MIDDLE BRONZE AGE ANIMAL-BASED SUBSISTENCE AT TOPRAKHISAR HOYUK AND TELL ATCHANA: A ZOOARCHAEOLOGICAL STUDY

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ABSTRACT

MIDDLE BRONZE AGE ANIMAL-BASED SUBSISTENCE AT TOPRAKHISAR HOYUK AND TELL ATCHANA: A ZOOARCHAEOLOGICAL STUDY

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This thesis examines the contribution of animal subsistence patterns at Middle Bronze Age Toprakhisar Höyük and Tell Atchana to understanding socio-economic dynamics and key historical events of the period: the abandonment of Toprakhisar Höyük and the destruction of Alalakh by the Hittites.

By analyzing species diversity, skeletal representation, and demographic profiles, central dietary species are identified alongside evidence of variation in animal use and consumption practices across chronological phases, which may reflect both local adaptations and broader inter-site interactions.

Comparisons between the two sites reveal a mixed subsistence strategy at Toprakhisar Höyük, involving domesticates (caprines, pigs, cattle) and wild animals, and a more specialized caprine-focused exploitation approach at Tell Atchana, potentially confirming their center-periphery roles within the Syro-Anatolian region.

Keywords: Zooarchaeology, Subsistence Strategies, Syro-Anatolian Region.

ÖZ

TOPRAKHİSAR HÖYÜK VE TEL ATÇANA'DA ORTA TUNÇ ÇAĞI HAYVANCILIK TEMELLİ GEÇİM: BİR ZOOARKEOLOJİK ÇALIŞMA

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Bu tez, Orta Tunç Çağı Toprakhisar Höyük ve Tell Atçana'daki hayvansal geçim kalıplarının sosyo-ekonomik dinamikleri ve dönemin temel tarihi olaylarını anlamadaki katkısını inceler: Toprakhisar'ün sonlanması ve Hititler tarafından Alalah'ın yıkılması.

Tür çeşitliliğini, iskelet temsilini ve demografik profilleri analiz ederek, merkezi diyet türleri, kronolojik evreler boyunca hayvan kullanımı ve tüketim uygulamalarındaki çeşitliliğe dair kanıtlarla birlikte belirlenir; bu, hem yerel adaptasyonları hem de daha geniş alanlar arası ilişkileri yansıtabilir.

İki alan arasındaki karşılaştırmalar, Toprakhisar Höyük'te evcil (keçiler, domuzlar, sığırlar) ve yabani hayvanları içeren karma bir geçim stratejisinin, Tell Atçana'da ise daha uzmanlaşmış, keçi odaklı bir sömürü yaklaşımının varlığını ortaya koymakta olup, bu durum onların Suriye-Anadolu bölgesindeki merkez-çevre rollerini doğrulamaktadır.

Anahtar Kelimeler: Zooarkeoloji, Geçim Stratejileri, Suriye-Anadolu Bölgesi.

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ABBREVIATIONS

AT	Tell Atchana
BC	Before Christ
BP	Before Present (before 1950)
BSM	Bone Surface Modifications
c.	*circa*
Comp.	Complete
CUT	Cut marks
EBA	Early Bronze Age
et al.	and others
fr(s)	fragment(s)
Ibid.	*ibīdem* (same as preceding reference)
Ind	Indeterminate
juv.	Juvenile
L	Left side (*sinister*)
L.	Locus
LBA	Late Bronze Age
LP	Local Phase
MBA	Middle Bronze Age
MB I	Middle Bronze I
MB II	Middle Bronze II
Misc	Miscellaneous
MNI	Minimum Number of Individuals
MP	Marrow Processing
NSP	Number of Specimens
NISP	Number of Identified Specimens
R	Right side (*dexter*)
SCW	Syro-Cilician Ware (count in MNI)
S/G	Sheep/Goat
sp.	Species
spp.	Several species
Sq	Square
T	Total
TPH	Toprakhisar Höyük

ABBREVIATIONS (CONT.)

Anatomical Parts (Modified after Binford 1978)

ANTL	Antler
SK	Skull
UORB	Upper Orbital
LORB	Lower Orbital
PAR	Parietal
OCC	Occipital
MX	Maxilla
MAND	Mandible
ATL	Atlas
AX	Axis
CERV	Cervical vertebrae
THOR	Thoracic vertebrae
LUM	Lumbar vertebrae
CAUV	Caudal vertebrae
PEL	Pelvis
ILM	Ilium
ACET	Acetabulum
ISCH	Ischium
SAC	Sacrum
RIB	Ribs
ST	Sternum
SC	Scapula
HM	Humerus
PHM	Proximal humerus
DHM	Distal humerus
RD	Radius
PRD	Proximal radius
DRD	Distal radius
UL	Ulna
PUL	Proximal ulna
DUL	Distal ulna
RC	Radio-cubitus
PRC	Proximal radio-cubitus
DRC	Distal radio-cubitus
CARP	Carpals
MC	Metacarpal
PMC	Proximal metacarpal
DMC	Distal metacarpal
PAT	Patella
F	Femur
PF	Proximal femur
DF	Distal femur
TB	Tibia
PTB	Proximal tibia
DTB	Distal tibia
FB	Fibula
PFB	Proximal Fibula
DFB	Distal Fibula
TAR	Tarsals
CTAR	Central Tarsal
GCF	Grand Cuneiform
AST	Astragalus
CAL	Calcaneus
MT	Metatarsal
PMT	Proximal metatarsal
DMT	Distal metatarsal
MTP	Metapodial (MC or MT)
PHAL 1/2/3	1st/2nd/3rd phalanx
COR	Coracoid
CAR-MC	Carpo-metacarpus
TB-TAR	Tibio-tarsus
TAR-MT	Tarso-metatarsus

ABBREVIATIONS (CONT.)

Measurements (Modified after von den Driesch 1976)

B	Breadth (width)
GB	Greatest Breadth
TB	True Breadth
Bp	Breadth of the Proximal end
Bd	Breadth of the Distal end
SD	Smallest breadth of the Diaphysis
SB	Smallest Breadth of the shaft of the ilium
SBI	Smallest Breadth across the bodies of the Ischia
BG	Breadth of the Glemoid cavity
BT	Breadth of the Trochlea
BTp	Breadth of the *Trochlea patellaris*
BPC	Breadth across the Coronoid Process
BFp	Breadth of the *Facies articularis proximalis*
BFd	Breadth of the *Facies articularis distalis*
BA	Breadth of the Acetabulum
RM	Breadth (Calcaneus)
Bct	Breadth of the articular facet for the centrotarsal (Calcaneus)
Bas	Breadth of the lower articular facet for the astragalus (Calcaneus)
BMc	Breadth of the Medial condyle
BLc	Breadth of the Lateral condyle
MBS	Middle Breadth of the Sole

L	Length
GL	Greatest Length
GLpe	Greatest Length of Peripheral (Abaxial) half
PL	Physiological Length
Ll	Length of the Lateral part
Lm	Length of the Medial part
Ld	Length of the Dorsal surface
LFo	Inner Length of the *Foramen obturatum*
SLC	Smallest Length of the *Collum scapulae*
GLP	Greatest Length of the *Processus articularis*
LG	Length of the Glemoid cavity
LA	Length of the Acetabulum
LAR	Length of the Acetabulum on the rim
LeP	Length excepting the Plantar projection
DLS	Diagonal Length of the Sole

ABBREVIATIONS (CONT.)

Measurements (Modified after von den Driesch 1976)

H	Height
HTC	Height of the Collum of the Trochlea
SH	Smallest Height of the shaft of the Ilium
D	Depth
GD	Greatest Depth
Dp	Depth of the Proximal end
Dd	Depth of the Distal end
Dl	Depth of the Lateral part
Dm	Depth of the Medial part
DD	Depth of the Diaphysis
DTd	Distal Depth on medial side (Legge's Td)
DC	Depth of the *Caput femoris*
LD	Lateral Depth (Calcaneus)
DPA	Depth across the Processus Anconaeus
SDO	Smallest Depth of the Olecranon
DMv	Depth of the Medial verticillus
DLv	Depth of the Lateral verticillus
DMTc	Depth of the Medial Trochlear condyle
DLTc	Depth of the Lateral Trochlear condyle
SCi	Smallest Circumference of the shaft of the Ilium
CD	Smallest Circumference of the Diaphysis

Phases in the Correspondence Analysis Biplot (Figure 16)

P1	TPH 51+52.37 LP4a
P2	TPH 51+52.37 LP3
P3	TPH 51+52.37 LP2
P4	TPH 54.38 LP1
P5	TPH 54.38 LP2
P6	AT 33.32 LP4
P7	AT 33.53 LP3
P8	AT 45.44 LP5

CHAPTER 1

INTRODUCTION

1.1 Study Scope

1.1.1 The Bronze Age

The Bronze Age was a transformative period in human history, marked by significant technological, cultural, and economic advancements. Spanning roughly from 3300 to 1200 BC, it saw the rise of metallurgy as societies began crafting tools, weapons, and ornaments from bronze—an alloy of copper and tin. This era gave rise to urban centers, long-distance trade networks, and monumental architecture. The complex interactions between human innovation and environmental constraints during this period have led many to believe it laid the groundwork for many aspects of modern civilization, from political economies to institutionalization (Earle 2002).

Bronze Age societies showcased adaptability and creativity. In Central Europe, the Nebra Sky Disc, the earliest depiction of the cosmos, was crafted (Ehser *et al.* 2011). The British Isles saw the completion of Stonehenge, aligned with the solstices (Pearson 2009). The Sumerians in the Near East invented the wheel and cuneiform writing, while Minoans in the Aegean developed indoor plumbing at Knossos (Angelakis *et al.* 2014:15). Indus Valley cities like Mohenjo-Daro featured advanced drainage, public baths, and impressive sanitation systems (Jansen 1993:36).

Trade routes connected distant regions, enabling the exchange of goods and ideas. Tin from Central Asia fueled bronze production (Pigott 2020), while Afghan lapis lazuli adorned artifacts in Mesopotamia and Egypt (Huang 2018).

It is impossible to discuss the Bronze Age without acknowledging its profound environmental upheavals, which left an indelible mark on societies. From 3500 BC, the end of the African Humid Period triggered the Sahara's expansion, consuming vast swathes of habitable land across northern Africa (Wright 2017). Around 2200 BC, the 4.2-kiloyear event unleashed a prolonged drought that reduced Mesopotamian rainfall by up to 30% (Staubwasser and Weiss 2006) and led to the abandonment of many sites following a 300-year drought (Weiss *et al.* 2002). Many coastal settlements in Europe were submerged by rising sea levels, forcing communities to migrate inland (Walsh 2013:44, Barnett *et al.* 2020). In Anatolia and Greece, the Late Bronze Age collapse was marked by droughts, famines, and seismic activity, causing mass population declines and movements (Middleton 2018). Even the mighty Hittites succumbed to agricultural failure during the cold, dry period around 1200 BC (Manning *et al.* 2023).

Starting in the Bronze Age, human activity began to leave its first significant environmental footprint, marking the emergence of human-induced environmental changes. Practices like copper smelting introduced lead pollution (Cortizas *et al.* 2016), overirrigation led to soil salinization in Mesopotamia (Altaweel 2013), and widespread deforestation transformed landscapes in many regions (Lemmen 2009), which highlight the environmental costs of early technological and agricultural advances.

1.1.2 Subsistence Studies: Any Contributions?

Oftentimes, subsistence practices, while essential for the functioning of Bronze Age societies, are often seen as part of a broader process of adaptation to environmental or economic conditions, rather than as agents of change (Sherratt 1995:10). The idea that everyday survival strategies could drive cultural transformation may challenge the traditional view of history as primarily shaped by elite decision-making (Schwartz 2007:46–47) or major historical events, which tend to involve powerful individuals, large-scale conflicts, and striking societal transformations.

However, such views overlook the fact that subsistence practices are deeply embedded in social, economic, and environmental structures, influencing, and in turn, being influenced by, the broader political and ideological shifts (Schwartz 2006:6). The rise of complex societies during the Bronze Age cannot be fully understood without considering how changes in food production and distribution supported or hindered social organization, technological innovation, and trade networks. For instance, the intensification of agriculture and the introduction of new species provided the foundation for the emergence of political hierarchies (Çakırlar and Ikram 2016), while the shift toward specialized subsistence practices may have contributed to the development of trade and interregional interactions. Competition over limited food resources (Kirch 1980:140) and over key post-collapse agricultural and pastoral territories (e.g., the Amorite invasions during the Ur III period as part of ‘habitat tracking’ campaigns, Weiss 2017:145) gave rise to rivalries.

Furthermore, while the focus on military or political achievements often paints a picture of the Bronze Age as a period of grandeur and conflict, subsistence studies may reveal the more nuanced and everyday realities of the time. For example, the development of irrigation systems or the cultivation of new crops could have had profound long-term effects on settlement patterns and societal structures. The study of subsistence strategies invites a reconsideration of the Bronze Age as a period of profound transformation in human relationships to land, food, and survival. This focus does not undermine the importance of political or technological studies, but complements them by offering a more holistic view of how people in the Bronze Age navigated the complexities of their environment and resource management. Therefore, the contribution of subsistence strategies should not be dismissed as trivial but rather seen as a crucial lens through which the Bronze Age can be understood, offering insights into the daily lives and adaptive strategies that shaped its social and economic landscapes.

1.2 Study Aims and Research Questions

This study examines the role of animals in Middle Bronze Age diets at two Near Eastern sites: Toprakhisar Höyük and Tell Atchana, located in the Syro-Anatolian region, with a focus on animal use, subsistence strategies, and inter-site relationships.

The faunal material from the Middle Bronze Age at both sites remains largely unexamined, apart from a few contexts at Tell Atchana.

This research addresses significant gaps, including shifts in faunal composition between MB I and MB II, changes in priorities within animal-based subsistence between different local phases, as well as the variations between the two sites.

It also attempts to confirm the nature of the context in Square 33.32 Phase 4 at Tell Atchana from what has been suggested previously, based on the compositional and taphonomic characteristics of the faunal remains in this study, in combination with its associated features and finds. This context may have served as a storage space located beneath the palatial kitchen quarters in Phase 3c of the same square.

The following research questions have been formulated to guide this investigation, aiming to integrate site-level practices with broader regional patterns and assess their implications for the wider Near East:

1. Which animals were central to Middle Bronze Age diets at both sites?
    a. Did communities rely on a single species or a variety of animals?
    b. How did species distribution vary across local chronological phases?
2. What specific animal parts were consumed?
3. What do age and sex profiles reveal about animal use and subsistence patterns?
4. To what extent do the subsistence strategies at each site reflect potential inter-site dynamics?

CHAPTER 2

LITERATURE REVIEW

2.1 Syro-Anatolian Middle Bronze Age Subsistence Strategies

2.1.1 Spatio-Temporal Background

2.1.1.1 The Syro-Anatolian Region

The Syro-Anatolian region, in this thesis, will refer to the geographic zone situated at the intersection of southern Anatolia, northern Levant (also known as al-Jazira area), and the western fringes of Upper Mesopotamia. It includes parts of modern-day Syria and southeastern Türkiye. The Taurus and Amanus (Nur) mountain ranges define its northern and western boundaries respectively. The Orontes and Euphrates rivers run through the region, shaping settlement locations (**Figure 1**). Fertile plains formed around these rivers (Osborne 2021), suitable for agriculture. The mountainous areas supported pastoral activities like herding.

The climate in coastal areas was similar to the modern Mediterranean one, while the inland zones were more arid (Ibid.). The varied landscapes and climatic variation played a significant role in shaping the region's agricultural practices, settlement patterns, and modes of subsistence, with farming dominant in fertile areas and herding—along with 'dry-farming'—in drier regions (Geyer *et al.* 2007).

The region served as a critical nexus of trade between Mesopotamia, Anatolia, and the Mediterranean. Key trade goods included textiles, metals, and agricultural and livestock products, such as wool, wine, and oil (Larsen 2015, Massa and Palmisano 2018, Morgan and Richardson 2020, Akar *et al.* 2021, Herrmann *et al.* 2023:654). Although the interaction between the city-states was not always smooth, as political instability frequently disrupted trade routes (Nadali 2007:350, Osborne 2021). Nonetheless, the region remained a key player in ancient trade networks.

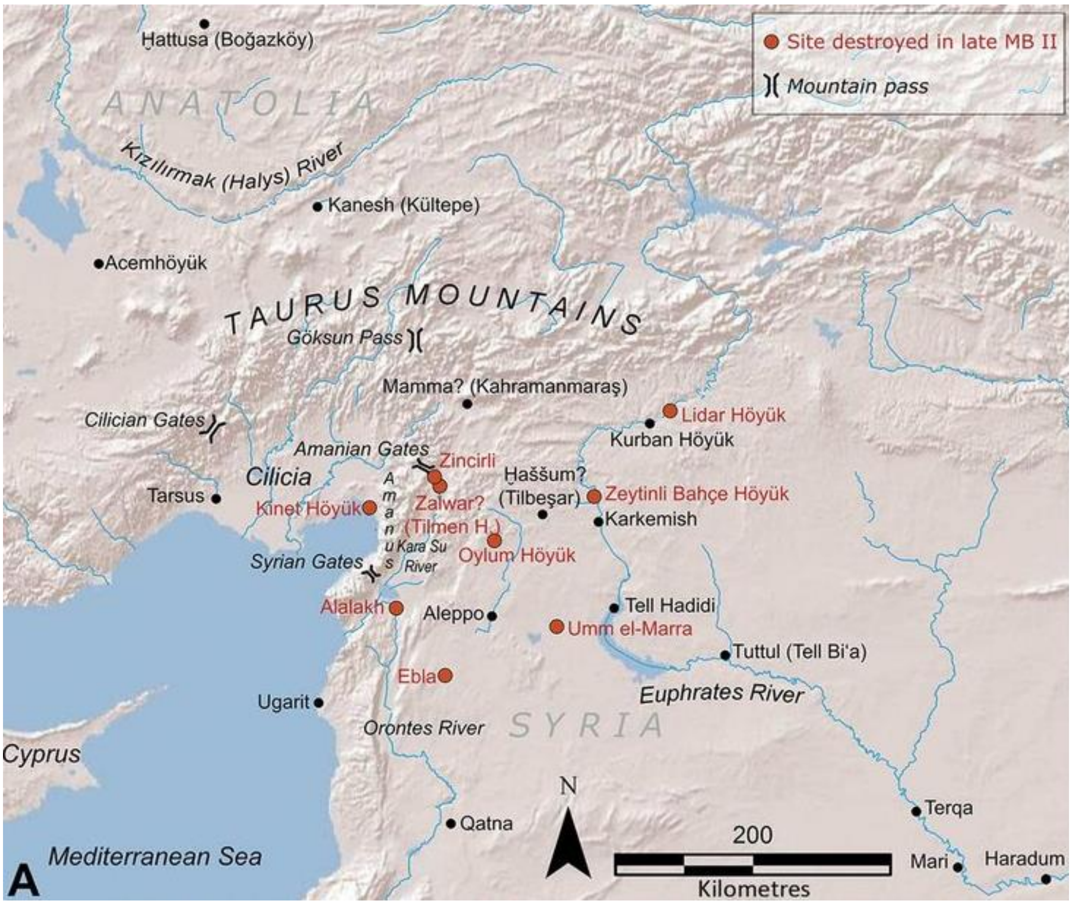

Figure 1 Map of Middle Bronze Age sites in Syria, Anatolia and Upper Mesopotamia
(© Image Credit: Herrmann *et al.* 2023:656)

Urban centers emerged as important trade hubs, connecting distant regions. However, these cities were heavily dependent on the rural hinterlands for food and raw materials (Fall *et al.* 1998, Wattenmaker 2009:116, Akar 2009, Palmisano 2017:221). Rural areas, in turn, relied on access to urban markets to sell their surplus goods. The interplay between urban and rural economies shaped regional development.

Cultural exchange was also a major feature of the Syro-Anatolian frontier. As trade increased, so did the movement of ideas, technologies, and people. Various populations migrated into the region, not just from neighboring areas but also as far afield as the Aegean (Mellaart 1958), often due to conflicts or the pursuit of resources and economic stability. Some groups fled from their previous settlements, which had been destroyed by fire or by natural disasters. These migrations led to interactions among various groups, creating a diverse and complex blend of cultures and languages (Akar 2009, Herrmann *et al.* 2023:655). This integration further enriched the region’s social fabric, setting it apart from other Bronze Age centers in Egypt, Mesopotamia, and Southern Levant, in that the latter received more scholarly focus on their internal developments, evidenced by chronologies rooted in local cultural sequences and material records (Bietak 1991), while the Syro-Anatolian region has been highlighted by researchers for its role as a crossroads of multiple influences.

2.1.1.2 The Middle Bronze Age

The Middle Bronze Age (MBA), spanning roughly 2000–1600 BC, represents a critical yet understudied epoch in the ancient Near East and eastern Mediterranean, framed by the transitional "collapse" events that delineate its beginning and end.

Collapse Events

The Early Bronze Age-Middle Bronze Age (EBA-MBA) transition, often characterized by gaps in settlement continuity (Weiss *et al.* 1993), is referred to as “The Intermediate Period”, with archaeological evidence pointing to the decline of early urban centers, the disruption of trade networks, and the increase in pastoralism (de Miroschedji 2009:109) and dry-farming (Weiss 2013), though not uniformly affecting all regions of the Near East (Genz 2015). Researchers hypothesize that climatic shifts (Wilkinson 1997, Pustovoytov and Riehl 2016), internal social strife (Schwartz 2006:6), and external invasions (Mellaart 1958) contributed to such fragmentation, although the exact interplay remains contested.

Similarly, the Middle Bronze Age-Late Bronze Age (MBA-LBA) transition, marked by regional political instability and the abandonment of some sites (**Figure 1**) was a phenomenon visible in settlement surveys revealing occupational hiatuses (Herrmann *et al.* 2023).

Unlike the extensively scrutinized LBA collapse of the 12th century BC, these earlier disruptions lack comparable scholarly attention, despite offering insights into the resilience and adaptability of Bronze Age societies.

Chronology

Several chronologies have been, and continue to be, proposed to divide the MBA (Gerstenblith 1980, Höflmayer *et al.* 2016, Greenberg 2019:182, McLoud 2019, Höflmayer and Manning 2022, Herrmann *et al.* 2023). In this thesis, the MBA is divided into MB I (roughly 2000–1800) and MB II (roughly 1800–1600) phases, defined by shifts in material culture, including pottery typologies, burial practices, and architectural styles, and dated primarily through stratigraphy and radiocarbon calibration (Akkermans and Schwartz 2003:291).

Characteristics

The MBA period is distinguished by the resurgence of urbanization (Akar 2006), the intensification of trade and warfare, and the institutionalization of complex sociopolitical systems, exemplified by the rise of city-states such as Mari, Qatna, and Alalakh (Klengel 1992). Studying the MBA is vital for understanding the socio-economic trajectories that shaped later Bronze Age civilizations.

The Middle Bronze Age also witnessed significant shifts in settlement patterns, as fortified cities (Burke 2004, Burke 2008) and monumental palaces became prominent features, reflecting a competitive and militarized landscape. Textual sources, such as the Mari archives, document the strategies of regional rulers in securing alliances, waging wars, and controlling trade routes (Mazar 1968:79).

Political and Military History

The Amorites, an ancient Near Eastern group, were first identified in texts from the late third millennium BC. They likely originated in the semi-arid steppes and mountainous regions of the western Euphrates basin, areas characterized by pastoralist economies (Burke 2017). The onset of the 4.2-kiloyear BP aridification event (c. 2200 BC) disrupted traditional agricultural systems in northern Mesopotamia, prompting widespread habitat-tracking and nomadization (Weiss 2013:370). By the early second millennium BC, Amorite pastoral nomad groups had begun settling in urban centers across the North Syrian region, establishing themselves as rulers of city-states and regional polities, under the Yamhad dynasty, thus regenerating societal complexity post-collapse (Schwartz 2006:7).

The first ruler of the Amorite Yamhad dynasty was Sumu-Epuh (c. 1810–1780 BC), who established Aleppo as the capital of a powerful regional kingdom. His reign coincided with the fragmentation of older political systems (the decline and collapse of centralized powers such as the Ur III dynasty in southern Mesopotamia c. 2004 BC, the weakening of earlier states in the northern Mesopotamian and Levantine regions, and the decline of cities such as Mari and Ebla), allowing Amorite leaders to rise to power (Schwartz 2013:4). Sumu-Epuh leveraged alliances and military strength to resist incursions from neighboring powers, particularly Shamshi-Adad I of Assyria, who sought to dominate northern Mesopotamia (Bryce 2009:773). Sumu-Epuh’s leadership laid the foundation for Yamhad’s influence, extending its control over key territories in northern Syria and the Euphrates basin.

Following Sumu-Epuh, his son Yarim-Lim I (c. 1780–1764 BC) expanded Yamhad’s territorial reach and influence. Yarim-Lim I established diplomatic alliances with Babylon, including ties with Hammurabi, and secured Yamhad’s dominance in the Levant through both military campaigns and strategic marriages (Ibid.). His reign is particularly noted for the consolidation of a vassal network, including cities like Mari and Qatna, ensuring the kingdom's economic and political stability. Yarim-Lim I's campaigns extended as far south as Diniktum, near the borders of Elam, showcasing Yamhad's growing military reach.

Hammurabi I (c. 1764–1750 BC), the son of Yarim-Lim I, inherited a stable and prosperous kingdom. He further solidified Yamhad's dominance by adding Carchemish to its vassal territories and maintaining control over key trade routes connecting Mesopotamia to the Mediterranean (Hamblin 2006:259).

During the reign of Abba-El I (c. 1750–1720 BC), Yamhad faced challenges from rival powers, including rebellious vassals and external threats. Abba-El's most significant political act was granting control of Alalakh to his brother Yarim-Lim, establishing a cadet branch of the dynasty (Lauinger 2015). This move ensured tighter control over the western territories and strengthened Yamhad's influence in the region.

Although limited information exists on Yarim-Lim II (c. 1720–1700 BC) and Niqmi-Epuh (c. 1700–1675 BC), their reigns appear to have upheld Yamhad's hegemony.

Yarim-Lim III's reign (c. 1650? –1625 BC) saw Yamhad confront its long-standing rival, Qatna, which posed a significant threat to its control in the Levant (Hamblin 2006:260). His military campaigns successfully subdued Qatna, reaffirming Yamhad's dominance. However, the kingdom faced growing pressure from northern powers, particularly the Hittites, whose incursions would eventually destabilize the region (Bryce 2009:27).

Hammurabi III (c. 1625–1600 BC) was the last significant ruler of Yamhad before its sacking by Mursili I of *Hatti* (Hamblin 2006:257). The Hittite campaigns marked the end of Yamhad's dominance in the region, leading to a brief period of political fragmentation before the Mitanni and other powers emerged to fill the vacuum.

2.1.2 Conceptual Background of Subsistence Strategies

2.1.2.1 Definition and Types

Subsistence strategies represent the dynamic ways in which Bronze Age communities likely adapted to meet their food needs, through a complex interplay of environmental conditions, social organization, and technological advancements.

Mixed farming, a cornerstone of many agrarian societies, integrated agriculture and animal husbandry, not only to produce crops and livestock but also to harness secondary products such as milk, wool, and traction power, which extended the utility of domesticated animals beyond immediate consumption (Sutton and Anderson 2004:225). This approach exemplified a holistic use of available resources.

Pastoralism, on the other hand, revolved around the herding of livestock and frequently incorporated transhumance, a seasonal movement of animals to optimize grazing opportunities across diverse landscapes (Arbuckle and Hammer 2019, Porter 2012:294). This strategy thrived in arid or semi-arid regions, where agriculture was limited (Nichols 2004:45), and emphasized not only meat and milk production but also the social and economic value of livestock as mobile wealth (Sutton and Anderson 2004:226). The adaptability of pastoralism underscored its significance in maintaining food security in marginal environments.

Foraging, including hunting, fishing, fowling, and gathering, remained present for many communities even after domestication became prevalent (van Neer *et al.* 2005, Nymann 2015), although it increasingly served as a demonstration of political authority rather than a primary subsistence strategy (Linseele *et al.* 2019:447). This strategy capitalized on the availability of wild resources, ensuring dietary diversity and offering a buffer during periods of agricultural failure. Regions rich in natural biodiversity often saw a blending of foraging with other strategies.

Beyond direct food production, trade and craft specializion played a crucial role in sustaining subsistence. Surpluses from agriculture or pastoralism were exchanged for goods and foodstuffs not locally available, facilitating access to diverse diets and fostering interdependence among communities (Scazzosi 2018:451). This interconnectedness illustrates how subsistence strategies were not isolated practices but part of larger socio-economic networks that adapted to varying challenges and opportunities.

2.1.2.2 Theoretical Approaches and Models

The following theories have been adopted here specifically to analyze Bronze Age subsistence and food procurement strategies, although they were initially designed to explore broader frameworks and aspects of environmental, ecological, cultural, and social dynamics.

2.1.2.2.1 ***Environmental Determinism, Cultural Ecology,*** **and** ***Niche Construction*** **Theories**

Theories such as *Environmental Determinism*, *Cultural Ecology*, and *Niche Construction* all focus on the dynamic relationship between human activities and environmental conditions, with each theory differing in the extent to which human or environmental agency is considered more dominant in shaping food systems.

Environmental Determinism posits that environmental factors, such as climate, geography, and natural resources, fundamentally dictate human subsistence choices (Arponen *et al.* 2019). In the framework of climate mediation, and to simplify the illustration, regions with specific environmental conditions, like arid zones, might naturally favor the husbandry of livestock, while fertile river valleys and areas with abundant precipiation promote crop cultivation (Smith 2005:12). Critics argue that this theory oversimplifies the relationship between humans and their environment by implying a one-way causal relationship, where environment drives and directs behavior in a deterministic manner (Ellen 1982:5, Hodder and Hutson 2003:7, Riede 2019). Modern scholars contend that it fails to account for cultural, technological, and social factors that influence subsistence decision-making. Despite these criticisms, Environmental Determinism remains influential in highlighting how environments can limit or enable certain types of subsistence practices (Meggers 1954), even though two geographically similar regions can be culturally different (Forde 1934:464).

Cultural Ecology expands on this idea by examining how cultural practices mediate the relationship between environment and subsistence. Rather than focusing on the environment as a static force, Cultural Ecology considers how societies adapt to and manipulate their surroundings through practices such as crop rotation, irrigation, or hunting strategies. This theory underscores the role of cultural knowledge in shaping food systems, suggesting that human agency plays a significant role in adapting to environmental challenges (Sutton and Anderson 2004). However, critics argue that Cultural Ecology can still overemphasize environmental constraints, sometimes downplaying the agency of human societies in controlling broader social, political, or economic factors that influence subsistence (Paddayya 1982:138).

Niche Construction Theory offers a more active perspective. Niche Construction Theory (NCT) sees humans as co-creators of their ecological niches, while Cultural Ecology tends to view humans as adapting to pre-existing environmental conditions. NCT emphasizes how humans intentionally modify their environments to improve food production. Through practices, similar to the ones mentioned in Cultural Ecology Theory, such as land clearing, soil enrichment, and irrigation, societies actively create and sustain ecological niches that support their subsistence needs over time (Spengler 2014). Some critics of Niche Construction Theory argue that it can be too focused on human agency, sometimes neglecting the broader environmental factors that may limit or shape those actions. Additionally, while the theory highlights human modification of the environment, it can be challenging to trace the long-term ecological consequences of these actions, especially in ancient societies where evidence may be sparse or ambiguous (Laland and O’Brien 2010:315).

2.1.2.2.2 Risk Management

Risk Management Theory offers a comprehensive lens through which archaeologists and anthropologists can examine the adaptive strategies employed by past societies to mitigate the uncertainties inherent in their environments or the systems they developed (Wilkinson and Stevens 2003:140). At its core, risk management addresses how human communities planned for and responded to potential disruptions in resource availability, whether due to environmental fluctuations, resource depletion, or social instability. Key strategies identified in this framework include, besides surplus production: mobility, diversification, storage, and exchange, each of which represents a calculated effort to buffer against potential subsistence failures (Ibid.).

Mobility involves the strategic movement of people or resources to areas where conditions are more favorable. It is exemplified here in the pastoral management of livestock, where herders move animals seasonally to access grazing lands, ensuring sufficient nutrition and avoiding overgrazing.

Diversification spreads dependency across a range of resources to minimize the impact of a single failure. In this context, it often involves maintaining herds of different species, such as cattle, sheep, goats, or pigs, each offering unique advantages in terms of resilience to disease (Earle 2002:390), dietary flexibility, or environmental conditions.

Storage serves as a temporal buffer, stockpiling surpluses to sustain communities during periods of scarcity. Storage in animal economies may manifest in the preservation of surplus animal products like dried meat, fat, or fermented dairy products, which extend the usability of perishable resources.

