architecture, was not excavated. Since the focus of excavations was on non-elite domestic and productive contexts, a study of non-elite household life is an appropriate avenue of research vis-à-vis the goals of the larger project.

The site was surveyed and excavated with the goal of mapping large horizontal expanses from different spatial contexts. Titriş Höyük was only intensively occupied for a short time, from the mid to late EBA. The single occupation of the site combined with the sampling strategy employed in the excavation make Titriş Höyük unique among EBA sites of the Near East. Most other EBA horizons are buried deeply below subsequent occupations, and are consequently rarely brought to broad horizontal exposures. At Titriş Höyük, at least 60% of mid-late EBA levels are located immediately below the surface (Matney and Algaze 1995). The total excavated area of the site has not been published. A detailed description of the site and its natural and built environments is described in Chapter 2.

Conclusions: significance of the thesis

The excavation of extensive areas of non-elite domestic and productive architecture conducted at Titriş Höyük provides a unique opportunity to examine the built environment of an EBA city at a scale unprecedented in Near Eastern archaeology since the 1930s and 1940s, when vast cities were exposed in southern Mesopotamia. The methodological approach to the excavation of Titriş Höyük lends itself to a study of the functional divisions of space and its resultant distribution of faunal remains as reflections of household economies. One of the Titriş Höyük project goals was to examine the use "of domestic buildings at the level of the individual household, i.e., the composition of family or residential groups, the allocation of working and living space, [and] household economies…" (Matney and Algaze 1997: 23). Furthermore, Matney and Algaze (1995:

45) ask how configurations of domestic space in the Lower Town resemble or differ from those of the Outer Town. The extensive analyses of the city's non-elite domestic architecture provide detailed data on its spatial divisions, which have functional, social and economic implications.

An analysis of the faunal remains that focuses on their spatial variability would represent an approach that incorporates two lines of evidence to solve a single paleoeconomic problem. Explaining that an ancient economy incorporated artifacts, animals, architecture and land "in single living system", McGovern (1984: 40) calls for zooarchaeologists to use multiple types of evidence since their combination is stronger than any single data type. This approach to faunal analysis has been advocated (Grant 2002; Maltby 1979: 94; Taylor 1948; Wilson 1994) and widely employed (Becker 1998; Crader 1984; Ijzereef 1988, 1989; Matthews *et al.* 1994; McGovern 1984; Meadow 1978; Milne and Crabtree 2001; Wattenmaker 1998; Wilson 1992). Though the faunal evidence will be the focus of the research, the architectural context will be used as a tool for corroboration. By incorporating the faunal data with the published architectural data, the functional use of space should be revealed.

There are several issues that deserve brief mention, which are beyond the means of the present research, but within the scope of an urban faunal analysis. Though economic implications of perceived cultural processes are sought in this research, there are many other potential explanations for variation in an urban faunal assemblage. These include ethnicity and social status. Though divergent dietary laws and food taboos between two or more distinct ethnic groups inhabiting Titriş Höyük might also explain variation in the faunal assemblage, data related to ethnicity is lacking. Likewise, several social or economic classes represented by several distinct spatial contexts might also explain the observed variation in the faunal assemblage. However, documentary evidence detailing the economic or social value of various animals and their parts is also lacking from the Titriş Höyük database.

This project will endeavour to contribute to our broader understanding of an early urban cultural system during the EBA of northern Mesopotamia, despite the narrow focus of this investigation into the nature of economic transactions in animal products. This will be accomplished by undertaking an analysis of the faunal data from a site that was excavated with the goal of preserving an unusually high degree of spatial resolution. The results of this project will add to the current knowledge base of animal exploitation strategies and their resultant spatial implications in the Near East during the period of early urbanism.

CHAPTER 2: REGIONAL SETTLEMENT, THE SITE, AND ITS ENVIRONMENT

Introduction

This chapter describes Titriş Höyük in terms of its cultural and natural settings. Its cultural role within the Karababa basin and the larger Upper Euphrates region will be outlined by detailing the structure of the city's morphological areas and how they have changed throughout its occupational history. Explanation of the natural setting of Titriş Höyük and the surrounding region will be fulfilled by relating research on local hydrology, vegetation and climate. The following review will set the stage for the chapters that follow.

Historical background

Relatively little is known of the archaeology of the Upper Euphrates Valley as compared with what is known from other regions of the Near East (Figure 2). The long history of excavation in Iraq and the Levant has resulted in a rich knowledge base of the political, social, religious and economic activities from the 7^{th} millennium B.C. through to the historic periods. Historically, archaeological investigations of the third millennium B.C. were mostly focused on Sumerian and Akkadian contexts in southern Mesopotamia. The possibility of complex society existing outside of this heartland at the same time as the great literate civilizations was not realized until recently. Adams (1966b: 106), in his assessment of urban origins in the Near East, explained that excavations in regions outside of the urban centres had only recently begun. Lloyd's (1984) book, *The Archaeology of Mesopotamia* includes a chapter entitled, "Pre-literate Peoples of Northern Mesopotamia". Several years earlier, Mellaart (1978: 29) commented that trade between cultures of the Mesopotamian heartland and cultures in Anatolia were known, but only through scanty evidence.

Though large third millennium centers such as Tell Brak in northern Syria and Carchemish in Turkey were known at this time, the traditional view held that the subsistence base of northern Mesopotamia was based on small-scale dry-farming (Wattenmaker 1998).

However, in the late 1970s and early 1980s these traditional perspectives of northern Mesopotamia started to change due to the initiative of new field projects in Syria and Turkey (Van De Mieroop 2004: 5). The early urban settlements of Tell Beydar (ancient Nabada), Tell Chuera, Tell Leilan and Tell Mardikh (ancient Ebla) in northern Syria, which were first published in the late 1970s, were instrumental in this regard. Tell Mardikh was especially important because it provided several thousand cuneiform tablets, which demonstrated literacy outside of Sumer and Akkad (Matthiae 1980). The tablets also confirmed the existence of complex economic and political systems outside of the Mesopotamian heartland.

In the case of Turkey, the traditional perspective did not change until the early 1980s when extensive surveys of the Upper Euphrates Valley were conducted. Surveys conducted by Wilkinson (1990), Özdoğan (1977), and Whallon (1979) led to several excavations, the first and second of which were responsible for the discovery of Titriş Höyük. Prior to this work, ancient settlement in this region was only known through limited excavations in adjacent areas. These surveys and subsequent excavations have revealed that several urban settlements of various sizes thrived in a complex network of interaction during the third millennium.

Description of region

Settlement pattern of the Karababa basin

Within the Upper Euphrates Valley, Titriş Höyük is located in the Karababa basin (Figure 3). The Karababa basin, measuring 70 km in length and 2 to 10 km in width, lies at the transition zone between the Taurus Mountains and the North Syrian steppe (Stein 1987: 103). Within 100 km^2 Titriş Höyük was surrounded by several towns that ranged between 5 and 15 hectares in size and by several villages that were between 0.5 and 1.5 hectares in size. Two of the towns, Kurban Höyük and Lidar Höyük, and two of the villages, Gritille Höyük and Hayaz Höyük have been published to varying degrees (Algaze 1990; Ellis and Voigt 1982; Hauptmann 1993; Thissen 1983; Voigt and Ellis 1981; Wattenmaker 1998; Wilkinson 1990). The data yielded by Titriş Höyük and its surrounding sites have revealed much about the social structure and political economy in relation to the settlement hierarchy of the region. While Titriş Höyük occupied the dominant position in the settlement hierarchy, Lidar Höyük, 11 km to the north, on the left bank of the Euphrates, held the second rank (Wilkinson 1990: 100; Wilkinson 1994: 488). The Karababa basin's three-tiered settlement hierarchy composed of a centre, and several towns and villages reflects state level political organization.

The regional settlement structure of the Mid-Late EBA is markedly different from that of the Early EBA. The network of sites became more nucleated, where populations were more concentrated in fewer, but larger settlements (Wilkinson 1990). A more developed road system in the Mid-Late EBA than in the preceding period indicates that communication between settlements in the region became strengthened (Pournelle 2001: Figures 25-27).

Beyond the Karababa basin: the Upper Euphrates and northern Mesopotamia

Beyond the immediate region of the Upper Euphrates, Tell Mardikh (Ebla) was a major commercial capital located in northern Syria (Matthiae 1980) (Figure 4). The extent of Tell Mardikh's long-distance trade network is great. Texts from the Main Archive at the site list many centres in Syria from the Mediterranean coast to the Tigris valley and from Central Anatolia to the Levant. In northern Mesopotamia, cities in the Balikh and Khabur River basins are mentioned frequently. The most frequently named centre in this region is Harran, which is close to Titriş Höyük. Harran's proximity to Titriş Höyük identifies the Turkish Upper Euphrates basin's interactions with Tell Mardikh. This relationship makes Tell Mardikh's documentary evidence relevant to activities carried out by its trading partners. Furthermore, ceramic evidence from Gritille Höyük shows close ties with northern Syria, rather than with the Anatolian highlands (Stein 1987: 103).

Contradictory ceramic evidence from Kültepe (ancient Kaneš) in central Turkey does indicate communication between southeast Turkey and northern Syria during the Mid-Late EBA (Özgüç 1986). Imported vessels found at Kültepe from these two regions, and the presence of other materials from as far as southern Mesopotamia suggest that the whole of the Near East was engaged in an extensive network of interaction.

Environmental setting

Two independent paleoenvironmental studies were carried out at Titriş Höyük. Rosen and Goldberg (1995) collected geomorphological data in the 1994 field season, and Pournelle (2001) analyzed satellite imagery for the purpose of investigating the city's landscape during the EBA. Paleoenvironmental data were also collected at Kurban

Höyük (Wilkinson 1990). These researches are not only relevant to the site from which the data derive, but also to the immediate region surrounding the site – the Karababa basin.

Hydrology

In the Mid-Late EBA, two small rivers framed the north and south edges of the mound. The Tavuk Çay, a small tributary of the Euphrates River, runs along the southern edge of the mound, while the Titriş Çay flowed roughly along the northern edge. The Tavuk Çay expanded its banks during the EBA, making it ideal for the movement of agricultural products such as grain, olives and wool downstream to Samsat (Pournelle 2001:62). Silt accumulation along the Titriş Çay indicates that this river's water flow was stable during the Mid EBA and possibly into the early part of the Late EBA. However, some time during the Late EBA the Titriş Çay's water flow was reduced because it became partially blocked with overburden due to soil erosion. This soil erosion was caused by quarrying, deforestation, ploughing and animal grazing. The result was a reduced water supply to the city (Pournelle 2001; Rosen and Goldberg 1995), which would have impacted agriculturalists and pastoralists.

Wilkinson's (1994) study of Titriş Höyük supports this contention. He developed an indirect method of inferring intensive farming. This method analyzes the densities of storage vessel sherd scatters that occur within and upon the topsoil. In general, sherd density diminishes as one moves away from the site. When he applied this methodology to Titriş Höyük, he found that sparse scatters of Mid-Late EBA ceramics occur in the nearby limestone hills, which were just as uncultivable in antiquity as they are today (Wilkinson 1994: 492). This result led Wilkinson to reason that the pressure on resources forced Mid-Late EBA agriculturalists to cultivate even the most unproductive land. The model that Wilkinson develops for Titriş Höyük is one where surrounding satellite settlements in its hinterland provided agricultural resources to compensate for the centres' deficiencies (Wilkinson 1994: 504). The catchment for Titriş Höyük and its surrounding satellites is estimated to have been a 7.5 kilometre radius (Pournelle 2001: 63).

Vegetation

A trend in deforestation has been observed at Kurban Höyük and the surrounding region (Wilkinson 1990: 27, 94). Three lines of evidence point to this trend. First, archaeobotanical data suggest that wood for fuel was replaced by dung starting at the beginning of the EBA. Second, north of Titriş Höyük in the Taurus Mountains, the pollen record from lake deposits at Golbaşi indicates deforestation at around 2850 BC. Third, zooarchaeological evidence indicates a decline in the use of pigs in favour of sheep and goats between the Late Chalcolithic and EBA. This trend may have followed a climatic drying period (see below). An arid climate would have made swine production difficult since these animals thrive in wet conditions. These three lines of data converge, pointing to significant depletion of forest cover and consequent soil erosion by the beginning of the 3rd millennium. This is a trend that has continued and resulted in very little forest cover in the Upper Euphrates region today.

In addition to natural environmental deterioration, depletion of forest cover was induced by clearance for grain cropping (Pournelle 2001). Over the course of the EBA, the forests around Titriş Höyük were progressively replaced by agricultural fields and grazing land. Tree species such as oak, pine, pistachio, poplar and willow flourished during the Early and Mid EBA, but were significantly reduced in density by the Late EBA. Archaeobotanical remains from Titriş Höyük in addition to the above-mentioned species include barley, wheat, lentils, grape, fig and olive (Pournelle 2001; Schlee 1995). Of note is the much greater frequency of barley over wheat. One theory posits that this ratio may be indicative of the use of barley as fodder for animals where pastoral economies are important (Schlee 1995: 31). Grazing land in the Mid EBA replaced much of the forest cover from the Early EBA. However, grazing land during the Late EBA was slightly reduced from its previous coverage in the Mid EBA (Pournelle 2001: Figures 25-27).

Climate

The EBA climate is one of the least well-understood aspects of the Upper Euphrates natural environment. This is the reason for the following brief and general description. Today the climate in the Upper Euphrates region is very hot and dry during the summer months, while winters are cool and wet (Wilkinson 1990: 11). Snow accumulates on the ground in the winter and usually remains for 10 to 30 days per year, depending on the topographic locale. The wet season ends in May, leading to warm and dry conditions for the ripening of cereals in May and June. Though this climate is classified as semi-arid, cereals can be produced without irrigation in most years. However, the low mean annual rainfall (400-500 mm per year) does produce very low crop yields in some years (Wilkinson 1990: 13; Wilkinson 2003: 102, Figure 6.2). The climatic conditions at the end of the Late EBA were much the same as they are today (Pournelle 2001; Rosen and Goldberg 1995). However, it is not known if the onset of these arid conditions coincided with the urban decline at the end of the Late EBA, or whether they began some time before (see Courty and Weiss 1997; Weiss 1997; Weiss *et al.* 1993; and Wilkinson 1997 for discussions of late EBA climatic aridification in northern Mesopotamia).

Description of Titriş Höyük [1]

Geographical and cultural context

Titriş Höyük is located in the Upper Euphrates basin of southeastern Turkey (Figure 2). It is located 45 kilometres north of the modern city of Şanliurfa (Urfa), the capital of the province of the same name. As a small urban centre on an important trade route on the historical Euphrates River crossing point at Samsat, it served as a regional Syro-Mesopotamian capital during the Middle (ca. 2700-2400 BC) and Late (ca. 2400/2300-2200/2100 BC) phases of the EBA. In the regional chronology, this period of urbanization falls within the Kurban IV period.

Site morphology

The excavators of Titriş Höyük have divided the site into six areas, each presumably reflecting distinct functional areas within the city (Figure 5). The settlement was composed of a central acropolis of about 3 hectares in area (Area 1). An extensive lower city, about 35 hectares in size, surrounds the acropolis. The lower city is divided into a Lower Town sector (Areas 2 and 3), which extends west of the acropolis and an Outer Town sector (Area 4), which extends over a natural ridge north and east of the

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[1] Preliminary site reports have been published since 1991, but the final publication has not yet been produced. Many of the specialist reports (including one on the fauna) have not yet been submitted, making the final word on Titriş Höyük still outstanding. The description of the site that follows has been gathered from the preliminary reports and through personal communications with Dr. Timothy Matney, the project co-director, and Dr. Lynn Rainville, the micro-debris specialist.

acropolis. The excavators of Titriş Höyük observed that during the Late EBA, the Lower Town was probably a higher status area of the settlement than was the Outer Town. Supporting evidence for this argument is the Lower Town's more massive architecture, and its resiliency to an occupational hiatus that occurred between the Mid and Late EBA (Algaze *et al.* 1995: 38). Other lines of evidence to support this position include the wider streets of the Lower Town, and its greater proximity to the central tell. Rainville (2001b: 272-274) contradicts this assertion in a specific analysis of neighbourhood dynamics. Here, she concludes that the architectural variability between the 30s (Lower Town) and 80s (Outer Town) neighbourhoods is overshadowed by greater variability within each of these neighbourhoods (Figures 6 and 7)[2]. This issue will be explored in Chapter 5 (see Hypothesis V).

During the Late EBA, a massive defensive wall/moat system was built at least along the eastern flank of the Outer Town. The interior face of the wall was buttressed at regular intervals. The niches between the buttresses were used as domestic spaces (Matney *et al.* 1999: 188-189; Algaze *et al.* 2001: 33-34). Surrounding the Lower and Outer Town sectors were nine distinct areas or "Suburbs" (Area 5), which are thought to have been specialized activity and habitation areas (Algaze *et al.* 2001). One of these areas, termed the "Core Area", was the locus of a specialized lithic production workshop. It may have supplied flint sickle blades to other sites in the region during the Mid EBA (Hartenberger *et al.* 2000; Hartenberger 2002). This and the other Suburbs cover about 11 hectares, extending the total urban extent of Titriş Höyük to about 43 hectares. A Mid

[2] The 30s and 80s neighbourhoods were named after the Easting coordinate of each trench within the area. The 30s neighbourhood is composed of trenches 33/12, 34/10-13, 35/10-13, 36/10 and 36/12. The 80's neighbourhood is defined by trenches 79/84-87, 80/84-87, 81/85-87, and 82/85-88.

EBA extramural cemetery (Area 6) was located on a knoll about 400 metres northwest of the Outer Town is.

To date, a final synthetic interpretation of the functional areas of the site has not been produced. Rather, preliminary interpretations are provided in a series of preliminary reports, the last of which (Algaze *et al.* 2001) is the most detailed. Within the aforementioned report and especially the dissertation from which it is derived, the analysis of micro-debris sampled from house floor, courtyard and street surfaces serves as the most direct means of identifying food-preparation areas, craft production areas, storage facilities, and other activity areas (Rainville 2001a; Rainville 2001b).

The micro-debris analysis that was conducted at Titriş Höyük employed a sampling strategy that was far more meticulous than the general excavation strategy (see Chapter 6 for discussion). The results of Rainville's (2001b) analysis yielded the highest-resolution reconstruction of domestic life of any Upper Mesopotamian city to date. Her analysis of activity areas helped to delineate functional areas of the site at different levels of resolution. In other words, she was able to differentiate rooms within a house, houses within a neighbourhood, and neighbourhoods within the settlement. For this reason, her established site morphology is used here as template on which the animal bones are studied.

Occupational history

Regional surveys of the area indicate a sparse settlement pattern in the Early EBA. This pattern was replaced in the Mid-Late EBA by a steeply hierarchical settlement pattern that was dominated by Titriş Höyük (Matney and Algaze 1995: 47). This intensification of settlement was accompanied by increases in occupied area, population, and agricultural production. Despite our inability to estimate urban populations with certainty (Kohl 1981: 99-100; Van De Mieroop 1997: 142), an early and conservative estimate of the settlement's population during the Mid-Late EBA is 2500-5000 (Wilkinson 1990: 99). It is well established that the state's complexity of political organization is commensurate with its population density (Carneiro 1967). One would expect that an urban population operated within a political environment that had the infrastructure to support its demands. It will become clear in later chapters that this assumption has obvious and direct implications for understanding patterns of domestic animal production, distribution and consumption.

Survey and palaeobotanical evidence indicate that the greater agricultural production that was mentioned above was manifest in the manuring of fields immediately surrounding Titriş Höyük, and the development of capital-intensive crops such as grapes and pistachios. After the end of the Late EBA, the settlement population was reduced to less than 1/10 of its earlier size. This smaller population was concentrated on the High Mound at the centre of the settlement, abandoning the Outer and Lower Towns (Algaze *et al.* 1995: 39).

The Late EBA is better represented than the previous Mid EBA in most of the relevant archaeological contexts. It was common for later construction to destroy the earlier one. Since most archaeological contexts are defined by a single period, chronological controls such as stratigraphy and associated ceramics, which would be important in a diachronic analysis, are not necessary in order to conduct this research.

Regardless, a brief description of the radiocarbon chronology of the site is relevant in order to understand the sequence of formation. Thirteen ^{14}C determinations spanning the Early to Late EBA have been published (Table 1). Seven of these dates fall within the Late EBA. One derives from the western lobe of the Lower Town, while the remaining six dates were taken from the Outer Town. This small corpus of dates collected is not sufficient to generate an absolute chronology, but a general sequence has been observed (Rupley 2001). By 3000 BC, the Early EBA likely began, followed by a transition into the Mid EBA by about 2800 BC. The reurbanization period began as early as 2400/2300 BC. However, the Lower and Outer Towns as well as the Suburbs were abandoned at the end of the Late EBA, about three to four hundred years after the city's foundation. This sequence accords well with radiocarbon chronologies from other EBA sites in the Upper Euphrates basin, such as Hassek Höyük, Arslan Tepe and Norsum Tepe.

Conclusions

Titriş Höyük achieved urban status during the Mid-Late EBA. In order to deal with greater population densities, a more intricate road system was built in the Karababa basin, and Titriş Höyük erected a massive defensive wall in the Late EBA. This process of urban intensification coincided with a period of environmental aridification, which brought on a depletion of forest cover and reduced flow of the Titriş Çay. The changing environment would have impacted agriculturalists and pastoralists, and by extension, the political and economic institutions that supported them. These institutions are the subject of the next chapter.

CHAPTER 3: EARLY URBANISM IN GREATER MESOPOTAMIA

Introduction

The themes included in this discussion are those that are directly relevant to the topic at hand, given the limited scope of this research. This chapter is not meant to offer a well-rounded synthesis of Mesopotamian culture history. The intertwining topics of politics, society and economy will be subject of this chapter, but only as they relate to the spatial structure of early cities and the exploitation of domestic animals. The discussion that follows is intended to establish the rules and customs that shaped the decisions of producers and consumers of domestic animal products.

Much of the data in our knowledge base of Mesopotamian history is derived from cuneiform tablets. They are a rich source of emic information on many aspects of life, which include literature, law, religion, lexical lists, king lists, and the exchange of commodities. In the third millennium, cuneiform tablets were written by scribes who were exclusively employed by temple and palace administrators. The vast majority of the general urban populace, which included commoners of all social classes, craft specialists, the rural sector, pastoral nomads, and women, were illiterate (Stein 2001: 356). This exclusivity has resulted in a perspective that is sharply skewed toward the activities of the elite (Pollock 1999: 123). Regardless of this bias, the epigraphical evidence offers unique ideological insights into the ancient use of domestic herd animals that the faunal remains do not provide.

The body of knowledge that we possess on the archaeology of the Upper Euphrates (especially in Turkey) is minimal in comparison to what exists for many other regions of the Near East, as was mentioned in the introductory chapter. For this reason, examples will be drawn from the far reaches of Mesopotamia (Greater Mesopotamia). Of course, every effort will be made to draw from the temporally and geographically most germane sources[3] (Table 2).

Models of the state

The origin of the state is one of the most extensively published theoretical topics in anthropology. Following the work of L.H. Morgan, Engels (1891) offered an early theory of state emergence. He proposed that the development of city-states was a way of institutionalizing inequalities of control of the means of production. Later, Childe (1952) suggested that cities developed as a result of surplus agricultural production, leading to craft specialization and the development of ruling elite. However, discussion of state origins is not relevant to research concerning the mid to late EBA of northern Mesopotamia because the earliest evidence for state emergence occurs in the preceding early EBA.

The present discussion of the state will focus on the mechanisms that serve to sustain that level of social organization once it is established. Knowledge of the range of possible mechanisms that contributed to maintain state level society is crucial for understanding issues such as differential access to animal resources and productive specialization since they are directly influenced and in some cases controlled by them.

Several recent theorists have described various factors that are required in order to maintain the state. Service (1975: 15) explains that the crucial ingredient for the state to function is for it to have the power and authority to enforce its laws. Adams (1966: 14)

[3] In a rank-size analysis, Falconer and Savage (1995) argue against the static treatment of pan-Near Eastern urbanism. They indicate that great variability in urban intensity existed between Lower Mesopotamia and the Levant, and even between the Uruk and the Diyala regions within Lower Mesopotamia. The general point to be taken from their discussion is that urbanism must be studied within its own cultural context.

also identifies force as the means of maintaining order, but formally defines the state as hierarchically organized on the basis of political alliances and territorial claims rather than on the basis of kinship ties. Wright (1986: 324) is also in agreement that force is the key to maintaining the state, but focuses his definition on the "internal and external specialization of a central control apparatus".

Flannery (1972: 403-404), however, has one of the most complex definitions of the state. His definition discusses criteria such as highly centralized government that has the authority to wage war, levy taxes and exact tribute, highly stratified society, residential patterns based on occupational specialization, and lawful social order that is forcefully maintained. Redman (1978: 280-281) incorporates many of these definitions into his own. According to him, four key elements together define the conditions of state level organization: increased military power; leaders whose support base is secular, but confirmed by the religious sector; increased rate of growth of the bureaucratic institution; and growth of local and long-distance exchange networks. Finally, Zeder's (1991: 9-18) dynamic model of the state is comparatively simple by combining three key features: social stratification, central governance and economic specialization.

Society

Mesopotamian society was based on a patrilineal kinship system. A typical southern Mesopotamian extended family consisted of a father, some of his sons or brothers, and their wives and young children. Kin relations not only define gender roles, but also directly influence relevant cultural practices such as residence patterns, agricultural and pastoral production, and craft organization (Trigger 2003: 167).

Social structure

A hallmark of state society is its distinctively hierarchical social structure in which ranked groups compete for higher status and the benefits that are associated with higher status (Engels 1891; Childe 1951: 151; Adams 1966a: 79-81; Service 1975: 282-286; Zeder 1991: 11-12; Wright 1994; Stone 1997: 16). Several workers have discussed the social structure of various societies in Greater Mesopotamia. In Nissen's (1988) description of Early Dynastic social structure in southern Mesopotamian, he alludes to the emerging conflict between the religious and secular ruling classes. Nissen (1988: 103-105, Figure 42) and Pollock (1999: 189-191, Figure 7.7), in their assessments of Mesopotamian ideology, interpret the layered four-frieze scene of the ordered natural world on the Uruk Vase as a metaphorical reflection of human social hierarchy. As another example, Zeder (1991) examines how the different classes of society obtained food resources in an early urban context in highland Iran.

Households

The basic unit of socioeconomic analysis for the archaeologist is the household. The family, whose members may have a variety of links with other groups, is less easily defined (Postgate 1992: 88). Our general conception of the household is usually as a kin-based dwelling group. However, the Sumerian and Akkadian household was manifest in many different forms. At the upper end of their social scale, the temples, royal palaces and wealthy estates owned by important public officials defined the elite households, or oikos (Gelb 1979: 3-5). At the lower end of the social scale, the household was composed of either a nuclear family or an extended family living in a dwelling. This latter configuration defined the non-elite household. Non-elites are those members of society not involved in political administration and who have relatively modest resources (Wattenmaker 1998: 9).

Non-elite women cooked and cleaned the home, tended to the children, and spun and wove cloth for the family. However, the division of tasks among women in a single household varied according to how many of them lived together (Trigger 2003: 167). Non-elite men engaged in agricultural work, but not exclusively. Documentary evidence describes very poor women who were hired to haul and process grain. Other documents describe female slaves as ox drivers.

Politics

Wright and Johnson (1975: 267) define the state as "a society with specialized administrative activities." This simple explanation was originally built upon by Wright (1977: 383) in a more developed definition, which he reiterates (Wright 1986: 324). He characterizes the state as a cultural entity "with both internal and external specialization of the central control apparatus."[4]

Central control and the decision-making hierarchy

A state that is composed of a dense population, various productive sectors and a large dependent labour force is too complex for a single individual to administer. States adopt a system in which personnel in a decision-making hierarchy are individually responsible for specialized levels of control. In a three-tier hierarchy, the highest or third-order personnel are involved in making decisions about lower-order decisions instead of making decisions about any particular commodity. Second-order personnel

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[4] The ways in which Mesopotamian political elites control their subordinate populace is discussed by Stone (1997).

coordinate the orders made by the third-order personnel, while first-order decision-making personnel are directly concerned with productive and transfer activities. This type of system allows for the administration of production to be accomplished by specialists who observe, summarize, transmit, and record data, as a means of efficiently managing mass amounts of information that flow through the control hierarchy (Wright and Johnson 1975: 267).

Household autonomy and state administration

The degree to which households were permitted to control their own affairs is the topic of this section. A key concept to be understood is that as consumers are less involved in the production of a commodity, its distribution is more specialized and regulated (Zeder 1988: 9). Economic activity in southern Mesopotamia at the end of the third millennium (Ur III period) was mostly controlled by the temple and palace, with merchants acting as their agents (Neumann 1999: 44).

Rothman's (1994) investigation of agricultural production at the early second millennium B.C. southern Mesopotamian city-state of Larsa demonstrates that the state and non-state sectors producing in the same industry can pursue different economic strategies. This research indicates that small private farmers pursued a different subsistence strategy than the decision-making state institutions. The private farmer tried to guarantee himself at least minimal returns by diversifying crops and relying on date production, while the state tried to maximize its returns by increasing labour input and focusing on barley production at the expense of all other crops. In general, this case demonstrates that agricultural production in early states can operate under heterogeneous strategies (Stein 2001).

Texts from Tell Mardikh indicate that North Mesopotamian states were selective about the types of commodities that they administered. The state administered agricultural and pastoral goods, and scarce raw materials such as textiles and metals that were destined for elite consumption (Archi 2003; Matthiae 1980: 179). Commodities that were made of widely available materials were produced by households or specialists working independently of state control (Wattenmaker 1994b: 194).

Evidence from Kurban Höyük's non-elite sector suggests a contrasting level of involvement in the administration of food production. Wattenmaker (1998: 203-204) expected that non-elite households produced food independently of state control, unless the state maintained secure supply systems and demand for surplus was high. Her justification for this expectation is that widely available raw materials and goods of low prestige value would have been produced at the household level. However, her data do not directly address the level of state involvement in food production, making this conclusion somewhat conjectural. These examples demonstrate the high degree of variability of specialization and state control that characterizes early urban political economies in the Near East.

Economy

Tributary and oikos economies

Since the origin of the state in southern Mesopotamia during the Uruk period (4^{th} millennium), a tributary system was in place in order to feed the increasing demands of the elite. Tribute is a transfer of goods from a subject state to a dominant state, often by way of military force (Trigger 2003: 376). This type of wealth appropriation benefited both the urban population that required raw materials from afar, and the rural population that depended on manufactured products. However, as the rural population dwindled due to increased urban settlement in the mid third millennium in the southern alluvium, the extraction of tribute from the rural sector became less feasible.

The urban elite households developed a different system of wealth allocation as a response to this process of increased urbanization. The temples, royal palaces and wealthy estates owned by important public officials are collectively termed 'great households' or oikos, from the Greek term for *households* (Gelb 1979: 3-5; Pollock 1999: 117-123). Also of interest here is the word *economy*, which is also rooted in the word *oikos* (Kohl 1981: 105). The oikos system locally employed a large labour force and the required means of production in order to meet their demands for surplus wealth and luxury products. This system, in which a great portion of the urban population participated, was necessary in very large urban conglomerations such as Tell Asmar and Khafajah in the Diyala region of southern Mesopotamia starting in the Early Dynastic II period (Pollock 1999: 137). However, the oikos system was not adopted outside of these very large settlements. The tributary economy remained in several less developed parts of the Near East, including northern Mesopotamia during the mid-late third millennium.

The Akkadian economy

The Akkadians formed the first true empire in Mesopotamia (ca. 2350-2100 B.C.). King Sargon unified the city-states of the southern alluvium by way of military force and political, economic and ideological centralization (Van De Mieroop 2004: 60). The Akkadian polities were controlled from a central capital at Akkad. Though Akkad has not yet been located, settlement pattern data and domestic architecture from other

Akkadian contexts suggest continuity from the preceding Early Dynastic period (Pollock 1999: 9-10).

The Akkadian economy was based on two different systems of exchange. Commodities that were consumed by the elite were procured through an oikos system. As mentioned above, oikoi were composed of the elite households. The oikos employed a large dependent non-kin labour force, which included managers, labourers and slaves. The oikos controlled great numbers of productive resources, such as animal herds, pastures, fields, storage facilities and workshops (Pollock 1999: 118). This system was designed to provide surpluses for the elite, which is one of the ways in which they reinforced their status.

Contributing members of the oikos included professional farmers and shepherds, who resided at least part of the year in the city. From there, the oikos sent these specialists and their supporting labourers into the hinterland to carry out their work (Pollock 1999: 120). It was fairly common throughout Mesopotamia to employ a professional shepherd to tend the flocks (Postgate 1990: 159-163). As the responsible custodian of the herd, the shepherd was liable for the flock's welfare and its productivity. The shepherd had a strong incentive to keep the flock healthy, as he was rewarded with a proportion of the flock's produce (Postgate and Payne 1975: 2).

The other system of exchange that existed in the Akkadian economy was one of independent household production and consumption. This self-sustaining system was used by the non-elite households. In this case, many domestic products were manufactured by the household for its' own consumption, while other products were produced by specialists. The non-elite household most likely controlled pastoral production. There is no evidence for state intervention in this enterprise.

Collapse of the Akkadian empire was roughly contemporaneous with the abandonment of Titriş Höyük and the de-urbanization of the Karababa basin. As was discussed in the previous chapter, the cultural collapse at the end of the third millennium occurred at a time of environmental change, specifically climatic aridification. A leading hypothesis for North Mesopotamian cultural collapse attributes the process to an increasingly arid climate, which led to the collapse of the Akkadian economy, an institution that was heavily dependent on strong yields in agricultural production (Weiss *et al.* 1993; Wilkinson 1997). Following the collapse of the Akkadian empire, its former polities were once again united under the Ur III dynasty.

The role of Titriş Höyük in the regional economy

Titriş Höyük never exceeded 45 hectares in area as the largest settlement in the Karababa basin. Population of northern Mesopotamian cities is estimated by applying the number 100 persons per hectare (Stone 1995: 244), while the population of southern cities is derived from a coefficient of 200 persons per hectare (Adams 1965: 41, 123). Titriş Höyük's level of urbanization is modest as compared with larger settlements in northern Mesopotamia such as Tell Leilan, Tell Chuera and Tell Taya, all of which reached maximal areas of 100 hectares (Weiss 1983: 49; Weiss *et al.* 1993: 995; Wilkinson 1994: 488). An unfair comparison may be made with Uruk in the southern alluvium, which reached 400 hectares in area during the ED period (Postgate 1992: 74-75). Uruk and other very large and densely populated urban centres would have required an oikos-based economy in order to thrive (Pollock 1999). Given their modest sizes relative to other large settlements in Greater Mesopotamia (especially the South), it is unlikely that northern centres would have required an oikos economy.

It is more likely that the northern Mesopotamian states operated under a tributary economy. In fact, the existence of a tributary economy during the Akkadian and Early Dynastic periods in Greater Mesopotamia is widely attested (for example, Adams 1966a: 143; Oppenheim 1964: 117; Stein 2001).

Wattenmaker (1998: 187-188) reports that the Karababa basin during the latter half of the third millennium was no exception. In her assessment, she describes three lines of evidence for a tributary system. First, a marked intensification of food production from the previous period has been observed from studies of Kurban Höyük's hinterland (see Chapter 2). Second, as the regional capital, Titriş Höyük's immediate surroundings could not have provided enough food to support its large population. It would have had to import surpluses from other settlements. Evidence for Titriş Höyük importing agricultural surplus was found by Wilkinson (1994), whose surface collection showed a higher proportion of pottery sherds from large storage vessels at Titriş Höyük relative to that from smaller sites in the region. Third, Wattenmaker's analysis of the faunal remains from Kurban resulted in a low proportion of prime-age domestic animals. She reasons that this might indicate that these "missing" animals were exported to the centre, Titriş Höyük, in order to meet tribute demands.

The structure of the Mesopotamian city

Introduction

While the cities of the southern Mesopotamia used water courses to separate functional areas of the community, the cities of northern Mesopotamia distinguished functional space according to proximity to the citadel on the tell (Stone 1995: 243). This was expressed by elite sectors on or near the apex of the tell and non-elite residential neighbourhoods located in the lower town at the base of the tell. Knowledge of the functional areas of city is prerequisite to an intra-settlement analysis of domestic animal production, distribution and consumption. The most salient elements of the Mesopotamian city are its fortification wall, streets and other open areas, neighbourhoods, houses, and suburbs. Each of these elements is described in turn.

The city wall

Mesopotamian cities were not built from a prototype. A high degree of variability is observable between cities (Van De Mieroop 1997: 5). However, a fixture of every city was a fortification wall along its periphery. The wall was a representation of its political identity, and even the smallest city was surrounded by a wall several metres thick (Postgate 1992: 75). Within the city wall, planning was heterogeneous. The temple was usually located at the centre. Beyond the location of this religious shrine, there are few general rules that governed the structure of the Mesopotamian city (Postgate 1992: 78).

Streets and open areas

The Mesopotamian city consisted of a network of winding streets and alleys. Streets, alleys, and other common open areas are archaeologically identified by their uneven and pitted surfaces. They are often marked by damp patches and channels through which water trickled. Outdoor surfaces are often found littered with potsherds, animal bones, animal dung, and plaster. Courtyard floors are generally found to be cleaner than those of streets and other common open areas (Kramer 1979: 149).

Neighbourhoods

The city was divided into neighbourhoods, which were delimited by walls with their own outer gates. Rainville (2001b: 241) defines the neighbourhood as "a grouping of structures, streets, and/or empty lots that were recognized by their inhabitants as separate from other areas of the city." Though there are Akkadian examples of patrilineally extended families that lived in adjacent houses and shared courtyards, there is no evidence to suggest that city neighbourhoods were normally spatially organized by kin groups (Trigger 2003: 171). Examples exist of city neighbourhoods defined by ethnic groups, but there is no evidence to support the notion that city neighbourhoods were defined by wealth (Trigger 2003: 127). Moreover, households of various statuses occupied a city neighbourhood, each aligned by kinship or ethnic ties.

Houses

Just as the typical Mesopotamian city plan did not exist, there was no standard Mesopotamian house. There was great morphological variability among Mesopotamian houses. Variables that influenced the structure of a house include household demographics and population, wealth, and environmental and climatic conditions. Despite this unpredictability, Kramer's (1979) ethnographic description of houses in a traditional Kurdish village in the Zagros region of Iran is useful as an illustrative example, but not necessarily as an ethnoarchaeological analog.

She explains that the typical house in the village of Shāhābād consists of several rooms and an unroofed courtyard that is enclosed by a high wall. Most rooms in a house are rectilinear. The house can be morphologically divided into three discrete areas. The living room is used for activities such as cooking, eating, entertaining, and sleeping. A second area is used for storage. A third area is the courtyard, where animal pens, troughs, beehives, chicken coops, latrines, warm-weather ovens, and wells are usually located. Also, most houses possess kitchens, which are spatially distinct from the living room cooking area. Many houses have stables at ground level, while others have subterranean stables in the form tunnels.

Each of the domestic areas has built-in features such as troughs, hearths, ovens, and storage bins. The kitchen typically contains an oven that is sunk into the ground. Storage bins are also usually found in the kitchen. The diagnostic feature of the living room is the hearth. They are hidden beneath a carpet during the warm summer months, but are exposed during the winter.

The floor of each room is also diagnostic of its function. Living room floors are smoothed, often plastered and whitewashed. Kitchen floors are usually not whitewashed. Storeroom floors are usually only roughly plastered, often with chaff-tempered mud. Stable floors are not finished, but are lined with dung and fodder, some of which might be preserved in an archaeological context. In this ethnographic case, villagers said that the kitchen, living room and foyer floors should be annually resurfaced. However, households that do not own land may not have been able to resurface their floors every year because they did not have enough chaff to do this job properly. Based on this premise, frequency and quality of floor resurfacing may reflect economic status of the household.

Second stories on residential houses are often built to accommodate an extended family. Second stories are archaeologically visible through a stairway leading up from the courtyard, and through the secondary walling to widen, and therefore, strengthen the supporting wall.

It is generally accepted that house size is determined by household wealth and population in the ancient and ethnographic Near East (Kramer 1979: 158). The construction materials used to build a Mesopotamian dwelling are relatively inexpensive. Wood, mud, bitumen, lime and stone are widely available natural resources in many regions. The value of a house was not measured by its component parts, but rather by its location within the settlement (Postgate 1992: 89) and often by its proximity to the centre (Trigger 2003: 122).

Suburbs

Just beyond the city walls, suburban areas may contain fields, orchards and houses. As the effects of urbanization unfold, the city's expanding population can often reach beyond the carrying capacity of its walls. In these cases, the city's walls can be expanded, but this choice often comes with very high labour and material costs. The alternative is to establish suburban occupations outside of the fortification wall. The major cost of this latter alternative is a sacrifice of security (Postgate 1992: 76). Since the choice of living in suburbs depended on the demographic and political climate at any given time, occupation was often intermittent. The ephemeral nature of suburbs makes them less archaeologically visible than the continuously occupied inner city (Van De Mieroop 1997: 68).

Conclusions

This discussion demonstrates the great contributions that archaeological and philological researches have made to our understanding of Mesopotamian pastoralism and the cultural institutions of which it supported. However, most pastoral production was practiced by illiterate, non-elite members of society, and as the majority of the urban populace, these non-elites also represented most of the consumers of pastoral products. As a result of these interrelated factors, the archaeological remains of the herd animals, which represented the means of production, distribution and consumption, are the most abundant and direct sources of information about the people who engaged in the economic exchanges of herd animals. As such, a review of urban animal bone analyses is the subject of the next chapter. In subsequent chapters the animal bones from Titriş Höyük will be used as a measure of how closely its pastoral economy resembles that of the other Mesopotamian urban contexts that were discussed in this chapter.

CHAPTER 4: URBAN ZOOARCHAEOLOGY

Introduction

The purpose of this chapter is to elucidate some of the current research on animal bone assemblages as they relate to urban process. Issues such as spatial patterning, domestic production, animal resource distribution systems, and non-elite consumption will be described with the use of examples drawn from urban contexts, without regard for geographic provenance.

Art historians (for example, see van Buren 1939), epigraphers and zoologists took initial scholarly interest in the role of animals of the ancient Near East during the first half of the 20th century (Hesse 1995b: 197). It was not until the processual movement starting in the 1950s that archaeologists widely realized that cultural information could be derived from excavated animal remains (Taylor 1948). Great methodological and theoretical advances in zooarchaeology were made in the following decades. Many of these advances were applied to the Neolithic origins of animal domestication. In an assessment of the status of Near Eastern archaeology, J.N. Postgate (1992: 159) remarks that,

> "the improved methodology of animal bone and plant remains analysis has scarcely been applied to urban contexts in the Near East, but in future there is a real prospect of matching the patterns of plant and animal exploitation attested in the texts with the excavated remains…"

To date, Postgate's statement remains true. However, there have been several important faunal analyses that have advanced the status of urban zooarchaeology in the Near East.

Despite this recent trend, urban zooarchaeological research in other parts of the world, namely North America and Britain, has been more active than in the Near East.

Urban faunal analyses

Introduction to the literature

A great deal of the research concerning ancient animal exchange systems has been conducted on Near Eastern contexts (Crabtree 1989: 159). One of the most salient zooarchaeological investigations of early urban economy in the Near East is that of Zeder (1984; 1988; 1991). Zeder focuses on how the management and distribution of animal resources is affected by the origin of specialized urban economy at Bronze Age Tel-e Malyan, a centre in highland Iran. She accomplished this research through various models, all of which take into account the architectural environment. The mode of animal product distribution at Tel-e Malyan was measured by three proxies: types of animals, ages of animals, and butchery practices. Tel-e Malyan is unique because it yielded the largest and most carefully collected faunal assemblages from a Near Eastern urban site to date. Its excavators kept very accurate spatial controls and collected over 100,000 bones from three distinct, but successive cultural phases (Zeder 1988: 17).

Zooarchaeological research by Wapnish and Hesse (1988) at the Middle Bronze Age site of Tell Jemmeh in the southern Levant has contributed to our understanding of a food production system during a period of re-urbanization. This work attempted to identify whether Tell Jemmeh functioned to produce animal resources for a larger settlement, whether it consumed animal resources from the rural hinterland, or whether it self-sufficiently produced and consumed most of its own animal resources. Their attempt to identify the production and consumption system at Tell Jemmeh failed, but they succeeded in determining that caprids were mainly raised for milk production.

The exploitation strategy taken by pastoral specialists is a central issue to urban subsistence. Payne's (1973) seminal study of mortality profiles based on ancient and modern sheep and goat mandibles and mandibular teeth outlines the zooarchaeological correlates for each of meat, milk and wool productive foci. Sherratt (1983) contributes the theoretical structure for the study of secondary products. Several notable studies subsequent to these two foundation studies combine Payne's methodological and Sherratt's theoretical frameworks in the examination of secondary products exploitation. All of these works will be elaborated upon in the discussion that follows.

Faunal analyses from beyond the Near East

Urban faunal analyses from data pertaining to cultural contexts outside of the Near East have examined relevant issues such as intra-site spatial patterning (Becker 1998; Hayden and Cannon 1983; Price 1985; Wilson 1989; Wilson 1994), status (Bellantoni *et al.* 1982; Brenner and Monks 2002; Crader 1984; Drucker 1981; Ijzereef 1988; Ijzereef 1989; Milne and Crabtree 2001; Pohl 1994; Reitz 1986; Reitz 1987; Rothschild and Balkwill 1993; Schulz and Gust 1983; Singer 1985; Thomas 1999), non-elite consumption (Crader 1984; Drucker 1981; Milne and Crabtree 2001), and economic systems (Crabtree 1996; Halstead 1996; Maltby 1984; Maltby 1994; O'Connor 1989). These publications examine data from urban contexts in Britain, Eastern Europe, Mediterranean Europe, historic (post-European contact) North America, and Mesoamerica. This list of references is not intended to be exhaustive or comprehensive.

Rather, these are some of the most prominent examples from geographic regions outside of the Near East. Some of these will be elaborated upon in the discussion that follows.

Substantive implications

Theories of urban development have zooarchaeological implications. Since towns and cities require food production from its community and its hinterland, control of this larger area is necessary. Bureaucratic control of pastureland, marketing, and butchering facilities must be held in order to maintain an urban structure (O'Connor 2000: 160-161). The bones of livestock that are recovered from an urban context may have been raised locally or off-site. Since a proportion of the consumer population abstained from producing their own food, one may expect an uneven allocation of food to these non-food producers. The mechanism of marketing or redistribution creates the potential for significant differences in the quantities, types, parts and ages of animal products that are acquired by various households or neighbourhoods. Consumers can be provided with food through large-scale redistribution, through market exchange, and through individual exchanges between producers and consumers (Crabtree 1989: 158; Postgate 1992: 191). This differential access may be indicative of the degree of control, power and wealth exercised by a particular segment of the urban population (O'Connor 2000: 160-176; Van De Mieroop 1997: 142-145).

The spatial pattern of animal bone deposits may carry pertinent information about the taphonomic characteristics of the context (Meadow 1978b) and about the activity areas[5] in which the bones were deposited (Price 1985). With respect to this latter phenomenon, the configuration of faunal deposits may indicate whether the remains were deposited as household waste or as refuse from a larger-scale butchering activity. In addition to the remains of subsistence animals, urban faunal assemblages contain the remains of companion animals such as dogs (Harcourt 1974; O'Connor 1992; Wapnish and Hesse 1993), and commensal fauna such as rodents (Brothwell 1981; Ervynck 2002; Morlan 1994; Redding 1978; Tchernov 1984) and birds (Dawson 1969; Tchernov 1984). Thus, urban faunal assemblages have the potential to provide information about the social and economic structure of an urban site and its rural hinterland, about the function of different spatial divisions of an urban site, and about the wider urban ecosystem (O'Connor 2000).

Post-depositional taphonomy

Before one can attribute an observed pattern to a cultural process, one must first consider if one or more post-depositional taphonomic agents produced it. Between the time of deposition and recovery several agents have the potential to significantly deplete the original deposited population (Lyman 1994). Carnivore gnawing, weathering, preservation, and the excavator's strategy are some of the ubiquitous non-cultural, post-depositional taphonomic factors at play.

Bone structural density, which has great implications for bone survivorship, is an important factor to be considered in this respect. Experimental work on sheep skeletons shows that, in general, structural density of most bone elements increases as the animal

[5] After Kent (1984: 55), an activity area is defined as any locus at which a particular human event has occurred one or more times.

matures (Binford and Bertram 1977: 108). However, this trend is complicated by the fact that during maturation different bone elements increase in density at different rates. This finding translates into differential survival properties of different elements of different ages. Prior to this experimental research, Brain (1967; 1969) conducted ethnoarchaeological research in a Hottentot village, which sought to identify how bone density influences element survivorship. However, his study did not take into account bone maturity. Regardless, recent research confirms Brain's initial conclusions that low-density bones are more often ravaged by carnivore scavengers than high-density bones (Lyman 1994: 236).

Meadow (1978b) explains that after an animal is processed by skinning, disarticulation and cooking, some of these procedures often leave traces on the bone in the form of cut marks, chop marks, breaks and colour change. Since different procedures will often be carried out in different contexts, bones may become widely scattered. Disposal at the site of preparation or consumption is termed *primary disposal*[6]. Meadow contrasts the situation where the location of final discard is not the original location of use, but instead, bones are transported some distance from this location. These locations are called *secondary disposal* sites. Post-depositional processes like erosion and redeposition are termed *tertiary deposition* processes. Meadow applies this taxonomy to the Neolithic village of Hajji Firuz. He found that interior (sheltered) contexts protect the deposited faunal remains from dog scavenging and the weather, while exterior (open-air) contexts leave the bones exposed to these agents, which results in a significant preservation bias (Meadow 1978b: 16).

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[6] Meadow's (1978b) trichotomization of refuse disposal patterns is largely based on the work of Schiffer (1972).

Animal production

Two fundamental issues of animal production are investigated here. First, were animal resources produced in and around the city or were they produced in the rural hinterland? Second, was the pastoral economy focused on certain commodities such as meat, milk, or wool, or were herd animals exploited in a broad-spectrum strategy?

Production and consumption systems

Wapnish and Hesse's (1988) work has produced three distinctly testable models for the production and consumption system at Tell Jemmeh. In the self-contained production/consumption model, the community produces and consumes all of its own animal products. In the producing economy model, animals are produced for both local and external consumption. In the consuming economy model, animals are acquired from pastoral specialists, but may be supplemented by local flocks (Wapnish and Hesse 1988: 84). Each of the three models are known by signature mortality profiles for a given animal species.

Zeder (1991) found that the mode of production of animal resources was less easily measured. Much like Wapnish and Hesse (1988), Zeder found the range of species to be the best measure of animal resource production strategies, followed by age distributions. Beyond these two proxies, faunal data are limited in their capacity to reflect production strategies (Zeder 1991: 248). The problem is that it is often difficult to distinguish the role of pastoral management concerns from the influence of provisioning goals.

As a proposed remedy, Zeder suggests that it would have been more profitable to sample occupation areas that were more likely to have had direct access to animal resources (i.e., lower status areas). Her rationale is that faunal assemblages from these contexts have greater potential to yield information about production strategies because in these cases the influence or interference of the redistribution mechanism would not have been a factor (Zeder 1991: 249).

Productive specialization

Domestic livestock are raised for a variety of products, the combination of which are dependent upon productive strategy. Some time following the Neolithic period, pastoralists in the Near East began to exploit secondary products, such as milk, wool, traction, transportation and dung, in addition to the primary products of meat, hide, sinew and bone. By the Early Bronze Age, pastoralists were specializing in the production of one or more products. An examination of productive specialization not only has economic implications, but also has dietary and technological implications.

The basic models of productive specialization, originally proposed by Payne (1973), are as follows. In a meat producing economy most male livestock will be culled before they reach maturity at the point at which they achieve optimal weight gain. A small fraction of the male herd will be kept for reproduction. Most female livestock will be culled during adulthood when their reproductive capacity dwindles. When milk is the productive emphasis, herders will keep a large supply of lactating adult females. Male livestock are less predictable in this model. If wool or hair production is the primary objective of the herder, then male and female livestock will generally be harvested in adulthood.

Several case studies deserve mention. A mixed meat/dairy culling strategy for cattle is thought to have been practiced at the Romano-British towns of Dorchester and Winchester (Maltby 1994: 100). Here, female adults and male calves were strongly represented relative to other sex-age classes. In another cases, Greenfield (1988) identifies the origin of secondary products exploitation in the central Balkans; Wapnish and Hesse (1988) identify milk as the productive emphasis at Tell Jemmeh during the Middle Bronze Age; and O'Connor (1989) found a reliance on the milk of young cattle at York toward the end of the Medieval period.

Animal distribution

The distribution of meat and other animal products should produce a pattern of faunal assemblages at both producer and consumer sites (Crabtree 1989: 158). Previous investigations of these issues have used three zooarchaeological correlates: species diversity and ratios, age distributions, and body part distributions (Maltby 1984; O'Connor 1989; Wapnish and Hesse 1988; Zeder 1991).

Zeder initially predicted that indirect distribution of meat would be visible through restricted species diversity and selection for species that best suit provisioners' goals. However, this measure is not successful because of the limited range of domestic species that was available to all early Near Eastern societies. Further, as was mentioned earlier, Zeder found it difficult to distinguish the role of animal management concerns from the influence of provisioning goals when evaluating the types of animals (Zeder 1991: 246).