Exchange, both within and between groups, facilitates the redistribution of resources and builds social networks (Halstead and O’Shea 1989:4, Wilkinson and Stevens 2003: 142) that can be activated during shortages or crises. Systems of exchange involving animals or animal products hold particular importance due to their unique characteristics. Unlike other goods, animals can be moved over long distances and can reproduce, providing a renewable resource that sustains communities over time. They offer multi-functional value, supplying not only consumables such as meat, and milk, but also labor, transport, and wool (Ford 1972:32). Moreover, animals often carry symbolic and social significance, serving as status markers, ceremonial gifts, or tokens of alliances that strengthen social cohesion (Dombrowski 1993). Livestock also acts as a flexible form of wealth storage, easily exchanged or consumed during times of need.

These strategies are not static; they often evolve into embedded patterns within broader social and economic systems, particularly in contexts where environmental challenges are persistent or cyclical. Over time, they can even become unconscious, ingrained in cultural practices and passed down through generations (Barton *et al.* 2024).

Risk Management Theory faces criticism and remains a topic of debate among researchers due to its broad applicability and challenges in archaeological interpretation.

One major critique of Risk Management Theory is its reliance on assumptions about rational decision-making (Nelson 1996:109). Critics argue that this perspective often projects modern economic principles, such as cost-benefit analysis, onto ancient societies, where decisions may have been guided by cultural, religious, or social factors rather than purely pragmatic considerations.

The theory has been criticized for oversimplifying how ancient societies responded to risks, often assuming they acted in a straightforward or uniform way to specific challenges. In reality, managing risks involved a variety of strategies tailored to the particular social, environmental, and economic conditions of each society. For example, responses to climate fluctuations, resource scarcity, or social conflict were not merely reactive; they required complex decisions based on local knowledge, cultural practices, and relationships with other groups (Halstead and O’Shea 1989:4).

The theory's linear approach often overlooks this complexity, reducing the decision-making process to overly general or deterministic explanations.

Another point of contention lies in its application to archaeological evidence. The material record rarely provides clear, direct evidence of intentional risk mitigation strategies, leading some researchers to question whether the theory relies too heavily on inference and speculation. The concept of "risk" itself can be problematic (Marston 2011:190), as it is culturally constructed and may not align with the perspectives or priorities of ancient societies. Moreover, we lack knowledge about how risk impacted different individuals within a society (Paulette 2012:183). Critics also caution against using the theory as a one-size-fits-all framework, as risk management strategies likely varied greatly across different ecological and social contexts.

2.1.2.2.3 *World-Systems* and *Social Complexity* Theories

The study of subsistence systems in the Bronze Age reveals complex interconnections between economic relationships, social hierarchies, and resource distribution. World-Systems Theory and Social Complexity Theory can provide complementary frameworks for understanding these dynamics.

World-Systems Theory emphasizes the economic disparities between core or center, periphery, and semi-periphery regions, highlighting how agricultural surpluses from peripheral areas sustained the demands of elite urban centers (Peregrine 1996). Peripheral communities often bore the costs of subsistence production, contributing labor and resources while receiving minimal benefits (Orser 2009:256). This dynamic was evident in Bronze Age agricultural hubs, which supplied grain and other staples to support elite consumption, urban populations, and even tribute systems.

Social Complexity Theory shifts the focus to the internal organization of societies, particularly the relationship between subsistence and social stratification. In hierarchical systems, elites controlled the labor of farmers and herders (Fall *et al.* 1998:111), redirecting agricultural surpluses to sustain their own status and to support non-food-producing specialists such as artisans, priests, or administrators (Hirth 1996:205, Wilkinson and Stevens 2003:143). These systems institutionalized disparities in wealth and access to resources, entrenching power dynamics within the division of labor. Subsistence, therefore, became a mechanism not just for survival but for maintaining social order and reinforcing authority.

Both theories, while widely used, either directly or indirectly, in archaeological and historical analyses, have attracted criticism. Each theory might offeer valuable insights but also faces limitations and contentious interpretations.

World-Systems Theory is often critiqued for its rigid categorization of regions into "core" or “center”, "periphery", and "semi-periphery", which can oversimplify the fluid and dynamic nature of economic and political relationships (Hall *et al.* 2011). Critics argue that these categories risk projecting, yet again, modern economic systems onto ancient societies, where interactions may not have operated within such a hierarchical framework (Ibid.). Additionally, the theory's emphasis on economic exploitation can overshadow other factors, such as cultural exchange, mutual dependence, or technological innovation, which also shaped interregional interactions.

Social Complexity Theory, meanwhile, is sometimes criticized for its reliance on hierarchical models that may not apply universally. Some researchers contend that the theory assumes a linear progression of social stratification, potentially overlooking more egalitarian or heterarchical systems that existed alongside or within complex societies (Souvatzi 2021). Furthermore, its focus on elite control over labor and resources has been described as deterministic, minimizing the role of negotiation, resistance, or alternative economic strategies employed by lower-status groups (Hall *et al.* 2011:241). Debates often center on how to measure "complexity" and whether it accurately reflects the diversity of social structures in ancient contexts.

2.1.3 Zooarchaeological Research

2.1.3.1 Zooarchaeology

2.1.3.1.1 What Is It?

Zooarchaeology is the study of animal remains from archaeological sites. It focuses on identifying and interpreting animal bones, shells, teeth, and other hard tissues (Gifford-Gonzalez 2018). These remains can range from whole specimens to small fragments, based on preservation. Whilst the material studied consists of animal remains, the ultimate goal of Zooarchaeology is to understand human behavior, with animals acting as proxies (Brewer 1992:199). This involves first understanding past human interactions with animals, including evidence for hunting, domestication, animal husbandry, and resource management. Additionally, it addresses questions of trade, social organization, and cultural practices (Crabtree 1990). The discipline also investigates paleoenvironments and paleoclimates that affected animal populations (Steele 2015). Zooarchaeology often works closely with other disciplines, like Paleontology, Taphonomy, and Forensic and Veterinary Sciences. This multidisciplinary approach provides a more comprehensive view of human-animal relationships.

2.1.3.1.2 What Is It Based On?

Zooarchaeology relies on analytical techniques designed to extract detailed information from faunal remains. This information can be demographic (e.g., taxonomy, age at death, and sex), biometric, taphonomic, pathological, biogeographic/isotopic, and even molecular (e.g., genomics, proteomics).

Species identification often involves taxonomic classification, where characteristics such as the size and shape of bones, teeth, and horn cores are matched to known species or taxon following Linnean nomenclature (Linnaeus 1758). While measurements can estimate size, age at death is more commonly inferred through dental eruption patterns or the fusion of growth plates. Sex determination often relies on sexually dimorphic features like pelvic structure, canine size, or horn morphology in species where males and females differ (Gifford-Gonzalez 2018).

Another important aspect is taphonomic analysis. This helps to understand how animal remains were deposited, preserved, or altered post-mortem. Taphonomic studies assess the impact of environmental and cultural processes on the remains, determining whether bones were gnawed by scavengers, altered by human activities such as butchery, or changed by natural processes like weathering or soil chemistry (Lyman 1987, Orton 2012).

Zooarchaeology also relies on Experimental Archaeology, where researchers recreate, for instance, past butchery techniques or bone tool production to better interpret cut marks or tool use found in faunal remains (Escosteguy *et al.* 2020).

Additionally, Ethnoarchaeology, by studying present-day human-animal relationships, helps provide analogies for understanding past behaviors (Binford 1978, Albarella 2011).

2.1.3.1.3 Why Is It Important?

Zooarchaeology offers insights into past human economies and subsistence strategies. In palaeoeconomic studies, it helps identify which species were exploited for food, labor, or raw materials (Brewer 1992:200). For example, a dominance of domesticated species may suggest an agropastoral economy. On the other hand, evidence for hunting and gathering indicates reliance on wild fauna. Moreover, it highlights the role of animals in trade and social systems. In subsistence studies, it helps to reconstruct diets and past food production strategies. In contextual studies, it reveals patterns of resource use.

Zooarchaeology, as is the case with all archaeological material studies, is grounded in archaeological context. Animal remains can be found in various contexts, including settlement layers, trash pits, and burial sites. Bones found in association with tools or structures can indicate how animals were processed, consumed, or used in daily activities (Landon 2009:84).

Particular to the Syro-Anatolian Middle Bronze Age, and even though written sources from this period existed in the form of cuneiform tablets, they mainly focused on administrative, legal, and economic aspects, often overlooking the everyday details of food acquisition practices (Hamlin 1976, Gifford-Gonzalez 2007). Consequently, changes in subsistence strategies—such as shifts in the consumption of certain animals, changes in the hunting versus herding ratio, the management of livestock (e.g., selective culling for secondary products like milk or wool), or technological changes in butchery—that may be visible in the archaeofaunal record might not be necessarily mentioned in these written records.

2.1.3.2 Zooarchaeological Records from Syro-Anatolian Sites

The comparison of the taxonomic composition of commonly-encountered mammals from various Middle Bronze Age Syro-Anatolian sites reveals significant variability in subsistence strategies, reflecting regional ecological conditions, cultural preferences, and economic priorities.

The data summarized in **Table 12** in **Appendix A** highlights these key differences and similarities across sites, allowing for a nuanced interpretation of animal exploitation and management practices.

Caprines dominate the assemblages across all sites, although at different degrees, underscoring their centrality to subsistence economies in the region. Their prevalence, whether domestic sheep or goats, is indicative of their dual utility as providers of secondary products such as milk and wool, in addition to meat. For example, the high representation of caprines at Northern Levant's Tell Afis, Southeastern Anatolia’s Tatarlı Höyük and Eastern Mediterranean’s Tell Tweini suggests a reliance on these animals as staples in local diets and as adaptable livestock suited to varying environmental conditions.

Cattle, while present in significant numbers, exhibit a more variable representation among the sites. In Southeastern and Eastern Anatolia, Upper Euphrates, and Eastern Mediterranean, cattle frequencies are relatively high, which might point to their use in agricultural labor, secondary products, or as prestige animals. Conversely, in Northern Levantine sites such as Umm el-Marra, Tell Tuqan and the Khabur Valley's Tell Mozan (Doll 2010, Omar and Erkman 2013), the percentage data suggests cattle played a more secondary role compared to caprines (and pigs, particularly at Tell Mozan). This disparity could indicate regional differences in land availability for pasture versus the integration of cattle into mixed farming systems.

Pigs present another intriguing pattern. They are notably abundant in the Upper Tigris Basin at Hirbemerdon Tepe, the Khabur Valley at Tell Mozan (Ibid.), and the Upper Euphrates at Lidar Höyük, a trend that may reflect specific cultural preferences or environmental conditions conducive to pig rearing, such as proximity to water sources. In contrast, their low representation at Tell Tweini, Tell Afis, and Umm el-Marra may indicate either cultural taboos —or perhaps the beginning thereof (van Wyk 2014, Slim *et al.* 2020, Price 2020)—, or ecological constraints. The variability in pig presence suggests their role as a supplementary resource, rather than a primary focus, in many sites.

Canids are less represented across most assemblages but are notable at Umm el-Marra, where their numbers surpass many other sites. In case of dogs, this might suggest that they were utilized in various ways, including consumption, as guard animals, as shepherd dogs, as hunting partners, as companions, or even in rituals. The presence of canids in varying numbers across sites points to their ambiguous role in human-animal interactions during the period.

Equids, comprising both horses and donkeys but also possibly mules and onagers, show marked variability. Their significant numbers at Northern Levantine Umm el-Marra and Tell Tuqan highlight their potential role in transportation or trade networks, essential for interregional connections. Additionally, the specific equid burials at the Umm el-Marra site (Schwartz *et al.* 2012) might imply a ritualistic role. Such instances are a rare exception unique to the latter sites, and are less evident in Southeastern Anatolia and Upper Tigris, but also in other Northern Levant sites, suggesting differences in socioeconomic systems or access to these animals.

Wild taxa such as cervids, gazelles, and leporids appear sporadically, often in minor numbers. Their presence often reflects opportunistic or incidental hunting or specialized activities, where hunting was not the primary focus but occurred as a secondary activity or in response to unplanned opportunities. This could involve hunting animals encountered during other tasks, such as herding or traveling, or targeting specific species based on environmental availability, rather than through coordinated, long-term hunting strategies.

Specialized activities could involve targeted hunting for specific purposes, such as ritual, or for acquiring particular animal products, which may not be part of regular subsistence strategies. For instance, cervids at Tilmen Höyük and Hirbemerdon Tepe, and gazelles at Umm el-Marra suggest a mixed strategy incorporating wild resources alongside domestic ones. Conversely, the near absence of wild taxa in sites like Tell Afis, Tell Tuqan, Tell Tweini, and Tilbeşar Höyük underlines a heavier reliance on domestic species.

Overall, the taxonomic distribution reflects a complex interplay of environmental availability, cultural practices, and economic strategies. Southeastern Anatolia, Upper Tigris and Upper Euphrates Basins, and the Khabur Valley sites lean towards greater diversity in animal use, potentially reflecting broader resource exploitation strategies. In contrast, sites in the Northern Levant generally display more pronounced specialization in one or two particular taxa. These findings offer a lens into the adaptive strategies employed by Middle Bronze Age communities in response to their diverse ecological and cultural landscapes.

2.2 The Sites of Tell Atchana and Toprakhisar Höyük

Both Tell Atchana and Toprakhisar Höyük lie within the fertile Amuq Valley.

The Amuq (also Amik) Valley, located in modern-day southern Turkey, is a fertile alluvial plain situated between the Orontes River and the Nur Mountains. It has been a focal point of human settlement and activity since the Neolithic period, owing to its rich agricultural potential and strategic position along trade routes connecting Anatolia, the Levant, and Mesopotamia. Archaeological investigations have revealed a dense concentration of ancient sites, including, among others, the prominent Alalakh (Tell Atchana), which flourished during the Middle and Late Bronze Ages and was significant to the region's political and economic activities, Tell Ta'yinat, Tell al-Judaidah, and Chatal Höyük (Braidwood *et al.* 1971). The valley's stratified settlements provide critical data for reconstructing long-term cultural and environmental changes in the Near East.

Tell Atchana, identified as the ancient Alalakh (Matthiae 1978, Yener 2005) and capital of the Mukish kingdom, was a major urban center. Toprakhisar Höyük, though less fully excavated (Akar and Kara 2018a:88), is situated 15 km away (Ibid.:86), and may have operated as a peripheral settlement with roles tied to agricultural production (olive oil, wine) and its administration, as well as locally based craftsmanship (Ibid.).

They likely demonstrated center-periphery dynamics during the MBA (Akar and Kara 2019). Archaeological evidence of olive consumption at both sites could potentially support textual references from Alalakh that document towns specializing in olive oil production (Ibid.:87).

Tell Atchana (AT)

Tell Atchana covers an area of approximately 22 hectares and is located 12 km east of Antakya (**Figure 2**). The multi-phase site was founded by the Amorites in the late 3rd millennium BC and occupied through the Middle and Late Bronze Ages and later during the Iron Age. The site saw its destruction around the second half of the 17th century BC by the Hittites (**Figure 1**), who also destroyed other cities in the region (Akar *et al.* 2021).

Figure 2 Aerial Photograph of Tell Atchana
(© Image Credit: Murat Akar, Alalakh Excavations Archive, Sinmez 2022)

Ancient Alalakh emerged as a key political center under Amorite control. Initially part of Yamhad's vassal network, Sumu-Epuh, king of Yamhad, transferred the city to his son-in-law Zimri-Lim of Mari, retaining ultimate authority. After Mari's fall in 1765 BC, Alalakh returned to Yamhad's direct control. The city became prominent when Abba-El I of Aleppo granted the city to his brother Yarim-Lim around 1735 BC (Lauinger 2015). Under rulers like Yarim-Lim and Ammitakum, the city saw urban development, including the construction of palaces and temples.

The site of Tell Atchana was first surveyed by Robert and Linda Braidwood in the 1930s and later excavated by Sir Leonard Woolley between 1936 and 1949, who focused on its western area; excavations at the site were restarted by Prof. Dr. K.

Aslıhan Yener in 2000, who directed the project until 2019, with Assoc. Prof. Dr. Murat Akar now serving as the current director.

Woolley's excavations at Tell Atchana revealed key MBA monumental architectural features (Level VII Palace, temple, and city fortification) suggesting urbanization. However, his final publication left many of the MBA remains and their stratigraphy unclear. As a result, the chronology needed re-examination to establish a more precise and detailed sequence (Ibid.:77).

Besides examining the changes in the topography and architecture of the Royal Precinct (Level VII and Level IV Palaces, and Level VII Gateway), Yener's excavations (**Figure 3**) in Squares 33.32, 33.53, and 32.57 revealed MBA layers, which not only provided new insights into the construction of the Level VII Palace but also contributed to uncovering earlier structures predating the Level VII and Level IV Palaces. In Area 3 (Squares 45.44 and 45.45), a series of fortifications from MB II to LB I and a cemetery were uncovered (Ibid.).

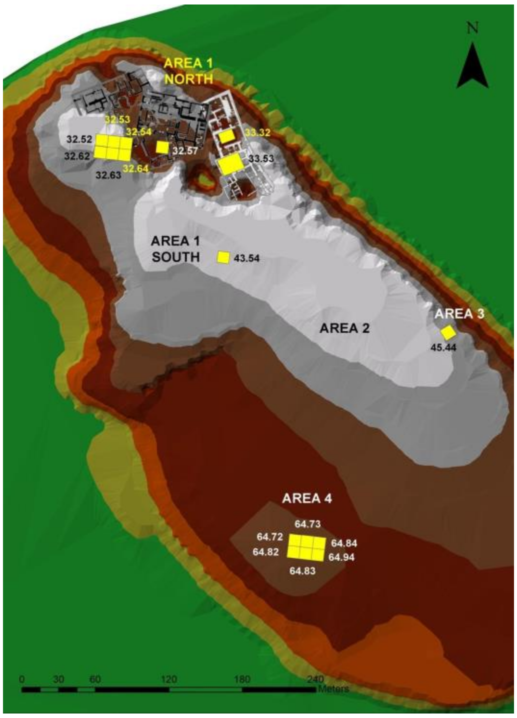

Figure 3 Map of Tell Atchana and Yener Excavations' Squares
(© Image Credit: Alalakh Excavations Archive, Bulu 2021)

Toprakhisar Höyük (TPH)

Toprakhisar Höyük, currently estimated at 2 hectares based on excavated areas, as much of the site remains unexplored (**Figure 4**). It lies along the Beyazçay River, connecting Altınözü to the Amuq Valley (Akar and Kara 2018a). Up to the most recent excavations, the multi-period site revealed no evidence of MB II or LBA activity. Occupation spanned from at least the Late Chalcolithic to the Iron Age II, with a hiatus in the later phases of the MBA and throughout the LBA (Akar and Kara 2022:3).

Figure 4 Aerial Photograph of Toprakhisar Höyük
(© Image Credit: Murat Akar, Alalakh Excavations Archive, Sinmez 2022)

Since 2016, the Alalakh team, under the auspices of Hatay Archaeological Museum, has been conducting rescue excavations at Toprakhisar Höyük in Altınözü. Excavations initially began in Square 51.37 and later expanded to Square 52.37 by 2017, with both squares now treated as one due to their similar stratigraphy, encompassing four local phases. The earliest architectural remains, identified in Local Phase 4 of Sq 52.37, consist of small domestic units. In contrast, Building 2, a two-storey administrative structure, belongs to Local Phase 3 and has been excavated in both squares. Meanwhile, Local Phase 2 is defined by the presence of MB I pits (Akar and Kara 2020:82).

In 2018, a new square (Sq. 54.38) was opened on the northern slope of the mound (**Figure 5**), which revealed three local phases with evidence of storage facilities and open-air activity areas, including silos and pits (Akar and Kara 2022:5). Additionally, human remains were found in a rubbish pit, interred in a manner unusual compared to the burial practices at Tell Atchana (Ibid.:7). Due to space limitations, excavation efforts have been restricted to these specific squares (Akar and Kara 2018a).

Figure 5 Aerial Photograph of Toprakhisar Höyük Squares
(© Image Credit: Murat Akar, Alalakh Excavations Archive, Sinmez 2022)

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

3.1.1 Provenance

This thesis focuses on the MBA *sensu stricto* (excluding transitional phases) and on its two divisions: MB I (roughly 2000-1800) and MB II (roughly 1800-1600), that could reveal some insight on the hiatus in TPH stratigraphy after MB I and on the destruction of Alalakh after MB II, rather than comparing the MBA to preceeding or succeeding periods (neither the EBA-MBA nor the MBA-LBA transitions). The contexts with mixed dating were not included. Therefore, the local phases of Toprakhisar Höyük included in this study are derived from excavated Squares **51+52.37 (LP2-4a)** and Square **54.38 (LP1-2)**.

As for Tell Atchana, MBA occupation has been identified in five squares (Bulu 2021, Akar *et al.* 2021):

- Sq 33.32 LP1-4 (Periods 7-10)
- Sq 33.53 LP1-3 (Periods 7-9)
- Sq 32.57 LP5a-g (Period 7)
- Sq 45.44 LP5 (Period 7)
- Sq 45.45 LP5 (Period 7)

Of these, only Sq 33.32 LP4 corresponds to MB I and is contemporaneous with TPH Sq 51+52.37 phases 2-3, with all other AT phases representing MB II (**Table 1**). This study includes only AT Squares **33.32 LP4**, **33.53 LP3**, and **45.44 LP5**.

A comprehensive overview of the contextual details for each square and local phase is summarized in **Table 2**, **Table 3**, and **Table 4**.

Table 1 Chronological Summary of the Selected Squares from TPH and AT

Site	Toprakhisar Höyük					Tell Atchana		
Area						Area 1 North		Area 3
Square	51/52.37			54.38		33.32	33.53	45.44
MB I Phases (~ 2000–1800 BC)								
Early MB I *beginning* c. 2000 BC			LP4a					
Roughly 2000-1900 BC	LP2	LP3		LP1	LP2			
Tentative 1950?-1800 BC						LP4 Period 10		
MB II Phases (~ 1800–1600 BC)								
Roughly 1800-1700 BC							LP3 Period 9	
Roughly 1700-1600 BC								LP5 Period 7
Excavation Seasons	2016 2017 2018			2018		2015	2016 2017 2019	2011 2012

Table 2 Descriptive Summary of Sq 51+52.37 LP2-4a from TPH

TPH Sq 51+52.37 LP2	TPH Sq 51+52.37 LP3 (**Figure 6**)	TPH Sq 51+52.37 LP4a (**Figure 7**)
General Context		
- Rubbish and pits, likely silos	- Monumental architecture - Storage and cooking activities	
Features/Structures		
	- Monumental building (Building 2) - An outer space - A passageway - Narrow rooms - Courtyards - Four decorated horseshoe-shaped hearths	- A semi-enclosed space L.52 - Oven with vitrified inner surface - Remains of stone foundations - A *tandır* [oven] installation
Artefactual Data		
	- Cooking pots - Grinding stones - Pestles - Weights - Chipped stones - Storage jars	- SCW (first appearance) - Female figurine (Akar *et al.* 2024)
Bioarchaeological Data		
- Botanical remains (Sinmez 2022) - Human remains retrieved from animal bone bags: NISP 1 1 comp. vertebra	- Botanical remains (Sinmez 2022)	- Botanical remains (Sinmez 2022)

Figure 6 Aerial Photograph of Building 2 in TPH Sq 51+52.37 LP3
(© Image Credit: Akar and Kara 2018a:271, Sinmez 2022)

Figure 7 Aerial Photograph of TPH Sq 52.37 LP4a
(© Image Credit: Toprakhisar 2018 Season Excavation Report, Sinmez 2022)

Table 3 Descriptive Summary of Sq 54.38 LP1-2 from TPH

TPH Sq 51/52.37 LP1	TPH Sq 51/52.37 LP2 (**Figure 8**)
General Context	
- Rubbish pits	- Silos for storing grains
Features/Structures	
	- Large deep multi-compartment silos - Smaller silos
Bioarchaeological Data	
- Botanical remains (Sinmez 2022) - Skeletal remains of two individuals that were thrown in the pits. - Human remains retrieved from animal bone bags: NISP ? A lot of metapodials and phalanges (complete)	- Botanical remains (Sinmez 2022)

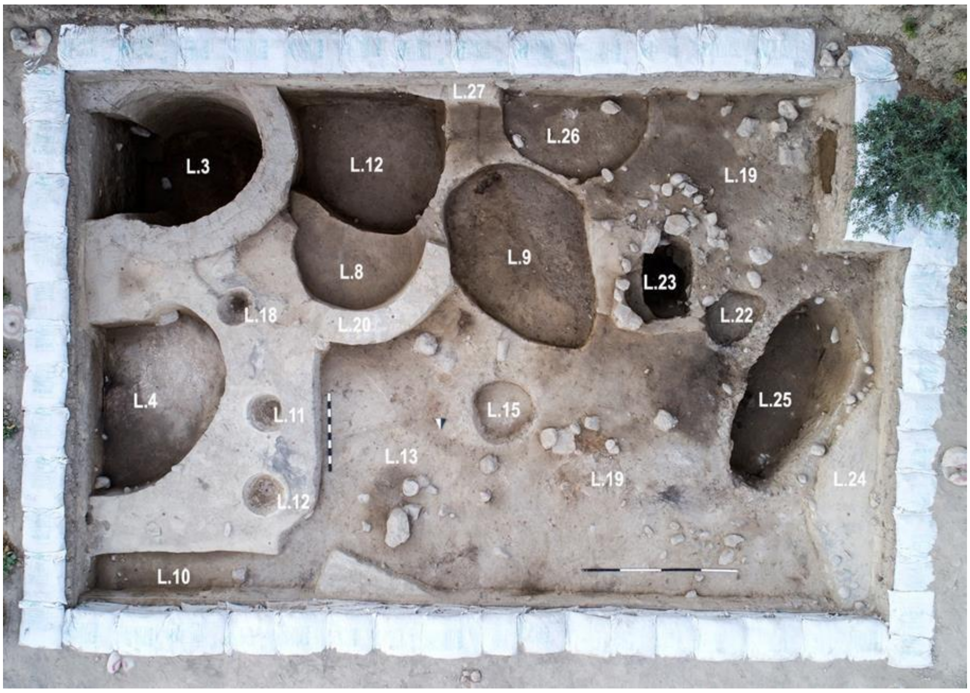

Figure 8 Aerial Photograph of TPH Sq 54.38 LP2
(© Image Credit: Sinmez 2022)

Table 4 Descriptive Summary of AT Sq 33.32 LP4, 33.53 LP3, and 45.44 LP5

AT Sq 33.32 LP4 (**Figure 9**)	AT Sq 33.53 LP3 (**Figure 10**)	AT Sq 45.44 LP5 (**Figure 11**)
General Context		
- Earlier palatial structure for cooking and storage activities	- Monumental building below the Level VII Palace	- Fortifications - Domestic + Workshops - Burials
Features/Structures (Bulu 2021)		
- Three burnt rooms L.115, L.105, and L.107 - Three square-shaped plastered benches - A mudbrick bench? L.112 - A *tandır* [oven] installation L.116	- Two burnt rooms - Mudbrick platforms - Scattered stone and ceramic concentrations	- Lower level of city wall - Two rooms west of the wall: L.140 and L.142 - Small ceramic concentration L.144
Artefactual Data		
- Partially complete *in situ* ceramic vessels - Ground stones - S-curve bowls - Cookpot - Pithos - Clay model wheel - 13 SCW (Bulu 2021)	- Comp. *in situ* pithoid jar - Figurines (1 animal, 1 human, 1 statue eye inlay) - Painted fresco fragments - Clay tuyères - Voussoir - Worked ivory, gold foil - Carnelian beads - Stone pounder - 33 SCW (Bulu 2021)	- Grave good: shoulder goblet (with L.146) - Figurines (2 animal and 1 human) - Metal fragments and a pyrotechnology feature - Cookpot - Baked clay bulla - Stone vessel and polisher - 58 SCW (Bulu 2021)
Bioarchaeological Data		
- Human remains retrieved from animal bone bags: NISP 2 1 proximal radius fr 1 skull fr	- Botanical remains (Burgaç 2022) - Human remains retrieved from animal bone bags: NISP 3 1 baby tibia fr 1 complete mandible 1 femur shaft fr	- Human burials (Ingman 2014) *Room burials* L.132 (Adolescent) L.146 (Older child) L.147 (Younger child: 4-5yo) *Intramural burials* L.145 (Infant) L.151 (Infant) - Human remains retrieved from animal bone bags: NISP 8 7 baby long bones 1 baby pelvis fr

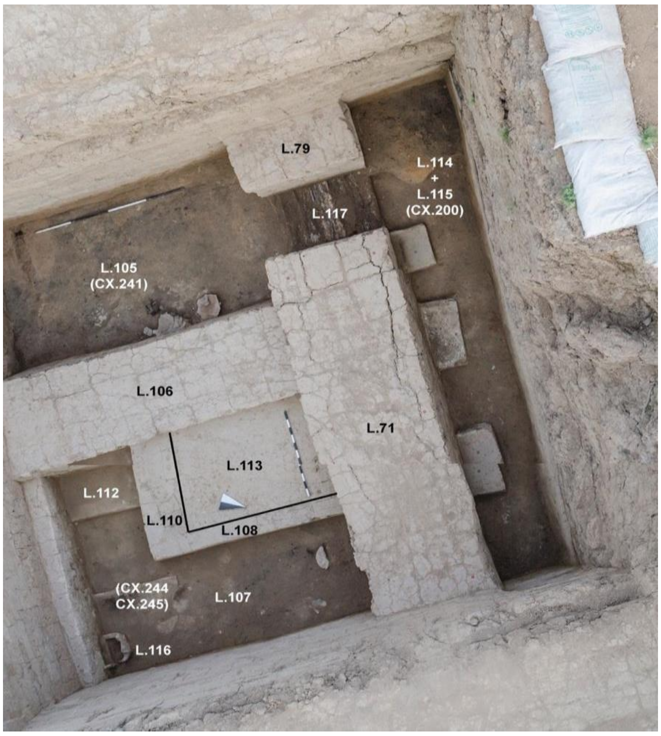

Figure 9 Aerial Photograph of AT Sq 33.32 LP4
(© Image Credit: Alalakh Excavations Archive, Bulu 2021)

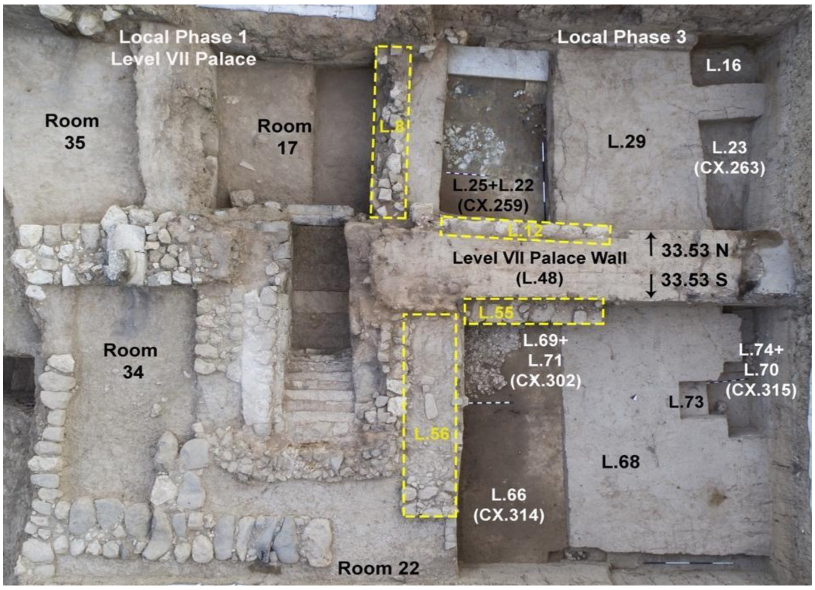

Figure 10 Aerial Photograph of AT Sq 33.53 LP1 (left), LP3 (right), and LP2 Features (yellow)
(© Image Credit: Alalakh Excavations Archive, Bulu 2021)

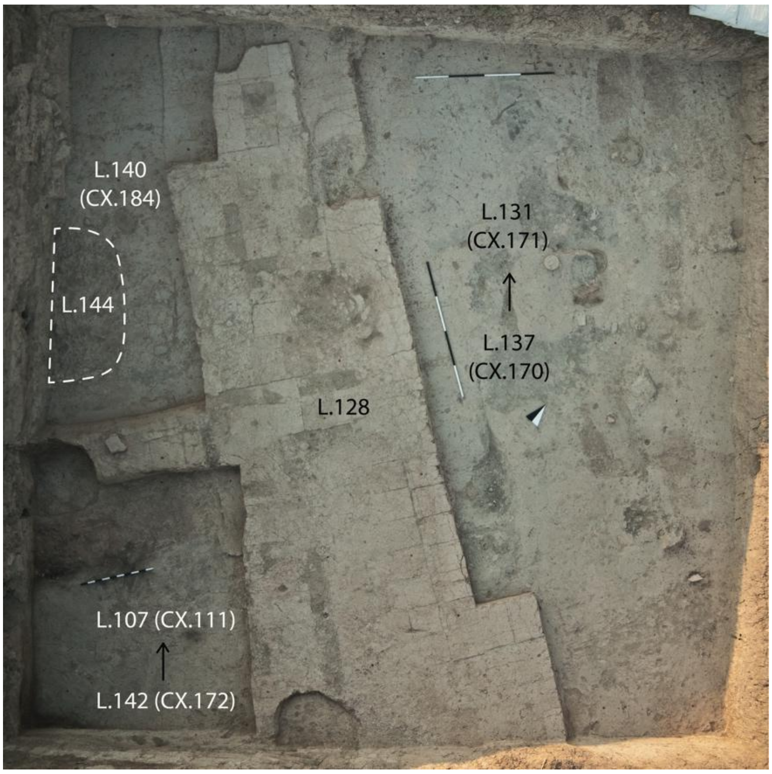

Figure 11 Aerial Photograph of AT Sq 45.44 LP5
(© Image Credit: Alalakh Excavations Archive, Bulu 2021)

3.1.2 Recovery

Specimens from Toprakhisar Höyük and Tell Atchana were mostly **hand-collected** into paper bags on each excavation day. Each bag was tagged with details including area, grid, square, locus, and lot, and was assigned a TPH (Toprakhisar) or AT (Atchana) identification/registration number. At times, and when sufficient soil accumulated, sediment residues were **sieved** through a 1 cm mesh screen. This method aimed to recover smaller fragments. **Water flotation**, conducted by archaeobotanists, recovered only a small number of specimens, up to ten fragments of fish and rodent bones and one dog first phalanx, from some Tell Atchana layers. Screening and heavy fraction methods did not significantly enhance the recovery of small-scale remains. The specimens were washed very gently and allowed to air-dry completely.