A more accurate measure of the mode of meat distribution proved to be the age distributions. Zeder predicted that indirect distribution of meat would be visible through a focus on a single age group of caprids. That age group was predicted to be the one that would provide the greatest meat yield for labour and forage investment (Zeder 1991: 247). At Tel-e Malyan, contexts with the most restricted age groups were found in specialized administrative and economic activity contexts. These were interpreted as households that engaged in indirect distribution. Broader age curves from other spatial contexts indicated direct distribution of animal resources (i.e., obtained directly from the herder or produced by the household).

Zeder's third measure for the mode of distribution was the selectivity of body part distribution and standardization of butchery. In one context at Tel-e Malyan, she found a focus on medium mammal limb bones, which indicated indirect distribution. In a different context, a high representation of medium mammal cranial elements suggested that this area of the settlement was a conduit for channelling caprids into the city. At Tell Jemmeh, body part distribution data was also used for identifying differential distribution. In this case all parts of the carcass of all the major food animals (caprids, cattle and pigs) were represented in anatomically expected proportions (Wapnish and Hesse 1988: 93). Body part selectivity and systematic butchery have been observed at Tower St. in Romano-British Cirencester (Maltby 1984:130-132). An initial butchery waste midden revealed a large number of low meat utility cattle skulls, mandibles and metapodia, in addition to some meat-bearing limb bones. These limb bones were consistently split axially and displayed evidence of stripping, which suggests that both marrow and meat were exploited.

Animal consumption

There are potentially many pre-depositional (or biotic and thanatic) taphonomic processes that can contribute to the condition of the deposited assemblage in addition to the previously discussed post-depositional taphonomy (Figure 1). Our present understanding of how these ancient behaviours determine archaeological context is most often credited to the seminal work of Schiffer (1972). He explains that during the life of an activity area people procure, prepare, consume and discard food and other consumables. This sequence and each stage within it leave a signature faunal assemblage in the archaeological record.

However, the excavated remains of an occupation area are by no means a *direct* reflection of past activities[7]. Binford (1968) was perhaps the first worker to offer the notion that the archaeological record is incomplete due to various deteriorative processes. The assumption that all material excavated from a floor or courtyard surface are the *primary* refuse of ancient human activities has been extensively questioned since Binford's initial statement (as examples, see Kent 1984; Schiffer 1972; Schiffer 1976). This critique holds that "unless one is certain that most refuse was discarded in one locus or that all faunal remains were treated in a similar fashion, it is unwise to assume that the remains from a single locus accurately reflect human preparation, consumption, and disposal behaviour from the site as a whole" (Price 1985: 55).

[7] The notion that the spatial distribution of artifacts and faunal remains *is* a direct reflection of past human activities was expressed by Watson, LeBlanc and Redman (1971: 117).

Ethnoarchaeological research has shown that regular cleaning of floor surfaces tends to remove large bones (> 3 cm), while smaller bones and bone fragments will often be swept into corners or trampled into surfaces (O'Connell 1987: 104; Price 1985: 55). The implication is that smaller remains are more likely to become *primary* refuse. Larger materials are usually deposited in close proximity to the use area, thus making them *secondary* refuse (Schiffer 1983: 679). In addition to cleaning activities during the use life of an activity area, several post-abandonment activities such as refuse disposal, carnivore transportation, and animal intrusion may be responsible for introducing large bones back onto floor or courtyard surfaces.

Ethnographic research on refuse disposal behaviour has shown that animal bones and other organic refuse are discarded in a "casual" manner, usually in close proximity to the location of use (Hayden and Cannon 1983: 126). In urban contexts, bones are commonly discarded in a street or a courtyard adjacent to the location of use, or even in a neighbourhood dump or in a river if it is in close proximity. Cases of organic refuse being moved beyond the neighbourhood are unusual due to the great effort required to transport garbage. Furthermore, since animal bones are prone to deteriorative effects such as carnivore scavenging and weathering, and since they do not hinder activities as sharp lithic detritus does, minimal effort is required to dispose of animal bone refuse (Hayden and Cannon 1983: 154). Moreover, it is a safe assumption that the final discard location of animal bone refuse was somewhere within the same neighbourhood within which it was originally used.

Becker (1998) provides a case study of animal bone spatial patterning. Three excavated houses at the Late Bronze Age site of Kastanas in northern Greece were quickly abandoned when a fire destroyed them. These contexts are especially conducive to a spatial analysis because the houses were only occupied during a single period of time, the inhabitants of the houses left much of their refuse behind, and a thick layer of ash provided optimal preservation until archaeologists recently excavated them. The spatial analysis showed that one building was perhaps used as a communal storage facility, while the other two buildings were family dwellings.

Ijzereef (1989) used faunal remains from cess-pits to distinguish Jewish from non-Jewish (i.e., kosher from non-kosher) households in 17^{th} and 18^{th} century Amsterdam. Household ethnicity was primarily identified by the quantity of pig bones present. Ijzereef was also able to develop a scale of wealth based on the types and parts of animals present in the household cess-pits. The wealthy mostly ate high meat-yielding cattle limbs, chicken, turkey, goose and tuna, while poor households were characterized by a more restricted array of species, which mostly included highly fragmented cattle and sheep bones, most of which were cranial and low meat-yielding lower limb elements (Ijzereef 1989: 48). This case demonstrates that intra-site faunal analyses can contribute to substantive issues such as ethnicity and status.

Conclusions

This discussion explored the salient scholarship on urban zooarchaeology. The topics that were reviewed were post-depositional taphonomy, domestic animal production, animal resource distribution systems, and animal bone spatial patterning. In the next chapter, the models that were described in this one will be reframed as testable hypotheses to address the pastoral economy of Titriş Höyük.

CHAPTER 5: TESTABLE HYPOTHESES, METHODS, AND TECHNIQUES

Introduction

The models devised in the preceding chapters concerning regional background, early urban societies in Mesopotamia, and urban zooarchaeology will be used to construct testable hypotheses about the pastoral economy at Titriş Höyük in this chapter. The predictions that follow are grounded in well-established models. Following this section, the methods and techniques that are employed in the analysis will be described. Faunal data from Titriş Höyük will be used to assess their efficacy in the next chapter.

Hypotheses

Post-depositional taphonomy

As explained in the previous chapter, before one can begin to understand how ancient human behaviours contributed to the archaeological record, one must first have a grasp of the various taphonomic processes affecting the material following original deposition. Though the following hypothesis cannot account for all of these potential processes, as no single model can, it will address a central issue in urban archaeology - architectural context.

Hypothesis I: *The observed differences in the faunal assemblages between open-air and sheltered contexts are attributable to differential post-depositional taphonomic histories.* Given that post-depositional taphonomic agents differentially affect open-air contexts and sheltered contexts, the following expectations would verify this hypothesis.

a. In open-air contexts, one would expect a greater than expected representation of structurally dense elements such as distal humeri, proximal radii, and distal tibiae, and mandibles relative to less durable elements (Brain 1969).

b. In sheltered contexts, one would expect a greater than expected representation of less durable and more carnivore scavenging-prone elements such proximal humeri, distal radii and proximal tibiae relative to more durable elements (Brain 1969).

Once the post-depositional taphonomic impact on the assemblage is established, one may then look for cultural processes that may have also contributed to the observed patterns. Some of these cultural processes are the subjects of the other hypotheses.

Animal production

Production and consumption systems

A central issue in studies of household economy is the degree of specialization and centralization. This issue may be addressed by examining the nature of production and distribution of animal products. In order to understand the variable distribution of animal remains across different parts of the settlement, one must first have an understanding of the means by which animals were produced. Were domestic herds raised off-site, and then shipped to Titriş Höyük, or were these herds raised within the settlement? If herds were produced on-site, were individual households raising their own animals for their own subsistence, or was animal production a specialized activity carried out by a limited number of expert herders and butchers? The overarching issue of the nature of the animal production system at Titriş Höyük must be established in order to address behavioural issues related to variable distributions of animal products.

Hypothesis II: *Given Titriş Höyük's paramount position in the regional settlement hierarchy, it was most likely a consuming economy.*

This hypothesis will be tested using the mortality models devised by Wapnish and Hesse (1988). The faunal data from Titriş Höyük should reflect one of the following classifications, as devised by the aforementioned authors.

a. In a self-contained economy animals are both produced and consumed locally. Their mortality profiles should include all age classes.

b. In a consuming economy animals are acquired from pastoral specialists for the most part and raised locally to a lesser extent. Their mortality profiles should include an abundance of market-age animals and relatively few animals of reproductive age.

c. In a producing economy mortality profiles should reflect neonates and accidental and disease-related deaths, as well as older animals.

Productive specialization

An important issue in studies of pastoral economies is the emphasis of production (Greenfield 1988; Payne 1973; Sherratt 1983). Was the focus of production on primary products (meat), or was it on secondary products (milk, wool, transportation, traction)? An examination of this issue not only has economic implications, but also has dietary and technological implications.

Hypothesis III: *The productive emphasis at Titriş Höyük will be identified by signature mortality profiles of sheep, goat and cattle.*

This hypothesis will be evaluated by following the models devised by Payne (1973). His three models for meat, milk and wool emphasis are presented below. Though Payne's models distinguished between the culling rates of males and females, the data do not lend themselves to such precise analyses because reliable identification of sex was not possible for the vast majority of specimens identified to date. Instead, following Greenfield (1988: 574-475) the mortality profiles for both sexes will be combined in the analysis.

a. In a meat producing economy, most male livestock will be culled before they reach maturity at the point at which they achieve optimal weight gain. A small fraction of the male herd will be kept for reproduction. Most female livestock will be culled during adulthood when their reproductive capacity dwindles.
b. When milk is the productive emphasis, herders will keep a large supply of lactating adult females. Male livestock are less predictable in this model.
c. If wool production is the primary objective of the herder, then male and female livestock will generally be harvested in adulthood.

Animal product distribution

The greater the state's scale of urbanization and the more consumers are removed from production, the more specialized and centralized are the distribution of its animal products (Zeder 1991: 33). This is especially true if demand for certain animal products is high. This assumption leads to the following hypothesis.

Hypothesis IV: *Given that Titriş Höyük was a regional capital and therefore by definition, highly urbanized, it is expected that consumers acquired animal products indirectly through specialized and centralized distribution rather than directly through individually self-sufficient household production.*

This hypothesis will be supported if the following hold true:

a. One would expect a low diversity of species, a relatively restricted age distribution of each species and a low diversity of each species' skeletal elements.
b. One would also expect to find a greater emphasis on species that would have been easily managed in large numbers.
c. Given that a skilled butcher has considerable knowledge of anatomy, butchery marks are expected to exhibit a high degree of standardization. This will be visible in the faunal material through consistent marks on the same locations on bone elements.

Animal product consumption

The exchange of animal products between producers and consumers within the settlement is the issue to be addressed here. A common feature of complex societies is productive specialization, for which we expect to find archaeological evidence for the allocation of food to non-food producing specialists. As the last hypothesis put forward, consumers can acquire food through large-scale redistribution by a centralized mechanism, through market exchange, or through individual exchanges between producer and consumer. The means by which food is distributed should produce a pattern in the faunal assemblages of both producers and consumers. By examining the range of exploited species, the relative importance of the different species, slaughter patterns and age ratios of the important domestic species (Crabtree 1989: 159) between spatially discrete areas of the settlement, the nature of intra-site animal product exchange at Titriş Höyük is identified.

Two neighbourhoods within the walls of the settlement will be analyzed in a comparative approach. The 30s neighbourhood in the Lower Town and the 80s neighbourhood in the Outer Town were established by Rainville (2001b) (Figures 6 and 7). They not only represent contiguous trenches to the archaeologist, but they were probably also considered to be parts of neighbourhoods in antiquity. It should be noted that the samples of excavated trenches only represent portions of neighbourhoods, not entire neighbourhoods. To reiterate the discussion from Chapter 2, the 30s neighbourhood is thought to have been of higher status than the 80s neighbourhood (Algaze *et al.* 1995: 38). However, Rainville (2001b: 272-274) debates this assertion by arguing that architectural differences between the two neighbourhoods are negligible. Having established the parameters of this part of the analysis, the faunal assemblages from the 30s and 80s neighbourhoods are compared in order to verify the validity of either notion.

Hypothesis V: *Given that the mechanisms of production and distribution of animal products creates the potential for differences in the quantities, types, parts and ages of animals that are acquired by households, differential access to animal products between neighbourhoods is expected to have contributed to the observed variability in the horizontal spatial distribution of the faunal assemblage.*

This prediction will hold true if the results show the following:

a. The 30s neighbourhood will display significant evidence for the exploitation of hunted animals, relatively high frequencies of prime age animals and of high meat-yielding body parts;

b. By contrast, the 80s neighbourhood will display no significant evidence for the exploitation of hunted animals, as this activity does not fit into the risk-lowering strategy of the typical non-elite household. The 30s neighbourhood will contain relatively low frequencies of prime age animals and high meat-yielding body parts.

Field recovery methods

Titriş Höyük was excavated in the Near Eastern tradition. Different features such as architecture, pits or changes in soil colour were assigned individual locus numbers. Within each locus number, the faunal remains were assigned a unique sample number. In terms of spatial resolution, the site was sampled in such a way that an excavated object can be accurately provenanced to a locus. This level of resolution provides the opportunity for a comparative examination of animal remains between neighbourhoods, but not between rooms of a building, nor between buildings in a compound, nor between compounds in a single neighbourhood.

Sieving experiments have shown that the rate of recovery of micro-fauna (taxa smaller than a rat) increases dramatically with the introduction of a 10-millimetre mesh sieve, as compared with the rate of recovery by hand collection (Clason and Prummel 1977). Since the taxa under investigation here are medium- and large-sized animals, the recovery of lizards, rodents and fish are of little consequence. However, sieving is crucial for recovering small elements such as carpals and tarsals, and small fragments of larger elements. Precise and controlled recovery methods of primary contexts are especially important in Near Eastern urban contexts, where the most frequently used excavation tools are the shovel, pickaxe and trowel.

At Titriş Höyük dry or wet sieving was mandatory for all well-preserved phases below the plough zone. This practice negates the type of sample bias described by Payne (1972). Dry sieving was accomplished with a 5-millimetre wire mesh screen. Primary contexts, such as occupational deposits directly over floors or surfaces, and pits cut from such surfaces, were sampled at a rate of 100 percent. This ratio may have been decreased to 25 percent if it appeared that results were disappointing or if the volume of deposits was overwhelming. However, flotation was performed on all material from primary contexts. Secondary deposits, such as deliberate fills and collapsed walls in well preserved phases were sampled at a rate varying from 10 to 25 percent, but sampling of such deposits was discontinued if results were meagre. Material from secondary and tertiary deposits was dry-sieved when appropriate (Algaze *et al.* 1995: 28; Greenfield 2002: 253; Matney, personal communication).

As a comparison, Rainville's (2001a, 2001b) sampling strategy for collecting the micro-debris, which she used in a comprehensive spatial analysis of the functional organization of the settlement, was far more meticulous. The micro-debris sample was collected only from well-preserved (*in situ*), primary and secondary context surfaces such as house floors, streets and courtyards. The sample was collected by laying down a grid (40 x 40 cm squares) across a given surface. All soil was collected for flotation. The mechanical flotation process used four screens of variable mesh size. After the material was sorted according to class (fauna, flora, ceramic, etc.), densities for each were calculated, and then plotted back into space. This strategy, in contrast to the general excavation strategy, afforded the opportunity to conduct a precise and systematic high-resolution spatial analysis.

Zooarchaeological methods

The hypotheses that have been outlined will be tested with certain zooarchaeological and spatial analytical methods and techniques. The details of these methods and techniques are the subjects of this section. The most common zooarchaeological methods used in this analysis are identification of bone element and taxon, determination of age at death, bone measurement, determination of sex, identification of pathologies, and pre- and post-depositional taphonomic biases. These methods will be employed by performing certain techniques, two of which deserve explanation: bone quantification and mortality profiles.

Identification

The strategy taken in the identification stage was to record as much data as possible about each bone sample. Each specimen was identified to the lowest possible taxonomic level. Identification was facilitated by the University of Manitoba Anthropology laboratory's faunal reference collection. The bones were identified to the specifications outlined by the Titriş Höyük faunal code (Greenfield 2001), a system that is based on the code of Meadow (1978a). All identifications were recorded in a Microsoft Excel spreadsheet. Some of the most important analytical categories (fields) include taxon, anatomical element, element part, fragment size, side, age, bone fusion, degree of weathering, butchery traces, cultural modification, gnawing, burning, and pathology.

The identification of taxon is of the greatest importance. In aspects where the reference collection was deficient, certain key pieces of literature were used. Schmid's (1972) atlas was used to generally distinguish between taxonomic Families. The atlas of Sisson (1914) was used as an auxiliary identification guide. Distinctions between large cervids and large bovids were facilitated by the work of Prummel (1988). Distinguishing morphologies between medium cervids and medium bovids was identified with the aid of

Lawrence (1951) and Stampfli (1983). Where possible, sheep and goats were distinguished using the criteria proposed by Boessneck (1969), Boessneck *et al.* (1964), Clutton-Brock *et al.* (1990), Halstead *et al.* (2002), Payne (1969), Payne (1985), Prummel and Frisch (1986), Reed and Schaffer (1972) and Stampfli (1983). As is common in Near Eastern faunal analysis, the term *Ovis/Capra* was used to describe sheep or goat specimens that could not be distinguished, which was a common occurrence. Where a specimen could not be identified to a low taxon, it was assigned a size category of small, medium, or large animal. If a specimen was fragmented to such a degree that a size class could not be defined, its taxon was described as unidentifiable.

The bone element (i.e., left humerus, right radius, rib, phalange) was also identified. In cases where the element could not be identified, a general element type such as long bone, flat bone, or compact bone was assigned. The field of element part was most useful for defining the portion of the bone that is preserved. Long bones often fracture along several points of weakness, which result in three types of parts: proximal ends, shafts, and distal ends (Hesse and Wapnish 1984: 73). In addition, the face of the bone element was described (i.e., anterior, posterior, superior, inferior). Whole teeth are often easily identifiable to taxon and location in the dental arcade. It is more difficult to identify fragmentary teeth, especially small portions of ungulate cheek teeth. A numerical classification system for the recording of tooth categories was used in order to facilitate subsequent analysis.

Age at death

Several important works aided in establishing the age at death of individual specimens. For mandibular teeth of cattle, sheep, goats, and pigs, the wear stages of

Grant (1975) and Payne (1973) were used. The work of Payne (1973) is of particular importance for the establishment of mortality profiles of domestic herds. His landmark study of archaeological and modern sheep and goat mandibles and mandibular teeth from Aşvan Kale, Turkey was used as the basis for the age classification system used in this research. For the maxillary teeth of ovicaprids, Crabtree's (1982) methods were used. For the maxillary teeth of cattle, Greenfield's unpublished eruption and wear sequence was used. Eruption and wear stages for all other animal taxa followed the simplified recording system of Ewbank *et al.* (1964). Age determinations based on the rates of epiphyseal fusion of post-cranial elements was based on the work of Silver (1969). Age estimates based on horn core surface texture followed research on British longhorn cattle (Armitage 1982). As a secondary method of age estimation, the presence and severity of muscle markings were recorded. Due to the range of variation around published timings of bone fusion and tooth eruption and wear, there is considerable difficulty of assigning precise numerical ages to individual specimens. As a remedy to this issue the recording of age used a relative, descriptive classificatory system rather than an absolute numerical one. Four general age classifications were employed: *infant*, *juvenile*, *sub-adult*, and *adult*. When more precise determinations could be made with confidence, these ages were prefixed with *young*, *middle*, or *old*.

Osteometry

Osteometric analysis, one of the most effective tools at the zooarchaeologist's disposal, can aid in various types of identification (Albarella 2002: 51-52). When morphological features cannot serve to distinguish closely related taxa, metric differences may be useful in drawing distinctions (Davis 1987). Measurements may also help to identify sexual dimorphism and age-related variation. The most widely used animal bone measurement guide and the one that will be used here is that of von den Driesch (1976). In addition to those outlined by von den Driesch, several published (Bartosiewicz *et al.* 1993; Beasley *et al.* 1993; Payne 1969) and unpublished measurements have been appended to the repertoire. Measurements were taken with dial calipers, but a measuring box was used when necessary.

Sex determination

The identification of sex can be accomplished on morphological and metrical grounds. The most basic methods for determining sex use the presence of bacula, cervid antlers and pig canines (Ruscillo 2003). However, these characters are irrelevant for determining the sex of bovids. Sex determination based on metrics should use bone elements that exhibit high sexual dimorphism and low age-related size variation (Howell-Meurs 2001). Characters with these traits include the height of the lateral wall of the acetabulum of the innominate, the distal metacarpus, the astragalus and the horncore of bovids. Parts of elements that exhibit sex-related morphological variation include the transverse processes of the atlas; the spinous process of the axis; the pubis, the medial wall of the acetabulum, and the medial termination of the muscle pit for the musculus rectus femoris of the innominate; and the horncore of bovids (Armitage 1982; Bartosiewicz *et al.* 1993; Boessneck 1969; Grigson 1982; Stampfli 1983).

Pathology

Evidence of pathology was also recorded. This type of data can be used for assessing the health and disease of animals. Since animal husbandry practices can directly impact the welfare of domestic herds, such information is of great potential value (Hagan and Bruner 1951; Siegel 1976). However, for several reasons it is difficult to identify and diagnose pathological conditions from archaeological fauna. The most prominent reasons for this difficulty include the inability to link a pathology to a specific disease, the fact that many diseases do not leave traces on hard tissue, and the phenomenon where pathological bones generally do not preserve as well as "healthy" bones (Hesse and Wapnish 1985: 82). Regardless, evidence for pathologies was sought despite their low frequency of identification. This field was recorded in a descriptive manner. Prevalent pathological conditions that were observed in the sample include healed fracture, osteoarthritis, exotosis and dental malocclusion (Figure 8).

Post-depositional taphonomy

The degree of surface weathering, the presence of calcium carbonate, the presence of rodent and carnivore gnawing (Figure 9), and the presence of rodent remains in primary contexts are the criteria that were recorded as a gauge of post-depositional taphonomic bias across the assemblage. In the analysis of the faunal assemblage these criteria were the main source of information for assessing the impact of non-human factors. The four-stage recording system for weathering used here is loosely based on the six-stage system of Behrensmeyer (1978) (see Figure 10 for an example).

As discussed earlier in this chapter, the variable impact of carnivore gnawing, perhaps the leading post-depositional taphonomic agent in an urban environment, is assessed through a comparison of expected and observed bone element frequencies for sheltered and open-air contexts. The frequency is expressed as the percentage of the expected number (MNI, see below) actually observed. The expected number of bones is known through the ethnoarchaeological work of Brain (1967; 1969). Since different ends of individual longbone elements have different densities, and therefore different susceptibilities to post-depositional taphonomic agents, it is necessary to define parts of each element based on structural density. The definitions used in this analysis are borrowed from Binford and Bertram (1977: 108). Following the recommendation of O'Connor (2000: 71), only a subset of the full range of elements is used in this dataset. The rationale for this decision is that many skeletal parts are contentious in terms of definition and counting, and their inclusion might only contribute ambiguous information.

Pre-depositional taphonomy

Though human-induced modifications such as burning, fracture and butchering are important for assessing pre-depositional taphonomy of the faunal assemblage, these criteria will also be used to investigate food processing. The presence of burning may indicate which body parts were roasted. A locational analysis of cut and chop marks with an understanding of muscle, tendon and ligament relationships in the main subsistence animals is used to yield important information about butchering patterns (Figure 11) (Dumont 1987; Luff 1994; Lyman 1977; O'Connor 1993). However, a limitation of this assemblage is the invisibility of fine cut-marks and other surface modifications due to the masking effect of encrusted calcium carbonate. Another criterion that was used to identify cultural modification to bone, but one that is unrelated to food processing, is surface polish. While a consistent pattern of polish over the entire surface of a bone may indicate fluvial action, polish restricted to a location on a bone may indicate that it was used as a tool or an ornament.

The final location of discard is another criterion for assessing pre-depositional taphonomy, but one that employs a primarily spatial analytical method. In this case, the spatial distribution of the assemblage is analyzed with respect to species, body part, and age at death. In an ideal situation, this spatial analysis would occur at various levels of resolution – between rooms within a house, between houses within a compound, between compounds within a neighbourhood, and between neighbourhoods within the city. However, because of the issues related to the regular cleaning of house floors that were discussed in Chapter 4, the faunal assemblage is not conducive to a spatial analysis at these different levels of resolution.

The spatial analysis of the faunal remains conducted in the present research only occurs between neighbourhoods. The reasons for which only this gross-level spatial analysis is feasible, and not any higher-level analysis, are twofold. First, site formation theorists posit that in urban contexts refuse is rarely discarded at its location of use (Schiffer 1972: 161-162). Butchers do not permanently dispose of their refuse on the shop floor, and households do not permanently dispose of their refuse on the kitchen floor. In other words, there are almost no primary contexts at urban sites. In the process of floor cleaning, this material is transferred to a secondary refuse area, such as a pit, street, courtyard, dump or river. Second, Rainville's (2001b) micro-debris analysis at Titriş Höyük, which includes micro-sized faunal remains, stands as the most direct and systematic functional analysis of the city at different levels of spatial organization. Moreover, to conduct room-, house-, or compound-level spatial analyses with the faunal assemblage would be dubious and redundant. Thus, only a comparison of the faunal assemblages between neighbourhoods is appropriate. This analysis will use the spatial delineations of the neighbourhoods established by Rainville (2001b).

Technique

Quantification

Several analytical techniques are used in this research. Quantification of taxonomic abundance is one of the crucial steps since this data will be applied in many subsequent analytical stages. Unfortunately, there are no rules to govern a correct choice. This is the rationale for the decision to use two of the most common measures of taxonomic abundance, NISP (Number of Identified Specimens) and MNI (Minimum Number of Individuals). NISP is a simple measure of the number of specimens identified per taxon. Its advantages are its simplicity of calculation and its direct reflection of the analysis. Its main drawbacks are the effects of unequal recovery, the fact that different taxa have different numbers of bones, differential fragmentation, structural density-dependent survivorship differences, and the effect of interdependence, or the risk of counting multiple specimens from a single individual (Marshall and Pilgram 1993). NISP, as a basic counting unit, is the measure by which all others in this analysis are derived (Grayson 1984: 17).

The traditional technique for calculating NISP treats *all* bone fragments as mutually exclusive, regardless of known articulations. Thus, a radius and an ulna that are known to derive from a single animal would have an NISP value of two. Likewise, a longbone that is broken into five fragments would receive a NISP value of five. The technique for calculating NISP is modified in this analysis. Here, articulating specimens are taken into account, treated as a single specimen, and in doing so, given an NISP value of one.