Preservation bias affected the recovered specimens taxa-wise, with mammalian bones and calcareous mollusc shells being more prevalent compared to bony fish, birds, and turtle remains. This bias may be due to differential preservation conditions or the higher density of certain types of bones, although the reasons for this remain unclear to zooarchaeologists (Lyman 1984, Lyman 1994b, Lyman 1995, Schmitt and Lupo 1995, Stahl 1996, Ugan and Coltrain 2012, Gifford-Gonzalez 2018:13). What is evident is that the presence of fish, birds, and turtles can vary significantly depending on the archaeological context. Their representation may range from totally absent to substantial. They are likely to be found in contexts such as pits, rather than, for instance, "sheet middens" (Friesen and Betts 2006:73) as their exposure might attract scavengers or accelerate decomposition. It will be addressed in later chapters whether this assumption holds true for the assemblages in this study.

The greater fragmentation and the abundance of "unidentifiable" or "indeterminate" fragments in the Tell Atchana assemblage, in contrast to those from Toprakhisar Höyük, could be attributed to the fact that the former remains have spent a longer duration in the warehouse/depot (5-13 years), compared to Toprakhisar Höyük (6-8 years). However, it remains speculative for this to be the sole explanation. Other factors could also account for this pattern, such as more intensive use of the carcasses. For instance, the MBA people might have deliberately broken bones to extract marrow or grease for cooking.

Many remains exhibited "excavator damage", with fractures and breaks caused by excavation tools, or by accidents during transportation or storage of the ecofacts. This can complicate the identification and analysis of the specimens, as well as the interpretation of BSM data, and limits the number and range of measurements that can be taken. Although such damage is often easily identifiable by distinctive white marks (Shipman 1981:366, Johnson 2017:104), these signatures were not considered in the analysis of breakage patterns or any form of modification.

Ethical considerations included managing the specimens carefully to mitigate further damage and accurately documenting their condition.

3.2 Methods

3.2.1 Analyzing the Specimen

Recording was carried out on a fragment-by-fragment basis using a web-based Google Sheets spreadsheet to ensure the data remained protected from potential hardware failures, while also being easily accessible and shareable. Graphs were created using the Apple spreadsheet application Numbers and Microsoft Office Excel 2013. Statistical tests and plots were done using the software PAST (PAleontological STatistics).

3.2.1.1 Basic Identification

3.2.1.1.1 Anatomical Element

Identifying anatomical elements of archaeological specimens is notably more challenging than working with recent ones. This difficulty arises because ancient remains lack soft tissue, exhibit reduced density, and can be very fragmented (Behrensmeyer 1978:151, Bartosiewicz 2008:70, Gifford-Gonzalez 2018:13). Furthermore, markings on these remains can become obscured. Unlike modern specimens, transparency, color differences, and pliability are not reliable criteria for discrimination. Instead, shape, morphology, surface texture, and porosity are used.

The method typically relies on macroscopic analysis to examine the visible characteristics of fragments, unless unusual wear patterns, or confusion between naturally occuring markings and taphonomic modifications, require closer inspection with a microscope.

The process began by determining the type of anatomical element which might have survived in the archaeofaunal record (Villagran *et al.* 2017), usually hard tissues, with bones being the most common, along with teeth (Hillson 2005), horn cores, antlers, and mollusc shells. Occasionally, costal cartilage, turtle shells, and egg shells were also found, though less frequently encountered.

There are various ways to classify bones in the body. This helped when precise element attribution could not be achieved.

- *By shape*: Bones are categorized into long, short, flat, irregular, and sesamoid types.

- *By location*: Bones can be grouped by divisions of the skeletal system. The axial skeleton consists of the skull, vertebral column, and rib cage. The appendicular skeleton includes limb bones and their attachments to the axial skeleton, such as the shoulder and pelvic girdles.

- *By histology*: The structure of bone tissue also varies between cortical and cancellous types. Cortical bone, or compact bone, is dense and forms the outer layer of bones, while cancellous bone, trabecular or spongy bone, is lighter and found within the interior (Burr 2019). Although all bones contain both cortical and cancellous tissues, the ratios of these vary between different bone parts.

When identifying bone elements, several factors were important for accurate attribution. To a great degree, distinct bone markings; projections and depressions, were a key consideration (Lele and Richtsmeier 1992). For example, prominences like condyles, trochanters, tuberosities, and tubercles helped differentiate between various appendicular skeletal elements (Bandovic *et al.* 2024). Other notable features include foramina, which are holes for nerves and blood vessels, and muscle attachment sites where muscles or tendons connect.

Next came the determination of the side of the element—whether it is from the right or left side of the body— and it was aided by examining the position and orientation of anatomical landmarks, foramina, and other distinctive features. When possible, the position of the element—whether cranial/caudal, dorsal/ventral, proximal/distal, medial/lateral, buccal/lingual— was also recorded.

Element attribution is of extreme importance. It acts as a precursory step prior to distinguishing between fauna.

3.2.1.1.2 Taxonomy

Taxonomic attribution was done by comparing skeletal elements, already identified, with modern reference collections found in the lab (METU Environmental Archaeology Research Unit EARU), supplemented by 2D atlases (e.g., Barone 1965 for domestic mammals; Pales and Lambert 1971 for mammalian carnivores and herbivores; Schmid 1972 for mammals; France 2008 for humans and non-human mammals; Cohen and Serjeantson 1996 for birds; Wheeler and Jones 1989 for fish; Sobolik and Steele 1996, Wyneken 2001 for sea turtles), and by 3D models (Sketchfab[1], MPI EVA 3D Comparative Skeletons[2], Vertébrés[3]).

The Taxonomic Identification Protocol operates on the premise that anatomical similarities equate to taxonomic similarities (Simpson 1942:144), which means that features like bone landmarks are taken into account. However, in practice, the threshold for what constitutes "similar enough" can differ from one researcher to another (Lyman 2019b, Hesse and Wapnish 1985:72, Reitz and Wing 1999:154, O’Connor 2000:37, Lyman 2005:839).

When species are closely related or osteologically similar (Bochenski 2008), specific references (Boessneck *et al.* 1964, Boessneck 1969, Kratochwil 1969, Payne 1985, Prummel and Frisch 1986, Halstead *et al.* 2002, Zeder and Lapham 2010, Zeder and

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[1] sketchfab.com

[2] eva.mpg.de/evolution/downloads/download-3d-skeletons-data

[3] vertebres3d.fr (Laetoli Production company, Samba Soussoko)

Pilaar 2010, Zedda *et al.* 2017, Salvagno and Albarella 2017 **for sheep and goats**; Peters 1998, Hanot and Bochaton 2018 **for equids**; Lister 1996 **for fallow and red deer**; Callou 1997 **for hares and rabbits**) helped distinguish between them.

Mammalian bones were assigned to a family, genus, or species when possible, and if not, categorized by size classes. In this thesis, they can either be:

- *Large size*: aurochs, domestic cattle, equids, red deer
- *Medium size*: wild boar
- *Small size*: sheep, goats, roe and fallow deer, gazelles, domestic pigs, canids
- *Very small size*: hares, rabbits, domestic cats

Size classes remain the main method for classifying unidentified animal remains used by zooarchaeologists, even with their limitations (Driver 2011:22). This is because various factors, including age at death, pathology, sexual dimorphism, domestication and selective breeding, as well as individual variations, can affect size (Albarella 2002:54-55).

Remains from non-mammalian vertebrates were assigned to a class level (fish, birds, turtles) due to their small numbers, unless they were distinctive or relatively complete. Indeterminate avifaunal remains were categorized by size, and they can be either:

- *Goose-sized*: goose
- *Duck-sized*: duck, crow
- *Robin-sized*: robin, blackbird

Mollusks were identified to a phylum or genus level for two reasons: first, identifying them below a genus level is difficult due to their high diversity; second, although they might suggest resource gathering strategies, they might not always be chronologically contemporaneous with the site (Thomas 2015), or might simply be nonfood animals, as the inclusion of crushed and pulverized shells as temper in ceramic cookware was documented (Morrison and Horowitz 2016), although starting in the Late Bronze Age at Tell Atchana (Horowitz 2020).

3.2.1.1.3 Age Estimation

Mammalian postcranial bone age was estimated mostly by examining epiphyseal fusion. This involved identifying whether the epiphyses of long bones have fully fused to the diaphysis (Wilson *et al.* 1982, Ruscillo 2006, Gifford-Gonzalez 2018:116). Fusion was classified as complete (no visible fusion line), partial (epiphysis attached with fusion line present albeit reduced), or absent (epiphysis entirely separate from the shaft). Stages were recorded as “fused”, “fusing, or “unfused” respectively, for any or both epiphyses (proximal/distal).

Teeth were also important indicators. Deciduous teeth, mandibular molar eruption patterns, and wear stages (Wilson *et al.* 1982, Grant 1982, Ruscillo 2006) were analyzed in relation to specific age brackets.

Each element is inspected individually, then compared to established growth timelines specific to each taxon (Silver 1963, Chaplin 1971, Wilson *et al.* 1982, Ruscillo 2006). Identifying age stages—fetal, neonate, juvenile, subadult, and adult—is crucial, as each stage reflects specific biological and social implications. Fetal and neonatal remains, in particular, offer valuable insights due to their implications for animal husbandry, breeding patterns, and mortality rates (Yeomans *et al.* 2021).

3.2.1.1.4 Sex Determination

Many animals are sexually dimorphic to some degree (Mank 2009), meaning there are physical differences between males and females, such as size, shape, or features like horns or tusks. However, this dimorphism can be subtle or difficult to detect in archaeofaunal remains due to various overlapping factors, which means that only a small percentage of specimens are sexed with high confidence (Klein and Cruz-Uribe 1984:41).

Sex identification typically relies on sexually dimorphic features (Wilson *et al.* 1982, Ruscillo 2006). Pelvic bones, particularly the poorly-preserved pubic symphysis, provide the most reliable indicators (López and Domínguez-Rodrigo 2014 for the acetabulum). Cranial morphology can further assist in determining sex (Trouth *et al.* 1977, Brassard and Callou 2020). For species like goats and cattle, horn core size can indicate sex, with males usually having more pronounced or larger horns (Armitage and Clutton-Brock 1976, Sykes and Symmons 2007). For pigs, sex identification can be inferred from the size differences and cross-sectional shapes of the canine teeth, often called tusks (Mayer and Brisbin 1988, Mayer 2009). Male pigs, especially wild boars, have larger and more curved canines, while females either lack pronounced tusks or have smaller, less developed versions.

Determining the sex of animals provides insights into herd management and breeding practices, revealing preferences for male or female animals in economic activities like milk production, labor, or meat procurement (deFrance 2009). Even a small sexing dataset can indicate selective culling or use patterns, offering clues about resource allocation and subsistence priorities.

3.2.1.2 Metric Analyses

3.2.1.2.1 Diagnostic Zones and Bone Fragment Sizes

Bone completeness is a variable that can be used to measure, evaluate, and compare how intact or incomplete animal skeletons were found and which parts of the skeleton have survived. This helps to understand the processes that affected the preservation of remains, whether they were taphonomic or behavioral (Marom 2016). Fragmentation can be estimated through multiple models and approaches, such as the distribution of fragments by type (e.g., articular, axial, cranial) and size class or interval (Outram 2004b:176).

In this thesis, diagnostic zones were selected to assess bone completeness. Fragment size classes were used to assess the level of fragmentation for each species within the assemblage.

Diagnostic zones refer to specific, easily identifiable bone landmarks, such as articular surfaces (Dobney and Rielly 1988). The postcranial skeletal elements of mammals, originally designated for economically significant domesticates, are divided into zones, each assigned a numerical code (Ibid.:81). These zones are selected because they remain recognizable even in highly fragmented specimens, making them useful for assessing how much of a skeletal element is preserved.

Each diagnostic zone was assigned a numerical value based on the extent of preservation, employing the 50% rule (Watson 1979, Morin *et al.* 2019:774): a numerical value of 1 is given when the zone is more than 50% present, and a value of 2 is assigned when is less than 50% present. If a diagnostic zone is completely absent, no value is recorded. This method helped standardize the assessment of fragmentation of identified specimens in a consistent manner across the assemblage.

In addition to diagnostic zones, a separate count for remains that are 98-100% complete was included, listed as (Comp.) in the skeletal representation tables in **Appendix B** (and recorded as “Whole” in the fragment size classes). These whole or nearly whole remains are also recorded with their percentages (%Comp.), providing further insight into the preservation state of the assemblage.

3.2.1.2.2 Measurements

Measurements were taken, from identified elements, using a digital caliper in millimeters (mm), adhering to the standard guidelines outlined by von den Driesch (1976).

The full range of possible measurements taken for this study is provided in the **List of Abbreviations** and the measurement tables can be found in **Appendix C**.

For elements that undergo fusion, only fused bones were measured, given that at least one fully fused epiphysis was present for long bones. Erupted lower M3 molar tooth crowns of ruminants and pigs, whether loose or still in the mandible, were specifically measured for length (L) and width (B) to help differentiate between domestic and wild forms (Reed 1961, Boessneck *et al.* 1963, Mayer *et al.* 1998, Albarella and Payne 2005), although such criterion was deemed questionable by many (Evin *et al.* 2013, Zeder and Lemoine 2020).

Measurements can help in species identification, body size estimation, or sex differentiation, by comparison with known ranges. In particular, they might be helpful in discriminating wild from domestic animals (Payne 1987, Zeder 2006, Peters *et al.* 2005) or between osteologically similar species (Lister *et al.* 2010). Data is always cross-checked against existing literature to ensure consistency (Degerbøl and Fredskild 1970, Wright *et al.* 2016, Schmölcke and Groß 2021 **for aurochs/domestic cattle**; O'Connor 2007 **for wild/domestic cats**). Any deviation is noted, as it may reflect individual or species-level variation, environmental factors, or changes over time within the population.

3.2.1.3 Anthropic and Taphonomic Modifications

3.2.1.3.1 Marrow Processing (MP)

Marrow processing is important to study in the context of subsistence strategies and animal economies because it provides insights into how past populations maximized the utility of animal resources. Marrow is a rich source of fat and nutrients, which were valuable in environments where food could be scarce (Binford 1978, Mead *et al.* 1986, Outram 2004a). By examining evidence of marrow extraction, we can better understand how thoroughly people exploited the animals they hunted or raised, reflecting economic strategies like risk management, resource efficiency, and nutritional priorities (Thompson *et al.* 2019, Blasco *et al.* 2019). This can also reveal cultural practices related to food preparation (Binford 1978:152-154, Manne 2012, Hastorf 2016:99, Isaakidou *et al.* 2018:121, Gifford-Gonzalez 2018:332), tool use (Soulier *et al.* 2014:326, Tartar 2012), and labor organization (Leechman 1951:356, Hastorf 2016:99) within communities.

Evidence for possible marrow extraction was identified through the presence of distinctive bone breakage patterns and specific chop marks. Diaphysis fractures were thoroughly analyzed to assess whether they had been intentionally broken to access marrow. In the skeletal representation tables in **Appendix B**, an MP (Marrow Processing) count, along with its percentage (%MP), was included to account for only those bones that exhibited fractures with the following particular characteristics:

- A helical, curved outline
- Smooth fracture edges
- An angle either acute or obtuse relative to the bone surface

Taken together, the latter were indicative of fresh or green bone breakage (Villa and Mahieu 1991, Outram 1998, Outram 2001, Johnson *et al.* 2016). Additionally, smooth longitudinal fractures running along the length of the long bone shaft, which could have resulted from splitting with a heavy tool (Marom 2020:521), were also incorporated into the MP count.

3.2.1.3.2 Bone Surface Modification (BSM)

Bone Surface Modifications (BSM) are changes to bones caused by both human activities and natural processes (Lyman 1994b, Fisher 1995). They include human-induced alterations like cut, chop, and scrape marks from butchery and tool use, as well as natural changes such as gnaw marks from scavengers and weathering from environmental exposure. The analysis of BSMs is not straightforward as they are often intricate and intermingled (Olsen and Shipman 1988, Gifford-Gonzalez 1991, James and Thompson 2014, Bello and Parfitt 2023). A canine tooth puncture might be mistaken for a perforation made by a tool, or a heavily gnawed surface might be misinterpreted as a bone that has been digested.

In this thesis, the focus was on cut and chop marks. Canid and rodent gnawing evidence was not particularly useful for the scope of this thesis, because it typically results from post-depositional processes—as scavengers often gnaw on bones after they have been discarded— rather than direct human activity. Although it helps understand site formation and use, contribute to the site's taphonomic history, and provide insights into environmental conditions and broader ecological dynamics, it was not recorded in this thesis. Nevertheless, consulting references such as Shipman 1981, Eickhoff and Herrmann 1985, and Fisher 1995:36-42 was necessary to differentiate between gnawing and butchery marks.

3.2.1.3.2.1 Cut and Chop Marks

Animal carcasses are cut and chopped, with the aid of implements, to process body parts for various purposes. Cutting facilitates the removal of meat, skinning, and separation of body parts, making it easier to prepare, consume, or preserve food (Costamagno *et al.* 2019). Chopping, which involves using heavier tools, is used to break large bones, access marrow, and dismember larger sections for easier transport or further processing (Gifford-Gonzalez 2018:290). These methods also enable the extraction of nonfood materials like hides, antlers, or tendons, which may be used for clothing, toolmaking or other utilitarian or ritual purposes (Soulier *et al.* 2014:326, Scanes 2018). This processing reflects the efficient use of animal resources in past subsistence strategies.

Marks left by cutting and chopping carcasses are direct evidence of how animals were processed, used, and consumed by humans. These marks are exclusively anthropogenic in origin (Noe-Nygaard 1989, Seetah 2018:3), as no other processes can produce such modifications, although some peri- and post-mortem alterations may occasionally mimic their appearance (Shipman and Rose 1984, Olsen and Shipman 1988, Domínguez-Rodrigo *et al.* 2017).

Visual inspection under strong light and magnification was used to identify such marks. The skeletal representation tables in **Appendix B** feature a CUT count, and its corresponding percentage (%CUT), which includes both cut and chop marks.

3.2.1.3.3 Thermal Alterations

Bones undergo physicochemical and structural changes (Reiche 2010:131) when exposed to heat due to the degradation of collagen and transformation of mineral components. Color changes help in determining heat damage and its intensity (Shipman *et al.* 1984, Stiner *et al.* 1995), while warping suggests high-temperature contact with (Pearce and Luff 1994, Correia 1997). Bones may also show cracking from thermal shock (Ibid.), particularly when bones are subjected to sudden temperature changes.

In this thesis, the degree of heat exposure was assessed by colorimetric analysis. Initially, bones exposed to moderate heat might develop a reddish or brownish hue, signaling early stages of heating. As the temperature increases, bones turn black, indicating carbonization, where organic material is largely burned away. Further heating can cause bones to take on a grey-bluish color. Prolonged or extreme heat exposure results in a white color, signaling calcination, where bone minerals are transformed due to intense heat. The recording system categorizes thermal damage into five stages (following Johnson 2017:107): “roasted” (brown-reddish), “scorched” (localized black charring), “carbonized” (black), “approaching calcination” (grey-bluish), and “calcined” (white).

It is equally important to keep in mind that initial bone color changes to brown, yellow, or reddish can be misleading as indicators of roasting or exposure to dry heat, as they may also result from soil staining, presence of microorganisms or fungi, weathering and exposure to moisture and sun, or chemical reactions (Dupras and Schultz 2013). These colors by themselves are not reliable for confirming thermal alteration, let alone cooking method (Ibid., Subías 2002:11).

Understanding the extent of thermal damage, alone, may not help in differentiating natural from anthropogenic agents; such as cooking techniques (Wandsnider 1997, Roberts *et al.* 2002, Lambri *et al.* 2021), ceremonial commensality and feasting (Halstead and Isaakidou 2004, Isaakidou 2007, Rowley-Conwy 2018), ritual sacrifices and offerings (Bond 1996, Godart 1999, Russell 2011), post-consumption processing (Crader 1984:553, Gifford-Gonzalez 1989:187, Clark and Ligouis 2010:1, Russell 2011:56), or the use of bone for hearth maintenance along with other fuels (Théry-Parisot *et al.* 2005, Nesterova 2023). Therefore, other factors were considered in combination: the nature of archaeological context and associated finds, the level of bone fragmentation, the diversity of taxa, the relative distribution of heat-induced damage in bones of the same context, and signs of carcass processing.

3.2.1.4 Pathology/Anomalies

Pathological bone can present abnormalities in bone formation, destruction, or changes in size, shape, or density (Wawrzyniak and Balawender 2022:12). A few examples include bone swelling with a polished surface, unusual bone growth or curvature, asymmetry or misalignment of bone landmarks, among many others.

Similar to skeletal element identification, referring to previous literature (Harcourt 1971, Baker and Brothwell 1980, Thomas 2012, Bartosiewicz and Gál 2013, Thomas 2019, Maguire 2019; Hillson 2005 for dental pathologies) for comparisons—especially for commonly encountered pathologies—can help avoid pseudopathological diagnoses. However, this method can nevertheless lead to inaccurate diagnosis or overinterpretation, as lesions vary greatly between different individuals. Additionally, animal palaeopathology is still an emerging discipline

(Moodie 1923:27, O'Connor 2000:98), and some of its earlier literature might not be up-to-date.

For these reasons above, such meticulous work demands considerable experience and knowledge (Waldron 2009:21), which I admit I have yet to develop. Consequently, the assessment was kept concise, as the number of bones exhibiting pathologies was also limited.

Anomalies from conditions like osteoarthritis, osteoporosis, and bone inflammation, once confidently identified, can be attributed to a myriad of causes. It is quite possible that they might be human-induced; from herd management and animal keeping (Magnell and Carter 2007, Zimmermann *et al.* 2018), traction and load carrying (Bartosiewicz *et al.* 1997, de Cupere *et al.* 2000, Johannsen 2005, Sick and Kohut 2022), or feeding practices (Martiniaková *et al.* 2008). These pathologies can therefore indirectly inform us about subsistence strategies, reflecting choices in animal care, workload, and diet.

3.2.1.5 Possible Tools

Bones, horn cores, and antlers, suspected of being deliberately worked, were found in both assemblages, albeit in varying degrees. Examining these potential tools helps elucidate the application of specific animal by-products in daily practices and their role in generating economic value (Stemp *et al.* 2016:1, Nelson 1996:109). These tools might have been employed in activities like basketry weaving, woven textile making, hide processing, or ceramic manufacturing (Yavşan 2021, Mărgărit 2017). They could also have served as ornamental items or game pieces (Meier 2013).

Tools were not examined in this thesis, as their manufacture was not directly relevant to the study of dietary and subsistence choices. Nevertheless, photographs of these artifacts **(Figures 33-44)** were taken for future reference and are included in **Appendix D**.

3.2.2 Analyzing the Assemblage

The quantitative analysis of an archaeofaunal assemblage is fundamentally built upon the detailed qualitative examination of individual specimens. Data from individual specimens are integrated to form a comprehensive view of the assemblage, and any inaccuracies or distortions at the specimen level can be amplified when scaled up to the assemblage level (Dobney and Rielly 1988:82).

It is also important to note that methods used to analyze an archaeofaunal assemblage depend on assumptions (Driver 1982, Badenhorst *et al.* 2022:2), which have been established to account for both the fragmentation of remains and the need to efficiently handle a large number of fragments, a process that can be time-consuming. These assumptions influence both the interpretation of the data and the conclusions about past animal populations and human-animal interactions (Driver 2011). By recognizing these assumptions, zooarchaeologists can better guide their analysis and reach more informed conclusions.

3.2.2.1 Species Abundance

Quantifying species abundance in archaeofaunal assemblages involves raw counts of identified specimens as a first step (Faith and Lyman 2019:197-233). This method provides a baseline measure of species frequency but can be skewed by biases such as differential preservation rates, which affect how well different species are represented in the assemblage. For instance, a substantial number of bone density studies and experiments, reviewed by Lam *et al.* 2003, show that more robust bones may survive better than those with lower density, leading to an overrepresentation of certain species or elements. As outlined in earlier sections, excavation and recovery techniques, including screen mesh sizes and sorting methods, can influence which fragments are recovered. Preservation conditions, such as soil acidity and moisture, further complicate accurate counts.

While raw counts provide a direct measure of species presence, they may not always accurately represent past population sizes due to the abovementioned biases. To enhance reliability, zooarchaeologists must account for these factors and use complementary methods when interpreting data. In this thesis, two basic calculations were used: NISP and MNI, although there are many more. Together, these two methods yield a minimum (MNI) and maximum (NISP) estimate of the number of individuals represented within one specific assemblage (Knüsel and Outram 2004:86).

3.2.2.1.1 Number of Identified Specimens (NISP)

The Number of Identified Specimens (NISP) can be used to measure species abundance by counting identified faunal fragments, though it was developed to represent anatomical rather than taxonomic proportions (Domínguez-Rodrigo 2012:52). To calculate NISP, we first attempt to identify each fragment taxonomically. The Number of Specimens (NSP) refers to all faunal fragments, regardless of identification (Grayson 1991:487, Lyman 1994a:45). NISP is derived from NSP by classifying each fragment to a genus or species level.

This process can be complex due to fragmentary and incomplete preservation (Cannon 2012). For instance, skull bones tend to be very fragmented, when comparing their representation in relation to teeth (Stiner 2002), due to their irregular and complex structure. Even when zooarchaeologists attempt to minimize this bias by recording distinctive parts separately, such as the occipital, parietal, petrous, or orbital bones, fragmentation remains a challenge.

Accurate NISP requires avoiding double counting and precise identification. NISP reflects only species presence and relative abundance but should be complemented by other metrics, including, but not limited to the Minimum Number of Elements (MNE) and the Minimum Number of Individuals (MNI) as well as a layout of the levels of fragmentation per taxon, for a better taxonomic representation (Payne

1975:14). Despite its limitations, NISP remains a widely used metric among zooarchaeologists due to its relatively straightforward approach (Lyman 2018).

3.2.2.1.2 Minimum Number of Individuals (MNI)

The Minimum Number of Individuals (MNI) provides the lowest possible number of individual animals that need to be present in the site, so as to have the particular bone counts found in the assemblage under study. To achieve this, zooarchaeologists and human osteologists have developed several methods to estimate MNI in mixed assemblages (Lambacher *et al.* 2016), much like the faunal collections examined in this thesis. The "traditional" method (White 1953) was chosen.

White's method focuses on identifying the most frequently occurring anatomical element for each species. For elements that are singular (here: most of the axial skeleton), it involves a straightforward raw count of that element. For elements that come in left and right pairs (here: all of the appendicular skeleton as well as hemimandibles), only the elements from the dominant side are counted. For example, finding multiple left femurs but few right femurs, in one species, can indicate at least as many individuals as there are left femurs, assuming each animal has a matching right femur. This way, it adjusts for the possibility of multiple different bones coming from the same animal skeleton (White 1953). This method was also used to estimate the MNI of avian elements, as no zones were recorded for the long bones and coracoids; only the surviving parts were noted: proximal, distal, and/or shaft.

MNI, as a unit of quantification, has been long criticized for having several limitations (Domínguez-Rodrigo 2012, Lyman 2019a). One significant drawback is that it often underestimates the true number of individuals, especially if the assemblage is dominated by a few species or if preservation is uneven. This can lead to the inflation of the %MNI of minor taxa, as it disproportionately represents these taxa relative to their actual abundance in the assemblage. Additionally, the method can be biased toward more commonly preserved bones, same as NISP, which may skew the representation of less common ones.

3.2.2.2 Degree of Fragmentation

In assessing the levels of fragmentation within an assemblage, the distribution of all remains—whether attributed to a specific taxon/to a precise element or not—will be categorized by type, according to the most dominant features in the specimen, and size (adapting the approach outlined by Outram 2004b with some modifications).

In this thesis, the element type categories are:

- *Cancellous*
    - *Cephalic*: cranial, facial, maxillary, and mandibular bones, hyoids, antlers, horns
    - *Axial and Girdular*: ribs, sterna, vertebrae, sacra, coccyxes, pelvises, scapulae
    - *Short and sesamoid*: carpals, tarsals, 3rd phalanges, patellas, sesamoids
    - *Cancellous Miscellaneous*: Loose epiphyses and unidentified fragments
- *Cortical*: long bone shafts with or without epiphysis/es

The size intervals, in millimeters, are: 1-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, 100+, and “Whole” (complete elements).

This bone fragment-size distribution will be presented in stacked bar charts for each site and for each taxon. Subsequently, comparisons between taxa and sites will be conducted to draw inferences about any observed differences.

3.2.2.3 Body Size Estimation

Body size estimation in this thesis employed an allometric approach based on linear measurements of bones and teeth (Reitz *et al.* 1987). This method was only applied when sufficient measurements had been taken, or as many as possible, given the highly fragmented nature of the assemblage. The primary purpose of body size estimation is to identify clusters or groups within the sample and to facilitate comparisons against known reference data, or against other samples. The results of these analyses are presented visually through scatterplots, which allows for a clear representation of size variation and comparative trends among the groups.

The identification of different clusters can reveal several distinct, but also combined, patterns:

One potential interpretation of these clusters is the differentiation between wild and domestic forms. This method was particularly useful for economic domesticates (cattle, caprines, and pigs), but also for cats. However, it was not applied to dogs/wolves, as the discrimination criteria are valid only for cranial measurements and cannot be reliably used with postcranial bones for these taxa.

Additionally, the clusters may indicate patterns of sexual dimorphism (Ruscillo 2014:8005). Clusters can also reflect variations in size among taxa of the same site, which might reflect individual variation. Furthermore, size differences between taxa across the two sites may be indicative of regional variation or differing feeding practices.

3.2.2.4 Kill-off Patterns and Mortality Profiles

At the core of inferring subsistence strategies is understanding how past human populations sourced food and what they prioritized, specifically by examining any aggregate demographic patterns or trends in the animals they slaughter or harvest. Kill-off patterns refer to the systematic age-at-death (and occasionally sex) distribution in domestic fauna, within the context of husbandry and herd management systems, whereas mortality profiles are used in wild (hunted, fished, or gathered) fauna, relating to human predation practices (Gifford-Gonzalez 2018:113-114).

Examples of human manipulation can take the form of sex-biased culling (e.g., targeting males during hunts while keeping females as the limiting reproductive resource to maintain stable breeding and ensure future reproduction), age-biased culling (e.g., allowing raised animals of one or both sexes to mature into adulthood for secondary products), or both (e.g., harvesting specifically young males for meat while limiting the culling of reproductive females) (Stiner *et al.* 2022:3).

Age estimates, for each taxon, were visually represented in stacked area and bar charts that display the frequency distribution of individuals (y-axis) who died at various age stages (x-axis). When data was available, additional stacked bars were added to represent sex-specific proportions for each age group. Subsequently, any specific profiles (e.g., attritional/U-shaped targeting very young and very old individuals, catastrophic/living structure/L-shaped representing fewer and fewer individuals as age increases, old-dominated, prime adult-dominated) can be recognized (Domingo *et al.* 2012, Discamps and Costamagno 2015).

CHAPTER 4

RESULTS AND DISCUSSION

The total mammalian and non-mammalian NSP for both sites, in the selected squares and local phases, is 5223 specimens (**Table 5**).

Mammalian bones and teeth were dominant in both assemblages. In regards to non-mammals, mollusks, fish, and turtles were more prominent in Toprakhisar Höyük, comprising, with birds, 19% of the assemblage. In contrast, Tell Atchana had much fewer non-mammalian finds (11%), but more abundant avifaunal remains (4%).