As a remedy to the effects of interdependence, MNI calculates the minimum number of animals of a given taxon needed to account for the number of specimens in a sample. It is calculated by sorting the most abundant element into left- and right-side specimens according to NISP. If the most abundant element is axial, such as an atlas or axis, this step is not necessary. The higher of the left and right side elements is taken as the minimum number of individual animals of that taxon which could account for the given sample. MNI has its drawbacks as well. Among them are its tendency to overestimate rare taxa and its dependence on sample size. O'Connor (2000: 60) comments that while MNI estimates a minimum number, NISP estimates a maximum number. The validities of either extreme do not lie in their respective accuracies. This is the rationale for calculating both NISP and MNI.

A third method for counting taxonomic abundance is MNE (Minimum Number of Elements), which is a refinement of MNI. It is a measure of the minimum number of skeletal element portions to account for a given taxon. Like MNI, this analytical unit is calculated by sorting the most abundant specimens into left and right sides. However, MNE considers portions of elements (and complete elements), thus further reducing the risk of interdependence. A further step is to divide the observed bone count for each anatomical unit by the number of times that it occurs in a live animal. This step standardizes the data so that phalanges, of which there are 24 in the ungulate skeleton, are not over-represented relative to femora, of which there are two. Mid-shaft fragments are eliminated from this calculation due to the great likelihood that they are splinters from other specimens with articular ends. For more thorough discussions of the quantification of taxonomic abundance, see reviews by Casteel and Grayson (1977), Gilbert and Singer (1982), Grayson (1978), Grayson (1984: 16-92), Lyman (1994), and Marean *et al.* (2001).

Parts of the skeletal anatomy of each taxon are also quantified in this analysis. The term *specimen* includes several categorical levels of inclusiveness. Examples of body part (several articulated elements), element (a complete bone) and fragment or portion (an incomplete bone) are hindquarter, femur, and distal femur, respectively (Lyman 1994: 101). One of the quantitative units used in the analysis is body part frequency. This unit is established by first grouping anatomical elements into functional units, and then classifying each one to an ordinal meat-yielding value (Table 3). The value assigned to each body part is derived from the fact that certain parts of the ungulate skeleton carry significantly greater quantities of meat than other parts.

Mortality profiles

The primary technique for reconstructing herding strategies is to generate mortality profiles. Profiles are only generated for those taxa that are significantly represented in the assemblage. Following the research of Payne (1973), the technique for generating such profiles involves analyzing the state of mandibular tooth eruption and wear (Figure 12). Data derived from epiphyseal fusion and horn core development are not used as data in mortality profiles because of the potential of immature, unfused bones to be underrepresented in the sample (Payne 1973: 283). Though unfused mandibular bone is fragile, the teeth of young animals are just as sturdy as those of mature animals. Another reason for the exclusion of fusion data is that a fused bone only reflects a minimum age, whereas tooth attrition is a process that continues until the death of the animal.

The mandible-derived mortality data, though reliable, is supplemented here by bone fusion-derived age data. The reasons for using the fusion data are twofold: first, the size of the mandible samples when split between the two neighbourhood assemblages becomes so small that its reliability becomes questionable; second, bone fusion, which starts before birth and finishes some time before of adulthood (depending on the bone element in question), better reflects early mortalities.

Mandibles and their teeth are used for the construction of mortality profiles to the exclusion of maxillae and their teeth because the former tend to be the most represented skeletal element in MNI estimates. The wear stage is identified by the extent to which the enamel has been worn to expose the dentine. Tooth eruption and wear is recorded for the third deciduous molar (m_3), the fourth pre-molar (PM_4) that replaces it and the three permanent molars (M_1, M_2, M_3).

The tooth eruption and wear recording system initially used the one proposed by Grant (1975). An advantage of Grant's system over Payne's is that it lends itself to a comparison of the taxa of her study: sheep (and by extension, goat), cattle and pig. However, Grant's system is designed to express age structure in a frequency diagram as a function of the number of mandibles that represent each wear stage. Furthermore, each of Grant's wear stages is weighted equally even though the later stages of attrition last longer than the stages of eruption and early attrition (Moran and O'Connor 1994). This structure can result in a dubious identification of increased mortality rate, when in fact the length of the wear stage is responsible for the peaked frequency (Hambleton 1999: 63).

By contrast, Payne's classification system is exclusively intended for the construction of mortality profiles of caprids. Payne's recording system expresses tooth wear in a mortality curve as a function of the percentage of the population that is alive at the end of each successive stage (Hambleton 1999: 62; Payne 1973). A particularly important quality of the Payne system is that each of the wear stages is weighted according to the duration of the particular stage. Also, the format of the mortality curve, rather than the frequency diagram, is more amenable to identification of signature profiles that reflect meat, milk and wool exploitation strategies. Simply put, Payne's means meet the ends of the present research design.

Since Payne's system is more appropriate, following the instruction of Hambleton (1999: 64-67), the data that was initially recorded in the Grant age classification system was converted to a Payne system (Tables 4 and 5). Once this conversion is complete, the process of generating the mortality profile is accomplished by first summing the number of individuals in each wear stage, and then expressing each as a function of survivorship on a line graph. Following Payne (1973), mortality is usually expressed as a percentage of survival.

The task of assigning a calendar age to each wear stage is interpretive in nature. Though Silver (1969) has published this information, there is potential variation in maturation rates between breeds. Furthermore, tooth eruption and attrition rates can be dependent on unknown factors such as sex, diet, nutrition and health (Moran and O'Connor 1994: 269-270). As such, Silver's calendar ages are considered only for their heuristic value. The attribution of specific calendar ages is only useful if attempting to identify the season at which culling occurred. In the present case, this level of precision is not only unnecessary, but also impossible given the many unknowns of these archaeological animal populations.

Conclusions

The methods and techniques of analysis were chosen because they are the most germane means of evaluating the testable hypotheses. In the next chapter, the results of the analysis will be presented, followed by interpretations of the results. It is here that the efficacy of the hypotheses will be considered.

CHAPTER 6: DATA DESCRIPTION AND ANALYSIS

Introduction

The five hypotheses that were outlined in the previous chapter are addressed in this one. I will describe and analyze the domestic animal remains from Titriş Höyük in an effort to test these hypotheses. The analysis will be presented through the application of the methods and techniques that were described in the previous chapter.

Since the Neolithic period, the four most important domestic animal species of the typical Near Eastern subsistence base were sheep, goat, cattle and pig. By the EBA, urban dwellers relied on these animals for both their primary and secondary products (Greenfield 1988; Sherratt 1983). In contrast, their rural counterparts typically produced and consumed a more varied set of subsistence animals, which included locally available wild animals (Zeder 1994).

General description of data

Identification and curation

The material under investigation does not include *all* faunal remains from the site. A different specialist is responsible for the identification and analysis of shell remains. Culturally modified bones, such as tools, figurines, ornaments, and cylinder seals, are not included in the sample. This deficiency is due to Turkish law that prohibits the removal of certain cultural materials from its borders. All other faunal remains have been identified and analyzed at the University of Manitoba. However, the present research will only investigate animal taxa that are relevant to a study of production and consumption. Discussion of non-domestic and/or non-food animals, such as equids, dogs, cats, rodents and birds, are omitted in favour of a focused study of the exploitation of herd animals.

The faunal material was shipped in boxes to the University of California at San Diego some time following excavation, where it was stored by one of the co-directors of the Titriş Höyük Project, Professor G. Algaze. Over the span of several years, individual boxes were shipped for analysis to the University of Manitoba where Professor H. Greenfield, the faunal analyst for the project, currently stores it. Since 1998, Professor Greenfield and various students under his guidance have identified portions of the faunal sample. A preliminary faunal report on the early years of excavation was recently published (Greenfield 2002). From November of 2001 until February of 2004, I identified the remainder of the fauna under the supervision of Professor Greenfield. This portion constitutes 44 percent of the total sample.

Cleaning

The bones were cleaned by means of a soft toothbrush and a dental pick. The purpose of cleaning was to remove excess soil and calcium carbonate from the bones. Though common practice, the use of water for cleaning was avoided, as it is time-intensive and can result in the splintering and cracking of the bones in the process of drying. Exceptions to this rule were made if dirt was stubbornly concealing the occlusal surface of teeth, and in cases where butchering marks were encrusted.

Prevalent characteristics

The most common feature of the faunal assemblage is that almost all bones are encrusted in light grey calcium carbonate (Figure 13). Though this sedimentation may have beneficially protected the bones during their burial history, it has the negative characteristic of concealing many subtle surface features such as muscle markings, surface polish and cutmarks. The colour of the bones is generally yellowish grey, which combines the natural colour of the bones with the colour of the soil that surrounds them.

Another common characteristic of the faunal sample is excavation or post-excavation damage to individual bones. The majority of the bones exhibit some degree of fresh breakage due to careless excavation, cleaning damage in the field or transportation. As a remedy to this problem, freshly broken bones were mended with white glue whenever possible.

Sample considerations

All archaeological samples are plagued by excavation-related biases. Titriş Höyük is no exception to this rule. In an ideal scenario, the entire ancient settlement, including the tell and extramural suburbs, would have been fully excavated. Unfortunately, due to practicalities, only certain areas of the site were systematically excavated (Figure 5). Furthermore, some of these areas were excavated more systematically than others. For instance, trenches in the 80s neighbourhood were far more intensively excavated than the trenches in the 30s neighbourhood. This recovery procedure bias produced a much larger faunal sample in the 80s neighbourhood than in the 30s neighbourhood (Table 6). Despite this and other taphonomic factors, these biases can be controlled. If they are corrected, as many of them will be, they do not necessarily have to hinder the use of the faunal assemblages in an examination of Titriş Höyük's pastoral economy.

Description of domestic animal species

Sheep and goats

Sheep and goat are commonly considered together under the non-taxonomic category of *Ovis/Capra* in zooarchaeological research because of the difficulty of consistently distinguishing their osteological remains (see Chapter 5). However, sheep and goats have different properties in terms of behaviour, ecological resilience and productive capacity. Sheep are a higher energy commodity than goats; they have higher meat yields and they produce more wool than goats produce hair. Goats have a higher reproductive rate than sheep and are better adapted to poor environments. Sheep and goats have in common the same costs of herding and they can be herded in a single flock (Redding 1984).

A total NISP of 3254 (MNE = 152) of all Caprinae are identified. Caprinae is the taxonomic subfamily that includes *Ovis aries* (domestic sheep), *Capra hircus* (domestic goats) and, for analytical purposes, *Ovis/Capra* (domestic sheep or goats). Of the Caprinae, 329 specimens are specifically identified as *Capra hircus*, while 484 specimens are identified as *Ovis aries*. The remaining (majority) portion of 2441 is generally identified as *Ovis/Capra*. A ratio of 1.5:1 *Ovis* to *Capra* is calculated from these NISP counts (Table 7).

Mesopotamian textual evidence sheds light on these results. Several Old Babylonian (early 2nd millennium) texts were contracts between sheep owners and shepherds, and describe the compositions of the flocks. These documents show that flock composition varied from 4 to over 200 animals. Some flocks included up to 25 percent goats, while others did not have any. Ewes represent the majority of sheep, with enough males kept in order to practice mixed-products husbandry. Primary interest in sheep was for its wool, but some were kept for slaughter (Postgate and Payne 1975). Goats were mainly raised for their hair and hides (Hesse 1995a: 213-214). This is attested by texts from Ur III Girsu that describe as many as thirteen thousand female weavers that may have worked in the production of textiles in the vicinity of Ur (Robertson 1995: 447).

Cattle

Bos taurus specimens account for an NISP of 1362 (MNE = 57). A ratio of 2.4:1 Caprinae to *Bos taurus* indicates a significantly stronger abundance of the former over the latter in the assemblage (Table 8). Even though the bones of large mammals are generally more resilient to deteriorative agents and are less susceptible to negative recovery bias, the abundance of cattle is low relative to the medium-size Caprinae. Thus, cultural selection, rather than attritional taphonomic process, best explains the higher ratio of Caprinae to cattle.

Textual evidence tells us that cattle were primarily used for traction and transport, and secondarily for milk and leather (Postgate 1990: 163). It was common for these animals to be reared within the city and close to the home, since they required fodder to supplement grazing. In fact, cattle were often kept within the household courtyard (Van De Mieroop 1997: 144-145). A single household, whether of elite or non-elite status, rarely kept more than a single head of cattle. A single cattle yields approximately the same amount of meat as four or five sheep or goats (Clason and Buitenhuis 1998: 234). The small herd size of cattle was due to the facts that they are more expensive to feed as compared to sheep and goats, and their hides are not as easily processed as the wool of sheep. Insight into the Mesopotamian ideology of cattle is provided by Old Babylonian texts, which show that cattle were named, just as a family member would have been (Postgate 1990: 164). Unlike sheep and goats, they could not feed by grazing across the land, and their role as beasts of burden precluded them from eating while on the job. Due to these circumstances, their fodder consisted of barley and reeds, as well as some grazing vegetation (Postgate 1990: 164).

Pigs

Sus scrofa domesticus remains from Titriş Höyük account for only 0.0005 percent (NISP = 12, MNE = 2) of the total bone assemblage. Domestic pigs (*Sus scrofa* domesticus) only yield primary products; they cannot be milked, used for traction, nor for transportation (Zeder 1991: 30). Though they are of limited or no use in terms of secondary products, they provide very high meat yields. Furthermore, their meat provides the highest fat and caloric values of any Near Eastern domesticate (Flannery 1969: 84, Table 3). They have larger litters and faster growth rates than any bovid. In theory, these qualities make pigs ideal animals for specialized meat production; but in practice, they have played only a minor role in Near Eastern economies since the EBA, of which the Karababa basin is no exception. The near absence of this species at Titriş Höyük will be explained in the next chapter.

Analysis

The previously described data is next used to test the expectations that were outlined in the previous chapter. Each of the five hypotheses dealing with (1) post-depositional taphonomy; (2) economic mode of animal exploitation; (3) productive specialization; (4) animal product distribution; and (5) animal product consumption, are addressed in this section.

Post-depositional taphonomy

Post-depositional taphonomy will be investigated through an analysis of bone element portion survivorship. Figures 14, 15 and 16 present this data. The element portions are ordered according to the ranking of Brain's (1969) control sample (Figure 14). Several skeletal elements, such as vertebrae, ribs, carpals and tarsals, were eliminated due to an inability to consistently identify these elements to a low taxonomic level.

Brain's survivorship frequency histogram presents the results of ethnoarchaeological testing of carnivore attrition on goat bones from a Hottentot village. It is important to remember that Brain's experiments were conducted in an open-air context where carnivores would have had easy access to the goat bones. Thus, while the open-air assemblage (Figure 15) from Titriş Höyük was predicted to conform to Brain's results, the sheltered assemblage (Figure 16) was expected to diverge from it. The assemblage from open-air contexts was predicted to show a greater than expected representation of structurally dense elements such as distal humeri, proximal radii, and distal tibiae, and mandibles relative to less durable elements. Likewise, the assemblage from sheltered contexts was expected to demonstrate a greater than expected representation of less durable and more carnivore scavenging-prone elements such proximal humeri, distal radii and proximal tibiae relative to more durable elements.

The assemblage from the open-air contexts mostly conforms to the expectations of the hypothesis (Table 9). Structurally dense element portions, such as mandibles, distal humeri, proximal radii and distal scapulae, are well represented. Less structurally dense element portions, such as proximal humeri, phalanges, and distal femora, are not well represented (Figure 15). Proximal and distal metacarpals occur more frequently than expected. This observation may be attributable to cultural selection for these parts, which may have overshadowed the effects of carnivore scavenging. Structurally dense distal tibiae occur much less frequently than expected. Possible explanations for this observation include their secondary use as tools, or some other form of cultural selection. These possibilities will be explored later in this chapter.

The faunal assemblage from the sheltered contexts expectedly does not conform to Brain's (1969) control sample (Table 9). This histogram is characterized by higher-than-expected frequencies of many element portions. Notably over-represented are distal humeri, proximal and distal radii, proximal and distal metatarsals, proximal metacarpals, and proximal tibiae (Figure 16). These high frequencies fit with the proposed model given that the sheltered assemblage was protected from carnivore scavengers, and perhaps from deteriorative processes such as weathering and diagenetic agents. However, the low frequencies of distal tibiae, distal metacarpals, distal femora, and proximal humeri suggests that other factors such as human selection may have contributed to the observed assemblage, a notion that will be explored later in this chapter.

To summarize these results, the open-air assemblage generally conforms to Brain's attrition model. This result suggests that in the open-air assemblage, relative durability was the primary factor that contributed to its differential representation. The sheltered assemblage sharply diverges from this model, with certain elements relatively over-represented. This result suggests that, in addition to relative durability, limited access of scavenging dogs to this bone refuse was an important contributing factor to the sheltered assemblage. Now that I have assessed architectural context as a post-depositional taphonomic bias of attrition, it is now feasible to address some of the human behaviours that may have contributed to the faunal sample.

Animal production

Production and consumption systems

Titriş Höyük was hypothesized to have functioned as a consuming economy during the Mid-Late EBA given its first-order ranking in the settlement hierarchy of the Karababa basin. This assumption is tested by analyzing the survivorship curves generated from the sheep, goat and cattle mandible assemblages. These results are presented in Figure 17. Tables 4 and 5 present the definitions of the wear stages of sheep/goat and cattle used in this analysis.

The *Ovis/Capra* mortality histogram shows a bimodal distribution with peaks at wear stages D (1 - 2 years) and H (6 - 8 years) (Figure 17a). The derived survivorship curve displays these peaks as two kinks in a descending pattern (Figure 17b). These data indicate that about 30 percent of *Ovis/Capra* were slaughtered before the end of their first year; 50 percent were culled before the age of four; and about 80 percent were harvested before the age of six. However, since it is well established that the exploitation strategies of sheep and goats can be different, the utility of this mixed data is questionable. It is entirely possible that sheep and goats were raised for different reasons, which, if true, would produce different culling patterns expressed in different survivorship curves.

Fortunately, the mandibles and teeth of sheep and goat are readily distinguishable in many cases. This allows for the culling data to be compiled for each of sheep and goats, and for them to be treated in a comparative fashion. Figures 17c and 17d present these data. The *Ovis aries* mortality histogram shows a unimodal distribution that peaks at wear stage D (1 - 2 years), which coincides with the definition of market age for this species (Payne 1973). The associated survivorship curve smoothly descends from this point onward. These data indicate that approximately 45 percent of *Ovis aries* were culled before the end of their first year; about 60 percent died before their second year; 85 percent were slaughtered before the age of four; and over 90 percent were killed before their sixth year of life.

The *Capra hircus* mortality histogram also displays a unimodal distribution, which peaks at wear stage G (4 - 6 years), a point that marks the end of the reproductive capacity of this species (Figure 17e). Its survivorship curve abruptly kinks at the beginning of wear stage F, and then again at the start of wear stage I (Figure 17f). These two points frame the culling emphasis that occurs in the second half of the scale. The data show that about 20 percent of *Capra hircus* were slaughtered before the end of their first year; about 30 percent died before their second birthday; about 45 percent were culled before their third year of life; about 70 percent were slaughtered before the age of four; and over 95 percent were culled before the age of six. Despite the small size of this particular sample, the data suggest that most of the goats were culled in the latter half of life.

The *Bos taurus* mortality data suffers from an even smaller sample size. This mostly unimodal pattern peaks at wear stage D (1.5 - 2.5 years), equivalent to the market age of cattle (Figure 17g). Its derived survivorship curve is not smooth, reflecting abruptly changing values between successive wear stages (Figure 17h). The data indicate that about 20 percent of *Bos taurus* were harvested before the first 18 months of life; about 55 percent were slaughtered before they reached 30 months of age; about 80 percent died some time before young adulthood; and approximately 90 percent were killed before they reached senility. These results must be regarded with caution since they were gathered from a very small sample of mandibles.

The question remains, did Titriş Höyük's economy serve itself, did it serve to provision other communities, or did other communities provision Titriş Höyük? Unfortunately, this line of evidence alone does not clearly point to any one of these modes of production. Within any given animal category, at least one age group is emphasized. Put together, all of the important age categories are represented. Market age sheep and cattle are strongly represented, as are reproductive age goats. Given this scenario, sheep and cattle could have been produced for their meat, while goats could have been produced for their secondary products until they were too old. The point to be taken here is that any of the three possible modes of production (self-sustaining, consuming or producing) could have been feasible given the diverse age structures of the herd animals.

However, the picture becomes clearer by incorporating diversity measures of element portion representation into the equation (Tables 10 and 11, and Appendix A). Following the terminology of Kintigh (1989), two components of diversity are richness (the number of categories) and evenness (the relative abundance of those categories). The richness figures of Caprinae and cattle are both very high. I.e., the number of represented element portions is high for both animal categories. Furthermore, the evenness scores for Caprinae and cattle are also high. The fact that all of the skeletal elements of these animals are fairly evenly represented indicates that either animals were brought to Titriş Höyük on the hoof and then butchered, or that animals were raised and butchered at the site in the self-sustaining or producing economic mode. The even representation of all elements precludes the possibility that Titriş Höyük was a consumer site in which selective animal parts were supplied from outside pastoral specialists or from a supplier site.

Productive specialization

Productive emphasis on primary or secondary products was hypothesized to be identifiable by signature mortality harvest profiles, following the models of Payne (1973). The same kill-off data that was used in the previous section is used here for the investigation of productive specialization.

Figures 17c and 17d display the kill-off pattern of the *Ovis aries* sample. As was mentioned in the previous section, about 60 percent of the sheep were culled before the age of two. Sheep reach their optimal weight gain between 1.5 and 2.5 years of age, which is the ideal point at which to cull them if meat is the desired product. Thus, according to Payne's (1973) model, the kill-off pattern of sheep suggests a pastoral strategy primarily focused on meat production. However, to return to an issue that was raised in the previous chapter, female sheep that are reared in a meat exploitation strategy can be milked without any consequence for meat yields or herd structure (Greenfield 1988: 576). Given that the median of the *Ovis aries* distribution falls on the sub-adult age class (wear stage D), and that the second-most frequently occurring value in the array is the young-adult age class (wear stage E), the data hint to a mixed meat and milk exploitation strategy with respect to sheep.

The kill-off pattern of *Capra hircus* is presented in Figures 17e and 17f. This pattern shows a strong emphasis on the culling of goats of three to eight years of age. In sharp contrast to the kill-off pattern of sheep, only about 30 percent of the goats were slaughtered before the age of two. About 70 percent of the goats survived until the age of six. This pattern fits Payne's (1973: 281) wool (hair, in the case of the goat) production model in which the animal is sheared until the quality of its fibres becomes poor. This loss of quality usually occurs in adulthood (3 – 6 years of age), at which point the animal is culled. It is curious that goats seem to have been raised for their hair, while sheep were raised for their meat considering that goat hair is of far less economic value than sheep wool. In fact, goat leather, a non-renewable product, is thought to be a more useful commodity than its hair (Noddle 1994: 121). However, certain breeds of goat, particularly the modern Angora goat, produce a high quality hair of great economic value. If EBA goats produced hair of a similar quality, it is understandable why they were reared for their fibres.

The culling pattern of *Bos taurus* is presented in Figures 17g and 17h. Though the reliability of this dataset is questionable because of its small size (n = 11), general impressions of productive specialization can be gleaned from the data. Approximately half of the cattle deaths occurred between juvenility and sub-adulthood, which is a focused interval relative to the other half of the cattle deaths that are distributed more evenly over the much longer interval of adulthood. This apparent emphasis on young cattle is not surprising considering that they would not have been raised for their exploitable fibres, for which they have none. As was the case with the sheep data, it is difficult to identify whether these cattle were raised for the purpose of exploiting meat, milk, or both, especially in light of the meagre size of available data.

Animal product distribution

In Chapter 5, consumers were predicted to have acquired domestic animal products indirectly through specialized and centralized distribution channels rather than directly through individually self-sufficient household production. The mode of distribution is reflected in the species, parts, butchery patterns, and ages of the animals in the faunal assemblage. These proxies are used in conjunction, but are discussed in turn below.

Diversity of animal taxa is the first variable that will test the hypothesis (Table 12, Appendix A). The Shannon-Wiener Information Function (Kintigh 1989) was chosen in favour of all other similar statistics to measure diversity in order to generate results that could be compared to diversity scores from Kurban Höyük (Wattenmaker 1998). Richness (H'), the number of taxa, is a difficult measure to interpret on its own. It is most useful if compared with other richness scores. In a diachronic analysis, a common exercise is to compare richness scores from different chronological phases. In this synchronic analysis, all material is treated as a single assemblage. However, comparable diversity scores have been published from levels at Kurban Höyük that are contemporaneous with those under study (Wattenmaker 1998: 165, Table 20). A mean richness score of 2.84 from Kurban Höyük (from periods IV.3 - IV.1) is more than twice the value of the richness score from the Titriş Höyük assemblage. This low richness value suggests that relatively few animal taxa were exploited at EBA Titriş Höyük.

Evenness (V'), the relative frequency of different taxa, is measured on a scale of 0 to 1, and thus does not require comparative scores for interpretation. The score of 0.49 reflects an uneven taxonomic representation, focused mainly on the three staple domesticates – cattle, sheep and goat. Thus, both richness and evenness scores indicate low taxonomic diversity of the Titriş Höyük faunal assemblage, thus reinforcing the assertion of indirect distribution.

Next, the diversity of skeletal portions of individual taxa is an indication of the mode of distribution. If meat is distributed through indirect channels, the state's goals will likely be to provision a standard array of body portions. The diversity scores for the element portions of *Bos taurus* and *Ovis/Capra* are presented in Tables 10 and 11. The richness (H') values of both are high and almost identical (Appendix A). Contrary to the above prediction, most of the element portions of the herd animals are represented. Not only are they represented, but also the evenness (V') scores of both animal categories are high. Thus, the portions that were provisioned are fairly richly and evenly represented. Moreover, this line of evidence suggests that, regardless of the state's involvement in animal product distribution, whole animals, whether live or as carcasses, were provisioned to consumers.

A related issue is the degree of uniformity of butchery marks across the faunal assemblage. Just as one would expect the state to distribute a restricted array of body part types, one would also expect cutmarks to show a restricted pattern across the assemblage if butchery and meat preparation were conducted by a limited number of skilled specialists (Crabtree 1989: 168-169).

Figure 18 presents the distribution of butchery marks across the *Ovis/Capra* and *Bos taurus* bone assemblages. Traces of butchering were infrequently observed in the Caprinae and cattle faunal assemblages (n = 107). This low frequency is most likely due to the ubiquitous masking of most bone surfaces by calcium carbonate. Though many other bone fragments were likely butchered, a relatively small number of them were clean enough for butchery marks to be visible. Despite this low frequency of observation, enough were observed for this data to be useful. In Figure 18, the distribution of butchered body parts of both Caprinae and cattle are fairly restricted. In both cases, only about half of the element portions are represented. This relatively limited variability in butchery marks across the assemblages suggests that butchering was a specialized activity carried out by a limited number of practitioners.

The final proxy for testing implications of animal product distribution uses age data. Following the prediction of indirect distribution, if meat distribution was controlled by a system wherein central decision-makers had influence that overrode the preferences of consumers, then one would expect uniformity in the ages of animals provisioned in this system. Once again, the age distribution for cattle, sheep and goat are presented in Figure 17.