Table 5 NSP of Different Skeletal Elements at Both Sites

Taxon	Element	TPH		AT		T	
		NSP	%NSP	NSP	%NSP		
Mammals							
Mammalia	Bones	2198		1753		4458	
	Teeth	265		127		457	
	Horns	15		47		69	
	Antlers	7		0		7	
	Costal cartilage	1		1		4	
T (*Mammals*)		2486	81%	1928	89%	4995	
Non-mammals							
Mollusca	Bivalve shells	183		58		265	510
	Gastropod shells	199		26		245	
Aves	Bones	22		94		118	
Pisces	Bones + teeth	90		41		133	
Testudines	Carapace + bones	86		10		99	
T (*Non-mammals*)		580	19%	229	11%	860	
T		3066	100%	2157	100%	**5223**	

4.1 Findings

4.1.1 Results per Assemblage

4.1.1.1 Fragmentation

The data presented in **Figure 12** and **Figure 13** showcases the distribution of fragmentation types across various size classes in Toprakhisar Höyük and Tell Atchana. Long bones were intensively processed in Tell Atchana, as cortical fragments are represented in every size class. In contrast, fragmentation was more focused on cancellous fragments in Toprakhisar Höyük, especially in smaller sizes. This pattern may suggest the possibility of pot-sizing for bone grease production or soup/stew making. Evidence from experimental archaeology (Janzen *et al.* 2014) shows that smaller bone fragment sizes require less water and fuel for grease production. This efficiency in resource use may have been particularly advantageous during the Bronze Age, a period known for its climatic fluctuations and episodes of drought.

In Toprakhisar Höyük (**Figure 12**), cancellous fragments dominate in every size range, exceeding 50% of the total fragments in all of them. Cortical fragments are present in all size classes but become more pronounced in the 30–39, 50–59, 60–69, and 70–79 mm size classes, where they make up more than 30% of fragments. Whole bones, unsurprisingly, exhibit higher frequencies of complete long bones as well as short and sesamoid bones, comprising up to 60% of the whole specimens.

The high frequency of complete long bones, short bones, and sesamoid bones among whole specimens can be explained by their inherent structural characteristics and functional uses. Long bones, particularly the larger ones like femora and humeri, are highly durable due to their dense cortical structure. Short and sesamoid bones, while smaller, are also relatively compact and robust, contributing to their higher likelihood of remaining intact in archaeological contexts. Functionally, short and sesamoid bones may have been less targeted for grease production compared to cancellous-rich elements like vertebrae or pelvises. Their minimal nutritional yield and lower utility for secondary purposes (e.g., tool production, except for the astragalus) could have led to their preservation in whole form. For long bones, the emphasis on preserving certain elements intact might also reflect specific cultural practices, such as deliberate selection for symbolic or utilitarian purposes.

In Tell Atchana (**Figure 13**), cortical fragments are represented across all size classes, although inconsistently. They dominate larger size classes, particularly in the 70–79 and 90–99 mm ranges, where they account for more than 50% and 70% of the fragments respectively. Smaller size classes (10–19 mm and 20–29 mm) show a high frequency of cancellous fragments, but their representation decreases sharply beyond between the 40–49 and 70–79 mm size classes, where cortical fragments become more predominant.

The presence of approximately one-third of cortical fragments (long bone flakes) in small size classes could suggest intensive processing of long bones, likely aimed at extracting marrow or producing other by-products. It could also reflect a culinary preference for the portioning of meat and its preparation or its distribution in smaller parts. This could also have a taphonomic explanation. Taphonomic processes such as trampling, soil pressure, and natural weathering can contribute to the fragmentation of cortical bone over time. Long bones, despite their durability, are subject to these forces in the archaeological record, which can cause even initially larger fragments to break down into smaller pieces. Additionally, differential preservation could play a role. Cortical bone, due to its dense and compact structure, is more resistant to chemical degradation compared to cancellous bone. This durability might explain why cortical fragments are found across all size classes, including the smallest ones, as they are more likely to survive environmental and post-depositional processes.

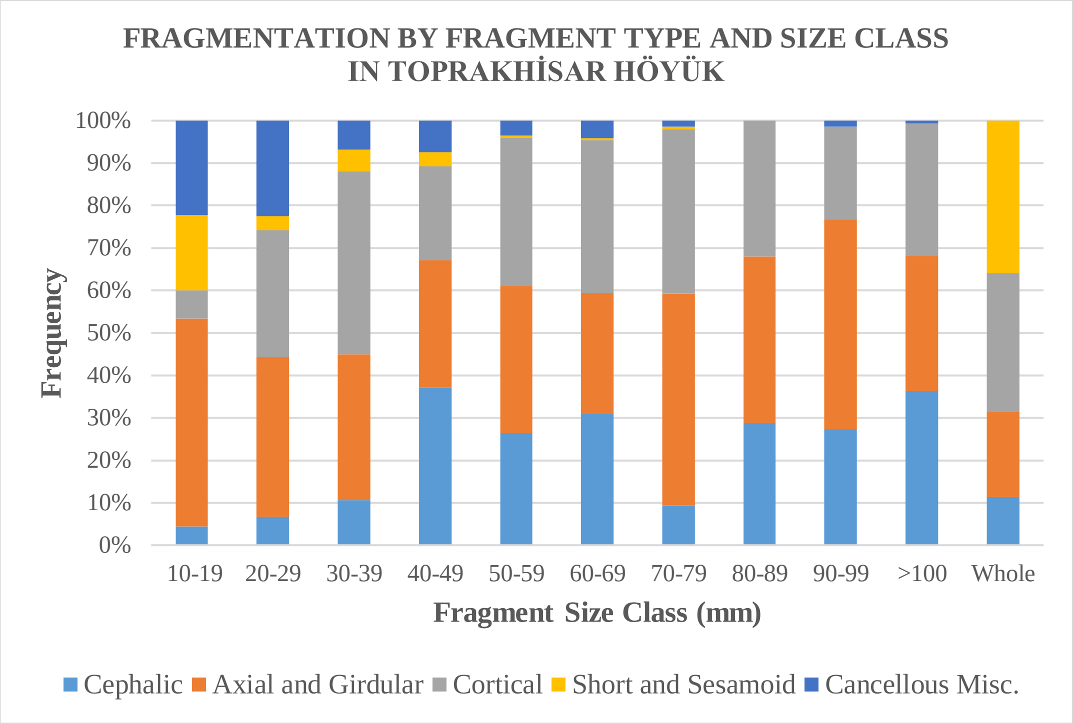


Figure 12 Degree of Fragmentation in Toprakhisar Höyük

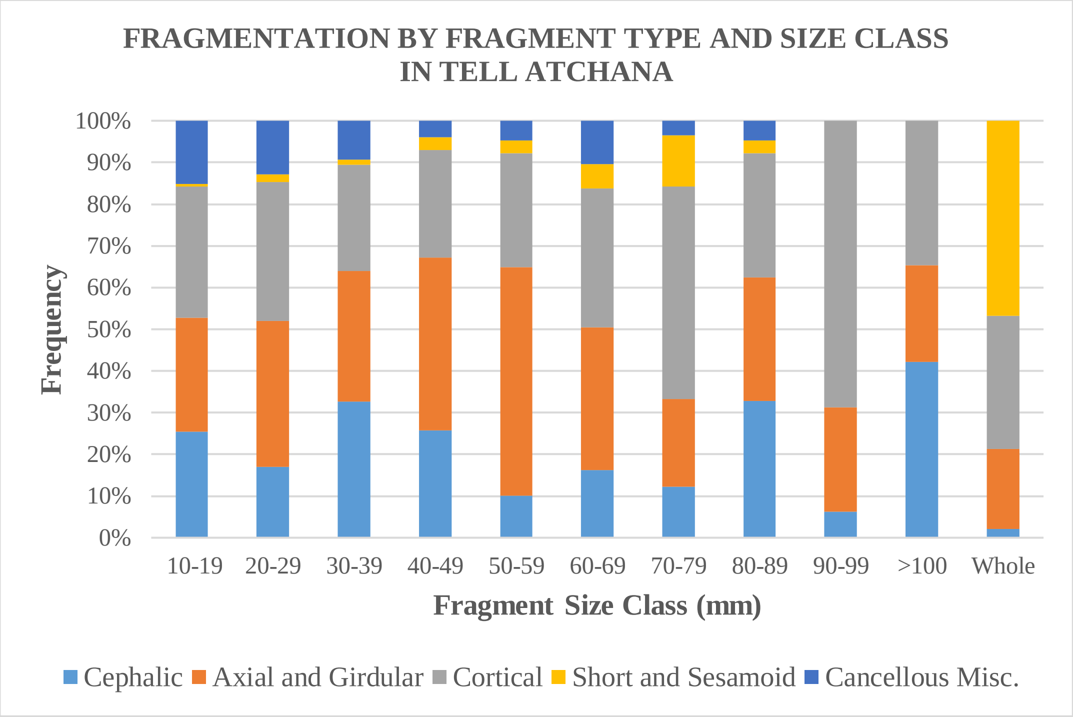


Figure 13 Degree of Fragmentation in Tell Atchana

4.1.1.2 Taxonomic Distribution

4.1.1.2.1 Mammals

Toprakhisar Höyük

Only 56% of Toprakhisar Höyük's mammalian remains (2486) were sufficiently diagnostic to be identified at the family, genus, or species level (**Table 6**). Among the unidentified specimens, approximately two-thirds could be attributed to sheep-sized animals, while one-third likely came from cattle-sized taxa.

Table 6 Taxonomic Distribution at Toprakhisar Höyük: Mammals

Taxon	NSP	%	MNI	%
Mammals, Total	2486	81%	—	—
Unidentified Mammals, Total	1095	44%	—	—
Large size	289	26%	—	—
Medium size	50	5%	—	—
Small size	755	69%	—	—
Very small size	1	<1%	—	—
Identified Mammals, Total	1391	56%	149	—
Caprines	560	40%	35	23%
Sheep (*Ovis* sp.)	60	9%	—	—
Goat (*Capra* sp.)	55	10%	—	—
Sheep/Goat	445	79%	—	—
Pigs (*Sus* sp.)	507	36%	74	50%
Cattle (*Bos* sp.)	231	17%	12	8%
Equids (*Equidae*)	31	2%	—	—
Donkey (*Equus africanus asinus*)	16	52%	1	1%
Horse (*Equus ferus caballus*)	10	32%	1	1%
Equus spp.	5	16%	2	1%
Deer (*Cervidae*)	36	3%	—	—
Roe Deer (*Capreolus capreolus*)	3	8%	2	1%
Fallow Deer (*Dama dama*/*mesopotamica*)	7	19%	3	2%
Red Deer (*Cervus elaphus*)	8	22%	3	2%
Cervidae spp.	18	50%	6	4%
Canids (*Canidae*)	18	1%	5	3%
Dog/Wolf (*Canis lupus* sp.)	14	78%	—	—
Large Dog/Wolf	4	22%	—	—
Gazelle (*Gazella*/*Eudorcas* spp.)	3	<1%	1	1%
Deer/Gazelle	2	<1%	2	1%
Hare (*Lepus* sp.)	2	<1%	1	1%
Cat (*Felis catus* sp.)	1	<1%	1	1%

Identified mammals constituting a little more than half of the total NSP (1391 specimens) and are lead by caprines (NISP 40%, MNI 23%). Within identified caprines, goats (NISP 156, 21%) were higher than sheep (NISP 71, 9%).

Pigs are the second most represented identified taxon, making up 36% of the identified NSP and 74 individuals in terms of the Minimum Number of Individuals (MNI 50%), the highest among all species. This possibly indicates they were better preserved, as the MNI for pigs comes from mandibles, which are very robust.

Cattle account for 17% of the identified NSP (231 specimens) and 12 individuals (8% of the MNI).

All other mammals collectively account for 7% of the mammalian assemblage in NISP, with equids contributing 2% (MNI 3%), cervids 3% (MNI 9%), canids 1%, (MNI 3%) and gazelle, hare, and cat each representing less than 1%.

Except for the equids, canids, and cat, which could be domestic, the remaining taxa represent wild species, which reflects opportunistic hunting or localized exploitation of wild fauna, and the use of wild game as a supplementary resource alongside domesticated animals can provide insight into the diversity of subsistence strategies.

The ratios of the three most common taxa: caprines (NISP 40%, MNI 23%), pigs (NISP 36%, MNI 50%), and cattle (NISP 17%, MNI 8%) at Toprakhisar Höyük I exhibits a mix of both common and unique features compared to typical Bronze Age faunal assemblages in the Near East.

Caprines dominate the assemblage in NISP, which aligns with broader patterns observed during this period. Sheep and goats were favored for their adaptability, secondary products such as milk and wool, and efficient grazing, especially in arid or semi-arid environments. Similarly, the relatively low proportion of cattle could fit the general regional trends in Northern Levant (in contrast to Southeastern Anatolia and Eastern Mediterranean, see **Appendix A**, **Table 12**), as cattle were often less common due to their higher maintenance requirements —including access to substantial amounts of water often more than smaller livestock and particularly in warmer climates—, and slower reproductive rates. Their primary roles likely involved traction, plowing, or as a secondary source of meat.

However, the high percentage of pigs at Toprakhisar Höyük is unusual, but not unheard of (see Hirbemerdon Tepe in **Appendix A**, **Table 12**), for a Middle Bronze Age site. In most settlements across the Near East, pigs typically constitute a minor component of the assemblage, often around or below 10–15%, due perhaps to cultural preferences or environmental constraints. The substantial presence of pigs here may indicate favorable local environmental conditions, such as wetter landscapes or forested areas, that supported pig husbandry. Alternatively, it could reflect specific cultural or subsistence practices that prioritized pigs more than at other sites. It is also possible that Toprakhisar Höyük functioned as a center for pig farming, supplying pigs either as live animals or in meat form to other sites, such as Tell Atchana, hence the high frequency of pigs within the faunal assemblage.

This composition among domesticates at Toprakhisar Höyük highlights a *mixed* subsistence strategy that balances meat production, secondary product use, and labor, while also showcasing local or cultural adaptations.

Tell Atchana

A total of 1928 mammal specimens were recorded for Tell Atchana’s selected phases, making up 89% of the assemblage, with 1154 of these being unidentified, accounting for 60% of the mammal remains (**Table 7**). This high proportion of unidentified specimens means that many bones could not be confidently assigned to a specific species, genus, or even family, due to the high fragmentary nature of the remains.

Among the unidentified specimens, a significant portion (81%) is categorized as small/sheep size, with fewer specimens in the large/cattle (16%) and medium/boar (3%) size categories, indicating that small mammals, mainly smaller ungulates, were the most commonly found but difficult to identify.

Table 7 Taxonomic Distribution at Tell Atchana: Mammals

Taxon			NSP	%	MNI	%
Mammals, Total			1928	89%	—	—
Unidentified Mammals, Total			1154	60%	—	—
	Large size		186	16%	—	—
	Medium size		31	3%	—	—
	Small size		936	81%	—	—
	Very small size		1	<1%	—	—
Identified Mammals, Total			774	40%	61	—
	Caprines		540	69%	32	52%
		Sheep (*Ovis* sp.)	55	10%	—	—
		Goat (*Capra* sp.)	99	18%	—	—
		Sheep/Goat	386	72%	—	—
	Cattle (*Bos* sp.)		130	17%	9	15%
	Pigs (*Sus* sp.)		69	9%	11	18%
	Mustelids: Weasel (*Mustela* spp.)?		15	2%	2	3%
	Canids (*Canidae*)		11	1%	2	3%
		Dog/Wolf (*Canis lupus* sp.)	10	91%	—	—
		Dog/Jackal (*Canis* spp.)	1	9%	—	—
	Hare (*Lepus* sp.)		4	<1%	3	5%
	Rodents (*Rodentia* spp.)		4	<1%	1	2%
	Fallow Deer (*Dama dama*/*mesopotamica*)		1	<1%	1	2%

Of the 774 identified mammal specimens (40% of the total), caprines are the dominant group, comprising 69% of the identified specimens. Within this category, the remains of sheep (10%) and goats (18%) are represented, but the largest portion (72%) consists of sheep/goat remains, which means that many of the caprine remains, similarly to Toprakhisar Höyük, could not be definitively attributed to one species or the other. Cattle (*Bos* sp.) contribute 17% of the identified specimens, though they represent only 9 individuals (15% of MNI), indicating that cattle were present but less frequent in terms of individual animals, perhaps playing a secondary role in the subsistence strategy compared to caprines. Pigs (*Sus* sp.) account for only 9% of the identified specimens, with a higher representation in MNI (18%), suggesting that pigs were more frequently represented than cattle, by individual animals, possibly indicating they were better preserved, as the MNI for pigs comes from proximal tibiae, which are relatively robust and can be denser than pig femora (Zedda *et al.* 2019).

Carnivores, limited here to mustelids and canids, are represented in smaller numbers. Mustelids, possibly weasels, make up 2% of the identified specimens, with 3% of the MNI. Canids (dog/wolf species) are also rare, contributing 1% of the NSP and 3% of the MNI.

Other wild species include hares (*Lepus* sp.), represented by 4 specimens (<1% of NSP) but with a higher MNI of 3 (5%), indicating that while hares were infrequent, they may have been hunted occasionally. Rodents are similarly rare, with only 4 specimens (<1% of NSP) and a single individual recorded in the MNI. Fallow deer (*Dama dama/mesopotamica*) are the least represented species, with only one specimen and a single individual, which highlights their rarity in the assemblage.

Overall, the data suggests a subsistence strategy heavily reliant on domesticated livestock, almost unequivocally on sheep and goats, with some occasional reliance on cattle and pigs. The presence of wild species like hares, mustelids, and canids could suggest occasional hunting or scavenging practices, though these animals were not major contributors to the diet, if at all. The high proportion of unidentified mammal remains highlights the challenges of species identification in archaeological contexts, which is unfortunate. Although it is unclear how much these ratios would change if the indeterminate fragments were assigned to specific taxa, such an effort would still be valuable.

4.1.1.2.2 Non-mammals

Non-mammalian remains make up smaller percentages within the assemblages (19% at TPH, **Table 8**; and 11% at AT, **Table 9**), that, nevertheless, are still noteworthy. Mollusks dominate in both sites. The substantial presence of *Unio* sp. in Toprakhisar Höyük and Tell Atchana suggests the exploitation of freshwater environments, likely from the Beyazçay river tributary and the Orontes river's major branch, respectively.

Fish remains were at 90 or 3% at Toprakhisar Höyük and a little lower at 41 or 2% at Tell Atchana, highlighting the use of aquatic resources, though their relatively low percentage may indicate either limited fishing activities or preservation bias in the zooarchaeological record.

The Greek Tortoise, with 66 remains (2%) at Toprakhisar Höyük and only 10 remains (representing less than 1% of the total assemblage) at Tell Atchana, are another significant non-mammalian component. This indicates their availability and ease of capture, as tortoises are terrestrial. Nevertheless, we cannot ensure that these tortoises were indeed animals captured and consumed in the past or animals that burrowed for hibernation at the site and died.

Table 8 Taxonomic Distribution at Toprakhisar Höyük: Non-mammals

Taxon		NSP	%
Non-mammals, Total		580	19%
Mollusks (*Mollusca*), Total		382	12%
	Unio spp. — Freshwater mussels	181	47%
	Bivalvia spp.	2	1%
	Gastropoda spp.	199	52%
Fish (*Pisces*), Total		90	3%
Turtles (*Testudines*), Total		86	3%
	Greek Tortoise (*Testudo graeca*)	66	77%
	Sea Turtles (*Chelonioidea* spp.)	20	23%
Birds (*Aves*), Total		22	1%
	Eurasian Magpie (*Pica pica*)	1	
	Duck (*Anatidae* spp.)	1	
	Goose (*Anatidae* spp.)	1	
	Duck/Goose	1	
	Rails (*Rallidae* spp.): Coot (*Fulica* sp.)?	2	
	Aves spp.	16	
Total assemblage		3066	~100

Sea turtles at Toprakhisar Höyük, although less confidently identified and in certain need of further investigation, could suggest that marine environments, or possibly trade, provided access to these species, and would thus expand the subsistence base to include coastal or marine resources.

Birds, although constituting a small portion of the Toprakhisar Höyük assemblage (22, <1%) and a bigger portion at Tell Atchana (94, 4%), are still significant. Among the avian remains, waterfowl being the most prominent at TPH, but more variety is observed at AT. While the low percentages of bird remains may reflect, similarly to fish remains, limited reliance on avian resources or preservation issues, their presence nonetheless highlights the exploitation of local bird species for food.

Table 9 Taxonomic Distribution at Tell Atchana: Non-mammals

Taxon	NSP	%
Non-mammals, Total	229	11%
Mollusks (*Mollusca*), Total	84	4%
Unio spp. — Freshwater mussels	54	64%
Bivalvia spp.	4	5%
Gastropoda spp.	26	31%
Fish (*Pisces*), Total	41	2%
Greek Tortoise (*Testudo graeca*), Total	10	<1%
Birds (*Aves*), Total	94	4%
Pigeons (*Columbidae*)	3	3%
Wood Pigeon (*Columba palumbus*)	1	33%
Columbidae spp.	2	67%
Ducks (*Anatidae* spp.)	14	15%
Goose (*Anatidae* spp.)	1	1%
Duck/Goose	1	1%
Partridge (likely *Alectoris chukar*)	1	1%
Scolopidae spp. (likely curlew *Numenius* sp.)	1	1%
Vulture (*Accipitridae* spp.)	1	1%
Ostrich [egg shell fragments] (likely *Struthio camelus syriacus*)	3	3%
Aves spp.	69	73%
Total assemblage	2157	~100

Chi-squared Test

The faunal composition has been statistically analyzed using a chi-squared test to determine whether significant differences exist in the distribution of taxa between the two sites. The aim was to assess whether the faunal assemblages reflect similar or distinct patterns of subsistence and resource utilization.

The chi-squared test is a non-parametric test that can be used for categorical variables, such as the ones we have here. Here, the test was used to compare the categorical variable "species" across two different samples: "TPH" and "AT". This test was chosen over the t-test because it is used for large samples and does not require the data to conform to a normal distribution. Its primary advantage lies in its simplicity and ability to handle categorical data. However, the test is not without limitations. It assumes independence between categories and can be sensitive to sample size; small frequencies in certain categories may compromise the reliability of results.

In this context, the null hypothesis H_0 posits that the faunal composition at TPH and AT does not significantly differ, while the alternative hypothesis (H_1) suggests a difference in the distribution of taxa between the sites.

With a chi-squared value of 428.2, 7 degrees of freedom, and a p-value of <0.000001, the results (**Appendix E**) unequivocally reject H_0, demonstrating that the faunal compositions of the two sites are statistically distinct. This statistical distinction suggests that people at these two sites had different approaches to subsistence or were influenced by distinct environmental, cultural, or economic factors.

4.1.1.2.3 Distribution by Local Phase

Figures 14 and **15** show the composition in taxa for the different sites, squares, and phases.

TPH Sq 51+52.37 LP4a had the lowest number of remains (N=63), of which 41% were caprines (with dominance of goats), 30% were pigs, 6% were cattle, and 23% were mollusks. This phase has been limited to these taxa.

TPH Sq 51+52.37 LP3 had the highest number of remains (N=751), of which 38% were pigs, 30% were caprines (sheep being more dominant), and 8% were cattle. Along with TPH Sq 54.38 LP2, these phases were the only ones where pig percentages exceeded those of caprines. Equids were at 2% and canids were at (2, <1%). This phase had the highest number of deer remains (16, 2%) among the TPH phases. All non-mammals made up to 20% of the assemblage, with high numbers of turtle remains.

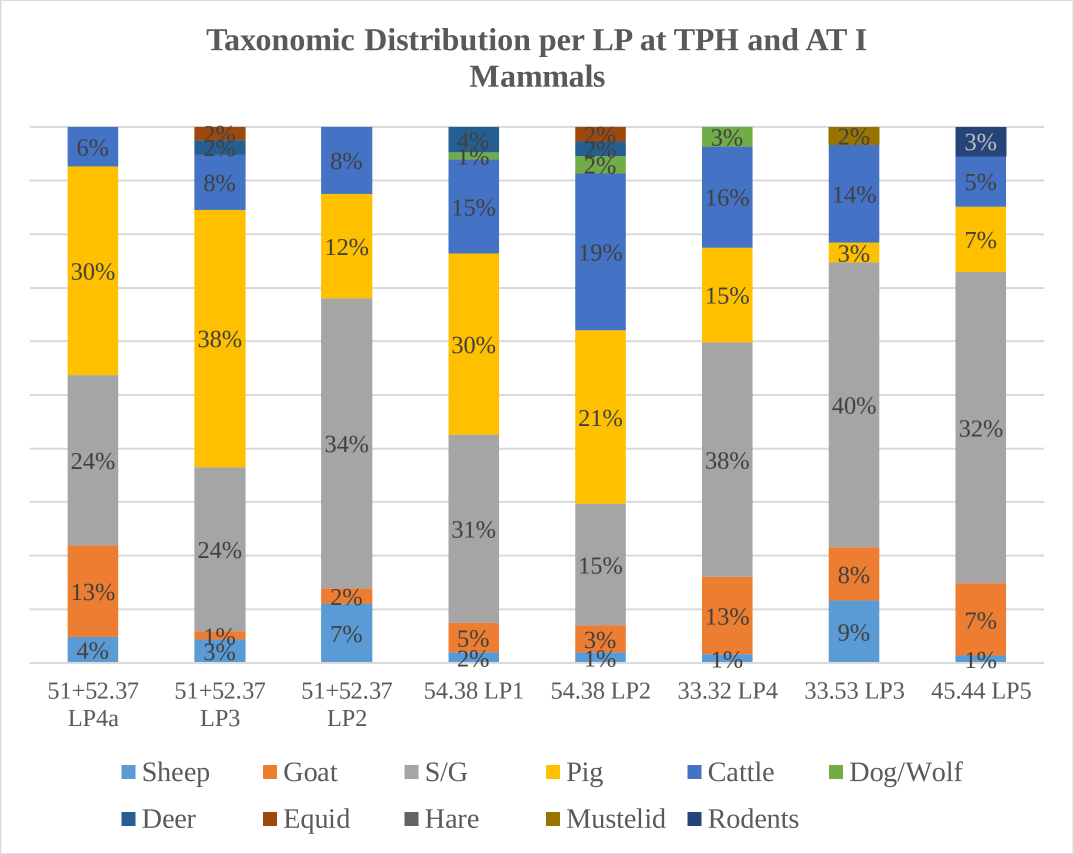


Figure 14 Taxonomic Distribution per LP at TPH and AT I Mammals*

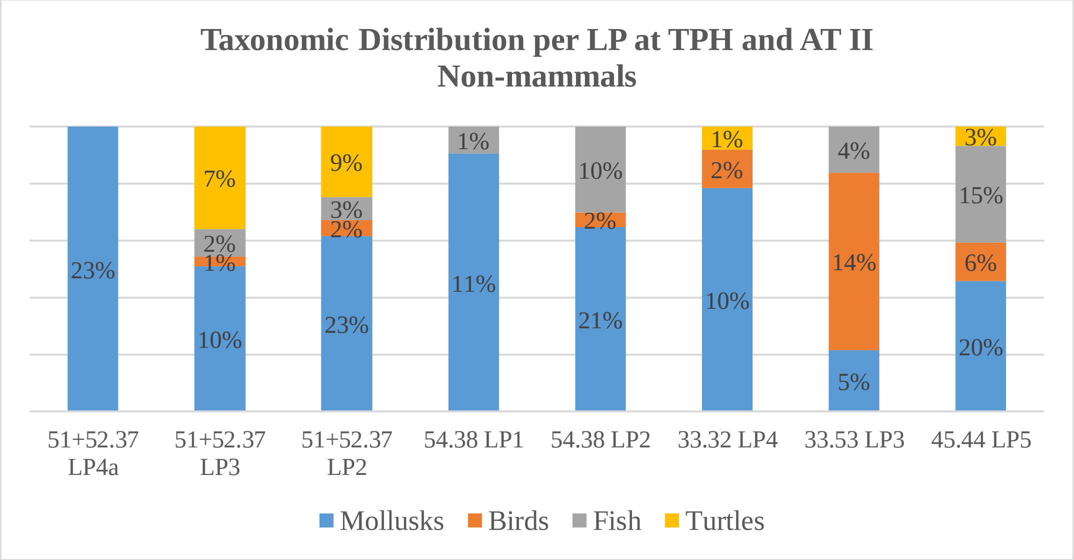


Figure 15 Taxonomic Distribution per LP at TPH and AT I Non-mammals*

(*Some taxa are absent from **Figures 14-15** as their percentages are below 1%).

TPH Sq 51+52.37 LP2 had 354 remains, of which 43% were caprines (sheep being more dominant), 12% were pigs, and 8% were cattle. No canids, cervids, or equids were found. The only wild mammalian taxon was a single gazelle. Non-mammals make up to 37% of the assemblage.

TPH Sq 54.38 LP1 had 181 remains, the second lowest, of which 38% were caprines (slight dominance of goats), 30% were pigs, 15% were cattle, 4% were deer, and only 1% were canids (N=2). Non-mammals were limited to mollusks at 11% and fish at 1%.

TPH Sq 54.38 LP2 had 622 remains, the second highest, of which 21% were pigs, and 19% were caprines (goats being more dominant). Cattle were at a surprising 19% (the highest number of cattle remains among all phases). This phase also had the highest counts of fish remains (64, 10%). Taxa in this phase were varied, as we see the introduction of cat and hare remains in TPH exclusively during this phase.

This phase had the highest number of canid remains (13, 2%) among the TPH phases. Other taxa included cervids at 2%, equids at 2%, mollusks at 21%, birds at 2%, and gazelles and turtles at less than 1%, similarly to cats and hares.

All of the Tell Atchana phases contained canid remains.

AT Sq 33.32 LP4 had 290 remains, of which 52% were caprines (with dominance of goats), 16% were cattle, 15% were pigs, 3% were canids, and with the non-mammals, comprising mollusks, birds, and tortoises, at 13%. It is during this phase that we witness the first and only presence of the single deer remain found in Tell Atchana.

AT Sq 33.53 LP3 had 574 remains, of which 57% were caprines (with slight dominance of sheep), 14% were cattle, only 3% were pigs, and 2% were mustelids. Among the non-mammals, mollusks were at 5%, birds at 14% (the highest number of bird remains in all phases: N=81), and fish at 4%. Canids, hares, and tortoises were at less than 1% of the assemblage.

AT Sq 45.44 LP5 had 139 remains, of which 40% were caprines (goats being more dominant), 7% were pigs, 5% were cattle, 3% were rodents, whilst canid, hare, and mustelid, make up less than 1% of the assemblage, represented each by one single specimen. Among non-mammals, mollusks were at 20%, fish at 15%, birds at 6%, and tortoises at 3%.

Correspondence Analysis

Correspondence Analysis (CA) is a multivariate statistical method used to investigate relationships between categorical data, such as taxa and archaeological contexts. CA examines associations between rows and columns of a contingency table by reducing multidimensional data into a smaller number of dimensions, which are represented graphically. A key limitation is its reliance on large datasets to produce meaningful results, as small sample sizes can distort relationships.

In this study, the aim was to elucidate differences in faunal compositions between Toprakhisar Höyük and Tell Atchana. Specifically, seeking to identify taxa that drive variation between the two sites, explore their associations with different chronological phases, and interpret these patterns in the broader framework of subsistence strategies and environmental exploitation.

The eigenvalue summary (**Appendix E**) provides insights into the distribution of variability across the dimensions. The first axis explains 43.7% of the variability in the dataset, the second 22.3%, and together they account for 66% of the total variation. Subsequent axes contribute diminishing amounts of variability, with the third axis explaining 16.3% and the remaining axes collectively adding smaller contributions.

These results indicate that most of the variation can be captured in the first two dimensions, justifying their use for interpretation in the biplot (**Figure 16**)

The Correspondence Analysis plot reveals distinct patterns in the faunal compositions of TPH and AT. Taxa such as pigs and turtles are strongly associated with TPH contexts, particularly those positioned on the negative side of the first axis. Their prominence at TPH suggests that these animals played a significant role in subsistence strategies at the site. Mollusks also show a strong association with TPH, contributing substantially to the variability along the second axis, which reflects the importance of aquatic resources in the site's faunal assemblage.

Conversely, birds and sheep are more closely associated with AT, located on the positive side of the first axis. This pattern indicates their higher frequency or greater cultural and dietary importance at Tell Atchana. Taxa such as cattle, goats, and smaller mammals, clustered closer to the origin, appear to be more evenly distributed between the two sites and contribute less to the overall variation.

Taxa that are farthest from the origin, such as pigs, birds, and mollusks, contribute most to the differentiation between the sites. These taxa highlight significant differences in subsistence strategies or environmental exploitation between TPH and AT.