The unimodal age distributions of *Ovis aries* and *Capra hircus* (Figures 17c and 17e) clearly demonstrates that most deaths tightly surround a single age (sub-adulthood and later adulthood, respectively). The few outlying values on these histograms may represent anomalous individuals. In the case of sheep, the few individuals that occupy wear stages H and I (senility) may represent ewes that were culled when their reproductive potential diminished. The outlying goat deaths that occurred during juvenility may represent diseased animals that died prematurely. If these outliers are considered anomalous, the age data for both sheep and goats appears to be relatively uniform and restricted.

The age distribution of *Bos taurus* is more difficult to interpret (Figure 17g). The possibility remains that these results are misleading due to the small size of the sample. This problem aside, most deaths are widely distributed between juvenility and early sub-adulthood. This indicates that if an indirect distribution system existed, cattle were not under its control. Rather, the varied mortality pattern of cattle suggests that decisions regarding their exploitation were made at the level of the household.

In order to understand whether animal resources were directly or indirectly distributed at EBA Titriş Höyük, it is necessary to synthesize the various lines of evidence that were used in this portion of the analysis – species, parts, butchery patterns, and age. Evidence for indirect distribution comes from the following: only three animal species predominated the assemblage, butchery marks were restricted to a limited number of bone portions, and the age distribution of caprids was focused. Evidence for direct distribution is supported by a relatively wide distribution of caprid and cattle element portions, and a broad distribution of cattle mortalities.

These two results, however, do not necessarily have to be interpreted as evidence for direct distribution. First, the fact that all animal portions are represented implies that whole animals were provisioned, but not necessarily to individual households. If whole animals were provisioned to groups of households, and then divided among them, then all parts of those animals should be represented in the assemblage. Alternatively, even if portions were provisioned to individual households, the remains of all portions from disparate households would be expected to end up in the community garbage dumps (Zeder 1991: 41). Since it was not possible to compare the assemblages of individual households, the assemblage in this part of the analysis consists of everyone's garbage. Though all animal portions are represented, and most are well represented relative to their expected frequency (see above), this result does not necessarily point to direct provisioning from herders to consumers.

Second, the broad distribution of cattle mortalities must be understood in the cultural context of that species. To reiterate the Mesopotamian textual evidence, cattle were commonly raised at the household level and close to the home because of their intense foddering requirements. It would have been quite common for each household to keep a single head of cattle in a courtyard or in a proper animal pen. In fact, Rainville (2001b) interprets Room 12 in Building Unit 5 (trenches 35/12 and 36/12) and Rooms 16 and 16b in Building Unit 4 (trench 81/87) as enclosed and sheltered animal pens inside of house structures. If cattle exploitation was practiced at the discretion of the individual household, then variable culling patterns are expected. Different households would have had different production goals, which are dependent upon factors such as household size, status, and taste. With this in mind, the cattle age data is in line with what we know of traditional Mesopotamian cattle production, though not in line with the hypothesized indirect distribution.

To summarize, the various lines of evidence suggest that caprids were distributed indirectly through specialized and centralized channels, while cattle were raised and exploited at the level of the household.

Animal product consumption

To this point, I have examined domestic animal production and distribution. This last issue concerns consumption - the final sequence in the domestic animal exchange system. Two neighbourhoods, one from the Lower Town and one from the Outer Town at Titriş Höyük, are compared with conjunctive zooarchaeological and spatial approaches. The two areas of the settlement are compared in order to test the prediction that households in the 30s neighbourhood had greater access to animal products than households in the 80s neighbourhood. The types of animals, their ages, and parts are examined in this part of the analysis.

The 30s neighbourhood faunal assemblage was predicted to show evidence for the exploitation of hunted animals, whereas the 80s neighbourhood assemblage was predicted to show little or no evidence for such practices. The justification for this supposition is that a hunting regime does not fit into the risk-minimizing strategy in which households in the 80s neighbourhood are thought to have been engaged (O'Connor 2003: 82). Reitz and Zierden (1991: 397) remark that, "a human population can support energetic extravagances only if basic nutritional requirements are met through more efficient and less costly mechanisms." This line of reasoning accords with Ijzereef's (1989: 48) results that indicated a more varied array of species consumed by wealthy households, in contrast to a very restricted array consumed by poor households.

Table 13 presents a comparison of wild food taxa distributed between the 30s and 80s neighbourhoods at Titriş Höyük. The data show that many more bones from wild food animals were found in the 80s (NISP = 251) neighbourhood than in the 30s neighbourhood (NISP = 28). However, this discord is an obvious product of the sampling bias that was discussed above.

Also, a greater number of taxa are represented in the 80s neighbourhood (n = 24) than in the 30s neighbourhood (n = 11). Though cultural selection may have contributed to this pattern to some degree, the likelihood of recovering some of these rare taxa is much greater in the more intensively sampled neighbourhood. A different approach to comparing the neighbourhood data is to assess relative frequencies of each taxon per neighbourhood. In many cases for which a taxon is represented in both neighbourhoods, it has a greater relative representation in the 30s neighbourhood than in the 80s neighbourhood (i.e., Bivalvia, *Bos primigenius*, *Cervus elaphus*, *Lepus sp.*, and *Vulpes sp.*). Again, this observation is likely a function of sample size bias.

A more equitable method of comparison is to examine the taxa that display the most divergent frequency values between neighbourhoods. In this case, these divergent results are often characterized as presence-absence ratios. For instance, the 80s neighbourhood yielded *Capreolus capreolus* (6%) and *Equus hemionus* (21%), whereas the 30s neighbourhood did not yield either of these wild food taxa. The 30s and 80s neighbourhoods both contained quantities of *Cervus elaphus*, Gastropoda, *Lepus sp.*, and Osteichthyes.

The sampling bias between the two neighbourhood assemblages makes these results difficult to interpret. However, it is reasonable to deduce that the 30s neighbourhood did not yield a more varied array of wild food species than did the 80s neighbourhood. If anything, the opposite notion is true. Thus, this line of evidence does not support the assertion that the 30s neighbourhood households had greater access to animal products than the 80s neighbourhood households.

Next, households in the 30s neighbourhood were predicted to have had greater access to prime age animals (1 to 2 years for caprids) than households in the 80s neighbourhood. Of course, this assumption is only applicable to animals that were indirectly provisioned. In the previous section, I concluded that sheep and goat were indirectly channelled to households, while cattle were raised and exploited at the household, without the state's intervention. Thus, the assumption of differential access between neighbourhoods is only relevant to animal species that were outside of the household's control - i.e., sheep and goat. For this reason, cattle age data are excluded from this part of the examination.

The sheep and goat age data are presented in Figure 19. The mandible-derived age data, though reliable, is supplemented here by bone fusion-derived age data. As was briefly discussed in Chapter 5, the fusion data is useful for supplementing the mandibular data's deficiency of under-representing early mortalities.

The bone fusion data for sheep and goat (Figures 19b and 19d) show that both neighbourhood assemblages have strikingly similar age distributions. With only a few exceptions, the fusion data show parallel mortality frequency distributions between the 30s and 80s neighbourhoods. These distributions are focused on the sub-adulthood and adulthood age classes. The sheep and goat mandible data in Figures 19a and 19c do not show such close parallels between neighbourhoods. Sheep deaths in the 30s neighbourhood are fairly evenly distributed between five age classes, whereas about 45 percent of sheep deaths in the 80s neighbourhood occur in wear stages D and E (sub-adulthood and early adulthood), which conforms closely with the bone fusion data. All of the goat mortalities in the 30s neighbourhood fall on wear stages H and I (senility), whereas goat mortalities in the 80s neighbourhood are more evenly distributed from wear stage B through H (early juvenility through early senility).

In general, these results do not support the prediction that the 30s neighbourhood had greater access to animal products than the 80s neighbourhood. The bone fusion data indicates very few age-related differences between the neighbourhoods. Clear differences between the neighbourhoods are observable in the mandible data, but these differences do not suggest differential access. Sub-adult and adult sheep are relatively abundant in the 80s neighbourhood, and senile goats are relatively abundant in the 30s neighbourhood. Though these results are distinguished from the rest of the data, they do not reflect greater access to prime age sheep or goats in either neighbourhood. This line of evidence alone does not support the hypothesis.

The third measure of consumption is the differential distribution of body part units. Just as cattle data were excluded from the previous section of the analysis, they are excluded here for the same reason; cattle were not provisioned indirectly, and thus have no bearing on differential access by consumers.

Recall from Chapter 5 that a body part unit is a set of articulated elements that are grouped according to meat-yield value. Table 3 presents the definitions of these body parts and their ordinal meat-yield values. Axial elements, such as vertebrae and ribs, must be considered with caution because these elements are less readily identifiable to the species level. Fragments of most axial elements were commonly identified as "medium mammal". Therefore, they are probably under-represented in Figure 20, which shows the distributions of body parts for sheep and goat between the 30s and 80s neighbourhoods. The opposite problem occurs in which ubiquitous loose teeth result in a gross over-representation of crania. These quantification issues must be kept in mind when interpreting the results.

The ratio of high- (forequarter and hindquarter) to low- (cranium and lower limb) meat-yield body parts is fairly even between the 30s and 80s neighbourhoods across all animal categories (Figure 20a, b, c). High-meat-yield body parts contributed to between 12 and 30 percent of the 30s neighbourhood assemblage, and to between 12 and 26 percent in the 80s neighbourhood assemblage. Low-meat-yield body parts contributed to between 21 and 35 percent of the 30s neighbourhood assemblage, and to between 12 and 41 percent in the 80s neighbourhood assemblage[8]. For any given body part in any one animal category, frequency differences are marginal (≤10 percent).

The uniformity of the body part data between the 30s and 80s neighbourhood assemblages clearly indicates that one neighbourhood did not have greater access to animal products than the other. Add to this the species representation and caprid age evidence, and one can confidently conclude that access to animal products was not conditional upon the neighbourhood in which one lived. This finding is in line with Rainville's (2001b: 272-274) interpretation of Titriş Höyük's architecture in which she concludes that differences between neighbourhoods are negligible.

Conclusions

The first part of this chapter described the animal bone sample in terms of its qualitative characteristics. Geological sedimentation processes, sampling decisions,

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[8] The 41 percent value represents Ovis/Capra crania. Of these, 59 percent are individual loose teeth, and therefore, this value is probably misleading.

identification bias, and curatorial issues were identified in order to elucidate some of the limitations of the dataset. In effect, this section described sullegic and trephic processes, which are last two stages in the taphonomic trajectory (Figure 1). The second section of this chapter described sheep, goat, cattle and pig in terms of their cultural and physical properties. Their importance in the typical Near Eastern subsistence economy was compared vis-à-vis their importance at EBA Titriş Höyük by evaluating their relative abundances in the faunal sample. The third, final, and most substantial section of this chapter presented the analysis of the faunal remains. Five hypotheses relating to issues of post-depositional taphonomy, the economic mode of production, productive specialization, distribution, and consumption were addressed.

This analysis yielded results that were both expected and unexpected. As expected, architectural context was a primary post-depositional taphonomic factor that contributed to the observed differential element preservation. The analysis of the economic mode of production and consumption yielded ambiguous results, but eliminated the possibility that Titriş Höyük operated as a consuming economy. Also under the heading of production, it is now clear that different domestic animals were strategically exploited for different purposes. Sheep and cattle were mainly raised for meat and/or milk, and goats for their fibres. In the next sequence of the animal exchange system, the results of the analysis indicate that a very limited range of domestic animal species was provisioned. Caprids were indirectly provisioned and cattle were raised and exploited at the household level, without apparent state intervention. In the final sequence, the indirectly provisioned caprids were not preferentially distributed to households according to the neighbourhood in which they were located. These results will be transferred to the next chapter, where they will be discussed a wider context.

CHAPTER 7: DISCUSSION

Introduction

Recall the objectives outlined in the first chapter in which I had hoped to contribute to our understanding of how the pastoral economy functions in an EBA northern Mesopotamian urban context, and also to contribute to our general understanding of Mesopotamian urban process. Of course, it is for the reader to decide if these goals have been met. The purpose of this last chapter is to put the results of this research into a perspective that transcends the static, site-specific faunal analysis. Below, several methodological and theoretical issues will be raised in hope of making the promised substantive contributions.

First, some of the glaring methodological problems that were encountered in the faunal analysis will be discussed. Second, the dearth of pig remains that was quantified earlier will be put in its cultural context. Next, the results from the analysis of Titriş Höyük's faunal remains will be compared to other published faunal records in the Karababa basin in an effort to place the urban centre in the context of its regional settlement. Following this, a broad synthesis of Titriş Höyük's pastoral economy will be offered. Finally, possible directions that may be taken in future research will be considered.

Methodological considerations

Mortality profiles

The methods used to understand productive specialization at Titriş Höyük are problematic. Each of the three models is not equally distinguishable from the others.

Though each model produces a signature mortality profile, the meat production model can produce a profile of greater distinction compared to the secondary products' profiles. Furthermore, the profiles generated by the milk and wool models are potentially not easily distinguishable. This pattern may result in an analysis where it will only be possible to identify whether the herding strategy was based on primary products (where the animal must be slaughtered for products) or secondary products (where the animal can be repeatedly exploited over its lifetime). If secondary products were emphasized, it may not be possible to identify whether milk or wool were of most importance.

Another caveat to be considered is the likely possibility that the pastoral economy used a mixed strategy in which primary and secondary products were sought (Greenfield 1988: 576; G. Monks, personal communication). Greenfield (1988: 576) explains that if herders were operating in a meat exploitation regime while also emphasizing milk production, the harvest profile will closely resemble that of a meat-only pattern. This is due to the fact that a ruminant raised for its meat can be easily milked over the course of its life without affecting the end result. The only difference that might be visible on a harvest profile from this mixed meat and milk type of strategy will be a shift of emphasis to late subadult and adult age classes.

Sex determination

Another consideration is the difficulty of determining sex for most bone specimens. There is as yet no known sexually dimorphic feature of mandibles. If there were, it would be possible to incorporate the sex ratio into the mortality data. This addition would be of great potential value since males and females have different productive and reproductive properties, which play a primary factor in herding strategies.

In fact, to not know the sex ratio within the mortality profile is a major deficiency of the method. A solution to this problem, and one that can be considered in future analyses, would involve using a bone element that can be systematically separated by sex and age. The distal metacarpus is one such element that, if both measured and observed for its state of epiphyseal fusion, can yield both sex and age data (Davis 1987: 39).

Calcium carbonate

The most widespread problem encountered during the identification of the faunal sample was the masking effect of calcium carbonate encrustations on bone surfaces (Figure 13). This sediment was removed manually if it could be done without doing damage to the bone. However, in most cases, this sediment was fused to the bone surface to such a degree that its removal took with it periosteum. This result defeats the purpose of "unmasking" the bones since many of the subtle surface features, such as butchery marks, weathering, and pathologies, are only visible on the periosteum. It is possible to treat these specimens in a chemical solution that removes the sediment without doing harm to the bone, but the copious quantities of bones from Titriş Höyük might make this task an overwhelming one.

The unpopular pig

Several theories have been proposed to explain the unpopularity of the domestic pig in the Near East. Today the pig is a forbidden animal throughout much of the Near East due to dietary laws of Jews and Muslims that prohibit contact with its carcass and consumption of its meat (Borowsky 1998: 141-144; Hesse 1995a: 215). This food taboo began in Canaan (in modern Israel) and possibly Egypt not earlier than the Late Bronze

Age, about one thousand years after the Late EBA decline. The late occurrence of this prohibition makes it an unlikely cause of the pig's scarcity during the EBA.

An environmental deterministic theory posits that since pigs thrive in wet and forested climates, they would not have succeeded during climatic aridification and deforestation trends of northern Mesopotamia since the third millennium B.C. (see discussion in Chapter 2). However, an argument against the environmental theory is that the decline of the pig's popularity began at the beginning of the third millennium (Early EBA) at Kurban Höyük, as much as a millennium before the environmental degradation trend began (Frangipane and Siracusano 1998: 241). However, the temporal onset of the aridification trend is not precisely known, thus not precluding the environmental theory for this reason alone.

A stronger argument against an environmental theory explains that since climatic conditions affected broad regions of the Near East, climatic conditions alone cannot explain differential domestic pig abundance between sites within a relatively small geographic region. For example, early in the third millennium, pig representation at Kurban Höyük became very low in comparison to cattle and caprines. At nearby Hassek Höyük pigs were not only the predominant domestic animal at this time, but they increased in relative abundance from the previous Late Chalcolithic period (Clason and Buitenhuis 1998: 236, Figure 3).

An alternate theory for the demise of the domestic pig in Near Eastern subsistence economies focuses on differential economic and organizational factors. A negative correlation exists between level of urbanization and importance of pigs. During the Mid-Late EBA in the Karababa basin, pigs contributed about 17 percent and 10 percent of the faunal remains at the villages of Gritille Höyük and Hayaz Höyük, respectively (Stein 1986: 8; Buitenhuis 1985: 70). At the town of Kurban Höyük (period IV ~ Mid-Late EBA) pigs represented an average of about 9 percent of the faunal remains over sub-periods 1-4. At Titriş Höyük, the top of the settlement hierarchy, domestic pig bones are nearly absent (0.0005 percent, NISP = 12).

This pattern of domestic pig exploitation in the Karababa basin indicates that the importance of this species is proportionate to the level of political and economic engagement of each settlement, rather than with any environmental variable (Frangipane and Siracusano 1998: 242). The near absence of pigs at Titriş Höyük can be explained by the fact that pigs are less suitable than caprines for the large-scale, controlled animal management system of a city. Pigs require more grazing land and water than caprines. They require close supervision because of their aggressive nature, and are therefore best kept in sties. Pigs are also crop and garden predators, and therefore pose a risk to agriculturalists. Small-scale pig production is feasible at the household level if they are kept in sties close to the home. However, in an urban economy the central authorities might discourage household-level animal production since this could pose a threat to the state's control of the economy (Zeder 1991: 30-31, 253).

Comparable faunal assemblages

Though a thorough comparison between the faunal assemblage of Titriş Höyük and those from other sites in the Karababa basin is beyond the goals of the present research, a superficial comparison is in order. Published faunal analyses of Mid-Late EBA Karababa basin contexts are few. Comparable assemblages are described from four sites in the region: Hayaz Höyük (Buitenhuis 1985), Gritille Höyük (Stein 1986; Stein

1987; Wattenmaker and Stein 1986), Lidar Höyük (Kussinger 1988), and Kurban Höyük (Wattenmaker 1987a, 1987b, 1994a, 1994b, 1998; Wattenmaker and Stein 1986).

A direct comparison between Titriş Höyük and other sites is not presently feasible because materials from the Mid and Late EBA from these other sites were combined with materials dating to previous and subsequent periods (Wattenmaker 1998: 184). For example, the faunal material from Gritille Höyük was divided into three periods that do not align with the established regional chronology (see Wattenmaker 1998: 61, Table 2). A valid comparison would require one to isolate the assemblages dating to the Mid-Late EBA for each site.

Despite this discord, one is not precluded from making general comparisons of faunal assemblages dating to the latter half of the third millennium B.C. As is the case at Titriş Höyük, sheep, goat and cattle were the most abundantly recovered animal taxa at Kurban Höyük, Lidar Höyük, Gritille Höyük, and Hayaz Höyük. These two towns and two villages also yielded significant quantities of pig bones in contrast to the striking near absence of pig bones at the urban centre of Titriş Höyük.

During the EBA, the village of Hayaz Höyük focused its productive resources primarily on the exploitation of sheep and goats, and secondarily on cattle and pigs. Hunting of wild animals became much less important in the EBA as compared with the preceding Neolithic and Chalcolithic periods (Buitenhuis 1985).

At the village of Gritille Höyük, Stein (1987) interprets the culling patterns of caprines as reflecting a generalized, low-risk exploitation strategy. These results indicate that Gritille Höyük operated within a self-contained pastoral production system. This self-sufficient economic mode is not surprising given Gritille Höyük's low rank as a village in the settlement hierarchy of the Karababa basin.

The faunal evidence from the town of Kurban Höyük reflects a more integrated animal production system. In one phase at Kurban Höyük, a low representation of prime-age caprines suggests that it produced surpluses to be exported to the centre as tribute (Wattenmaker 1998: 175-176). More specifically, in the earlier phases of the Mid-Late EBA, both elite and non-elite households produced their own animals for their own consumption, while some high-ranking households may have pursued a riskier productive strategy by focusing on fewer animal species. In the final phases of the Mid-Late EBA, elite and non-elite household animal production appears to have become more specialized. Evidence for this increased specialization is a decreased reliance on pigs, the exploitation of herd animals to the exclusion of wild animals, and a relatively low frequency of mature animals (Wattenmaker 1998: 186).

Conformity of the model: weighing the evidence

The structure of this thesis has followed a deductive approach. Predictions about Titriş Höyük's economy were inferred from what we generally know. Well-established zooarchaeological methods and techniques were employed in order to verify whether or not Titriş Höyük's faunal evidence conforms to the general model of the city and its natural and built environments, and about Mesopotamian culture history. The perennial question begs to be asked: do the results of the preceding faunal analysis reinforce the notion that Titriş Höyük was a highly urbanized centre?

Titriş Höyük's natural and built environments

Titriş Höyük controlled the natural lines of communication on the Tavuk Çay, a tributary of the Euphrates River that would have been an ideal conduit for the movement of agricultural products to and from the centre. A network of roads that all led to Titriş Höyük were also built so as to facilitate overland trade. The city depended on towns and villages to the north since its immediate hinterland alone could not have fulfilled its agricultural and pastoral requirements. Furthermore, agricultural yields would have been stressed in this period of climatic aridification. Forests around Titriş Höyük and Kurban Höyük were cleared in favour of more agricultural fields and grazing lands. At Titriş Höyük, population density was at its height during the Mid-Late EBA. Suburban expansion and the erection of a massive defensive wall occurred during this period, perhaps as a response to increased demand for agricultural and pastoral production.

Mesopotamian culture history

Greater Mesopotamian historical evidence as related to urban process paints a picture of a stratified society organized along lines of patrilineal kinship. The political economy was structured by a decision-making hierarchy. However, certain productive sectors, which might have included pastoral production, operated independently of the state's control. While large urban centres in southern Mesopotamia engaged in an oikos economy, the smaller-scale centres in northern Mesopotamia participated in a tributary system of exchange. Evidence for the Karababa basin settlements' involvement in a tributary exchange system during the Mid-Late EBA is supported by increased agricultural production from the Early EBA, Titriş Höyük's inability to be productively self-sufficient, and prime-age animals being exported from Kurban Höyük.

Pastoral economics at Titriş Höyük

The faunal analysis of pastoral economics at Titriş Höyük yielded results that both agree with and diverge from the model. The model predicted that Titriş Höyük would have required surplus pastoral stock from satellite communities to be transferred in order to feed a growing demographic of non-food producing specialists. The results of the analysis into this issue (Hypothesis II) are ambiguous, and therefore, do not refute this assertion. However, the possibility that Titriş Höyük *only* operated in the consuming mode, and did not produce domestic animals, was refuted by the bone element diversity data. The other aspect of production, specialization (Hypothesis III), can be interpreted with greater certainty. These results clearly indicate that sheep, goats and cattle were each raised and exploited for different purposes. The data suggest that sheep and cattle were primarily raised for their meat and/or milk, and goats were primarily raised for their hair.

In the next sequence of events, the model predicted that, since a large portion of the consuming population abstained from food production, the distribution of pastoral products would have been centrally controlled (Hypothesis IV). The results of the faunal analysis demonstrate that a very limited range of species was provisioned, which suggests a highly specialized operation. However, not all species appear to have been indirectly distributed. The data indicate that sheep and goats were indirectly distributed, but cattle were raised and exploited at the level of the household, without apparent state intervention.

In the last sequence of the animal exchange system, consumers in the Lower Town (30s) neighbourhood were predicted to have had greater access to animal products than consumers in the Outer Town (80s) neighbourhood (Hypothesis V). This prediction stems from a preliminary interpretation of Titriş Höyük's domestic architecture by the excavators, who concluded that the Lower Town neighbourhood was of higher status than the Outer Town neighbourhood. The analysis of the spatial distribution of animal remains between the two neighbourhoods does not support this contention. Instead, the data show that intra-site differences in species, age, and body part representations are negligible. This result suggests that the indirectly distributed sheep and goats were not preferentially provisioned to consumers according to the neighbourhood in which they inhabited.

Implications of results

To answer the question that was posed at the beginning of this section, the results suggest that Titriş Höyük was not as urbanized as originally thought. The discrepancy that has been observed between the general model of an urban pastoral economy and the model of pastoral economics at Titriş Höyük is likely a function of a false preconceived notion of what an EBA urban centre should be.

Our knowledge of Near Eastern urban process has been mostly gathered from archaeological and textual materials from Uruk, Sumerian, Akkadian, Babylonian and Assyrian contexts. These states engaged in international militarily campaigns, controlled great expanses of territory and exacted tribute from its subordinate settlements in an extensive network of interaction. Some of these states even ascended to imperial status. Titriş Höyük, on the other hand, was an urban centre on a much smaller scale. Its territorial breadth seems to have been restricted to the Karababa basin. Though it is possible that Titriş Höyük was a northern outpost or regional centre in the Akkadian empire, there is only weak material evidence to support this position (Algaze *et al.* 1992: 47; Wilkinson 1990: 99-100). Titriş Höyük was more likely a local, indigenous centre that, according to ceramic evidence, is more akin to other urban centres in northwestern Syria (Matney and Algaze 1995: 49-50; Nissen 1988: 161; Wilkinson 1990: 97).

If Titriş Höyük was the indigenous development that it appears to have been, then it makes sense that it had simpler infrastructure than Akkadian and other South Mesopotamian centres. Its utilization of productive specialization and centrally regulated distribution for certain animal products, while maintaining household-level production for others, is a logical scenario considering its urban scale relative to that of other Mesopotamian states.

Directions for future research

The current research can be improved upon by not only incorporating some of the methodological recommendations that were made above, but also through the work of other researchers who are analyzing other materials from Titriş Höyük. For example, integrating ceramic, floral, lithic and faunal data is a recipe for understanding the relationship between pastoral and agricultural production. As another example, and one that is crucially relevant to this thesis, the incorporation of more detailed architectural data would allow for a higher resolution spatial analysis of the faunal remains. If this is achieved, a comparison of the spatial distributions of faunal assemblages between houses in a compound and between rooms in a house might be possible. This line of research would improve our understanding of household economics and the functional use of space.

In order to properly understand Titriş Höyük's economic role as an urban centre in the EBA settlement hierarchy of the Karababa basin, it will be necessary to compare its faunal assemblage to rural sites such as Kurban Höyük, Lidar Höyük, Hayaz Höyük and Gritille Höyük. If pastoral production took place in the rural hinterland, as the indirect distribution model suggests, it is crucially important to understand the exchange dynamics between the urban centre and its rural hinterland.