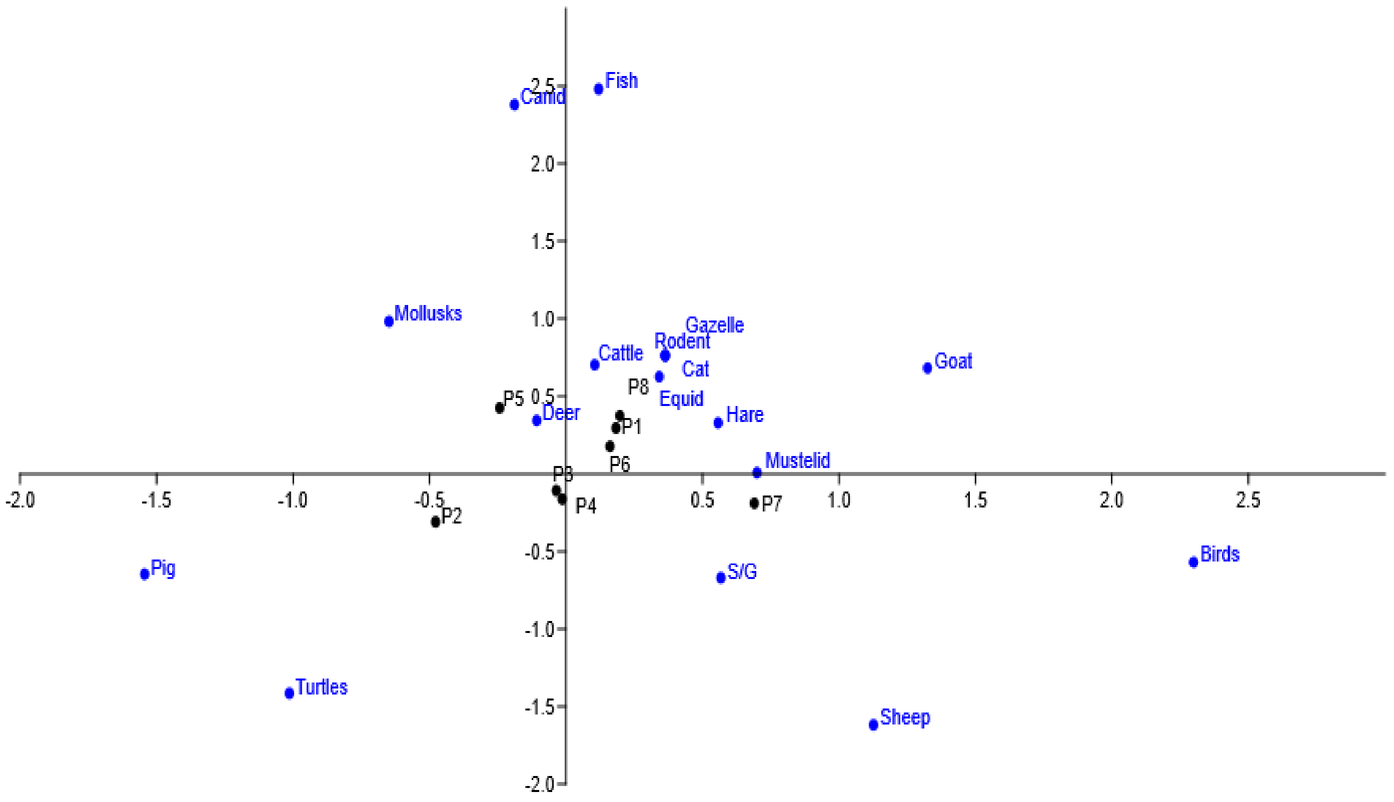


Figure 16 Biplot of the Correspondence Analysis

Abbreviations:
P1 = TPH 51+52.37 LP4a; **P2** = TPH 51+52.37 LP3; **P3** = TPH 51+52.37 LP2; **P4** = TPH 54.38 LP1
P5 = TPH 54.38 LP2; **P6** = AT 33.32 LP4; **P7** = AT 33.53 LP3; **P8** = AT 45.44 LP5

4.1.1.3 Age at Death

Caprines

Figures 17-19 depict the age distribution of caprines (sheep and goats) based on epiphyseal fusion data, with the average age for sexual maturity around 6 months: 6–9 months in domestic female sheep, 5–7 months in domestic female goats, and 4–6 months in domestic sheep and goat males, wild animals might mature later (Jainudeen *et al.* 2000).

The distribution prominently peaks at the 1–1.5 years age interval for both sites. This suggests that a majority of caprines were culled after reaching maturity. A smaller, secondary rise appears in the 2.25–2.5 and 2.5–3 years intervals, reflecting the presence of older individuals in the herds, particularly at TPH.

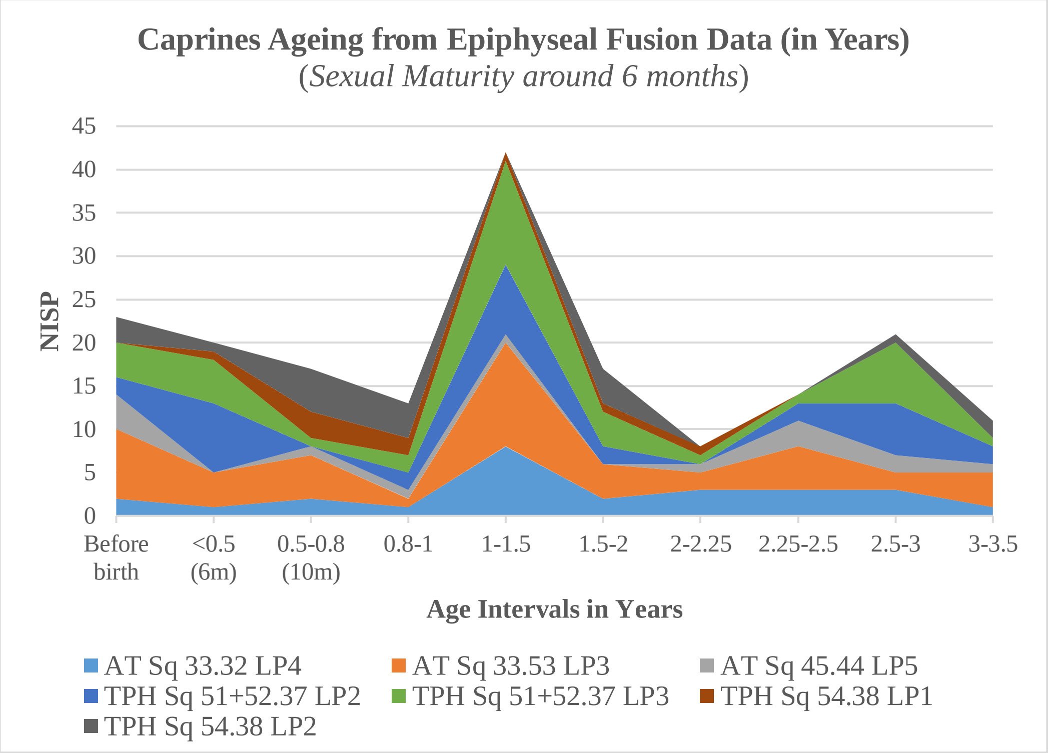
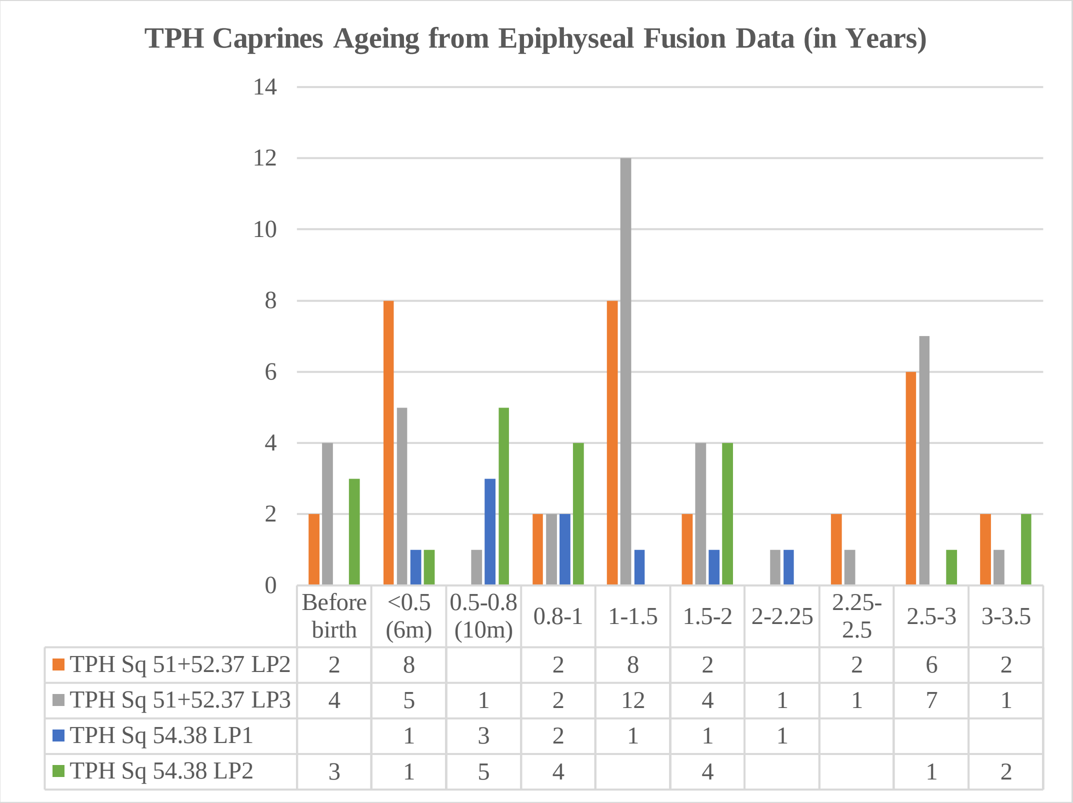
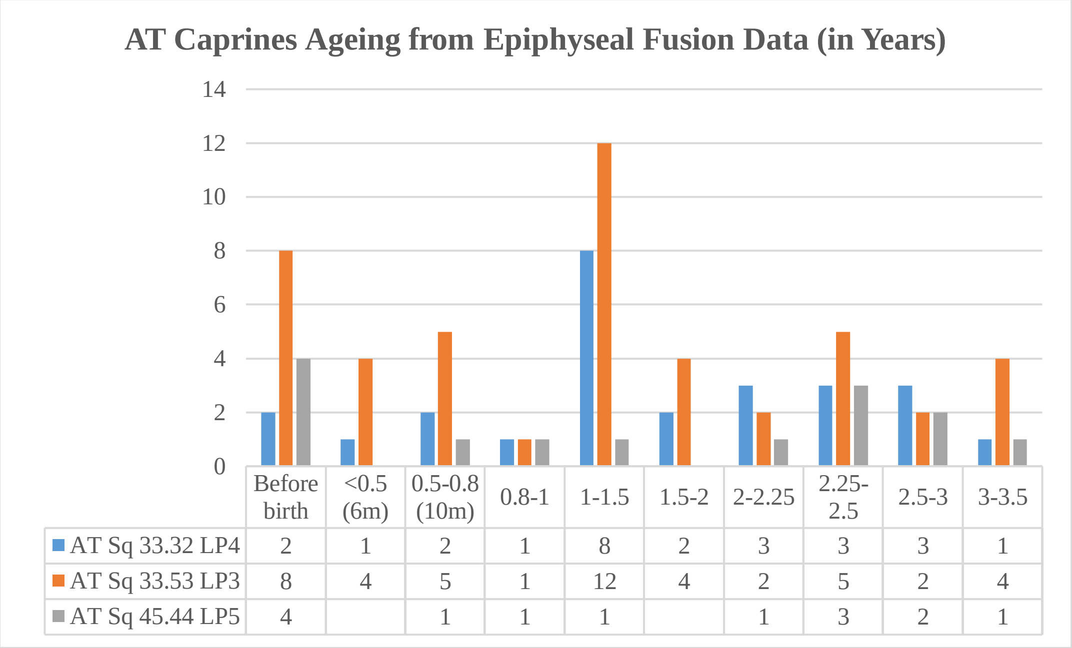


Figure 17 Caprines Ageing from Epiphyseal Fusion Data I



	Before birth	<0.5 (6m)	0.5-0.8 (10m)	0.8-1	1-1.5	1.5-2	2-2.25	2.25-2.5	2.5-3	3-3.5
🟧 TPH Sq 51+52.37 LP2	2	8		2	8	2		2	6	2
⬜ TPH Sq 51+52.37 LP3	4	5	1	2	12	4	1	1	7	1
🟦 TPH Sq 54.38 LP1		1	3	2	1	1	1			
🟩 TPH Sq 54.38 LP2	3	1	5	4		4			1	2

Figure 18 Caprines Ageing from Epiphyseal Fusion Data II TPH



	Before birth	<0.5 (6m)	0.5-0.8 (10m)	0.8-1	1-1.5	1.5-2	2-2.25	2.25-2.5	2.5-3	3-3.5
🟦 AT Sq 33.32 LP4	2	1	2	1	8	2	3	3	3	1
🟧 AT Sq 33.53 LP3	8	4	5	1	12	4	2	5	2	4
⬜ AT Sq 45.44 LP5	4		1	1	1		1	3	2	1

Figure 19 Caprines Ageing from Epiphyseal Fusion Data III AT

There is also a substantial representation of lambs and kids under 1 year of age, at both sites, excluding AT Sq 33.32 LP4.

TPH shows a broader and more evenly distributed dataset when comparing it to AT. This broader representation includes significant contributions from older age intervals, particularly 2.5–3 years, implying the retention of some animals for purposes beyond immediate meat production, such as milk, wool, or reproduction.

AT has a steep and narrow distribution, with the largest contribution concentrated in the 1–1.5 years interval. There is minimal representation in older age intervals (beyond 2 years), suggesting that caprines were primarily utilized for meat production at an earlier stage. The Tell Atchana distribution presents a lot of variations:

- AT Sq 33.32 LP4 exhibits a unique trend, where no very young or old caprines were found in the peaks of the age distribution. This pattern could be associated with a prime-age animal dominated mortality profile. Such a selective approach could reflect a strategy that prioritizes animals with the best combination of meat yield and physical condition. This could point to a more efficient use of livestock, with animals culled at an age when they would provide optimal returns through meat production. The absence of very young or old animals in the peaks might indicate that younger animals were either not raised on-site or were quickly moved elsewhere, while older animals were maintained for breeding purposes. This pattern could also suggest that people, during this phase, had access to supplementary sources of livestock, or a robust trade network, allowing them to focus on the most productive animals for their immediate needs, without relying on younger or older animals in their herd.

Mortality profiles dominated by prime-age meat animals are typically associated with consumer sites, which procure meat from external producing sites. This interpretation is logical, especially for Tell Atchana, a city-state, but it is also plausible for Toprakhisar Höyük, which, while less urban, is not entirely rural, with its administrative role. It could be proposed that animal husbandry was concentrated in even more rural villages in the hinterlands of Toprakhisar Höyük and Tell Atchana, where younger and older animals were retained, while larger settlements primarily received prime-age meat animals.

However, the presence of neonatal and foetal as well as older animals complicates this model. A possible explanation is that these younger and older animals might represent local breeding activities, even at consumer sites. This could suggest that some degree of animal husbandry occurred locally, potentially to support immediate needs, or maintain herds for milk or other secondary products. Alternatively, these remains could reflect mortality patterns from transported pregnant animals or animals that died in transit or shortly after arrival at the consumer sites.

There is also more butchery waste (feet) in the Tell Atchana assemblage than in TPH (phalanges I-II being more common in AT, and the absence of phalanges III in TPH for caprines, see **Appendix B**, **Tables 13-16**). This could suggest that animals were not butchered at the periphery, but rather sent alive to the center, where they were slaughtered.

- The trends at AT Sq 33.53 LP3 and AT Sq 45.44 LP5 are strikingly similar to each other in terms of the sharpness and positioning of the peaks. None of these phases are contemporaneous with each other (see **Table 1** in Provenance). The temporal separation could indicate that the observed similarities in the trends may not be due to simultaneous environmental or economic conditions, but rather reflect recurring or shared practices that persisted across different time periods.

Pigs

The data in **Figures 20-22** shows that most pigs were found either:

- before reaching sexual maturity (with a peak in the <3 months age range). This could be due to natural causes such as abortion, stillbirth, or infant mortality, or human-related factors like the slaughter of the mother while pregnant, culling to manage herd size, or other practices such as discarding unviable or surplus offsprings. Piglets (2-4 weeks) and weaners (until the age of 10 weeks) would provide minimal meat yield and were unlikely slaughtered for that purpose, although piglets might have been considered a special delicacy.
- or shortly after reaching sexual maturity around 6 months (Reiland 1978) (a prominent peak in the 0.5–1 year range), slaughtered for their meat.

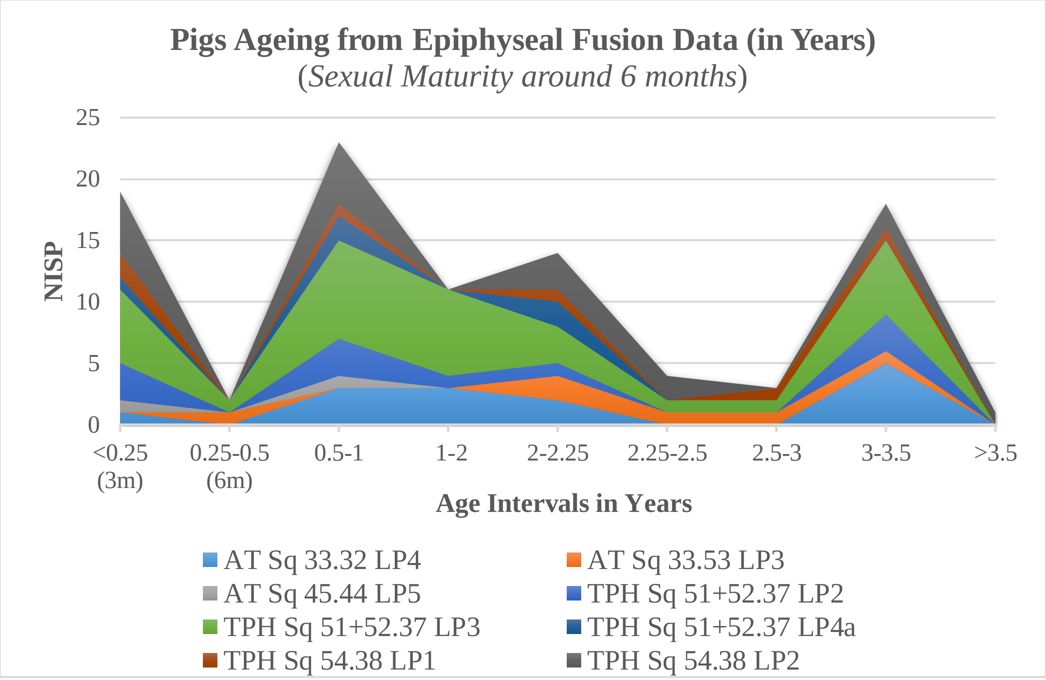
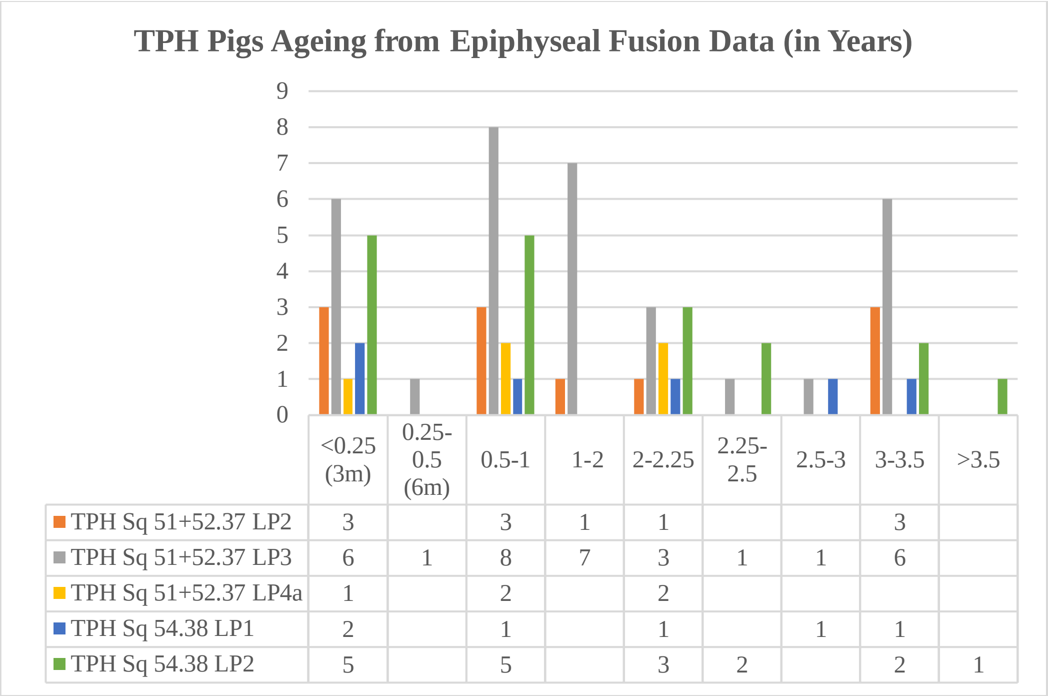
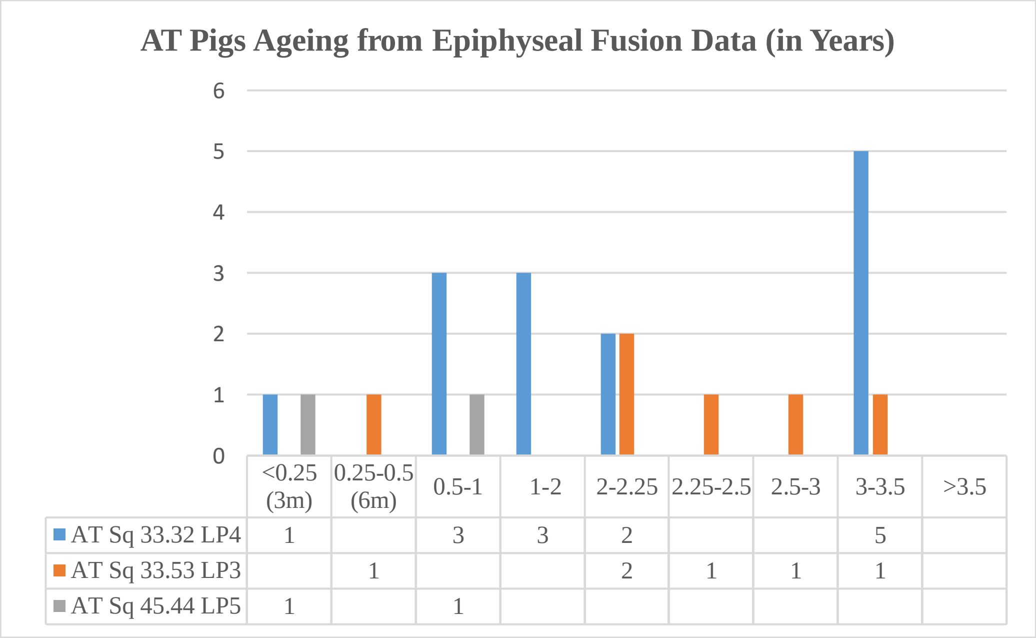


Figure 20 Pigs Ageing from Epiphyseal Fusion Data I



	<0.25 (3m)	0.25-0.5 (6m)	0.5-1	1-2	2-2.25	2.25-2.5	2.5-3	3-3.5	>3.5
■ TPH Sq 51+52.37 LP2	3		3	1	1			3	
■ TPH Sq 51+52.37 LP3	6	1	8	7	3	1	1	6	
■ TPH Sq 51+52.37 LP4a	1		2		2				
■ TPH Sq 54.38 LP1	2		1		1		1	1	
■ TPH Sq 54.38 LP2	5		5		3	2		2	1

Figure 21 Pigs Ageing from Epiphyseal Fusion Data II TPH



	<0.25 (3m)	0.25-0.5 (6m)	0.5-1	1-2	2-2.25	2.25-2.5	2.5-3	3-3.5	>3.5
■ AT Sq 33.32 LP4	1		3	3	2			5	
■ AT Sq 33.53 LP3		1			2	1	1	1	
■ AT Sq 45.44 LP5	1		1						

Figure 22 Pigs Ageing from Epiphyseal Fusion Data III AT

Another peak in the 3–3.5-year range likely represents pigs retained for breeding purposes, as older pigs have limited roles (no secondary uses) beyond reproduction.

At Tell Atchana, there is a more pronounced presence of pigs aged 3–3.5 years (the peak in 3–3.5 years is higher than in 0.5–1 and <0.25 years) compared to Toprakhisar Höyük (where the 0.5–1 year peak was almost always more noticeable no matter the local phase).

This could suggesting differing herd management strategies. The pattern may indicate that Tell Atchana prioritized breeding, possibly reflecting its role as an urban or administrative center, where the focus may have been on maintaining livestock for secondary products or long-term sustainability. In contrast, Toprakhisar Höyük, as a more rural site, might have been oriented towards immediate food production, with pigs raised and consumed at younger ages to meet local subsistence needs.

Another possibility would be to consider that the contrasting roles of the two sites—one potentially producing its own food and the other relying on supplies from the surrounding countryside—could indeed influence the age of animals consumed. At the urban site, older animals might have been more common due to delayed slaughter, while the rural site may have focused on rapid turnover of livestock for sustenance or trade. Other factors, such as local dietary preferences, economic strategies, and the availability of alternative resources, could also contribute to these differences.

Variability across squares and local phases is notable, although, for the most part, the local phases would follow the trends mentioned above for each site. Particularly at Toprakhisar Höyük, TPH Sq 54.38 LP2 displays a high proportion of young pigs, with a progressive decline in numbers of pigs as age increases, suggesting an L-shaped/catastrophic mortality profile typical of intensive meat production.

The pig profiles contrasts to some extent with the caprine profiles. While the latter primarily reflect meat production, with some juvenile animals indicating young mothers that were either pregnant or recently gave birth, the pig profiles, especially at Tell Atchana, include breeding-age (older) pigs. This suggests a different approach to pig husbandry, where breeding pigs were kept, unlike the strategy for caprines at AT Sq 33.32 LP4. Pigs are easier to manage on a household basis, in backyards or confined spaces, and can be fed household waste, whereas sheep and goats require pasturing. Another possibility is that the older pigs were wild pigs, which would align with the practice of hunting larger animals, although the limited number of measurements (**Appendix C**, **Table 35**) makes this theory inconclusive.

Cattle

Figures 23-25 shows cattle ageing data based on epiphyseal fusion. One of the most notable differences between the two sites, Tell Atchana and Toprakhisar Höyük, are the positioning and shape of the peaks for the different age intervals.

The most prominent peak, for both sites, occurs in the 1.5–2 years interval, with smaller peaks in the "before birth" category and in the 3–3.5 years range. Notably, there is very minimal representation of cattle over 5 years.

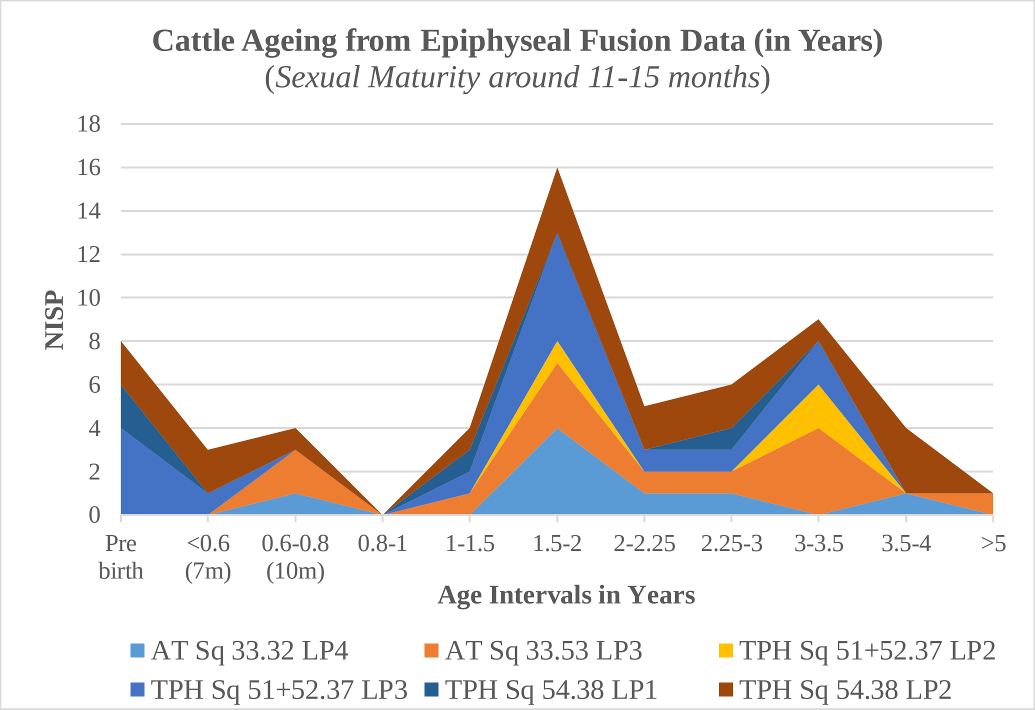
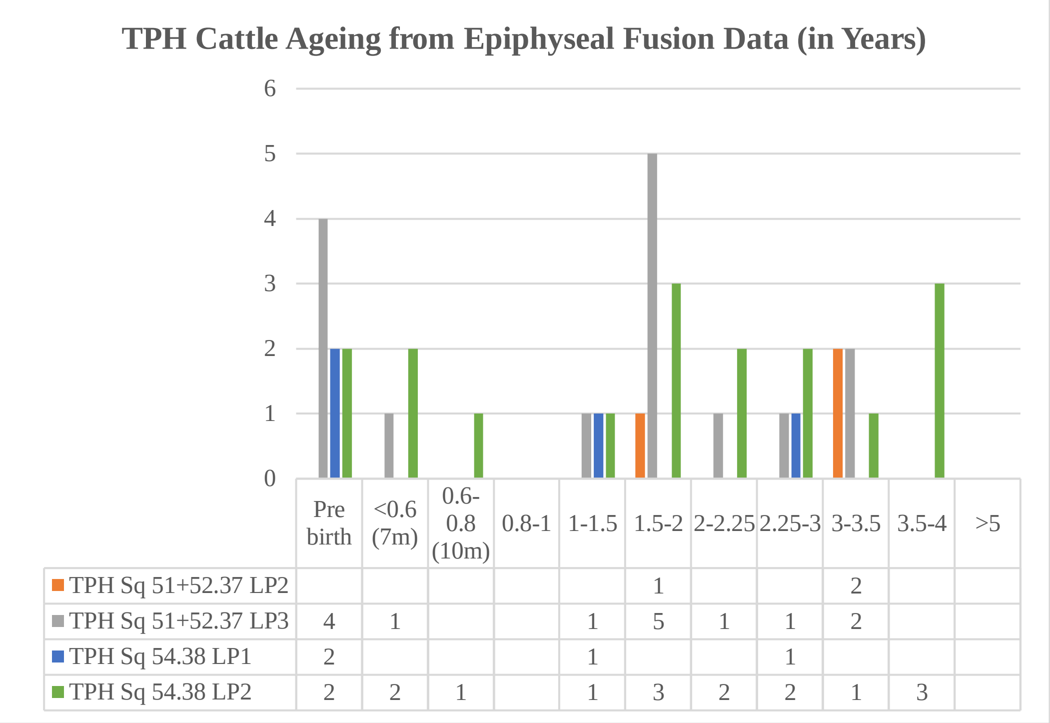


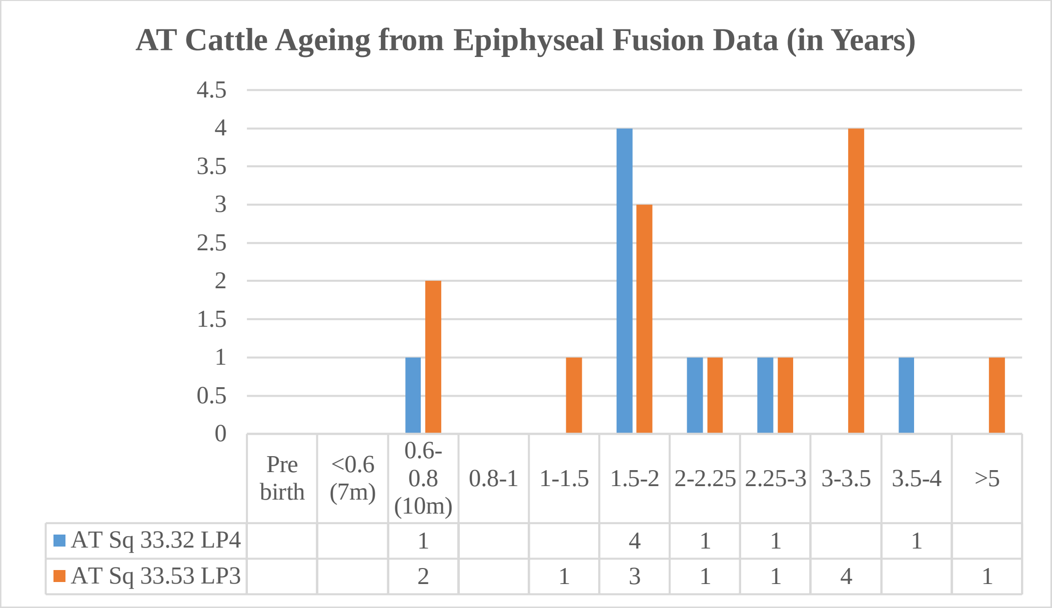
Figure 23 Cattle Ageing from Epiphyseal Fusion Data I

Sexual maturity for cattle (estimated at 11–15 months) (Rawlings *et al*. 2008, Day and Nogueira 2013) aligns closely with the 1–1.5 years interval, which marks the beginning of the sharpest peak. This suggests that a significant proportion of cattle were culled shortly after reaching sexual maturity, possibly for meat production or herd control. The presence of peaks in older age categories may imply additional uses for cattle, such as milk production or draught labor, before eventual culling.



	Pre birth	<0.6 (7m)	0.6-0.8 (10m)	0.8-1	1-1.5	1.5-2	2-2.25	2.25-3	3-3.5	3.5-4	>5
🟧 TPH Sq 51+52.37 LP2						1			2		
◼ TPH Sq 51+52.37 LP3	4	1			1	5	1	1	2		
🟦 TPH Sq 54.38 LP1	2				1			1			
🟩 TPH Sq 54.38 LP2	2	2	1		1	3	2	2	1	3	

Figure 24 Cattle Ageing from Epiphyseal Fusion Data II TPH



	Pre birth	<0.6 (7m)	0.6-0.8 (10m)	0.8-1	1-1.5	1.5-2	2-2.25	2.25-3	3-3.5	3.5-4	>5
AT Sq 33.32 LP4			1			4	1	1		1	
AT Sq 33.53 LP3			2		1	3	1	1	4		1

Figure 25 Cattle Ageing from Epiphyseal Fusion Data III AT

Toprakhisar Höyük generally exhibits a broader and more consistent spread of data across the age intervals, following the aforementioned general tendency. Although, TPH Sq 54.38 LP2 had a more pronounced presence of cattle between 2.25–3 years of age as well as cattle between 4–5 years of age, compared to other TPH contexts.

Two striking observations about Tell Atchana’s trends can be deduced:

- The absence of foetal and neonatal calves (<7 months interval) in both AT squares and phases, as the weaning phase is around 8–10 months. This could possibly imply that the cattle were not raised in Tell Atchana, but brought to the site from a periphery.
- At AT 33.32, there is a decline in cattle 3–3.5 years old, which counters the tendency of cattle of the same age interval at AT 33.53, where it instead comes to a peak, similar to the trend observed in all TPH phases. There is also a less sharp peak in cattle 3.5–4 years old at 33.32, that has not been attested in other contexts. These variations are indicative of temporal differences (AT 33.32 LP4 is MB I and AT 33.53 LP3 is MB II) in economic strategies, or possible environmental pressures forcing earlier cattle culling.

4.1.1.4 Sex

Female-to-male ratios

For caprines, females outnumber in one phase (TPH Sq 54.38 LP2), suggesting that females during this occupation, were typically kept for breeding and secondary products, primarily for milk (**Figure 26**).

Equal distribtion is observed in two phases (AT Sq 33.32 and TPH Sq 51/52.37 LP2), indicating the retention of both males and females for breeding purposes.

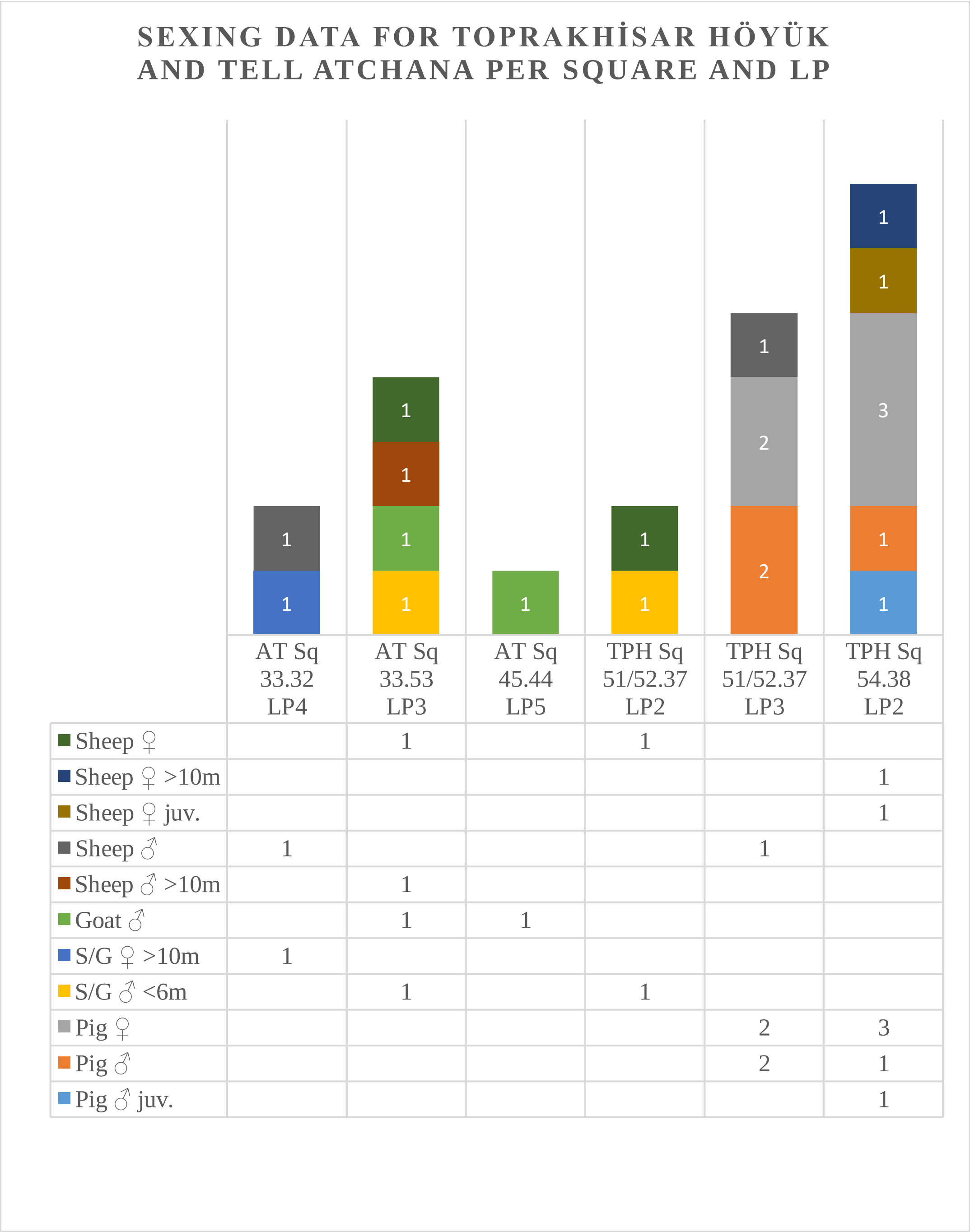
Males outnumber in three phases (AT Sq 33.53, AT Sq 45.44, and TPH Sq 51/52.37 LP3), which suggests that more males were killed, likely to retain females for reproduction.

These interpretations remain speculative due to the small sample size of sexed data, which limits the ability to draw definitive conclusions. Compounding the issue further is to attempt to compare male-to-female ratios across species, such as finding a male goat and a female sheep, which is largely unproductive. This highlights another recurring challenge in Zooarchaeology regarding the often problematic caprines. While sheep and goats can interbreed, their offsprings are typically stillborn due to incompatible chromosome numbers (Long 1990).

For pigs, there is a more balanced sex ratio, with a near-equal distribution of males and females in TPH Sq 51/52.37 LP3 and TPH Sq 54.38 LP2. This balance reflects a strategy to raise pigs primarily for consumption, where both sexes were slaughtered.

Sex- and age-specific culling

Female caprines were generally kept after reaching sexual maturity, likely for breeding or secondary products, except for one juvenile female sheep in TPH Sq 54.38 LP2. Male caprines, on the other hand, were typically slaughtered at a young age, likely for meat production, except for one male sheep older than 10 months in AT Sq 33.53.



	AT Sq 33.32 LP4	AT Sq 33.53 LP3	AT Sq 45.44 LP5	TPH Sq 51/52.37 LP2	TPH Sq 51/52.37 LP3	TPH Sq 54.38 LP2
■ Sheep ♀		1		1		
■ Sheep ♀ >10m						1
■ Sheep ♀ juv.						1
■ Sheep ♂	1				1	
■ Sheep ♂ >10m		1				
■ Goat ♂		1	1			
■ S/G ♀ >10m	1					
■ S/G ♂ <6m		1		1		
■ Pig ♀					2	3
■ Pig ♂					2	1
■ Pig ♂ juv.						1

Figure 26 Sexing Data for TPH and AT per Square and LP

4.1.1.5 Thermal Damage

Most roasted and carbonized bones were found in TPH Sq 51/52.37 LP3 (N=241 roasted bones, 62% of the thermally altered bones in this phase and N=55 carbonized bones, 14%), likely confirming the fire destruction event in Phase 3a (Bulu 2021), although there were no calcined bones (**Figures 27-28**).

In AT Sq 33.32 LP4, the predominance of scorched bones (N=255, 81%) aligns with cooking activities indicated by the presence of burnt rooms and features (*tandır* installation), yet again not reaching the calcination damage.

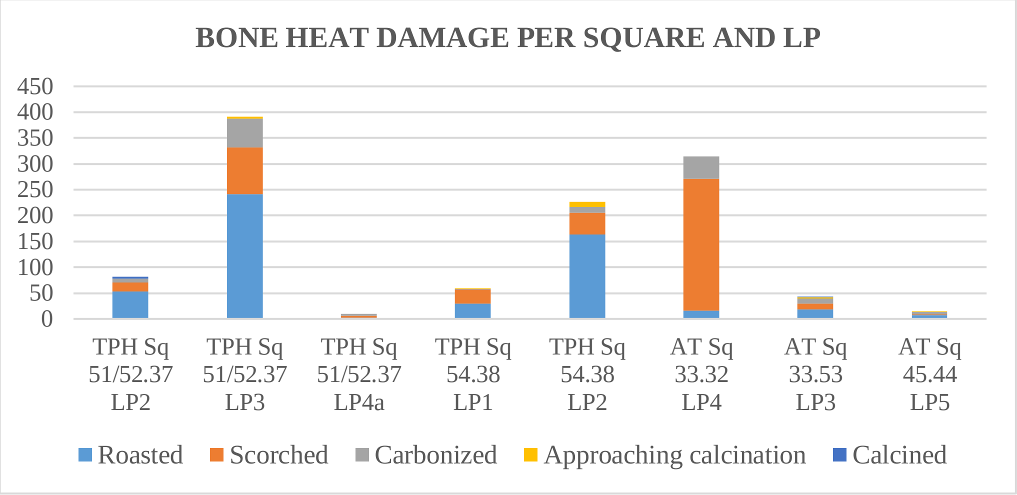


Figure 27 Heat Damage on Bones per Square and LP I

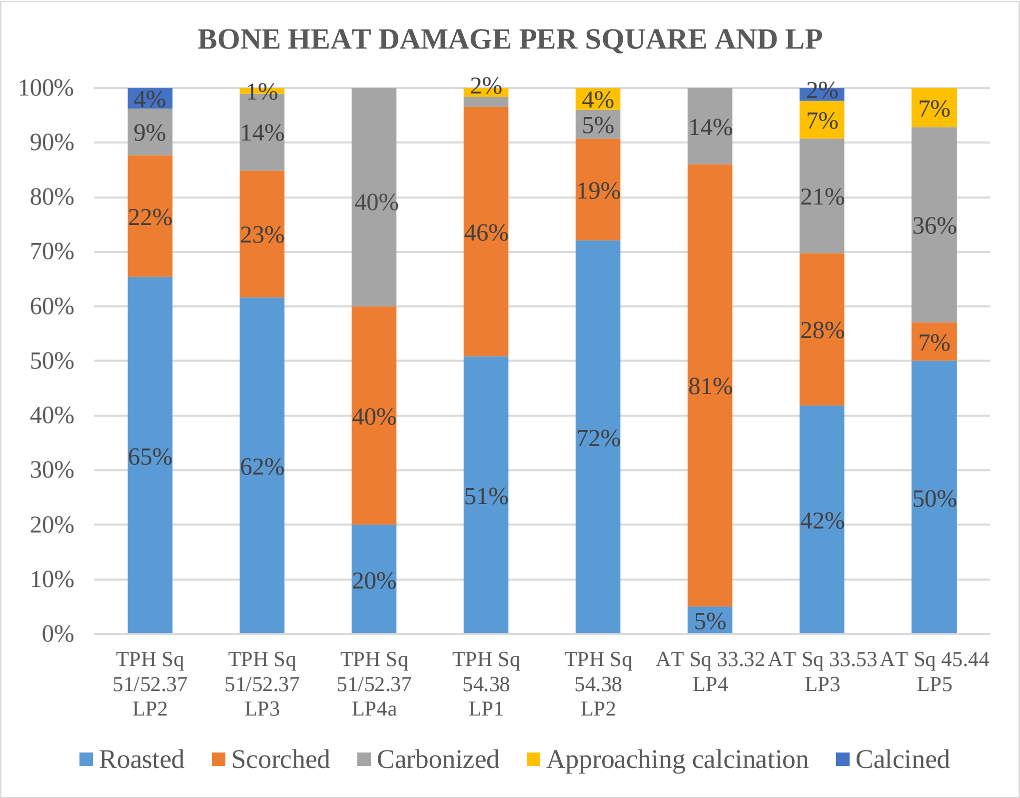


Figure 28 Heat Damage on Bones per Square and LP II

The heated bones in the silo contexts (N=81 at TPH Sq 51/52.37 LP2 and N=226 at TPH Sq 54.38 LP2) may suggest accidental burning near storage areas or secondary use, as silos may have been repurposed as dumping grounds for food waste or as areas for small-scale cooking or heating activities. No other explanations were considered plausible enough, but it is worth investigating further.

4.1.2 Results per Taxon

All skeletal representation data are compiled in **Appendix B**, while all measurement data can be found in **Appendix C**.

4.1.2.1 Caprines

At Toprakhisar Höyük, 560 caprine specimens (NISP) were identified, with 13% displaying cut and chop marks and 39% of marrow-bearing elements showing evidence of marrow processing. In contrast, Tell Atchana yielded 540 identified specimens, with only 10% exhibiting butchery marks and 25% of marrow-bearing elements processed.

Body Size Estimation

Measurements from the distal tibia (**Figure 29**) and lower M3 molars (**Figure 30**) allowed for observing any differences in body size in caprines.

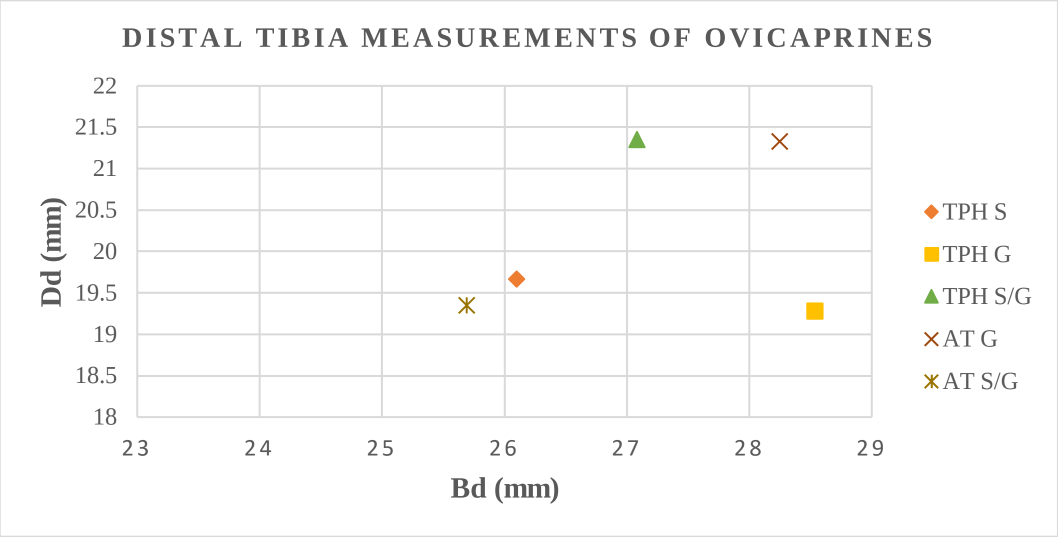


Figure 29 Distal Tibia Measurements of Caprines

Tell Atchana caprines seem to be, on average, larger than those from Toprakhisar Höyük, although there exists variability, in the form of outliers, within and between sites, indicating potential differences in species or sex profiles (Caprines were assumed to be domestic here, so size differences between wild and domestic forms were not sought after). This variability complicates the identification of a clear or consistent pattern that could imply specific husbandry practices.

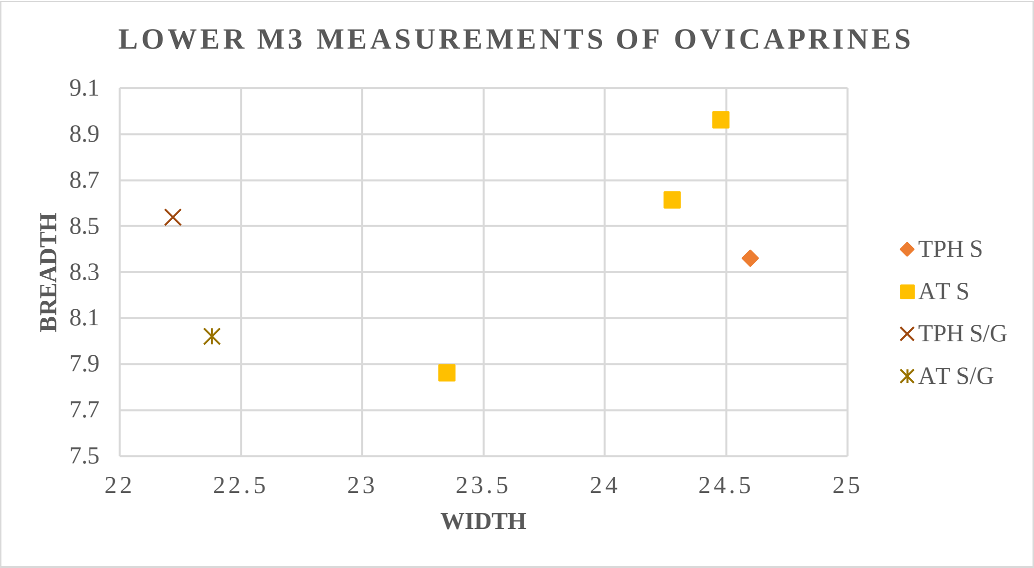


Figure 30 Lower M3 Measurements of Caprines

4.1.2.2 Cattle

At Toprakhisar Höyük, 231 cattle specimens (NISP) were identified, with 29% showing cut and chop marks and 55% of marrow-bearing elements processed for marrow extraction. In contrast, Tell Atchana yielded 130 cattle specimens, with only 9% displaying cut and chop marks and just 3% of marrow-bearing elements showing evidence of marrow processing. Cattle were thus more heavily processed for both meat and marrow at Toprakhisar Höyük compared to Tell Atchana, where butchery and marrow exploitation were less pronounced.

Body Size Estimation

The limited number of measurements available precluded an intra-site comparison of body size estimations for taxa other than caprines. Phalanges were deemed unreliable for size estimation due to the inherent size differences between forelimb and hindlimb phalanges in ungulates (Ocal *et al.* 2004).

4.1.2.3 Pigs

At Toprakhisar Höyük, 507 pig specimens (NISP) were identified, with 17% showing cut and chop marks and 33% of marrow-bearing elements processed for marrow extraction. In comparison, Tell Atchana had 69 identified pig specimens, a striking 23% of which exhibited cut and chop marks, while 21% of marrow-bearing elements showed evidence of marrow processing. Despite the smaller sample size at Tell Atchana, the higher percentage of cut and chop marks suggests a different butchery approach, possibly reflecting a distinct subsistence strategy or utilization of pigs at the two sites.

4.1.2.4 Equids

Equids were found exclusively at Toprakhisar Höyük, where 31 identified specimens (NISP) were recorded. Of these, 19% exhibited cut and chop marks, and 33% of marrow-bearing elements showed evidence of marrow processing. The relatively high frequency of butchery marks and marrow extraction, given the limited sample size, suggests that equids were actively processed for both meat and marrow, possibly indicating their importance in the subsistence strategy at this site. The absence of equids at Tell Atchana may reflect differences in animal husbandry preferences/priorities or resource availability between the two locations, with Toprakhisar Höyük perhaps having greater access to or reliance on equids.

4.1.2.5 Cervids

At Toprakhisar Höyük, 36 deer specimens (NISP) were identified, with 31% displaying cut and chop marks and 67% of marrow-bearing elements showing evidence of marrow processing. In contrast, Tell Atchana yielded only one deer specimen, which showed cut and chop marks but no signs of marrow processing. The significant difference in both the number of deer identified and the extent of marrow processing suggests that deer were more actively utilized at Toprakhisar Höyük, possibly as a regular part of the subsistence strategy, although to a much lesser extent than the top three domesticates (caprines, pigs, cattle).

The minimal presence of deer at Tell Atchana may indicate a lower reliance on or less frequent hunting of deer at that site, similar to the absence of equids. This could reflect regional differences in hunting practices, availability of resources, or ecological conditions between the two sites.

4.1.2.6 Mustelids

Mustelids were found exclusively at Tell Atchana, with 15 identified specimens (NISP), none of which exhibited cut or chop marks. These are likely wild (weasels), as domestication of ferrets during this period is unlikely. Weasels are carnivorous and primarily prey on small mammals, such as mice, voles, and occasionally small rabbits. The absence of butchery marks and the completeness of all the remains suggest these animals were not exploited for meat. Given their diet, it is possible that these weasels were either involved in controlling rodent populations around storage areas at Tell Atchana, where they could have helped reduce the threat posed by mice and other pests, or were themselves scavenging on meat stored there, or both.

4.1.2.7 Canids

At Toprakhisar Höyük, 18 canid specimens (NISP) were identified, with an impressive 67% showing cut and chop marks. These canids also displayed a high frequency of osteoarthritis in the vertebrae and radio-ulna that could be related to old age or intensive labour (**Figure 31**). In contrast, at Tell Atchana, only 11 canid specimens were identified, none of which exhibited any butchery marks.

This stark difference indicates that at Toprakhisar Höyük, canids were consumed for their meat, as the locations of the cut marks were unlikely indicative of skinning. In contrast, the lack of butchery marks on canids at Tell Atchana could suggest that they were either less involved in subsistence practices or served a different role, such as companionship or guarding, without being exploited for food.

Evidence of *cynophagy* (consumption of dog meat) exists at several Near Eastern and Eurasian Bronze Age sites (Price *et al.* 2020, Curci 2020), where it may be linked to belief systems or specific rituals, such as rites of passage (Anthony and Brown 2017). Nevertheless, it is premature to draw definitive conclusions about the role of canids in this particular site. This highlights, yet again, the need for caution in avoiding the imposition of modern standards and expectations of subsistence on ancient societies, as their practices and cultural meanings may have been vastly different from contemporary interpretations.

4.1.2.8 Hares

Hares were the only taxa at Toprakhisar Höyük that did not exhibit any cut or chop marks, with only two specimens (NISP) identified. Similarly, at Tell Atchana, four identified hare specimens (NISP) were found, none of which showed any butchery marks. The lack of butchery marks on hares at both sites could suggest they were less commonly hunted. Their underrepresentation within the respective faunal assemblages (of not only Toprakhisar Höyük and Tell Atchana, but also other MBA Syro-Anatolian sites, see **Appendix A**, **Table 12**) could be linked to preferential preservation due to taphonomic agents, or it could indicate that hares were generally not sought after for consumption.

Figure 31 Dog/Wolf Ulna and Radius with Arthritis and Cut Marks

4.1.2.9 Cat

Cats were found only at Toprakhisar Höyük, where a single complete right ulna was identified, exhibiting cut marks. The fully fused ulna epiphyses in the cat indicate it was at least 11.5 months old (Smith 1969). The BPC (8.51) and DPA (10) measurements taken in mm (**Appendix C**, **Table 42**) were more within the range of domestic (BPC average: 8.74, DPA average: 11.08) than wild cat (BPC average: 11.16, DPA average: 13.16) (O'Connor 2007). Among all the sites summarized in **Appendix A**, only Tell Tuqan had cat (*felis catus*) remains.

The two thin long oblique cuts on the proximal ulna are more likely to be butchery or disarticulation marks rather than related to skinning activities for fur removal. A similar butchery pattern was observed in the East Mediterranean Iron Age site of Elbistan Karahöyük (Silibolatlaz Baykara 2022:Figure 12e).

4.1.2.10 Gazelle

Gazelles were found only at Toprakhisar Höyük, represented by three identified specimens (NISP). Of these, only one exhibited chop marks. The limited number of gazelle specimens at Toprakhisar Höyük contrasts with other faunal remains, which may indicate that gazelles were either less frequently hunted or not as commonly processed for food compared to other species. Nevertheless, this number is still consistent with the number of gazelle remains found in most other MBA Syro-Anatolian sites, excluding Umm el-Marra and Tell Tuqan (**Appendix A**, **Table 12**).

4.1.2.11 Rodents

Four rodent vertebrae were recovered from flotation bags from Square 45.44 LP5 at Tell Atchana.

4.1.2.12 Non-mammals

Non-mammals comprised 19% of the faunal assemblage of Toprakhisar Höyük and 11% of Tell Atchana. These non-mammalian remains primarily consisted of mollusks, fish, turtles, and birds, with freshwater mussels (*Unio* sp.) being common in both assemblages.

The bird remains at Toprakhisar Höyük consisted of 22 specimens, of which only 6 were identified to a family, genus, or species level (**Table 10**). The avifaunal remains distributed across somewhat diverse taxa and elements. Key identifications include corvids (Eurasian Magpie, *Pica pica*) and waterfowl such as ducks and geese. There is also evidence of coots (*Fulica* sp.) from the *Rallidae* family, indicating, along with the waterfowls, a connection to wetland habitats. The presence of 14 unidentified fragments among the 22 total specimens highlights the challenges in achieving taxonomic resolution for avian remains that are too fragmented due to the lack of diagnostic parts.

Table 10 Skeletal Representation of Toprakhisar Höyük Birds

Taxon/Size class		Element	Side	NSP
Corvid	Eurasian Magpie (*Pica Pica*)	TAR-MT	L	1
Anatidae spp.	Duck	TB-TAR	R	1
Anatidae spp.	Goose	COR	R	1
Anseriform	Duck/Goose	H	L	1
Rallidae spp.	Coot (*Fulica* sp.)?	SC	R	1
Rallidae spp.	Coot (*Fulica* sp.)?	UL	R	1
Unidentified		TB-TAR		1
Goose size		Long bone		1
Unidentified				14
Total				22

The bird remains at Tell Atchana (**Table 11**) consisted of 94 specimens, showcasing greater taxonomic diversity (7 ‘distinct’ taxa in AT) compared to Toprakhisar Höyük (4 ‘distinct’ taxa in TPH). Identified taxa include pigeons (*Columba* sp. and *Columba palumbus*), ducks (e.g., Mallard duck: *Anas platyrhynchos*), geese, partridges (*Alectoris chukar*), curlews (*Numenius* sp.), vultures, and ostriches. The predominance of ducks and geese aligns with subsistence strategies involving wetland resources. However, the presence of species like curlews and vultures indicates a broader exploitation of avian resources, though it remains unclear whether they were deliberately captured, or even consumed at all.

Table 11 Skeletal Representation of Tell Atchana Birds

Taxon/Size class		Element	Side	NSP
Columbid	Pigeon (*Columba* sp.)	COR	L	1
Columbid	Pigeon (*Columba* sp.)	CAR-MC	L	1
Columbid	Wood Pigeon (*Columba palumbus*)	HM	L	1
Anatid	Mallard Duck (*Anas platyrhynchos*)?	F	R	1
Anatid	Mallard Duck (*Anas platyrhynchos*)?	F	R	1
Anatid	Mallard Duck (*Anas platyrhynchos*)?	F	L	1
Anatidae spp.	Duck	COR	R	2
Anatidae spp.	Duck	COR	L	1
Anatidae spp.	Duck	COR	R	1
Anatidae spp.	Duck	SC	R	1
Anatidae spp.	Duck	HM	L	2
Anatidae spp.	Duck	UL	L	1
Anatidae spp.	Duck	TB-TAR	R	2
Anatidae spp.	Duck	TB-TAR	L	1
Anatidae spp.	Goose	TB-TAR	L	1
Anseriform	Duck/Goose	COR	R	1
Phasianid	Partridge (likely *Alectoris chukar*)	UL	R	1
Scolopacid	Curlew (*Numenius* sp.)?	CAR-MC	R	1
Accipitrid	Vulture	TAR-MT	L	1
Unidentified		COR	R	1
Unidentified		SC		1
Unidentified		SC		2
Unidentified		UL		1
Unidentified		TB-TAR		4
Ostrich (likely *Struthio camelus syriacus*)		Egg shells		3
Unidentified				60
Total				94

Three undecorated ostrich eggshell fragments, measuring 2.1–2.2 mm in thickness, were recovered (**Figure 32**). The fragments were attributed to the extinct *Struthio camelus syriacus* (Arabian/Syrian/Middle Eastern ostrich) based on the site's geographical location, though they could possibly have originated from an African subspecies and been introduced via trade.

This is not the only occurence of a possible extinct species in the Syro-Anatolian region (e.g., the *Syrian Elephants*; namely in the Ghab and Amuq Valleys during the MBA and LBA) (Pfälzner 2016, Çakırlar and Ikram 2016).

Figure 32 Ostrich Egg Shells from AT

The discovery of ostrich eggshell fragments at Tell Atchana is particularly significant. These findings may provide a glimpse into the biodiversity and human-animal interactions of the period, or else the potential trade networks that may have facilitated the movement of exotic species, in case the bird was not native.

4.2 Subsistence Practices at Times of Change

4.2.1 The Situation Just Before TPH's MB I-MB II Hiatus

The period before the Middle Bronze Age I-II stratigraphic hiatus at Toprakhisar Höyük represents a complex interplay of subsistence practices, adaptive strategies, and regional dynamics that influenced settlement continuity. The zooarchaeological record from Toprakhisar Höyük and comparative data from Tell Atchana Square 33.32 LP4 might offer valuable insights into how communities navigated environmental, social, and economic factors before the hiatus.

At both Toprakhisar Höyük and Tell Atchana (33.32), the predominance of caprines, particularly goats, suggests a reliance on resilient and adaptable species suited for herding.

The high frenquencies of pigs at both TPH and AT (Sq 33.32 had the highest representation of pig remains among the AT squares) might be indicative of a strategic diversification of subsistence practices due to the inherent flexibility in their management. However, this could also signal acute resource stress, because pigs are omnivorous and can be raised on household waste, making them a practical fallback during periods of food scarcity or environmental unpredictability. In times of stress, their rapid reproduction and low space requirements would make them a reliable meat source when other livestock or wild game became less available.

The focus on cattle, to a lesser extent, at both TPH and AT (33.32), likely for secondary products such as milk and labor, further demonstrates a multipurpose approach to livestock management, emphasizing sustainable resource use over immediate meat yields.

On the other hand, evidence of intensive butchery practices at Toprakhisar Höyük, including marrow extraction and pot-sized bone fragmentation, reflects resource efficiency that could indicate scarcity-driven behavior, though this is not certain, since it could also mean different culinary preferences. These techniques often align with a community adept at maximizing caloric returns from available resources.

Age profiles of livestock at Toprakhisar Höyük and Tell Atchana reveal deliberate herd management strategies. Caprines in TPH were maintained to balance meat production with wool and milk yields, while in AT (33.32), there was a focus on prime-age meat animals. The mortality patterns of pigs suggest periodic intensification of meat supply in TPH, while in AT (33.32), older, breeding-age pigs/boars were found, with the possibility that they were not raised on-site.

The Middle Bronze Age I-II abandonment of Toprakhisar Höyük invites nuanced interpretation. It may have resulted from a number of interconnected factors such as environmental shifts, regional political realignments, or changing trade dynamics. The evidence from faunal remains does not necessarily suggest subsistence collapse, rather an economising and flexible strategy. It is though possible that these practices signal a subsistence system at the edge of possible failure or on a fragile balance which in turn may have contributed to the abdonment of the site. Nevertheless, the evidence could be interpreted in various ways, with some viewing it as a sign of stress, while others see it as reflecting cultural choices.