A more local direction that can be taken would involve incorporating other faunal categories, such as fish, birds, mollusks, and other mammals. With reference to this last category, one intriguing avenue to consider would be a study of the equid remains. Preliminary osteometric calculations suggest that there are at least two species of equids from Titriş Höyük. The relative representation of the wild onager (*Equus hemionus*) and the domestic horse (*Equus caballus*) are as yet not understood. A comparative osteological study of these two species would clarify their importance at Titriş Höyük.

Conclusions

At the outset of this thesis, I had hoped to make a significant contribution to our understanding of how the pastoral economy contributes to urban process. Though this was an optimistic goal, I think that I have accomplished it to some degree. At minimum, I have made clear the daunting complexities that are inherent in tackling this problem.

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TABLES

Radiocarbon dates from EBA levels at Titriş Höyük

Chronological phase	Sample #	Locus	Radiocarbon years (B.C.)	Calibrated (B.C)
Early EBA	TH 96206	40-34:78	4560±70	3520-3020
Early EBA	TH 96208	40-34:78	4040±130	2900-2200
"Latest" Early EBA	TH 96098	40-34:330	4300±100	3350-2550
"Latest" Early EBA	TH 96076	40-34:328	4420±90	3350-2890
Mid EBA	TH 96113	40-34:324	4110±70	2880-2490
Mid EBA	TH 96058	40-34:308	4110±80	2880-2470
"Latest" Mid EBA	TH 3806	80-85:34	3720±60	2300-1940
Late EBA	TH 6162	79-85:31	4260±170	3400-2300
Late EBA	TH 15038	34-12:10	3860±70	2500-2130
Late EBA	TH 12560	79-87:42	3860±70	2500-2130
Late EBA	TH 8267	79-87:46	3630±60	2200-1770
Late EBA	TH 8274	79-87:47	3860±70	2500-2130
Late EBA	TH 3771	80-85:15	3860±180	2900-1800
Late EBA	TH 12161	81-85:65	3770±60	2410-1970

Adapted from Algaze et al. (2001: 76, Table 4)

Table 1. Radiocarbon dates from EBA levels at Titriş Höyük.

Chronology of the Near East

Dates (B.C.)	Southern Mesopotamia	Northern Mesopotamia/ Northeast Syria	Northwest Syria	Southeast Anatolia	Southwest Iran (Susiana)	West-Central Zagros, Iran	South Zagros, Iran	Levant
						Iron I		
1500	Kassite				Old Elamite III			
					(Sukkalmah)			
							Kaftari	
	Old Bablylonian	Habur Ware (Leilan I)						
	Isin-Larsa				Old Elamite II (Simaski)			
2000				Kurban III		Godin III:4		
	Ur III		Amuq J					
		Leilan II		Kurban IV.1				EB IV
	Akkadian		(Ebla Palace IIB)	Kurban IV.2				
				Kurban IV.3				EB III
			Amuq I	Kurban IV.4		Godin III:5		
2500	Early Dynastic III				Old Elamite I	Godin III:6		
					(Awan)			
	Early Dynastic II		Early Bronze	Early Bronze				
		Ninevite V						
		(Leilan III Raqa'l 3-7)	Amuq H	Kurban V		Godin IV	Late Banesh	EB II
	Early Dynastic I							
3000	Jemdet Nasr	Late Chalcolithic	Late Chalcolithic	Late Chalcolithic	Protoliterate	Godin Terminal V/VI	Middle Banesh	
			Amuq G		Late Uruk			
	Late Uruk	Late Gawran	(Habuba Kabira)	Kurban Via				
						Godin V/VI		EB I
		Gawra IX-VIIA					Early Banesh	
3500	Middle Uruk	(Middle Gawran)			Middle Uruk			
			Amuq F			Godin VI	Lapui	
		Gawra XI/X						
		(Early Gawran)		Kurban Vib				
					Early Uruk			
	Early Uruk	Gawra XII, XIA-B				Godin VII	Late Bakun	Chalcolithic
4000					Susa A	Godin VIII		
	Ubaid 4		Amuq E	Kurban VII				
							Middle Makun	

Table 2. Chronology of the Near East.

Based on Levy (1986: 86), Wattenmaker (1998: 61); Wilkinson (2003: xviii-xix).

Body part units used in analysis*

Cranium	Axial	Forequarter	Hindquarter	Lower limb
Skull	Atlas	Scapula	Innominate	Carpal
Mandible	Axis	Humerus	Femur	Metacarpus
Hyoid	Cervical v.	Radius	Patella	Tarsal
	Thoracic v.	Ulna	Tibia	Metatarsus
	Lumbar v.		Fibula	Phalanx
	Sacrum			
	Caudal v.			
	Rib			
	Sternum			
Low	-	High	High	Low
Meat-yield value				

Note: Axial elements are not assigned a meat-yield value because they are quite variable in their meat-yield. They are also more difficult to identify to a low taxonomic level than most other elements.

* Sesamoids are excluded from this part of the analysis because they can only rarely be identified to a low taxonomic level.

Table 3. Body part units used in analysis.

Key to Sheep and Goat Wear Stages

Payne age stage	Payne absolute age	Payne definition*	Grant definition	Grant MWS**	Age class
A	0-2 months	m3/P4 unworn	m3/P4 <a	1-2	Infant
B	2-6 months	m3/P4 in wear, m1 unworn	m3/P4 >b, M1 <a	3-7	Juvenile
C	6-12 months	M1 in wear, M2 unworn	M1 >b, M2 <a	8-18	
D	1-2 years	M2 in wear, M3 unworn	M2 >b, M3 <a	19-28	Sub-adult
E	2-3 years	M3 in wear, posterior cusp unworn	M3 b - d	29-33	
F	3-4 years	M3 posterior cusp in wear M3 pre □□-	M3 e-f	34-37	Adult
G	4-6 years	M3□□- , M2 □□	M3 = g, M2 = g	38-41	
H	6-8 years	M3 □□-; M2 post- □□	M3 = g, M2 >h	42-44	Senile
I	8-10 years	M3 post- □□-	M3 >h	45+	

* The mature wear-state is schematically expressed by □□ for M2 and □□- for M3.
Adapted from Grant (1975); Hambleton (1999); and Payne (1973).

Table 4. Key to sheep and goat wear stages.

Key to Cattle Wear Stages

Halstead age stage	Halstead absolute age	Halstead definition	Grant definition	Grant MWS*	Age class
A	0-1 months	m3/P4 unworn	m3/P4 <a	1-3	Infant
B	1-8 months	m3/P4 in wear, M1 unworn	m3/P4 >b, M1 <a	4-6	
C	8-18 months	M1 in wear, M2 unworn	M1 >b, M2 <a	7-16	Juvenile
D	18-30 months	M2 in wear, M3 unworn	M2 >b, M3 <a	17-30	Sub-adult
E	30-36 months	M3 in wear, posterior cusp unworn	M3 b - d	31-36	
F	young adult	M3 posterior cusp in wear, M3 <g	M3 e-f	37-40	
G	adult	M3 = g	M3 = g	41-43	Adult
H	old adult	M3 = h or j	M3 h - j	44-45	
I	senile	M3 = k or above	M3 >k	46+	Senile

* The Grant MWS (mandible wear stage) is calculated by summing the numerical equivalent values of the three permanent molars.

Table 5. Key to cattle wear stages.

Distribution of taxa by neighbourhood

		30s		80s	
Taxon	Common name	NISP	%	NISP	%
Accipitridae	hawk	0	0.00%	2	0.02%
Anseriformes	goose	0	0.00%	1	0.01%
Antilocapridae	antelope	0	0.00%	3	0.03%
Artiodactyla	artiodactyl	0	0.00%	2	0.02%
Aves	bird	4	0.28%	26	0.24%
Aves - medium	bird - medium	0	0.00%	2	0.02%
Aves - small	bird - small	0	0.00%	4	0.04%
Bivalvia	bivalve	3	0.21%	10	0.09%
Bos primigenius	auroch	2	0.14%	3	0.03%
Bos taurus	cattle	136	9.48%	1078	10.14%
Bovidae	bovid	0	0.00%	10	0.09%
Canidae	canid	1	0.07%	16	0.15%
Canis familiaris	dog	8	0.56%	106	1.00%
Canis lupus	wolf	0	0.00%	1	0.01%
Capra aegagrus	bezoar goat	0	0.00%	1	0.01%
Capra hircus	goat	23	1.60%	269	2.53%
Capreolus capreolus	roe deer	0	0.00%	14	0.13%
Capridae/Antilocapridae	caprid/antelope	0	0.00%	1	0.01%
Carnivora	carnivore	0	0.00%	5	0.05%
Carnivora - small	small carnivore	0	0.00%	7	0.07%
Castor fiber	beaver	0	0.00%	1	0.01%
Cervidae	cervid	2	0.14%	9	0.08%
Cervus elaphus	red deer	4	0.28%	18	0.17%
Cervus elaphus/ Dama dama	red deer/fallow deer	3	0.21%	0	0.00%
Decapoda	crustacean	0	0.00%	4	0.04%
Equus caballus	horse	1	0.07%	3	0.03%
Equus hemionus	onager	0	0.00%	52	0.49%
Equus sp.	equid	6	0.42%	28	0.26%
Felidae	felid	1	0.07%	2	0.02%
Felis silvestris	wild cat	0	0.00%	2	0.02%
Gastropoda	gastropod	2	0.14%	52	0.49%
Lamniformes	shark	1	0.07%	0	0.00%
Lepus sp.	hare	7	0.49%	42	0.40%
Mammalia - large	large mammal	217	15.13%	1230	11.57%
Mammalia - medium	medium mammal	608	42.40%	4866	45.78%
Mammalia - small	small mammal	8	0.56%	166	1.56%
Meles meles	badger	0	0.00%	1	0.01%
Meriones sp.	gerbil	1	0.07%	0	0.00%
Microtus sp.	vole	0	0.00%	1	0.01%
Mollusca	mollusk	0	0.00%	3	0.03%
Mustelidae	badger/otter/weasel	0	0.00%	1	0.01%
Naticidae	mollusk	0	0.00%	1	0.01%
Osteichthyes	bony fish	2	0.14%	18	0.17%
Ovis aries	sheep	66	4.60%	352	3.31%
Ovis sp.	wild/domestic sheep	0	0.00%	2	0.02%
Ovis/Capra	sheep/goat	308	21.48%	1885	17.73%
Ovis/Capra/Cervidae	sheep/goat/cervid	15	1.05%	40	0.38%
Panthera leo	lion	0	0.00%	1	0.01%
Reptilia	reptile	0	0.00%	19	0.18%
Rodentia	rodent	1	0.07%	248	2.33%
Sus scrofa	pig	2	0.14%	9	0.08%
Testudines	turtle	0	0.00%	1	0.01%
Ursus sp.	bear	0	0.00%	1	0.01%
Vulpes sp.	fox	2	0.14%	11	0.10%
TOTAL		1434	100.00%	10630	100.00%

Table 6. Distribution of taxa by neighbourhood.

Ratio of Sheep to Goats			
Taxon	NISP	%	Ratio
Capra hircus	329	0.40	1.0
Ovis aries	484	0.60	1.5
TOTAL	813		

Table 7. Ratio of sheep to goats

Ratio of Sheep and Goat to Cattle			
Taxon	NISP	%	Ratio
Ovis/Capra	3254	0.70	2.4
Bos taurus	1362	0.30	1.0
TOTAL	4616		

Table 8. Ratio of sheep and goat to cattle

Basic statistics of assemblages from open-air and sheltered contexts			
	Brain (1969)	Open-air	Sheltered
Mean	21	21.78	37.45
Median	14.9	13.79	27.78

Table 9. Basic statistics of open-air and sheltered context assemblages.

Shannon-Wiener Information function of element portions of Bos taurus

Element portion	NISP	%	pi	Loge pi	pi Loge pi
Carpal	24	0.029232643	0.029232643	-3.532469279	-0.103263414
Femur, complete	1	0.001218027	0.001218027	-6.710523109	-0.008173597
Femur, distal	26	0.031668697	0.031668697	-3.452426571	-0.10933385
Femur, proximal	10	0.012180268	0.012180268	-4.407938016	-0.053689866
Humerus, complete	1	0.001218027	0.001218027	-6.710523109	-0.008173597
Humerus, distal	56	0.068209501	0.068209501	-2.685171419	-0.183154202
Humerus, proximal	13	0.015834348	0.015834348	-4.145573752	-0.065642459
Mandible	95	0.115712546	0.115712546	-2.156646218	-0.249551024
Metacarpus, distal	29	0.035322777	0.035322777	-3.343227279	-0.118092072
Metacarpus, proximal	35	0.042630938	0.042630938	-3.155175048	-0.134508071
Metatarsus, distal	27	0.032886724	0.032886724	-3.414686243	-0.112297842
Metatarsus, proximal	40	0.048721072	0.048721072	-3.021643655	-0.147217718
Phalanx	148	0.180267966	0.180267966	-1.713310836	-0.308855059
Radius, distal	24	0.029232643	0.029232643	-3.532469279	-0.103263414
Radius, proximal	35	0.042630938	0.042630938	-3.155175048	-0.134508071
Scapula, distal	37	0.045066991	0.045066991	-3.099605197	-0.139689881
Scapula, proximal	5	0.006090134	0.006090134	-5.101085197	-0.031066292
Tarsal	15	0.018270402	0.018270402	-4.002472908	-0.073126789
Tibia, distal	29	0.035322777	0.035322777	-3.343227279	-0.118092072
Tibia, proximal	28	0.03410475	0.03410475	-3.378318599	-0.115216712
Ulna, distal	6	0.007308161	0.007308161	-4.91876364	-0.035947116
Ulna, proximal	22	0.02679659	0.02679659	-3.619480656	-0.096989737
Vertebra	115	0.140073082	0.140073082	-1.965590981	-0.275326386
TOTAL	821	1	1	**H'=**	**2.725179242**
				V'=	**0.86913866**

Table 10. Shannon-Wiener Information function of element portions of *Bos taurus*.

Shannon-Wiener Information function of element portions of Ovis/Capra

Element portion	NISP	%	pi	Loge pi	pi Loge pi
Carpal	26	0.01656051	0.01656051	-4.10073436	-0.067910251
Femur, complete	1	0.000636943	0.000636943	-7.358830898	-0.004687153
Femur, distal	31	0.019745223	0.019745223	-3.924843694	-0.077496914
Femur, proximal	36	0.022929936	0.022929936	-3.77531196	-0.086567663
Humerus, complete	3	0.001910828	0.001910828	-6.26021861	-0.011962201
Humerus, distal	104	0.066242038	0.066242038	-2.714439999	-0.179810038
Humerus, proximal	20	0.012738854	0.012738854	-4.363098625	-0.055580874
Mandible	319	0.203184713	0.203184713	-1.593639796	-0.323803245
Metacarpus, complete	13	0.008280255	0.008280255	-4.793881541	-0.039694561
Metacarpus, distal	42	0.026751592	0.026751592	-3.62116128	-0.09687183
Metacarpus, proximal	69	0.043949045	0.043949045	-3.124724394	-0.137328652
Metatarsus, complete	4	0.002547771	0.002547771	-5.972536537	-0.015216654
Metatarsus, distal	30	0.01910828	0.01910828	-3.957633517	-0.07562357
Metatarsus, proximal	69	0.043949045	0.043949045	-3.124724394	-0.137328652
Phalanx	173	0.110191083	0.110191083	-2.205539304	-0.243030764
Radius, complete	7	0.004458599	0.004458599	-5.412920749	-0.024134042
Radius, distal	40	0.025477707	0.025477707	-3.669951444	-0.093501948
Radius, proximal	69	0.043949045	0.043949045	-3.124724394	-0.137328652
Scapula, complete	2	0.001273885	0.001273885	-6.665683718	-0.008491317
Scapula, distal	87	0.055414013	0.055414013	-2.89292278	-0.16030846
Scapula, proximal	7	0.004458599	0.004458599	-5.412920749	-0.024134042
Sesamoid	11	0.007006369	0.007006369	-4.960935626	-0.034758148
Tarsal	5	0.003184713	0.003184713	-5.749392986	-0.018310169
Tibia, complete	1	0.000636943	0.000636943	-7.358830898	-0.004687153
Tibia, distal	84	0.053503185	0.053503185	-2.928014099	-0.156658079
Tibia, proximal	43	0.027388535	0.027388535	-3.597630783	-0.098533837
Ulna, complete	1	0.000636943	0.000636943	-7.358830898	-0.004687153
Ulna, distal	8	0.005095541	0.005095541	-5.279389357	-0.026901347
Ulna, proximal	29	0.018471338	0.018471338	-3.991535068	-0.073728992
Vertebra	236	0.150318471	0.150318471	-1.894999093	-0.284853367
TOTAL	1570	1	1	**H'=**	**2.703929725**
				V'=	**0.794993475**

Table 11. Shannon-Wiener Information function of element portions of *Ovis/Capra*.

Shannon-Wiener Information function of food taxa (NISP)

Taxon	Common name	NISP	%	pi	Loge pi	pi Loge pi
Bos primigenius	auroch	6	0.001264755	0.001264755	-6.672876471	-0.008439557
Bos taurus	cattle	1362	0.287099494	0.287099494	-1.247926454	-0.358279054
Capra aegagrus	bezoar goat	1	0.000210793	0.000210793	-8.464635941	-0.001784282
*Capra hircus**	goat	1317	0.277613828	0.277613828	-1.281524239	-0.35576885
Capreolus capreolus	roe deer	15	0.003161889	0.003161889	-5.75658574	-0.018201683
Castor fiber	beaver	1	0.000210793	0.000210793	-8.464635941	-0.001784282
*Cervus elaphus***	red deer	33	0.006956155	0.006956155	-4.968128379	-0.034559072
*Dama dama***	fallow deer	1	0.000210793	0.000210793	-8.464635941	-0.001784282
Lepus sp.	hare	57	0.012015177	0.012015177	-4.421584673	-0.053126123
Mustelidae	badger/otter/weasel	1	0.000210793	0.000210793	-8.464635941	-0.001784282
*Ovis aries**	sheep	1937	0.408305228	0.408305228	-0.895740277	-0.365735438
Sus scrofa	pig	13	0.002740304	0.002740304	-5.899686583	-0.016166932
Total		4744	1	1	**H' =**	**1.217413838**
					V' =	**0.489923369**

* The category of Ovis/Capra (sheep/goat) was eliminated for the purpose of this statistic. Specimens that were recorded as Ovis/Capra were "split" into the "Ovis aries" or "Capra hircus" categories based on the ratio of proper Ovis aries to Capra hircus specimens (NISP). The sheep:goat ratio is 3:2. Thus, 60 percent of the Ovis/Capra specimens were applied to the Ovis aries category and 40 percent were applied to the Capra hircus category (see box below).

** The category of Cervus elaphus/Dama dama was eliminated for the purpose of this statistic. It was split between the categories of Cervus elaphus, Dama dama and Capreolus capreolus in the same fasion as above. The category of Cervidae was eliminated for the purpose of this statistic. It was split between the categories of Cervus elaphus, Dama dama, and Capreolus capreolus in the same fasion as above.

Following the logic of Wattenmaker (1998: 165), dogs, equids, rodents, and carnivores were excluded from this calculation because they may not have been exploited for the purpose of consumption. These exclusions facilitate comparability to Wattenmaker's results.

Mammals are only considered in this calculation.

Ovis/Capra redistribution			
"control"	NISP		Ratio
Capra hircus		329	0.404674047
Ovis aries		484	0.595325953
combined		813	1
Ovis/Capra (original) =		2441	
	Added to		NISP
OC-*Capra hircus*		987.8093481	987.8093481
OC-*Ovis aries*		1453.190652	1453.190652

Table 12. Shannon-Wiener Information function of food taxa.

Distribution of wild food taxa by neighbourhood

		30s		80s	
Taxon	Common name	NISP	%	NISP	%
Accipitridae	hawk			2	0.80%
Anseriformes	goose			1	0.40%
Antilocapridae	antelope			3	1.20%
Bivalvia	bivalve	3	10.71%	10	3.98%
Bos primigenius	auroch	2	7.14%	3	1.20%
Capra aegagrus	bezoar goat			1	0.40%
Capreolus capreolus	roe deer			14	5.58%
Castor fiber	beaver			1	0.40%
Cervidae	cervid	1	3.57%	9	3.59%
Cervus elaphus	red deer	4	14.29%	18	7.17%
Cervus elaphus/ Dama dama	red deer/fallow deer	3	10.71%		
Decapoda	crustacean			4	1.59%
Equus hemionus	onager			52	20.72%
Felidae	felid	1	3.57%	2	0.80%
Felis silvestris	wild cat			2	0.80%
Gastropoda	gastropod	2	7.14%	52	20.72%
Lamniformes	shark	1	3.57%		
Lepus sp.	hare	7	25.00%	42	16.73%
Mustelidae	badger/otter/weasel			1	0.40%
Naticidae	mollusk			1	0.40%
Osteichthyes	bony fish	2	7.14%	18	7.17%
Panthera leo	lion			1	0.40%
Sus scrofa	pig			1	0.40%
Testudines	turtle			1	0.40%
Ursus sp.	bear			1	0.40%
Vulpes sp.	fox	2	7.14%	11	4.38%
TOTAL		28		251	

Note: eliminated non-food wild taxa: Aves, Canidae, Canis lupus, Carnivora, Lamniformes, Mammalia, Meles meles, Meriones sp., Microtus sp., Reptilia, and Rodentia

Table 13. Distribution of wild food taxa by neighbourhood.

FIGURES

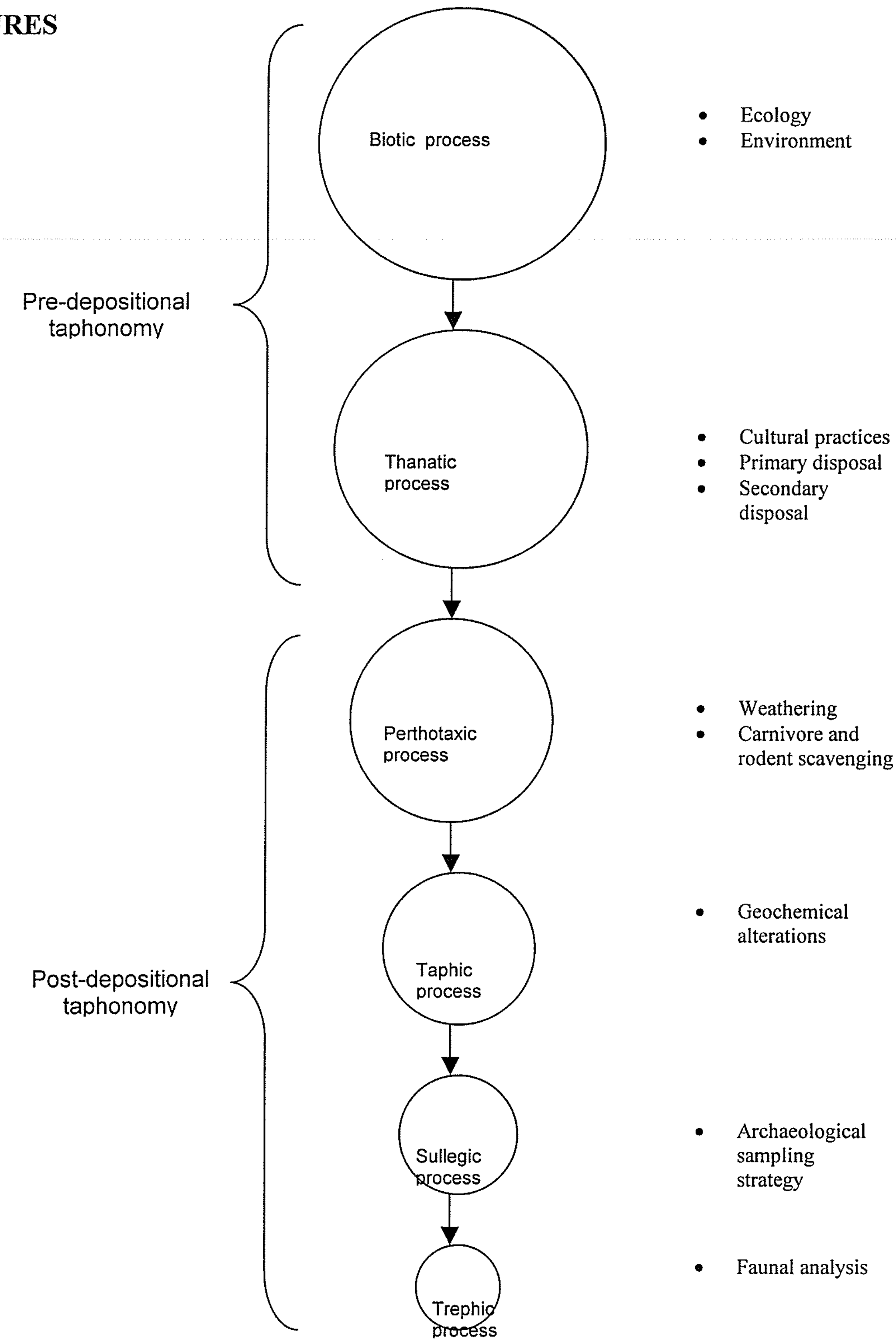

Figure 1. Taphonomic model of a bone assemblage.

The decreasing size of the circles represents the progressive loss of information through time (after Hesse and Wapnish 1985: 19, Figure 9; Meadow 1980: 67, Figure 1).