4.2.2 The Situation Just Before/During AT's Destruction by the Hittites

The subsistence practices at Tell Atchana during the later Middle Bronze Age, specifically in the phases corresponding to AT Sq 33.53 LP3 and AT Sq 45.44 LP5 are discussed to determine whether they can be inferred as indicators of change.

The substantial difference in the number of faunal remains retrieved from AT Sq 33.53 LP3 (574 remains) and the later AT Sq 45.44 LP5 (139 remains) is striking and suggests a variety of potential explanations. While one might consider stress-related factors, it is crucial to first examine the differences in the contextual settings of the two phases, as these may have had a significant impact on the quantity and nature of the faunal assemblages.

AT Sq 33.53 LP3 is associated with a monumental building situated beneath the Level VII Palace, a context that may have been more centrally located within the site, perhaps representing a domestic or administrative space. This could have naturally resulted in a higher volume of animal remains due to the more extensive and varied activities, such as feasting, food preparation, and the processing of animal products. In contrast, AT Sq 45.44 LP5 corresponds to a location with defensive architecture, possibly part of the city's fortifications. The context here suggests a more restricted or specialized activity, which might explain the lower number of faunal remains.

In terms of the animal taxa, the assemblage at AT Sq 33.53 LP3 show a predominance of caprines. This dominance is characteristic of a pastoral economy, where livestock management is central to the subsistence strategy. The high representation of birds, particularly during this phase, suggests that bird hunting played an important role in the dietary habits of the Tell Atchana group. The low representation of pigs and the higher reliance on cattle, however, points to a complex approach to animal husbandry, with the potential for cattle to be utilized for a variety of products, including meat, milk, and possibly secondary products such as leather or hides. The absence of foetal or neonatal calves suggests that cattle were likely not raised at the site but brought in from external sources, possibly from peripheral or rural areas.

At the later AT Sq 45.44 LP5, a shift in the relative proportions of taxa is evident. Caprines remain dominant, though goats have become slightly more prevalent than sheep, which may point to different management strategies or environmental conditions favoring goat husbandry over time. The increased representation of pigs and the significant rise in the proportion of mollusks (though it remains unclear whether these were consumed) and fish in this phase could be indicative of a diversification of subsistence strategies, perhaps in response to economic pressures or dietary preferences. The apparent increase in reliance on aquatic resources during this phase is notable and may suggest a greater integration of marine or riverine resources into the diet. The marked decrease in the representation of cattle could imply changes in local herd management practices, perhaps due to resource constraints or shifts in the regional trade network, possibly following the abandonment of Toprakhisar Höyük.

When examining these phases in relation to Tell Atchana's destruction by the Hittites, one might speculate that the observed shifts in subsistence practices are reflective of regional socio-economic changes or stresses. The marked focus on younger caprines and the lower reliance on older cattle could reflect a push toward more intensive, short-term meat production, possibly in anticipation of resource scarcity or in response to external pressures, such as military threat or upheaval.

The potential diversification of resources in AT Sq 45.44 LP5 might suggest an adaptive response to these pressures, with a greater reliance on more easily accessible or quickly consumable resources like pigs, mollusks, and fish. Such patterns could indicate a shift toward subsistence practices that favored immediacy and resilience.

However, these shifts alone cannot be definitively interpreted as indicators of the impending destruction. It is more likely that the patterns observed are reflective of the nature of both contexts compared, rather than being directly linked to the Hittite destruction.

Due to the very low number of identified specimens, particularly in AT Sq 45.44 LP5, comparisons and conclusions regarding differences remain weak. Therefore, the interpretations are tentative and cannot be confirmed without additional data.

CHAPTER 5

CONCLUSION

5.1 Summary of Findings

This thesis offered an in-depth exploration of animal-based subsistence strategies at Toprakhisar Höyük and Tell Atchana during the Middle Bronze Age. By analyzing the faunal remains from these sites, a comprehensive understanding emerged regarding the roles animals played in supporting local economies, dietary preferences, and broader socio-economic systems in the Syro-Anatolian region. The study highlighted variations in the exploitation of domestic and wild fauna, carcass processing practices, and demographic patterns. Particularly, through investigating the age profiles of the animals and the balance between slaughtering young animals and maintaining older, productive individuals, the nuances in calculated decision-making between the two sites were inferred.

The faunal evidence reveals that domesticated species, particularly caprines, formed the backbone of subsistence economies at both sites. In fact, of all the Syro-Anatolian sites discussed in this thesis, caprines were central to the subsistence economies at all of them, with relative frequencies ranging from 34% at Hirbemerdon Tepe (Upper Tigris Basin) to 78% at Tell Afis (Northern Levant) out of the common mammals (**Appendix A**). Toprakhisar Höyük (40%) and Tell Atchana (72%) fall within the range of these values. Caprine presence does not exhibit a clear geographic pattern, as their percentages vary significantly within each region. While they consistently dominate the faunal assemblages, their proportions appear to be mainly influenced by whether they were the primary focus of subsistence or part of a more diverse range of animals.

These animals provided not only meat but also secondary products such as milk and wool, which were critical for sustaining everyday life. At Toprakhisar Höyük, caprines show a mortality profile of a broader age range, including older animals, suggesting secondary product use alongside meat production. Tell Atchana, based on the presence of prime-age animals, is inferred to be a consumer site, with evidence that animals were sent alive and butchered on-site.

Pigs were notably abundant at Toprakhisar Höyük, an unusual pattern in the Syro-Anatolian region, especially when compared to other North Syrian sites (percentages range from 2% to 11% out of common mammals), unlike pigs at Tell Atchana (9%). To situate this within the Syro-Anatolian region (**Appendix A**), Toprakhisar Höyük aligns with sites in the Upper Tigris (28%) and Upper Euphrates (13–19%) valleys in terms of pig representation. In contrast, pigs at all other Syro-Anatolian sites, including Tell Atchana, remained below 11%. Their high representation at TPH may indicate favorable local environmental conditions, such as wetter or forested landscapes, or cultural practices that emphasized pig husbandry. The site could have also served as a center for pig farming. The pigs at Toprakhisar Höyük were typically slaughtered before or shortly after reaching sexual maturity, while older pigs at Tell Atchana might suggest that the latter was relying on supplies from a periphery.

It is worth noting that Tell Atchana's Sq 33.32 LP4, which is chronologically closest to Toprakhisar Höyük and more likely contemporary for at least a short time (see **Table 1**), appears to have more similarities with Toprakhisar Höyük regarding the higher consumption of pig. This might indicate the ties between the two settlements. Pig consumption at Tell Atchana overall declined significantly after this phase.

Cattle, though less prominent than caprines, were the second most consumed animal at Tell Atchana (17%, **Appendix A**) and the third most consumed animal at Toprakhisar Höyük (17%). A distinct regional pattern indicates a preference for cattle husbandry in certain areas. The values from Toprakhisar Höyük and Tell Atchana are more similar to those from Northern Syrian sites, such as Tell Afis (15%) and Tell Tuqan (13%), where cattle played a significant role, though not as prominently as in Southeastern Anatolia (where cattle frequencies range from 23% to 25%), the Upper Euphrates Valley (26–27%), or Eastern Anatolia (39%). The reasons behind the higher reliance on cattle in these latter regions, rather than for instance pigs, remain unclear. Cattle require considerable efforts, such as the provision of large amounts of water, whereas pigs can be sustained on waste. This, however, is considered from an economic standpoint and does not attempt to model the decision-making processes or ideologies of past communities. Cattle were more frequently processed for marrow and meat at Toprakhisar Höyük, while at Tell Atchana, they were likely imported as fully grown animals, aligning with its urban, consumer-focused role.

Other domestic taxa were consumed at Toprakhisar Höyük, with evidence of *cynophagy* (the consumption of dog meat), *hippophagy* (the consumption of horse meat, which also includes donkey meat here), and *ailurophagy* (the consumption of cat meat).

Wild taxa, such as deer and gazelles, were scarce in both TPH and AT assemblages but more common at Toprakhisar Höyük. Rather than exhibiting a clear regional distribution, deer appear to have been exploited more intensively at specific sites, such as Tilmen Höyük (12%, **Appendix A**) and Hirbemerdon Tepe (15%). At other sites, their representation generally falls within a range of 1–5%, with Toprakhisar Höyük yielding 3% cervids among its common mammal remains. Similarly, gazelle remains were only identified at certain sites, while others—such as Tatarlı Höyük, Tell Atchana, Tell Tweini, Hirbemerdon Tepe, and Korucutepe—lacked any evidence of their presence. Consequently, no clear geographical pattern can be established, particularly given the disparity in their representation: at Toprakhisar Höyük, gazelles account for less than 1% of the common mammals, yet at Umm el-Marra, also within the North Levantine region, they constitute 5%.

The presence of hunted taxa at Toprakhisar Höyük, alongside equids, points to a broader resource base and the potential integration of opportunistic hunting into daily life. Tell Atchana’s faunal record, by contrast, lacked equids (similarly to Southeastern Anatolia’s Tatarlı Höyük) and had fewer wild taxa, possibly reflecting its narrower focus on managed, domesticated animals, where caprines were heavily emphasized, aligning with the site's role as an urban center.

Equids present another intriguing challenge to identifying consistent patterns. While they are the second most represented taxa at the Northern Levantine sites of Tell Tuqan (29% of common mammals, **Appendix A**) and Umm el-Marra (31%), these figures stand in stark contrast to the rest, where equids typically account for only 1–6%.

Overall, and as far as our current knowledge extends, the Middle Bronze Age exhibits such high variability that no single subsistence trend appears to have been regionally followed. It is precisely this high variability that makes investigating dynamics between different sites particularly intriguing—exploring their levels of self-sufficiency or independence, the centralization or decentralization of their social structures, and the nature of their interactions with one another.

At Toprakhisar Höyük, the faunal assemblages suggest a more mixed approach to subsistence, incorporating a more diverse range of species. This diversity could point to an adaptive strategy aimed at minimizing risk and maximizing resource availability, possibly reflecting the site's semi-peripheral status within the regional hierarchy, although some might correlate diversity in subsistence behavior with site abandonment (Kirch 1980:137).

The absence of later MBA material at Toprakhisar Höyük suggests a potential decline in its role as a "*production hub?*", possibly influenced by shifting trade routes, environmental pressures, or political realignments in the region. While it is premature to definitively attribute the cessation of occupation at Toprakhisar Höyük to a collapse, it remains a significant gap in the archaeological record that requires further investigation. The lack of continuity into the later MBA complicates our understanding of the site's trajectory, and it is unclear whether this hiatus can be directly tied to broader patterns of societal collapse or simply reflects a change in settlement focus or mobility. Schwartz (2006:6), in his examination of collapse and regeneration, notes that, as Yoffee and Cowgill (1988) conclude, "*collapse rarely* *involves the complete disappearance of a group of people or of a 'great tradition'* ". This calls into question whether even the term 'abandonment' fully encapsulates the nature of this hiatus, as it is possible that the site was not entirely deserted but instead experienced a shift in population, with inhabitants moving to nearby mounds that shared similar characteristics with Toprakhisar Höyük.

Two critical reasons make the lack of a comprehensive analysis of this phenomenon particularly unfortunate. First, the scholarly attention given to peripheral sites has been limited in comparison to the focus placed on central sites in regional studies (Akar and Kara 2019, Akar and Kara 2022:2). This bias in research priorities has resulted in a neglect of the dynamics at play in semi-peripheral areas, which often hold key insights into the broader functioning and collapse of regional systems. The failure to examine such sites in detail leaves a significant gap in our understanding of how peripheral areas contributed to the larger socio-political and economic systems.

Second, the abandonment of sites such as Toprakhisar Höyük just after the first half of the MBA has not been addressed at all, nor has there been any discussion of the potential reasons behind such an event, unlike the other 'collapse' phenomena at the beginning and end of the MBA. This raises important questions about why Toprakhisar Höyük was abandoned at that particular time. What environmental, economic, or political factors might have influenced this shift?

This study represents one of the few comparative works of Tell Atchana and Toprakhisar Höyük addressing inter-site interactions within the Middle Bronze Age Syro-Anatolian region. While the findings in this thesis may not establish a direct connection between the two sites, they provide valuable insights into how each fulfilled its center or periphery role through subsistence strategies.

To expand on inter-site interactions, and while no definitive evidence of the movement of non-native or "exotic" species between the two sites has been identified—likely due to their geographical proximity and shared faunal diversity—the presence of ostrich remains at Tell Atchana (although likely from the Syrian ostrich) introduces intriguing possibilities. These remains may indicate specialized or symbolic roles for certain species, potentially linked to trade, elite or ceremonial consumption, or ritual practices. Therefore, these particular findings warrant further investigation to determine whether they reflect localized exploitation, the introduction of non-native species, or connections to broader trade networks.

Another aspect of inter-site dynamics involves the rearing and movement of livestock between peripheral and central sites, which may reflect deliberate management strategies, with animals selected for specific roles at each location.

At Toprakhisar Höyük, younger animals might have been raised in alignment with local environmental resources and community-scale needs, optimizing pasture use and minimizing resource depletion near the site. Once reaching a certain age or developmental stage, these animals could have been transferred to a central site.

This is not to dismiss that at Toprakhisar Höyük, older individuals may have also been kept for secondary products such as milk, wool, or traction. The presence of bone tools in especially Sq 54.38 of the site (see **Appendix D** for examples) further suggests that activities requiring skilled craftsmanship, such as textile production, basketry, hide processing, or even ceramic preparation, may have been integral to its economic and social functions.

This analysis also emphasized the potential for peripheral sites to influence regional systems. Toprakhisar Höyük's adaptability could highlight the potential agency of smaller communities in shaping resource use and perhaps socio-economic networks.

At Tell Atchana, livestock may have been utilized for secondary products such as milk or wool or slaughtered for meat, depending on the site's economic or ceremonial priorities.

Although a direct connection between Toprakhisar Höyük and Tell Atchana is still not definitively evidenced, the differential treatment of livestock suggest a potentially coordinated economic strategy. In this model, the peripheral site focused on labor-intensive rearing efforts, while the central site managed and redistributed animal resources to meet regional needs. However, further evidence is needed to confirm that Toprakhisar Höyük indeed functioned as a periphery to Tell Atchana.

5.2 Limitations and Future Research

The main limitation of this study, and a key focus for future research, is the need to increase the sample size for Middle Bronze Age assemblages, particularly for Tell Atchana, where the number of bones was limited. A larger sample size would allow more specimens to be aged, sexed, and measured, and would also help clarify the taxonomic distribution patterns (or the lack thereof). Additionally, the absence of truly contemporaneous contexts, such as those dating to Period 10 or Period 9 at Tell Atchana, poses a significant challenge, as any differences observed may be attributed to variations in site/context type, the site location, or just chronological variations.

One other limitation is the potential biases inherent in the faunal assemblages, which are influenced by preservation conditions, excavation methods, and the differential preservation of certain animal remains. Future studies could apply more refined taphonomic analyses to better understand the preservation patterns and to distinguish between actual subsistence practices and biases in the archaeofaunal record.

Additionally, more targeted research into the social implications of subsistence practices—such as how these practices varied by class or gender—could further illuminate the complexities of daily life in these societies.

Moreover, studying the surrounding mounds near Toprakhisar Höyük could provide insights into population mobility and site reorganization during periods of change.

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APPENDICES

A. Appendix A: Taxonomic Distribution of Common Mammals in Syro-Anatolian Sites

The NISP counts compiled in **Table 12** for caprines, cattle, pigs, canids, and equids include both the domestic and wild forms here (wild forms were found in very low frequencies), although they might have been reported separately in the original references.

The percentages were calculated based solely on the total of the eight mammal taxa discussed here and do not reflect proportions within the entire faunal assemblage.

Table 12 Taxonomic Distribution of Common Mammals in Syro-Anatolia

	Caprines	Cattle	Pigs	Canids Dog/Wolf	Equids	Cervids	Gazelles	Leporids
Southeastern Anatolia								
Zincirli – Building Complex DD (Deckers *et al.* 2023)	202 60%	84 25%	22 7%	3 1%	2 1%	15 4%	4 1	2 1
Tilmen Höyük – All areas in article (Curci 2020)	277 40%	219 32%	62 9%	10 1%	31 5%	79 12%	4 1	1 <1
Tatarlı Höyük (Silibolatlaz Baykara & Girginer 2018)	97 68%	33 23%	7 5%	3 2%	0	2 1%	0	1 1%
Northern Levant								
Tell Afis (Wilkens 2000)	352 78%	66 15%	9 2%	7 2%	5 1%	6 1%	3 <1	1 <1
Tell Tuqan (Minniti 2014)	645 44%	184 13%	154 11%	35 2%	423 29%	2 <1	20 1	2 <1
Umm el-Marra (Schwartz *el al.* 2000)	676 51%	86 6%	25 2%	61 5%	416 31%	2 <1	65 5	2 <1
Tell Atchana (Grissa 2025; this work)	540 72%	130 17%	69 9%	11 1%	0	1 <1	0	4 <1
Toprakhisar Höyük 1394 (Grissa 2025; this work)	560 40%	231 17%	507 36%	24 2%	31 2%	36 3%	3 <1	2 <1
Northern Levant – Eastern Mediterranean (Coastal)								
Tell Tweini (Linseele *et al.* 2019)	563 67%	247 29%	6 1%	8 1%	13 2%	6 1%	0	1 <1
Upper Euphrates Valley								
Tilbeşar Höyük (Berthon and Mashkour 2008)	333 48%	188 27%	94 13%	21 3%	41 6%	14 2%	3 <1	4 1
Lidar Höyük (Kussinger 1988)	5544 44%	3359 26%	2463 19%	293 2%	382 3%	629 5%	11 <1	23 <1
Upper Tigris Basin								
Hirbemerdon Tepe (Berthon 2014, using corr. NISP)	401 34%	212 18%	332 28%	44 4%	15 1%	181 15%	0	2 <1
Eastern Anatolia								
Korucutepe (Boessneck and von den Driesch 1974)	622 46%	528 39%	141 10%	19 1%	10 <1%	34 3%	0	0

B. Appendix B: Skeletal Representation Tables

Table 13 Skeletal Representation of TPH Caprines' Non-Long Bones

Element	Species	NISP						CUT	%CUT	Comp.	%Comp.
		R	L	Ind	T1	T2	%				
HORN	Sheep		4		4	12	2	0	0	0	0
	Goat			3	3			0	0	1	33
	S/G			5	5			0	0	4	80
SK	Sheep			14	14	39	7	0	0	0	0
	S/G			25	25			0	0	0	0
MX	Goat	2			2	46	8	0	0	0	0
	S/G	3		41	44			0	0	0	0
MAND	Sheep	3	1		4	46	8	0	0	0	0
	Goat		3		3			0	0	2	67
	S/G	**35**	3	1	39			1	3	0	0
Teeth	Sheep	5	8		13	124	22	—	—	—	—
	Goat	15	13	1	29			—	—	—	—
	S/G	18	22	42	82			—	—	—	—
ATL	S/G			8	8	8	1	5	63	2	25
AX	S/G			1	1	1	<1	1	100	0	0
THOR	S/G			4	4	4	1	1	25	0	0
LUM	S/G			1	1	1	<1	0	0	0	0
PEL	S/G		14	2	16	16	3	6	38	0	0
ILM	S/G	3	1		4	4	1	0	0	0	0
ACET	S/G		3		3	3	1	0	0	0	0
SAC	S/G			10	10	10	2	8	80	0	0
RIB	S/G			4	4	4	1	0	0	0	0
SC	S/G	8	24	1	33	33	6	0	0	0	0
CARP	S/G	1	3	1	5	5	1	1	20	5	100
TAR	S/G	3	4	1	8	8	1	2	25	5	63
AST	Sheep	4			4	7	1	0	0	1	25
	Goat	1			1			0	0	1	100
	S/G	1	1		2			1	50	2	100
Total Caprine Assemblage		—	—	—	—	560	~100	71	13%	36	6%

Table 14 Skeletal Representation of TPH Caprines' Long Bones

Element	Species	NISP						CUT	%CUT	MP	%MP	Comp.	%Comp.
		R	L	Ind	T1	T2	%						
PHM	S/G		1		1	1	<1	1	100	0	0	0	0
DHM	Sheep		1		1	7	1	0	0	1	100	0	0
	Goat		1		1			0	0	1	100	0	0
	S/G	2	3		5			1	20	3	60	0	0
RD	S/G	5	2		7	7	1	0	0	2	29	2	29
PRD	S/G	2	5		7	7	1	2	29	4	57	—	—
DRD	S/G	3			3	3	1	1	33	0	0	—	—
UL	S/G	2	2		4	4	1	2	50	0	0	0	0
PUL	S/G	2	1		3	3	1	1	33	0	0	—	—
RC	S/G		1		1	1	<1	1	100	1	100	0	0
PRC	Goat	2			2	2	<1	0	0	0	0	—	—
DRC	S/G	1			1	1	<1	1	100	1	100	—	—
MC	Sheep	5			5	20	4	1	20	0	0	0	0
	Goat	1	5		6			0	0	0	0	2	33
	S/G			8	8			0	0	8	100	0	0
PMC	Sheep	10			10	25	4	0	0	0	0	—	—
	S/G	5	10		15			10	67	10	67	—	—
DMC	S/G			1	1	1	<1	1	100	0	0	—	—
F	S/G			1	1	1	<1	0	0	0	0	0	0
PF	S/G	1	3		4	4	1	3	75	1	25	—	—
DF	S/G	3	5		8	8	1	6	75	4	50	—	—
TB	S/G	8	9		17	17	3	5	29	13	76	3	18
PTB	S/G	2	8		10	10	2	0	0	1	10	—	—
DTB	Sheep	2			2	34	6	2	100	2	100	—	—
	Goat	1			1			0	0	0	0	—	—
	S/G	28	3		31			2	6	13	42	—	—
MT	Sheep		2		2	13	2	0	0	0	0	0	0
	Goat	2	5		7			0	0	0	0	0	0
	S/G		1	3	4			2	50	1	25	1	25
PMT	Sheep		1		1	6	1	0	0	1	100	—	—
	S/G		5		5			2	40	5	100	—	—
DMT	S/G		2		2	2	<1	0	0	2	100	—	—
PHAL 1	S/G			10	10	10	2	1	10	0	0	5	50
PHAL 2	S/G			2	2	2	<1	0	0	0	0	0	0
Total Caprine Assemblage		—	—	—	—	560	~100	71	13%	74	39%[4]	36	6%

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[4] 74 out of 189 marrow-bearing elements.

Table 15 Skeletal Representation of AT Caprines' Non-Long Bones

Element	Species	NISP						CUT	%CUT	Comp.	%Comp.
		R	L	Ind	T1	T2	%				
HORN	Sheep			1	1	32	6	0	0	0	0
	Goat			31	31			11	35	0	0
SK	Goat			48	48	52	10	1	2	0	0
	S/G			4	4			0	0	0	0
LORB	S/G			1	1	1	<1	0	0	0	0
OCC	S/G		4		4	4	<1	0	0	0	0
MX	S/G	**32**	1	37	70	70	13	0	0	0	0
MAND	Sheep	2	6		8	68	13	0	0	2	25
	Goat	1	2		3			0	0	0	0
	S/G	1	16	40	57			0	0	0	0
Teeth	Sheep	8	26	1	35	105	19	—	—	—	—
	Goat	2	4		6			—	—	—	—
	S/G	10	12	42	64			—	—	—	—
Hyoid	S/G			1	1	1	<1	0	0	0	0
ATL	S/G			18	18	18	3	16	89	0	0
PEL	Sheep		2		2	7	1	2	100	2	100
	S/G	4	1		5			1	20	0	0
ACET	S/G	1			1	1	<1	1	100	0	0
SAC	S/G			1	1	1	<1	0	0	0	0
SC	S/G	23	1	1	25	25	5	0	0	0	0
CARP	S/G			2	2	2	<1	0	0	2	100
PAT	S/G	1			1	1	<1	1	100	1	100
TAR	S/G	4			4	4	<1	1	25	4	100
AST	Sheep	1	1		2	4	<1	0	0	2	100
	S/G	1	1		2			0	0	1	50
CAL	Sheep	1			1	7	1	0	0	1	100
	Goat	2			2			1	50	1	50
	S/G	3	1		4			0	0	0	0
PHAL 3	S/G			5	5	5	1	1	20	3	60
T		—	—	—	—	540	~100	55	10%	28	5%

Table 16 Skeletal Representation of AT Caprines' Long Bones

Element	Species	NISP						CUT	%CUT	MP	%MP	Comp.	%Comp.
		R	L	Ind	T1	T2	%						
HM				1	1	1	<1	0	0	1	100	0	0
DHM	Goat	1	3		4	11	2	4	100	3	75	—	—
	S/G	4	2	1	7			1	14	2	29	—	—
RD	S/G		1		1	1	<1	0	0	0	0	0	0
PRD	S/G	1			1	1	<1	0	0	0	0	—	—
DRD	S/G		2		2	2	<1	0	0	0	0	—	—
UL	S/G	1			1	1	<1	1	100	0	0	0	0
PUL	S/G	2	1		3	3	<1	2	67	0	0	—	—
DRC	S/G	3			3	3	<1	3	100	0	0	—	—
MC	Sheep	1			1	6	1	0	0	0	0	0	0
	S/G			5	5			0	0	3	60	0	0
PMC	S/G	7	12		19	19	4	0	0	8	42	—	—
DMC	Sheep	1	2		3	3	<1	2	67	0	0	—	—
F	S/G	5	1		6	6	1	0	0	1	17	0	0
PF	S/G	2	3		5	5	1	1	20	0	0	—	—
DF	S/G	2	3		5	5	1	2	40	0	0	—	—
TB	S/G	3	3	2	8	8	1	1	13	6	75	0	0
PTB	S/G	2	1		3	3	<1	0	0	3	100	—	—
DTB	Goat		2		2	11	2	0	0	2	50	—	—
	S/G	2	6		8			0	0	1	13	—	—
MT	S/G	7	1	2	10	10	2	0	0	2	20	0	0
PMT	S/G		1	1	2	2	<1	0	0	1	50	—	—
DMT	Sheep	1			1	6	1	0	0	0	0	—	—
	Goat	1	2	1	4			2	50	0	0	—	—
	S/G			1	1			0	0	0	0	—	—
PHAL 1	S/G			21	21	21	4	0	0	0	0	7	33
PHAL 2	S/G			5	5	5	1	0	0	0	0	2	40
T		—	—	—	—	540	~100	55	10%	33	25%[5]	28	5%

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[5] 33 out of 132 marrow-bearing elements.

Table 17 Skeletal Representation of TPH Pigs

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
SK	1	1	84	86	17	30	35	—	—	0	0
UORB	2	10		12	2	10	83	—	—	0	0
PAR	1	8	6	15	3	0	0	—	—	0	0
MX	20	3	12	35	7	0	0	—	—	0	0
MAND	**74**	15	1	90	18	7	8	—	—	8	9
Teeth	67	27	12	106	21	—	—	—	—	—	—
THOR			21	21	4	2	10	—	—	10	48
LUM			10	10	2	3	30			7	70
PEL	6			6	1	1	17	—	—	0	0
ILM		1		1	<1	1	100	—	—	0	0
ACET		2		2	<1	1	50	—	—	0	0
ST			1	1	<1	0	0	—	—	0	0
SC	6	4		10	2	8	80	—	—	0	0
HM	2	2		4	1	1	25	0	0	1	25
PHM	4			4	1	0	0	0	0	—	—
DHM	3	6		9	2	3	33	5	56	—	—
RD		4	2	6	1	2	33	2	33	2	33
PRD	4			4	1	3	75	2	50	—	—
UL	5	2		7	1	3	43	0	0	0	0
DUL		1		1	<1	1	100	0	0	—	—
MC III		1		1	<1	0	0	0	0	0	0
PMC III		1		1	<1	0	0	0	0	—	—
MC IV	3	3		6	1	0	0	0	0	3	50
MC V		1		1	<1	0	0	0	0	1	100
PAT	1	1	1	3	1	0	0	—	—	3	100
F	14	1		15	3	4	27	0	0	0	0
PF	3	19		22	4	1	5	22	100	—	—
DF	1			1	<1	1	100	0	0	—	—
TB	2	2		4	1	0	0	1	25	0	0
DTB	2			2	<1	2	100	2	100	—	—
DFB	2			2	<1	0	0	0	0	—	—
AST		1		1	<1	1	100	—	—	1	100
CAL	1	2		3	1	1	33	—	—	2	67
MT II	1			1	<1	1	100	0	0	0	0
PMT II		1		1	<1	1	100	0	0	—	—
MT III	3	1		4	1	0	0	0	0	2	50
PMT III	1			1	<1	0	0	0	0	—	—
PMT IV	2	1		3	1	0	0	0	0	—	—
PHAL 1			4	4	1	0	0	0	0	1	25
PHAL 3			1	1	<1	0	0	—	—	1	100
T	—	—	—	507	~100	88	17%	34	33%[6]	42	8%

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[6] 34 out of 104 marrow-bearing elements.

Table 18 Skeletal Representation of AT Pigs

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
SK			1	1	1	0	0	—	—	0	0
UORB			1	1	1	0	0	—	—	0	0
PAR			1	1	1	0	0	—	—	0	0
OCC	2			2	3	2		—	—	0	0
MX	1	1		2	3	1	50	—	—	0	0
MAND		4		4	6	0	0	—	—	0	0
Teeth	4	1	1	6	9	—	—	—	—	—	—
THOR			6	6	9	0	0	—	—	0	0
PEL	6			6	9	4		—	—	0	0
PHM		1		1	1	0	0	0	0	—	—
DHM		1		1	1	1	100	0	0	—	—
UL	1			1	1	0	0	0	0	0	0
PMC III	2			2	3	0	0	0	0	—	—
MC IV	1			1	1	0	0	0	0	1	100
PMC			3	3	4	0	0	0	0	—	—
PAT	1	1		2	3	2	100	—	—	2	100
F	1			1	1	0	0	1	100	0	0
PF	1			1	1	0	0	0	0	—	—
DF		5		5	7	5	100	5	100	—	—
PTB	**11**	1		12	17	0	0	0	0	—	—
DTB		1		1	1	0	0	1	100	—	—
FB		1		1	1	0	0	0	0	1	100
AST		1		1	1	0	0	—	—	0	0
CAL	1	2		3	4	1	33	—	—	2	67
PMT III	1			1	1	0	0	0	0	—	—
PMT IV	1			1	1	0	0	0	0	—	—
PHAL 2			1	1	1	0	0	0	0	0	0
PHAL 3			1	1	1	0	0	—	—	0	0
T	—	—	—	69	~100	16	23%	7	21%[7]	6	9%

Table 19 Skeletal Representation of TPH Cattle

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						

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[7] 7 out of 33 marrow-bearing elements.

HORN			1	1	<1	1	100	—	—	0	0
SK		1	29	30	13	1	3	—	—	0	0
LORB		4		4	2	0	0	—	—	0	0
OCC		1		1	<1	0	0	—	—	0	0
MAND	5	2	1	8	3	5	63	—	—	0	0
Teeth	15	11	8	34	15	—	—	—	—	—	—
THOR			2	2	1	0	0	—	—	0	0
PEL	6			6	3	0	0	—	—	0	0
ILM	3	**12**		15	6	10	67	—	—	0	0
ACET	4	2		6	3	1	17	—	—	0	0
ISCH	4			4	2	0	0	—	—	0	0
RIB			3	3	1	0	0	—	—	0	0
SC	8	3		11	5	3	27	—	—	0	0
PHM	2			2	1	2	100	2	100	—	—
RD	2			2	1	0	0	0	0	0	0
PRD	4	4		8	3	3	38	4	50	—	—
DRD	2			2	1	0	0	0	0	—	—
UL		1		1	<1	1	100	0	0	0	0
PUL	2			2	1	2	100	0	0	—	—
DRC	3			3	1	0	0	3	100	—	—
CARP	3		8	11	5	8	73	—	—	5	45
MC		2		2	1	2	100	0	0	2	100
PMC	1	2		3	1	1	33	3	100	—	—
DMC	2		4	6	3	1	17	4	67	—	—
PAT			3	3	1	0	0	—	—	0	0
F			3	3	1	0	0	3	100	0	0
DF		7		7	3	1	14	7	100	—	—
TB		1	2	3	1	2	67	3	100	0	0
DTB		1		1	<1	0	0	1	100	—	—
TAR		4	8	12	5	3	25	—	—	5	42
AST	1	1	1	3	1	3	100	—	—	1	33
CAL		1		1	<1	1	100	—	—	1	100
MT	1			1	<1	1	100	1	100	0	0
PMT	4	2		6	3	5	83	4	67	—	—
DMT	1	1		2	1	2	100	2	100	—	—
MTP			1	1	<1	1	100	0	0	0	0
PHAL			1	1	<1	0	0	0	0	0	0
PHAL 1			6	6	3	3	50	0	0	2	33
PHAL 2			5	5	2	2	40	0	0	3	60
PHAL 3			9	9	4	1	11	—	—	2	22
T	—	—	—	231	~100	66	29%	37	55%[8]	21	9%

Table 20 Skeletal Representation of AT Cattle

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						

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[8] 37 out of 67 marrow-bearing elements.