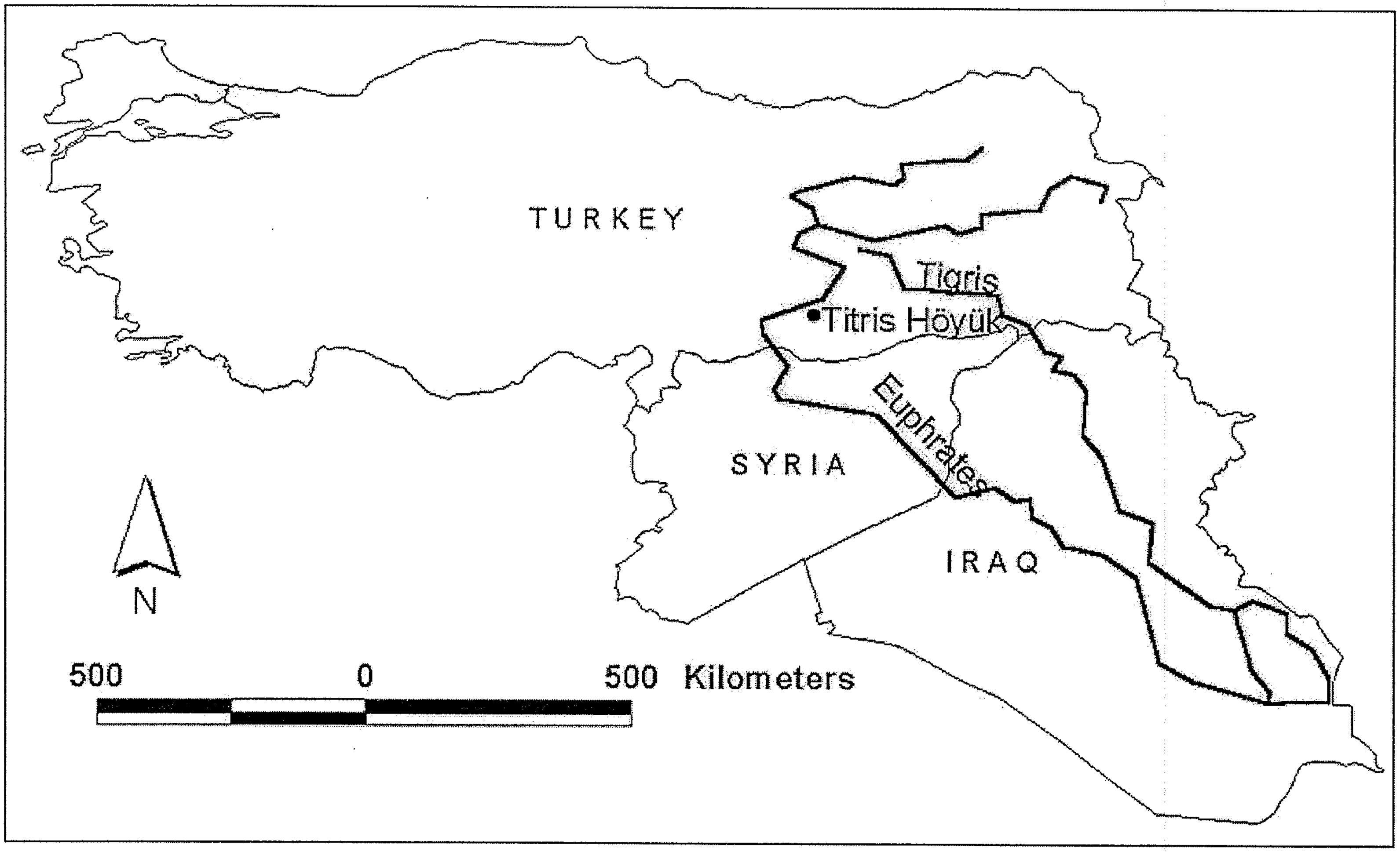

Figure 2. Map of the Near East showing location of Titriş Höyük.

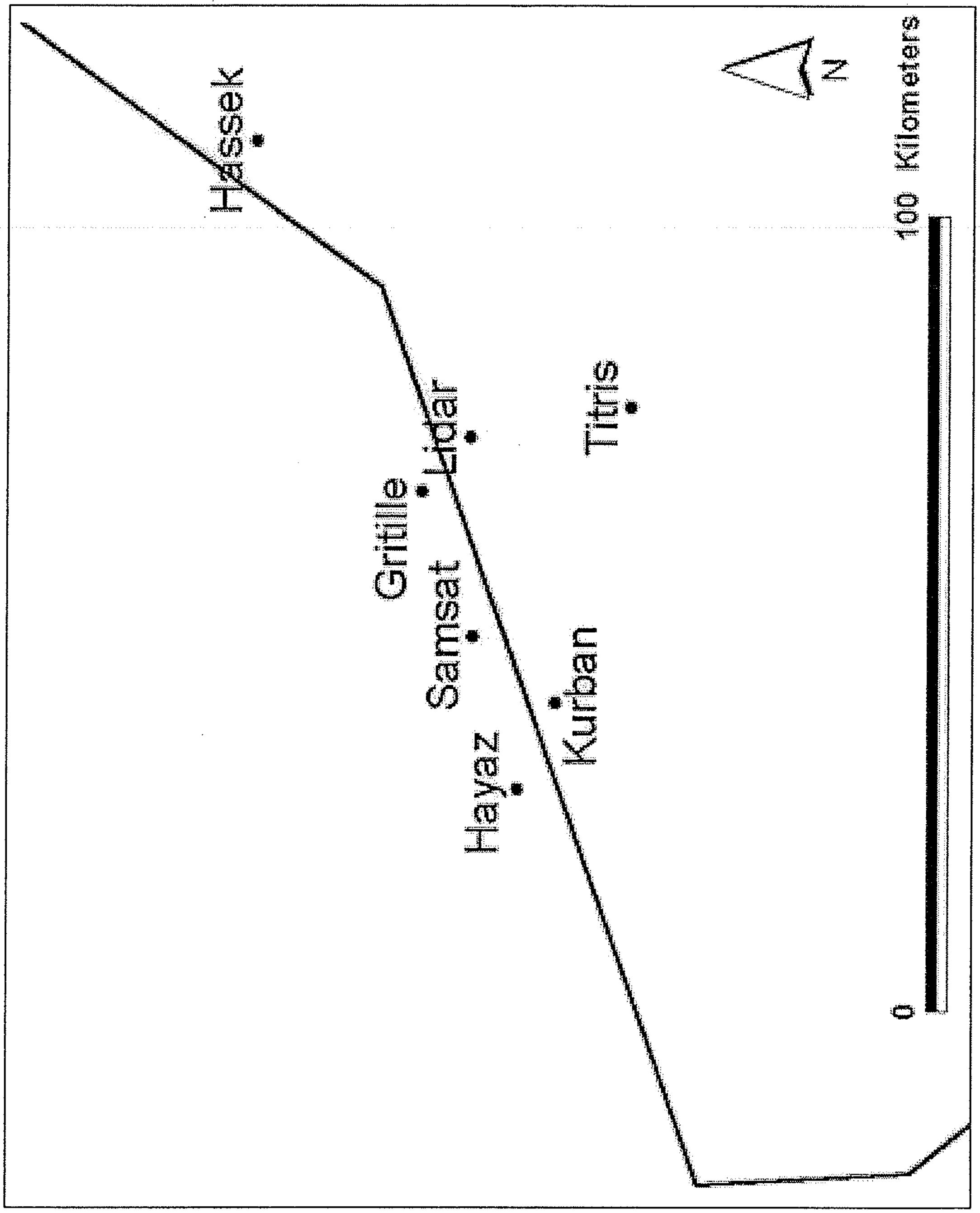

Figure 3. EBA settlements in the Karababa basin.

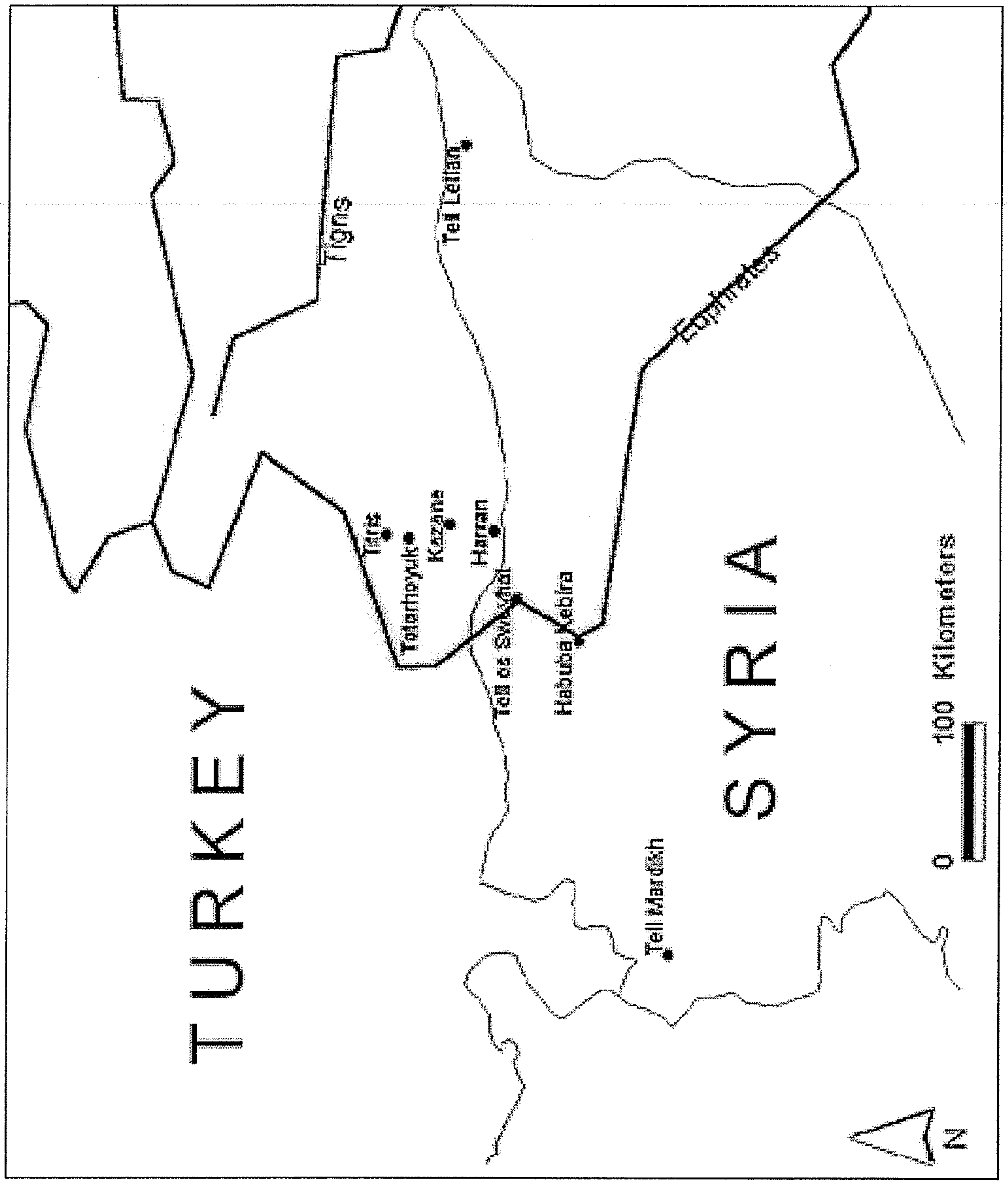

Figure 4. Northern Mesopotamia showing location of some sites mentioned in the text.

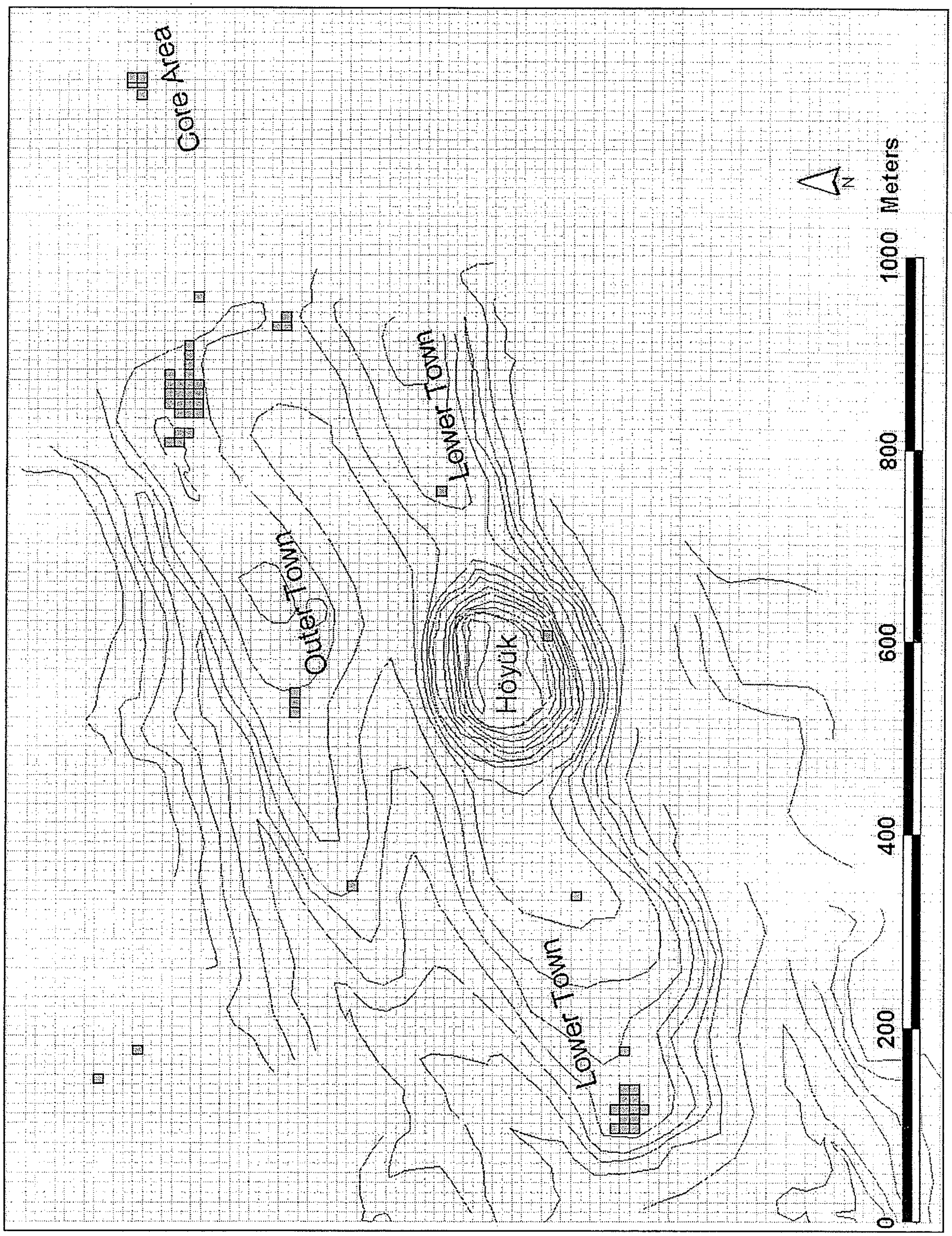

Figure 5. Topographic plan of Titriş Höyük showing locations of excavated trenches (adapted from Algaze et al. 2001).

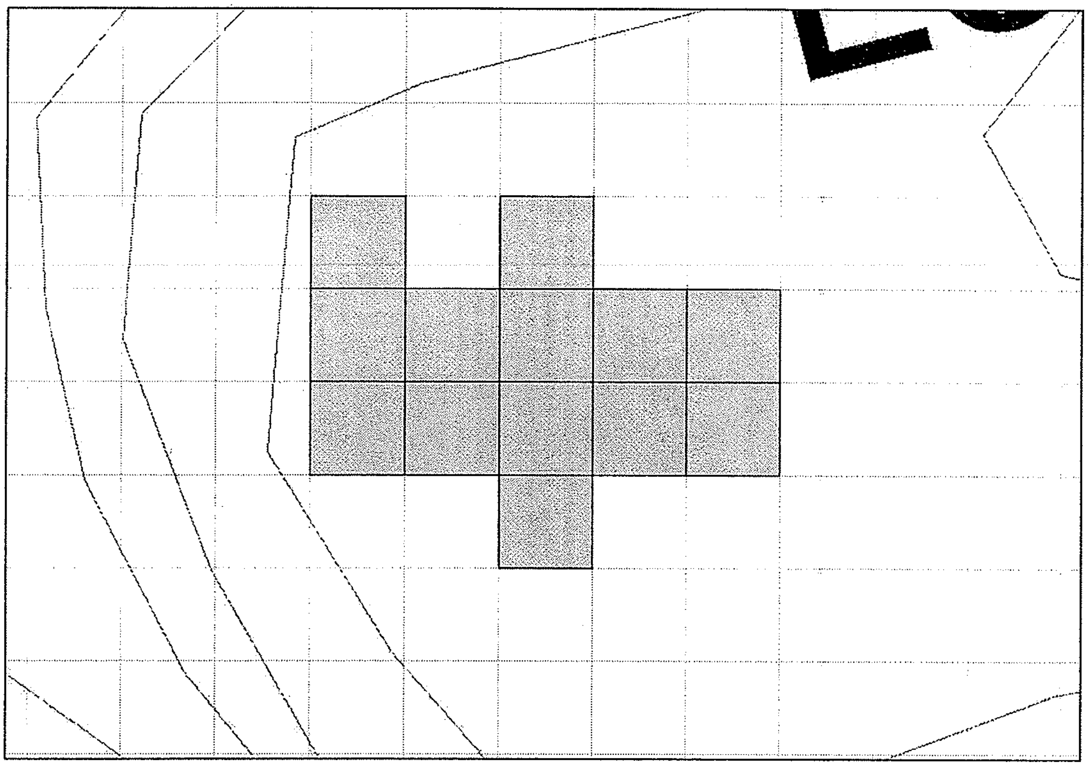

Figure 6. Excavated trenches of the 30s neighbourhood in the Lower Town.

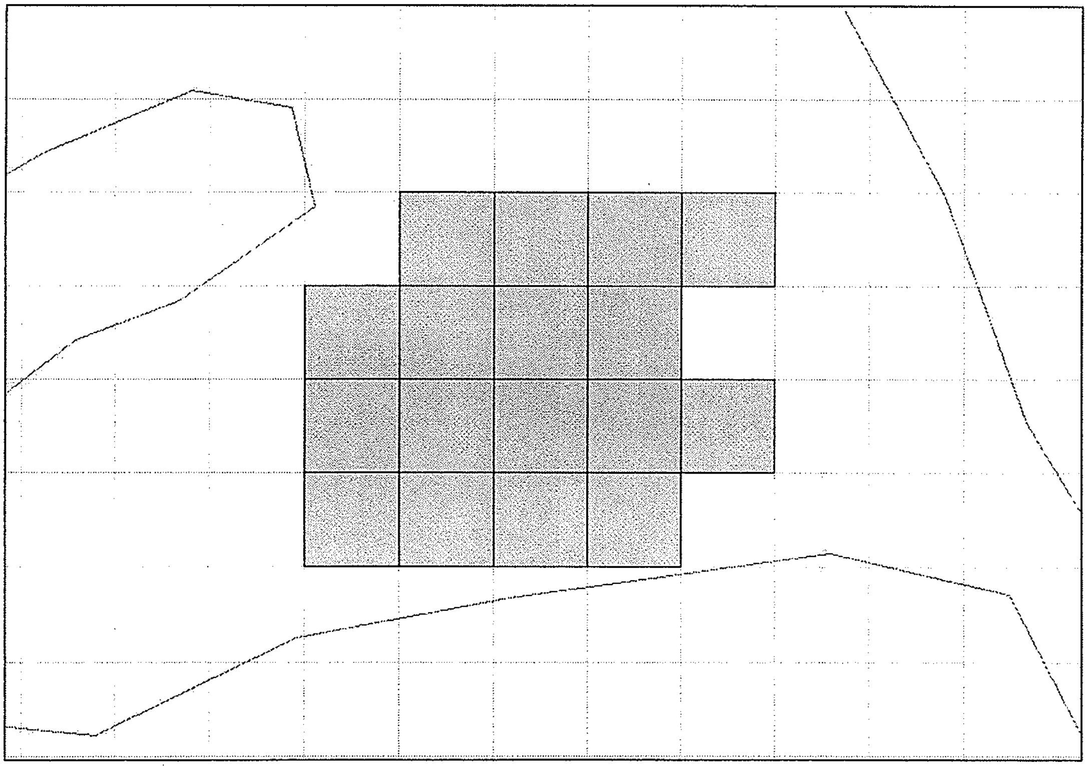

Figure 7. Excavated trenches of the 80s neighbourhood in the Outer Town.

Figure 8. *Ovis aries* mandible (TH12553-92), occlusal aspect, showing exotosis on lateral face. Photograph by B. Barth.

Figure 9. *Ovis/Capra* mandible (TH8034-12), lateral aspect, showing heaving carnivore chew marks. Photograph by B. Barth.

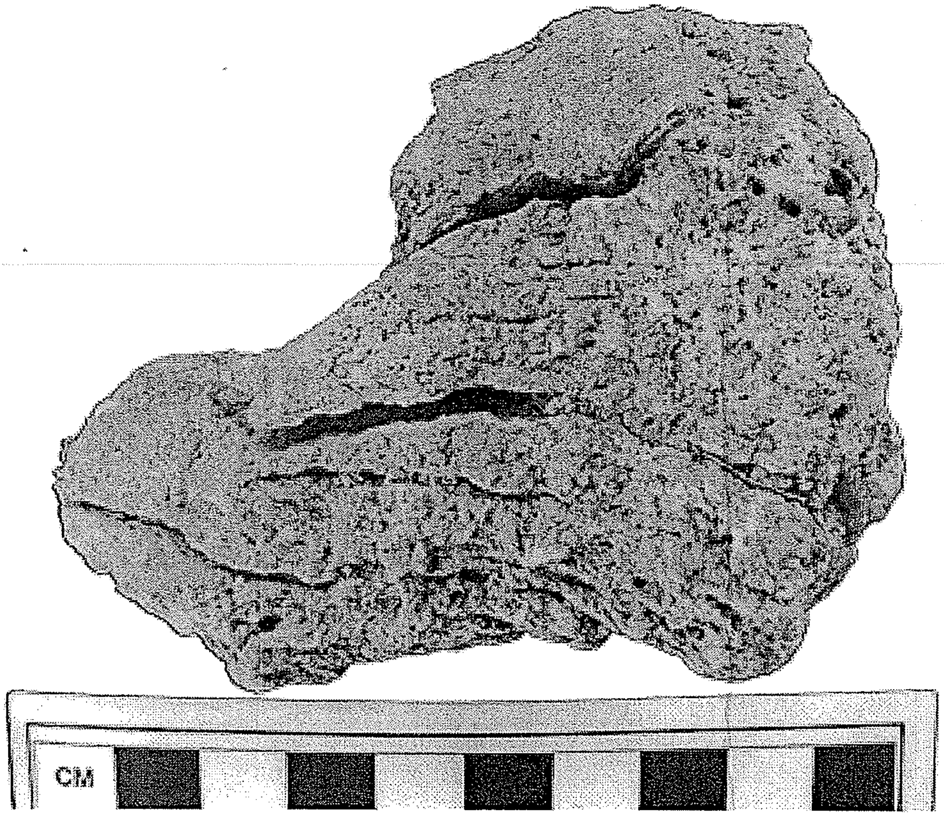

Figure 10. *Bos primigenius* **proximal metacarpus (TH62505-1), anterior aspect, showing heaving weathering damage. Photograph by B. Barth.**

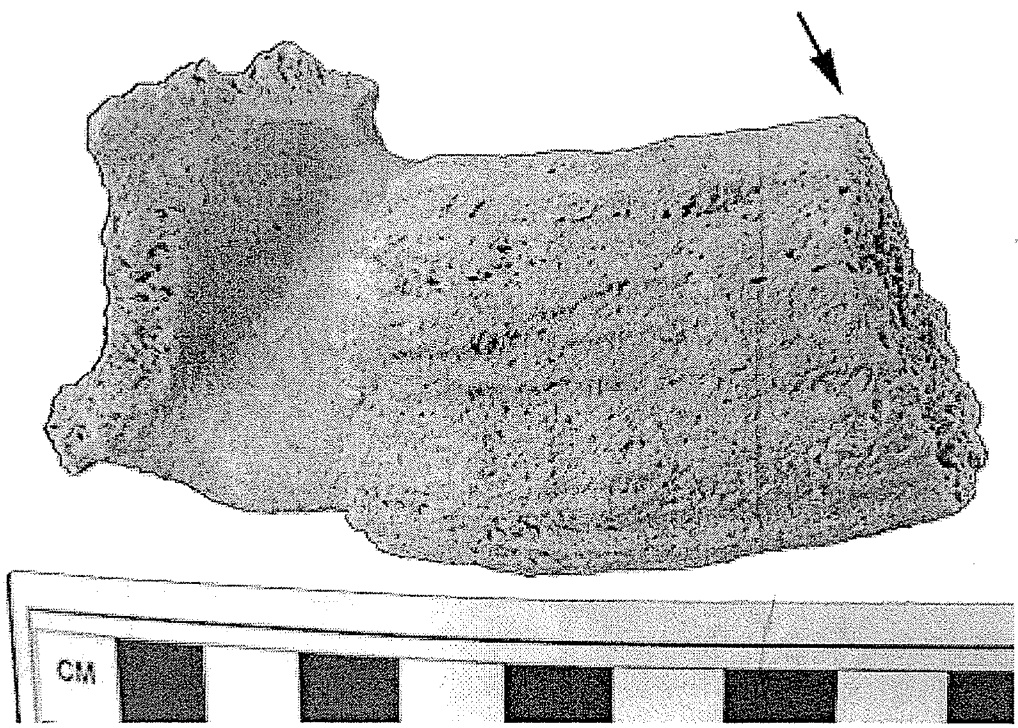

Figure 11. *Capra hircus* **horncore (TH10122-1), lateral aspect, showing chop mark. Photograph by B. Barth.**

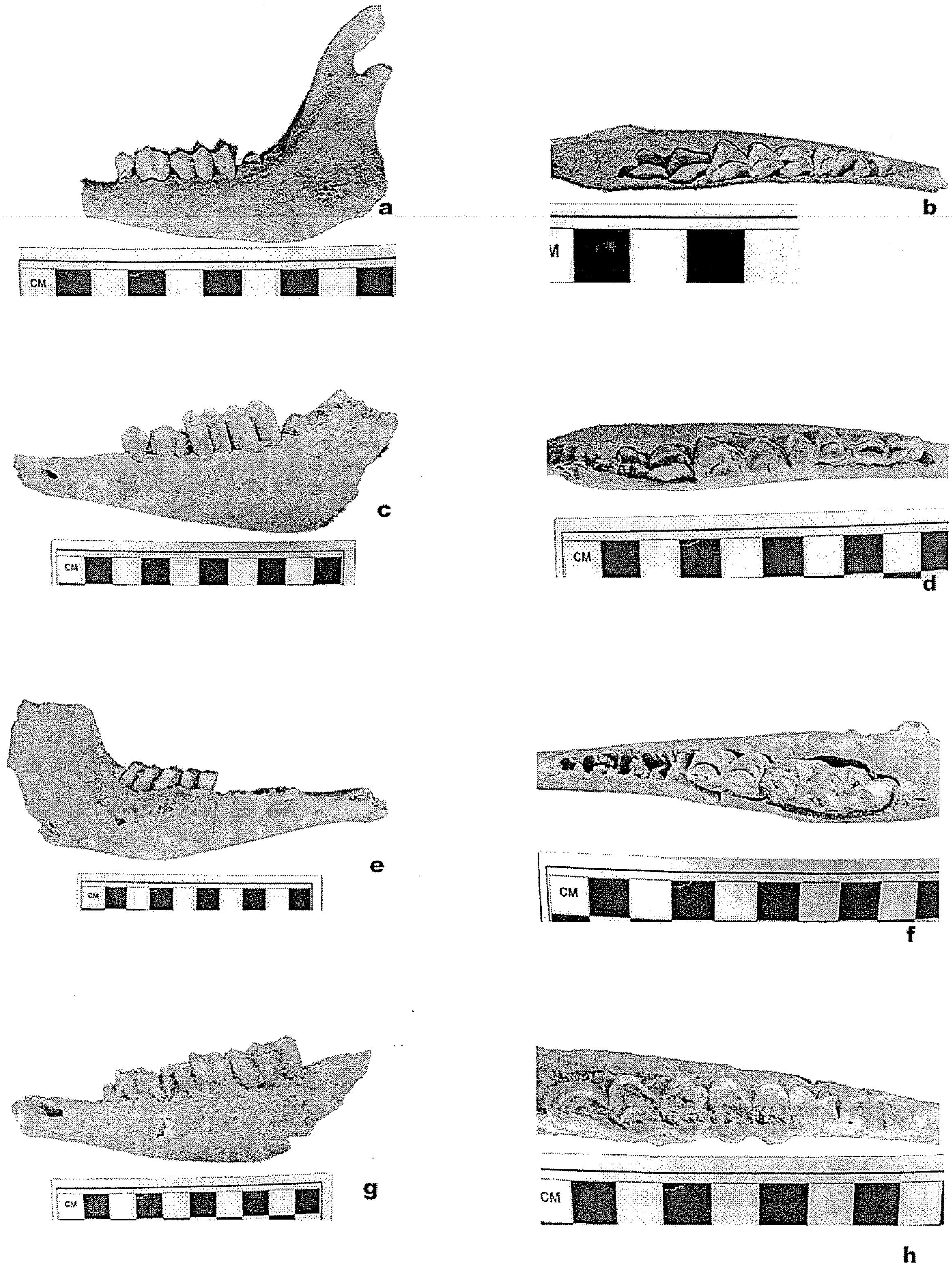

Figure 12. Examples of mandibles used for calculating mortality profiles: a and b, *Ovis aries* (TH91103-1); c and d, *Ovis aries* (TH8258-26); e and f, *Ovis aries* (TH12553-92); g and h, *Ovis/Capra* (TH8034-12). Photographs by B. Barth.

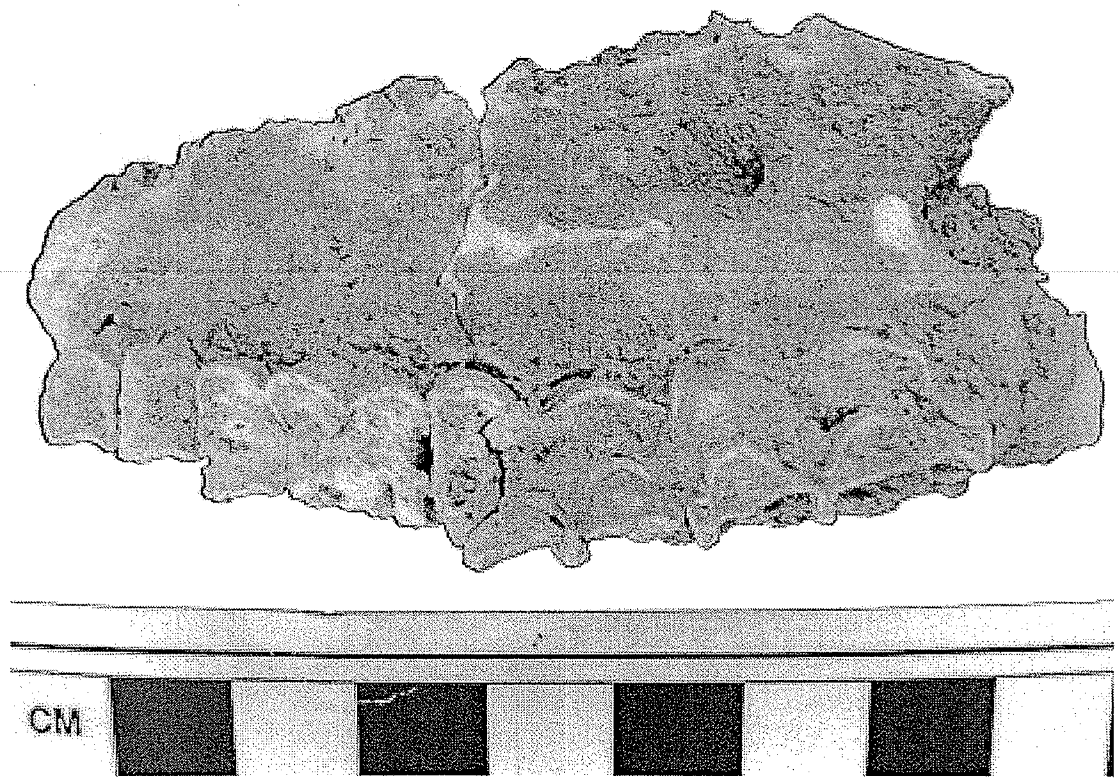

Figure 13. ***Ovis aries*** **maxilla (TH9140-2), occlusal aspect, showing heavy calcium carbonate encrustations. Photograph by B. Barth.**

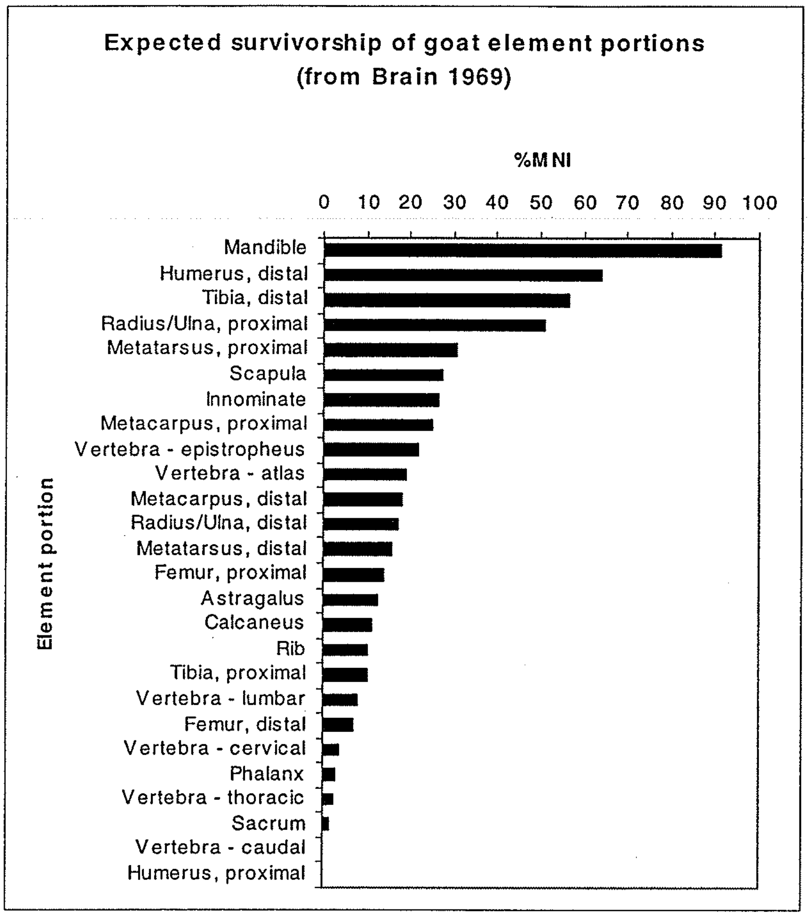

Figure 14. Expected frequencies of carnivore-scavenged element portions (adapted from Brain 1969).

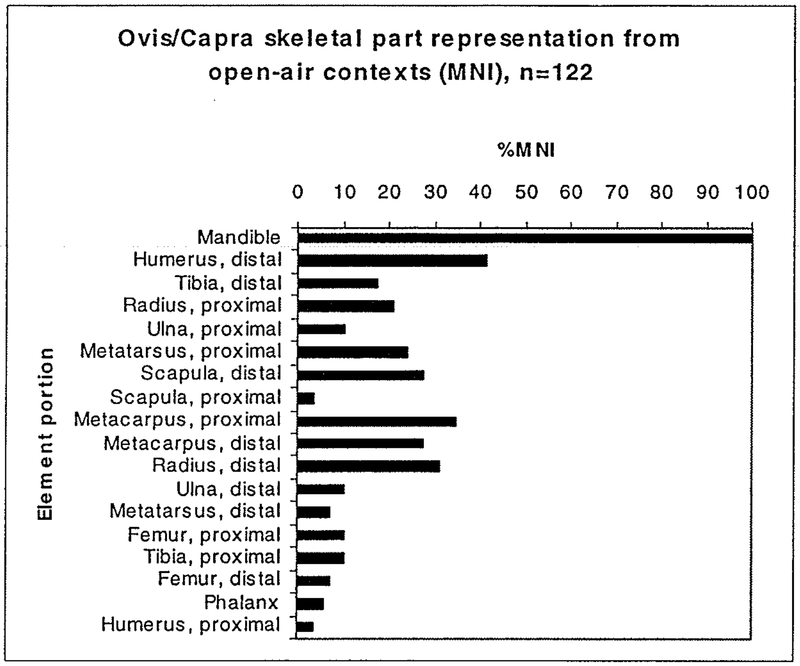

Figure 15. Open-air assemblage.

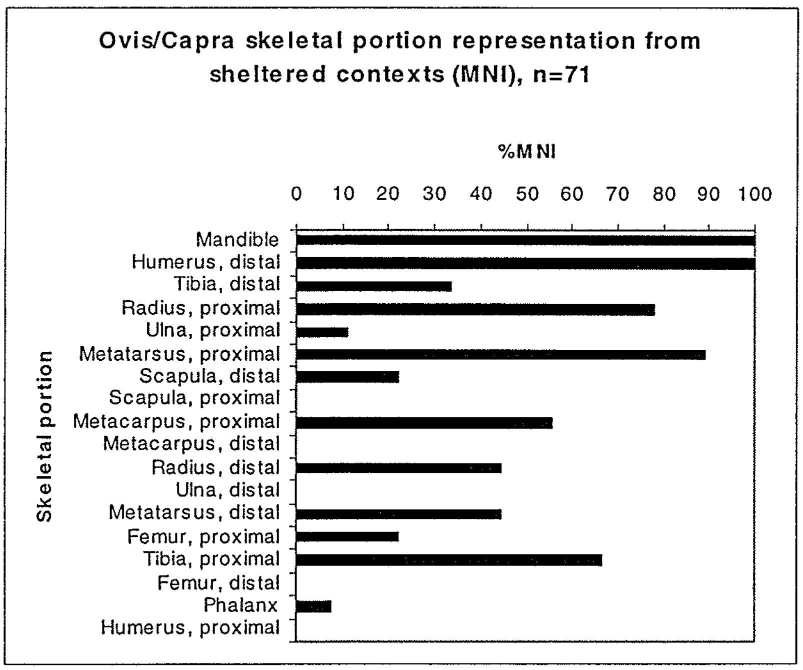

Figure 16. Sheltered assemblage.

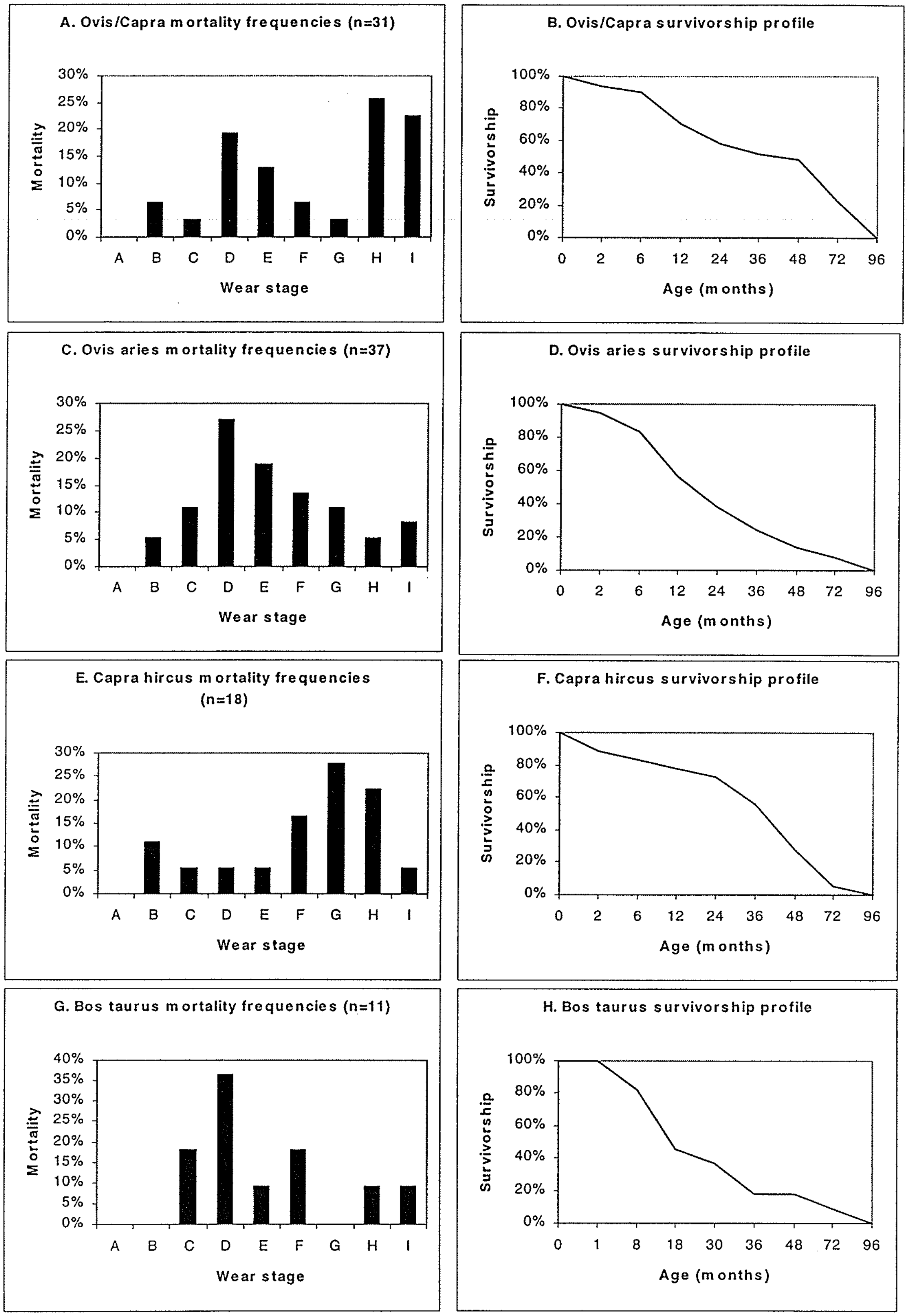

Figure 17. Age data based on mandibles.

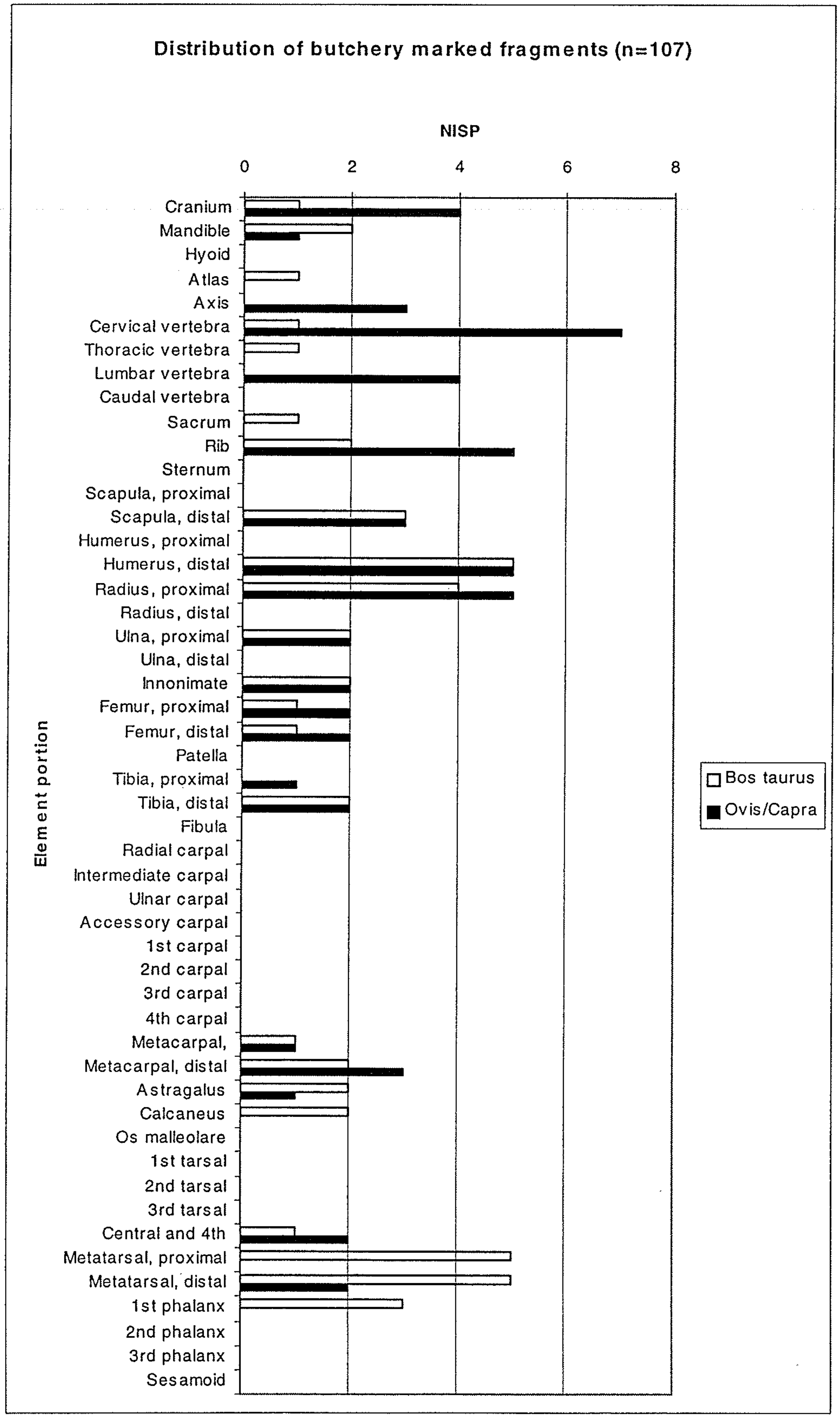

Figure 18. Distribution of butchery marked fragments.

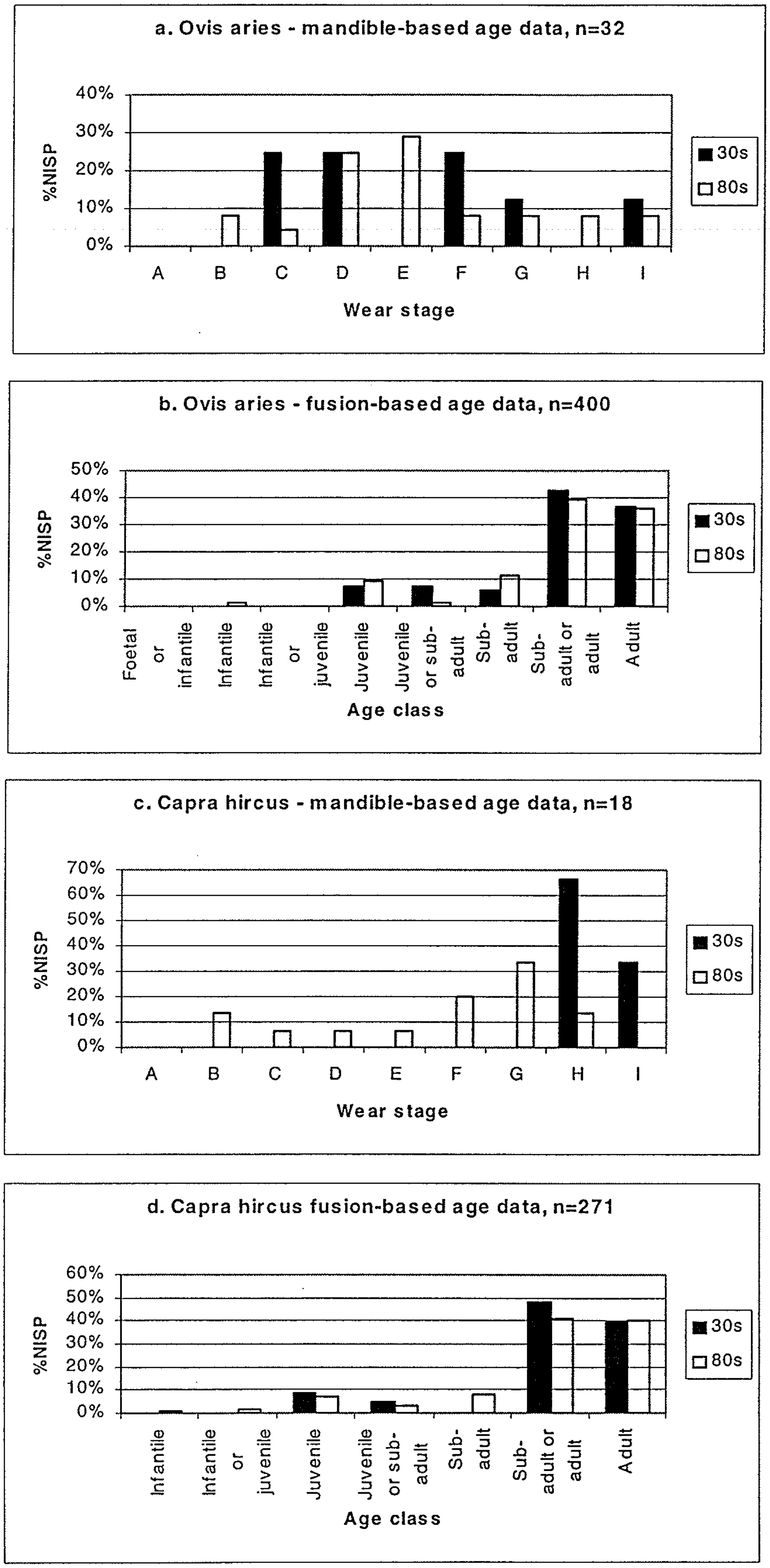

Figure 19. ***Ovis aries*** **(a-b) and** ***Capra hircus*** **(c-d) mandible and epiphyseal fusion age data.**

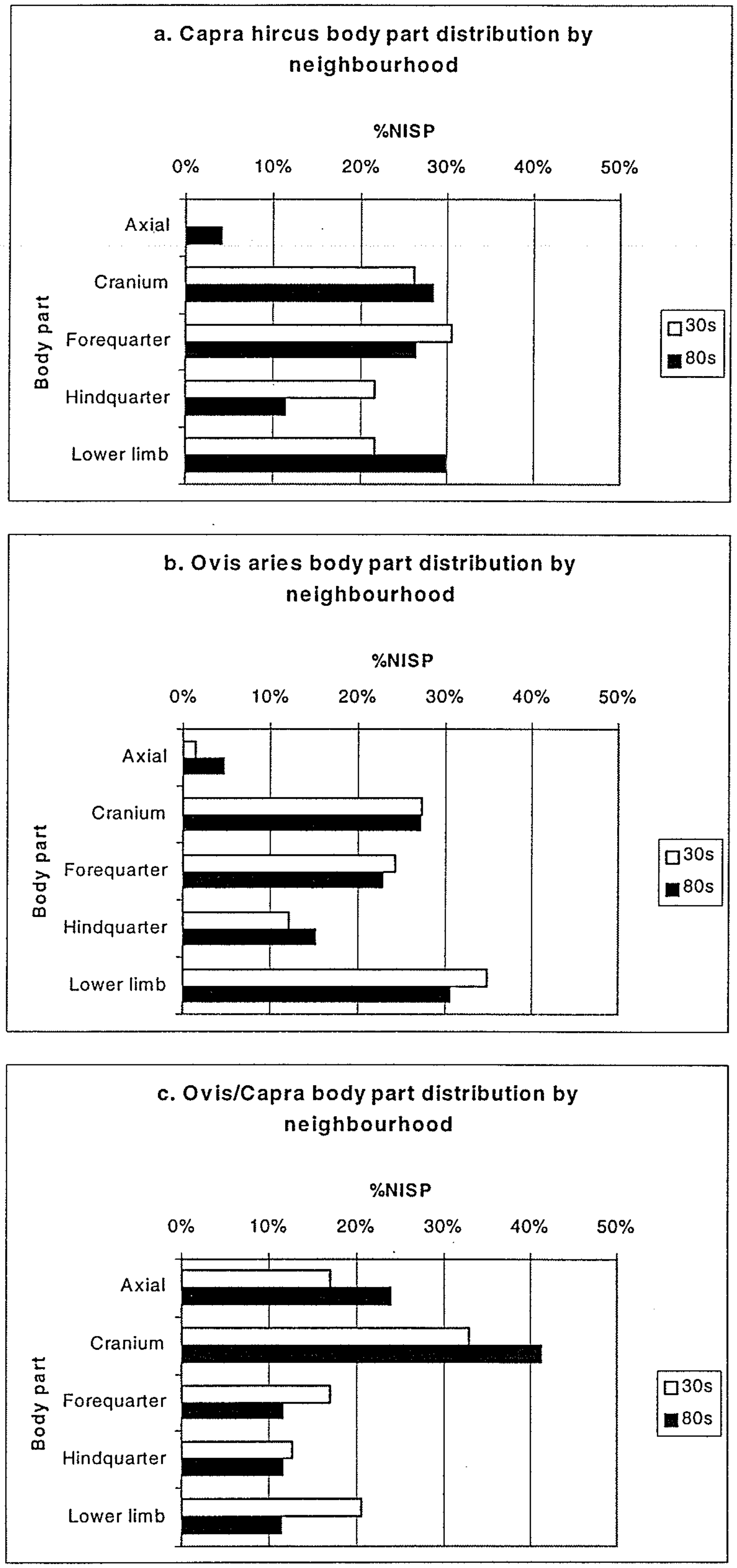

Figure 20. Caprinae body part distributions by neighbourhood.

APPENDIX A

Shannon-Wiener function is calculated as $H' = -\sum(p_i)(\mathrm{Log}_e\, p_i)$
Where H' = information content of the sample
p_i = the relative abundance of the i^{th} taxon within the sample
$\mathrm{Log}_e\, p_i$ = the natural logarithm of p_i.

Evenness is calculated as: $V' = H'/\mathrm{Log}_e\, S$
Where H' is the Shannon-Wiener function
S = the number of taxonomic categories

H' is the Shannon-Wiener function (richness)
V' is the Evenness score

(from Kintigh 1989: 29)

APPENDIX B

The data table is appended on the accompanying CD in .PDF format.

Professor H. Greenfield generously gave me permission to identify, analyze and interpret the fauna material under study in this thesis.

The accompanying CD contains Appendix B. The only file on the CD is entitled "Appendix B", and it is in .PDF format. See p. 160 of text for details.

AA
July 5, 2004