HORN			14	14	11	0	0	—	—	0	0
SK			25	25	19	1	4	—	—	0	0
LORB			1	1	1	0	0	—	—	0	0
OCC			1	1	1	0	0	—	—	0	0
MX		2	1	3	2	0	0	—	—	0	0
Teeth		1	9	10	8	—	—	—	—	—	—
ATL			1	1	1	0	0	—	—	0	0
CAUV			1	1	1	0	0	—	—	1	100
PEL	1			1	1	1	100	—	—	0	0
ACET			4	4	3	0	0	—	—	0	0
SC	3	1		4	3	1	25	—	—	0	0
HM		4	1	5	4	4	80	0	0	0	0
PUL	1			1	1	1	100	0	0	—	—
PRC	7			7	5	0	0	0	0	—	—
CARP	1		10	11	8	0	0	—	—	1	9
PF		1		1	1	0	0	0	0	—	—
PTB	1			1	1	0	0	1	100	—	—
DTB	2			2	2	0	0	0	0	—	—
TAR	1	2		3	2	1	33	—	—	2	67
CAL		**9**		9	7	0	0	—	—	0	0
MT		3		3	2	3	100	0	0	1	33
DMT		3	3	6	5	0	0	0	0	—	—
PHAL			3	3	2	0	0	0	0	0	0
PHAL 1			6	6	5	0	0	0	0	2	33
PHAL 2			4	4	3	0	0	0	0	1	25
PHAL 3			3	3	2	0	0	—	—	0	0
T	—	—	—	130	~100	12	9%	1	3%[9]	8	6%

Table 21 Skeletal Representation of TPH Equids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
OCC		4		4	13	4	100	—	—	0	0
MAND	10			10	32	0	0	—	—	0	0
Teeth	7	1	5	13	42	—	—	—	—	—	—
CARP III	1			1	3	0	0	—	—	1	100
MC I	1			1	3	1	100	0	0	0	0
PMC II		1		1	3	0	0	0	0	—	—
TB	1			1	3	1	100	1	100	0	0

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[9] 1 out of 39 marrow-bearing elements.

T	—	—	—	31	~100	6	19%	1	33%[10]	1	3%

Table 22 Skeletal Representation of TPH Cervids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
ANTL			7	7	19	4	57	—	—	0	0
OCC		2		2	5	0	0	—	—	0	0
SC	2		1	2	5	1	50	—	—	0	0
RD	1			1	3	0	0	1	100	0	0
PRD	7	1		8	22	0	0	8	100	—	—
UL	1			1	3	1	100	0	0	0	0
PUL	1			1	3	0	0	0	0	—	—
MC			1	1	3	1	100	1	100	0	0
DMC		2		2	5	0	0	2	100	—	—
PTB		1		1	3	1	100	1	100	—	—
PMT	1			1	3	1	100	1	100	—	—
DMT	1			1	3	1	100	0	0	—	—
MTP			2	2	5	0	0	2	100	0	0
PHAL 1			3	3	8	1	33	0	0	2	67
PHAL 2			2	2	5	0	0	0	0	2	100
PHAL 3			1	1	3	0	0	—	—	1	100
T	—	—	—	36	~100	11	31%	16	67%[11]	5	13%

Table 23 Skeletal Representation of AT Cervids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
PHAL 1			**1**	1	100	1	1	0	0	0	0
T	—	—	—	1	~100	1	100%	0	0%	0	0%

Table 24 Skeletal Representation of TPH Canids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
MAND		1		1	6	0	0	—	—	0	0
CERV		2		2	11	2	100	—	—	2	100
PEL	2	1		3	17	2	67	—	—	0	0

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[10] 1 out of 3 marrow-bearing elements.

[11] 16 out of 24 marrow-bearing elements.

SC		1		1	6	1	100	—	—	0	0
PRD	1			1	6	1	100	0	0	—	—
DRD	2			2	11	2	100	0	0	—	—
PUL	**5**			5	28	4	80	0	0	—	—
MC IV	1			1	6	0	0	0	0	1	100
PMT II		1		1	6	0	0	0	0	—	—
T	—	—	—	18	~100	12	67%	0	0%	3	17%

Table 25 Skeletal Representation of AT Canids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
CERV			**8**[12]	8	73	0	0	—	—	0	0
SC			1	1	9	0	0	—	—	0	0
PHAL 1			2	2	18	0	0	0	0	1	50
T	—	—	—	11	~100	0	0%	0	0%	1	%

Table 26 Skeletal Representation of TPH Gazelles

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
HORN			1	1	33	1	100	—	—	0	0
CAL		**1**		1	33	0	0	—	—	1	100
PHAL 1			1	1	33	0	0	0	0	1	100
T	—	—	—	3	~100	1	33%	0	0%	2	67%

Table 27 Skeletal Representation of TPH Hares

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
PF		**1**		1	50	0	0	0	0	—	—
MTP			1	1	50	0	0	0	0	0	0
T	—	—	—	2	~100	0	0%	0	0%	0	0%

Table 28 Skeletal Representation of AT Hares

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
PEL	**3**			3	75	0	0	—	—	0	0
MTP			1	1	25	0	0	0	0	0	0
T	—	—	—	4	~100	0	0%	0	0%	10	67%

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[12] Canids, as do most mammals, have 7 cervical vertebrae. So, White's MNI is 2.

Table 29 Skeletal Representation of TPH Cat

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
UL	**1**			1	100	1	100	0	0	1	100
T	—	—	—	1	~100	1	100%	0	0%	1	100%

Table 30 Skeletal Representation of AT Mustelids

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
MAND			1	1	7	0	0	—	—	1	100
Teeth			5	5	33	—	—	—	—	—	—
RIB			6	6	40	0	0	—	—	6	100
HM	**2**			2	13	0	0	0	0	2	100
TB	1			1	7	0	0	0	0	1	100
T	—	—	—	15	~100	0	0%	0	0%	10	67%

Table 31 Skeletal Representation of AT Rodents

Element	NISP					CUT	%CUT	MP	%MP	Comp.	%Comp.
	R	L	Ind	T	%						
Vertebrae			4	4	100	0	0	—	—	4	100
T	—	—	—	4	~100	0	0%	—	—	4	100%

C. Appendix C: Measurement Tables

Table 32 Measurement Tables of TPH Caprines

Element	Species	SH	SB	SCi
PEL	S/G	15.34	8.25	8.71
		14.8	6.73	6.63

Element	Species	Bd	BT	HTC
HM	Sheep	33.06	32.76	15.41
	Goat	31.68	30.98	12.6

Element	Species	Bp	BFp	Bd	BFd
RD	Goat	26.96	25.87		
	S/G			31.04	24.66
				31.94	27.51
		27.69	26.25		
		27.35	25.93		

Element	Species	Bp	SD	Bd	GL	BMc	DMv	BLc	DLv	DD
MC	Sheep		14.47	26.56	139.44	12.32	17.13	12.05	17.07	
		23.17		25.89	134.88	11.94	16.46	11.6	16.09	
	Goat	21.66	14.52	24.63	97.15	11.45	14.24	11.16	13.85	9.32
		24.54	15.41	25.9	107.79			11.73	16.11	
	S/G	20.26								
		20.51								
		23.92								
		21.61								
		22.57								

Element	Species	DC	Bd	BTp
F	S/G		34.64	18.54
		16.36		

Element	Species	Bd – Dd
TB	Sheep	26.1 – 19.67
	Goat	28.67
		28.54 – 19.27
	S/G	27.08 – 21.35

Element	Species	GLl	GLm	Dl	Dm	Bd	Bp
AST	Sheep		25.09			16.69	15.92
		30.39		16.36		19.94	
		27.08	25.86	14.31	14.63	15.2	16.15
	Goat	26.86	25.11	14.09	14.9	17.27	15.95
	S/G	29.18	27.45	14.41		17.8	17.78

Element	Species	GB	GD

CTAR	S/G	22.9	20.79
	S/G		21.23
	S/G	21.24	

Element	Species	TBp	GBp	SD	Bd	GL	DD	BMc	DMv	BLc	DLv
MT	Sheep		19.53								
								11.26		15.42	
	Goat				23.55			10.59			
					23.61		9.52	11.14	15.14	10.6	14.82
		24.61	24.06			137.64		12.93	18.78		
	S/G	19.08	20.16								
		19.28	19.21	11.87	22.17	101.53			14.75	9.35	14.45
					22.2		8.73	10.26	15.12	9.17	
		23.19	23.11								

Element	Species	GLpe	Bp	Bd	SD	BFp	BFd
PHAL 1	S/G			9.39			7.31
		34.65	13.22	12.14	10.48	11.86	7.91
		36.76	12.54	11.51	9.83	11.56	8.38
				9.17			7.21
		45	15.9	14.91	13.09	15.11	10.61
		34.53	12.46	11.44	9.93		8.65
PHAL 2	S/G	22.6	12.88	11.39	10.06		9.07

Table 33 Measurement Tables of AT Caprines

Element	Species	GLP	LG	BG
SC	S/G	34.8	29.46	22.55

Element	Species	LA	BA	SH	LFo	Sci
PEL	Sheep	28.4	25.69	11.21	37.71	15.04
	S/G	25.3	24.4			

Element	Species	Bd	BT	HTC
HM	Goat	33.74	32.05	14.72

Element	Species	SD	Bd	BFd
RD	S/G	16.88	30.54	25.54

Element	Species	DPA	SDO
UL	S/G	29.04	23.8

Element	Species	Bp	SD	Bd	BMc	DMv	BLc	DLv
MC	Sheep			25.81	11.92	15.27	11.97	15.1
				25.23	11.59	15.68	11.57	14.71
		26.05	15.18					
	S/G	25.76						
		25.64						
		25.5						
		21.64						
		23.82						

		23.49						

Element	Species	GL	GB	D
PAT	S/G	26.05	22.5	16.16

Element	Species	DC
F	S/G	20.54

Element	Species	Bp	Bd	Dp
TB	Goat		28.25	
	S/G		25.69	
		41.05		41.17
		42.64		41.23

Element	Species	GLl	GLm	Dl	Dm	Bd	Bp
AST	Sheep	29.17	27.87	16.31	16.96	17.71	18.14
		27.14	25.16	14.23	14.81	16.86	16.12
	S/G	29.8	27.4			18.87	17.38

Element	Species	GL	RM	LD	GB
CAL	Sheep	56.97	23.22	23.32	19.41
	Goat		21.92	22.3	
	Goat		22.28	22.14	

Element	Species	GB	GD
CTAR	S/G	23.03	19.69
		23.07	22.01
		23.76	22.34

Element	Species	SD	Bd	GL	DD	BMc	DMv	BLc	DLv
MT	Sheep	11.4	24.35		10.04	11.26	16.57	10.65	15.84
	Goat		23.19			10.84	13.69	9.99	13.04
			26.09		10.79	12.07	17.25	12.05	16.69
	S/G			150.29				13.02	17.46

Element	Species	Glpe	Bp	Bd	SD	BFp	BFd
PHAL 1	S/G	35.35	12.58	10.74	9.39	11.3	7.63
			13.97		10.66		
				11.09			8.56
			14.1				
		36.8	13.12	12.59	11.21	12.92	9.55
				12.61	9.65		8.96
		39.33	11.8	10.95	9.27	10.89	7.78
		39.79	12.04	11.16	9.92		
		36.34	12.48		10.14		
		38.69	14.38	13.1	11.85	13.33	9.59
		38.44	12.42	11.5	10.01	11.92	8.98
				13.35	11.84		9.08
		40.45	13.2	12.37	10.28	13.03	9
		37.81	12.58	12	9.92		
PHAL 2	S/G		13.6		9.97		

		23.44	12.86	10.69	9.78		
			12.93	9.25			
		21.44	12.46	9.99	9.33	11.12	7.62

Element	Species	DLS	Ld	H	MBS
PHAL 3	S/G	34.36	26.79	15.37	6.82
		31.75	22.19	16.21	7.1
		35.07	24.49	15.82	6.96
		30.9	24.56	15.33	6.05

Table 34 Measurement Tables of TPH Pigs

Element	SLC
SC	18.24

Element	LA	BA	LAR
PEL	33.53	29.6	28.54

Element	Bd	Bp	HTC
HM	37.85		17.24

Element	Bp	SD	Bd	GL
RD	26.59	15.7	30.48	126.94
	24.36			
	26.15			

Element	Bp	SD	Bd	GL	DD	LeP
MC III	13.33					
MC III	11.21					
MC IV	6.28					
MC IV	6.85					
MC IV	16.41	11.47	16.19	68.12	43.23	9.18
MC V	6.43					

Element	GL	GB
PAT	21.69	13.68
	19.41	14.07

Element	Bp	DC	SD
F	51.72	21.03	15.78

Element	Bd	Dd
TB	26.91	23.6

Element	GLl	GLm	Dl	Dm	Bd	Bp
AST	36.65	32.34	18.66	18.04	21	17.8

Element	RM	LD
CAL	21.59	27.72

Element	TBp	GBp
MT II	5.47	3.36
MT II	7.38	4.12
MT III	17.07	12.12
MT III	18.93	13.53
MT IV	17.71	11.89

MT IV	22.41	16.34

Element	GLpe	Bp	Bd	SD	BFd
			9.57		9.14

Element	DLS	Ld	H	MBS
PHAL 3	21.09	20.96	15.49	9.22

Table 35 Measurement Tables of AT Pigs

Element	GL	GB	D
PAT	25.42	16.14	19.66
	25.55	15.59	14.68

Element	GLl	GLm	Dm	Bd	Bp
AST	24.05	23.19	13.93	16.74	14.29

Element	RM	LD
CAL	22.79	27.8

Element	Bp	SD	Bd	GL	BMc	DMv	LeP
MC III	15.82						
MC IV	13.95	10.62	16.49	62.47	42.42	13.59	10.62

Element	Bp
PHAL 2	15.22

Table 36 Measurement Tables of TPH Cattle

Element	LA	BA	LAR
PEL	66.81	53.41	57.94

Element	Bp	BFp	Bd	BFd	GL
RD			62.35	60.95	
	76.55	70.14	76.92	66.7	286.09

Element	Bp	SD	Bd	GL	BMc	DMv	BLc	DLv	DD
			49.88		25.29	27.54	23.31		
	53.58	29.81	55.02	207.29	25.94	31.6	23.58	30.53	19.02
	66.43	39.15	74.16	220.31	37.06	35.15	35.12		23.41
					29.27	35.18			

Element	Bd	Dd
TB	64.28	48.75

Element	GLl	GLm	Dl	Dm	Bd	Bp
AST	70.21	63.89	38.06	42.19	45.53	41.98
					31.52	

Element	GB	GD
CTAR	46.28	46.04
	56.07	54.15

Element	GL	RM	LD	GB	Bct	Bas
CAL	140.29		64.18	49	12.33	13.42

Element	TBp	GBp	Bd	DD	BMc	DMv	BLc	DLv
MT			54.73		25.44	28.53	26.16	28.84

			49.75	21	23.3	27.72	22.7	27.03
	48.28	48.56						

Element	GLpe	Bp	Bd	SD	BFp	BFd
PHAL 1	65.61	32.54	32.72		31.03	24.44
			20.87	17.9		18.3
	64.66	27.37	27.63	21.48	25.79	20.37
	65.32	29.89	29.37	23.07	25.9	23.42
PHAL 2	31.44	24.57	21.23	19.68		
	41.24	34.37	26.97	26.47	30.76	19
	41.44	28.47	27.13	22.8	26.7	16.75

Element	DLS	Ld	H	MBS
PHAL 3	59.91	49.7	38.65	19.29
			47.66	20.86
			31.62	18.6
	78.29	54.56	43.46	25.44
				24.97

Table 37 Measurement Tables of AT Cattle

Element	DC
F	40.28

Element	GB	GD
CTAR		46.49
	50.99	44.37

Element	TBp	GBp	SD	Bd	GL	BMc	DMv	BLc	DLv
MT	53.71	50.22	27.46	58.88	246	28.24	34.25	28.5	33.57

Element	GLpe	Bp	Bd	SD	BFp	BFd
PHAL 1	52.6	25.49	28.32			
	67.14	29.49	27.37	23.25		22.38
	66.08	29.52	31.6	24.99	65.57	23.77
PHAL 2	33.51	25.8	22.45	21.18		15.87
		23.68		18.4		
	54.09[13]					
				23.31		

Element	MBS
PHAL 3	18.98

Table 38 Measurement Tables of TPH Cervids

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[13] This measurement was of the opposite abaxial half that would yield the greatest length GLpe. Therefore, the real GLpe measurement might be even bigger.

Element	Bp	BFp
RD	32.25	
	49.03	44.15

Element	BPC	DPA
UL	22.93	20.8

Element	Bd	BMc	DMv	BLc	DLv
MC	23.58	10.62	16.42	10.55	15.69

Element	Bp	SD
TB	65.41	70.64

Element	Bd	BMc	DMv	BLc	DLv
MT	36.63	16.88	23.39	17.73	23.25

Element	GLpe	Bp	Bd	SD	BFp	BFd
PHAL 1	50.68	19.38	16.95	14.28	18.25	12.9
	49.23	17.87	16.88	13.72	16.8	12.74
PHAL 2	35.22	18.63	15.33	13.54	17.55	9.58
	33.26	17.15	14.02	12.9	15.73	8.18

Element	DLS	Ld	H	MBS
PHAL 3	56.52	48.74	35.09	16.98

Table 39 Measurement Tables of TPH Canids

Element	LA	BA	SBI	LAR
PEL		23.97		24.7
	25.21	26.08	21.21	
	23.92	21.96		22.58

Element	Bp
RD	13.65

Element	GL	Bd
MC IV	50.7	6.77

Element	TBp	GBp
MT II	12.35	5.41

Table 40 Measurement Tables of AT Canids

Element	GLpe	Bp	Bd	SD	BFd
PHAL 1	20.69		5.69	3.91	3.97
	22.01	8.04	6.35	4.13	5.18

Table 41 Measurement Tables of TPH Gazelles

Element	GL	RM	LD	GB
CAL	54.9	23.74	21.33	18.29

Element	GLpe	Bp	Bd	SD	BFp	BFd
PHAL 1	40.8	11	9.28	8.18	10.83	6.97

Table 42 Measurement Tables of TPH Cat

Element	BPC	DPA	SDO
UL	8.51	10	9.11

Table 43 Measurement Tables of AT Hares

Element	LA	BA
PEL	11.22	10.81

Table 44 Measurement Table of Mandibular M3 for TPH and AT

Site – Species	Length	Breadth/Width
TPH – Pig	30.06	13
TPH – Pig	30.3	12.72
TPH – Cattle	34.48	14.69
TPH – Sheep	24.6	8.36
AT – Sheep	24.48	8.96
AT – Sheep	24.28	8.61
AT – Sheep	23.35	7.86
TPH – S/G	22.22	8.54
AT – S/G	22.38	8.02

D. Appendix D: Modified Bones/Horns/Antlers and Tool Fragments

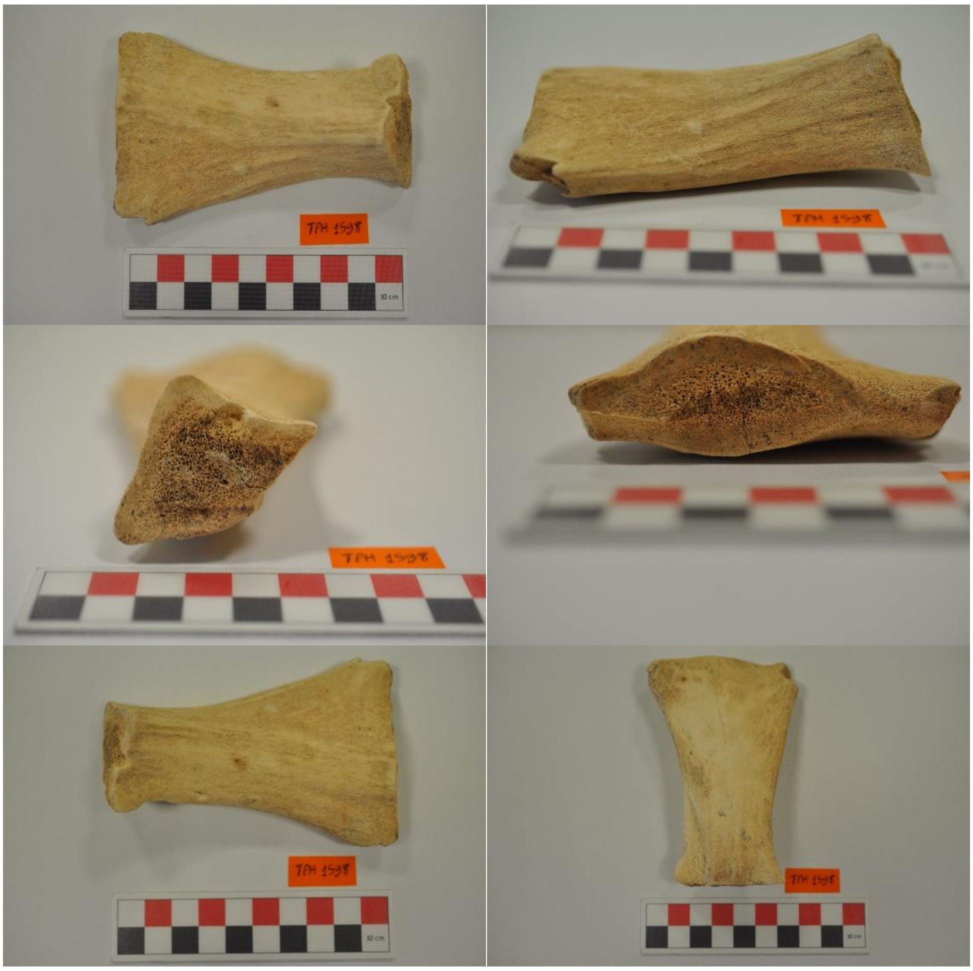

Figure 33 Worked Antler 1 from TPH

TPH number	TPH 1598
Square and LP	52.37 LP4a
Locus and Lot	L.55 Lot 175
Element	Antler
Taxon/Animal Size	Fallow deer

Comments

Chopped proximally and distally. The surface has a grainy sand-like texture, and is not abraded. The thin outermost layer was removed.

Figure 34 Worked Antler 2 from TPH

TPH number	TPH 1331
Square and LP	54.38 LP1
Locus and Lot	L.7 Lot 22
Element	Antler tine
Taxon/Animal Size	Deer

Comments

Round-ended. The surface texture is smooth. The end of the tine is polished, possibly the result of wear through repeated use. Several cut marks were found in all views at the center of the tine, but also near the tine split-off.

Figure 35 Worked Horn Core from AT

AT number	AT 18654
Square and LP	45.44 LP5
Locus and Lot	L.137 Lot 683
Element	Horn core
Taxon/Animal Size	Goat (male)

Comments

Round-ended. The surface texture is smooth. The end is somewhat polished. Several cut marks (20+ striations) were found in all views. The horn core appears to have been ineffectively worked, possibly left unfinished and then discarded as waste.

Figure 36 Worked Knucklebone from AT

AT number	AT 18652
Square and LP	45.44 LP5
Locus and Lot	L.142 Lot 658
Element	Astragalus
Taxon/Animal Size	Sheep/Goat

Comments

Three surfaces were flattened: the anterior, the medial, and the lateral. No perforations. Possibly used for ceramic finishing and polishing (Mărgărit 2017).

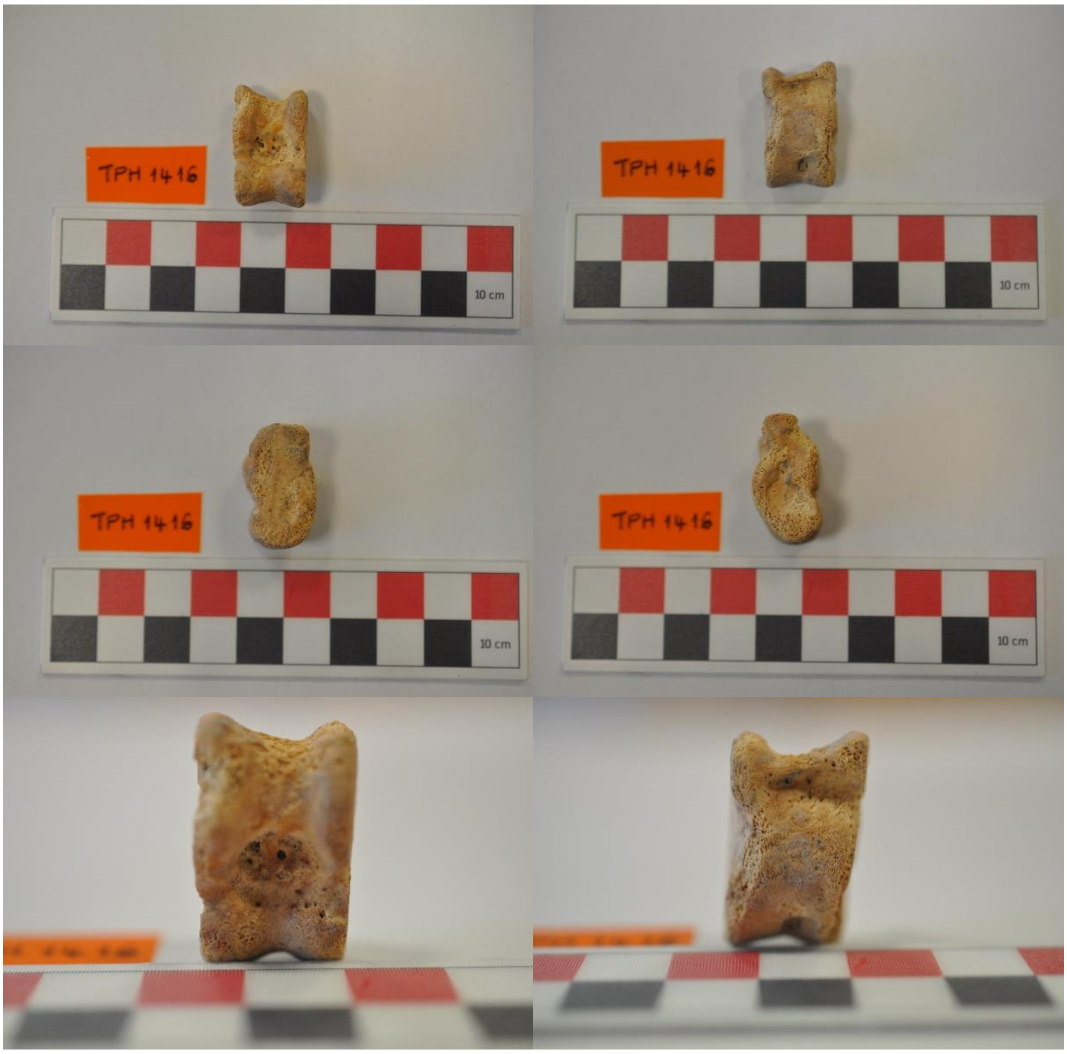

Figure 37 Worked Knucklebone 1 from TPH

TPH number	TPH 1416
Square and LP	54.38 LP2
Locus and Lot	L.10 Lot 25
Element	Astragalus
Taxon/Animal Size	Sheep (Female, Juvenile)

Comments

The sides (lateral and medial surfaces) are flattened. The surface texture is grainy, coarse, and porous, due to the animal being young. No perforations. Possibly used for ceramic finishing and polishing (Mărgărit 2017).

Figure 38 Worked Knucklebone 2 from TPH

TPH number	TPH 1781
Square and LP	54.38 LP2
Locus and Lot	L.26 Lot 81
Element	Astragalus
Taxon/Animal Size	Sheep/Goat

Comments

The anterior, lateral, and medial surfaces are flattened. The bone surface is very polished, even in areas not rubbed. No perforations. Possibly used for ceramic finishing and polishing (Mărgărit 2017).

Figure 39 Worked Knucklebone 3 from TPH

TPH number	TPH 1778
Square and LP	54.38 LP2
Locus and Lot	L.19 Lot 79
Element	Astragalus
Taxon/Animal Size	Sheep/Goat

Comments

Both lateral and medial surfaces could have possibly been flattened deliberately. The surface texture is coarse and porous, without sufficient evidence (no pitting) to suggest digestion. No perforations. Possibly used for ceramic finishing and polishing (Mărgărit 2017).

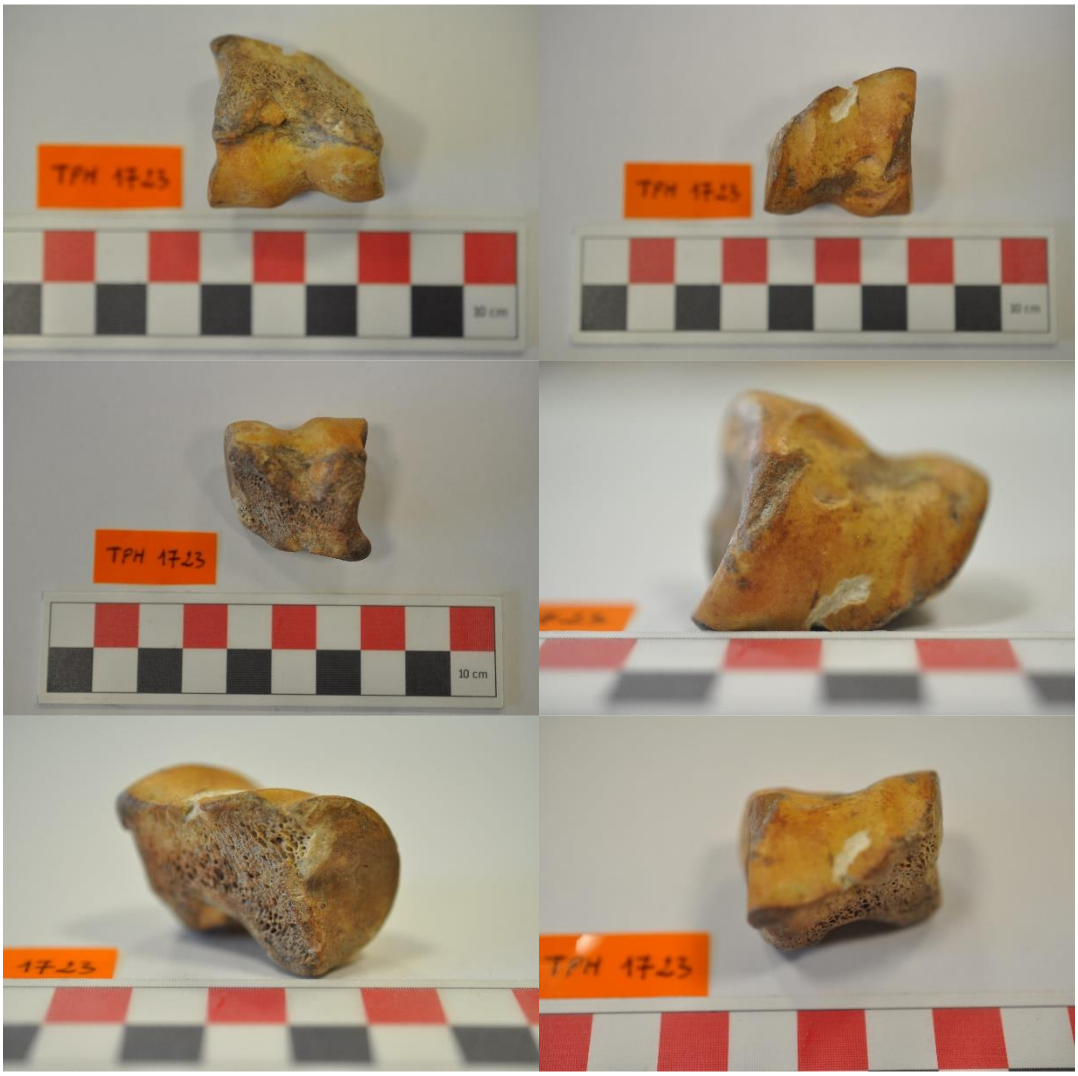

Figure 40 Worked Knucklebone 4 from TPH

TPH number	TPH 1723
Square and LP	54.38 LP2
Locus and Lot	L.23 Lot 71
Element	Astragalus
Taxon/Animal Size	Cattle

Comments

Extremely polished and rounded. Likely chopped obliquely and subjected to continuous abrasion against a rough surface. Possibly used for ceramic finishing and polishing (Mărgărit 2017).

Figure 41 Point-ended Tool 1 from TPH

TPH number	TPH 543
Square and LP	51.37 LP3b
Locus and Lot	L.61 Lot 124
Element	Tibia
Taxon/Animal Size	Sheep/Goat

Comments

Might have been used as an awl.

Figure 42 Point-ended Tool 2 from TPH

TPH number	TPH 1539
Square and LP	54.38 LP2
Locus and Lot	L.3 Lot 57
Element	Scapula
Taxon/Animal Size	Cattle size

Comments

Might have been used as an awl.

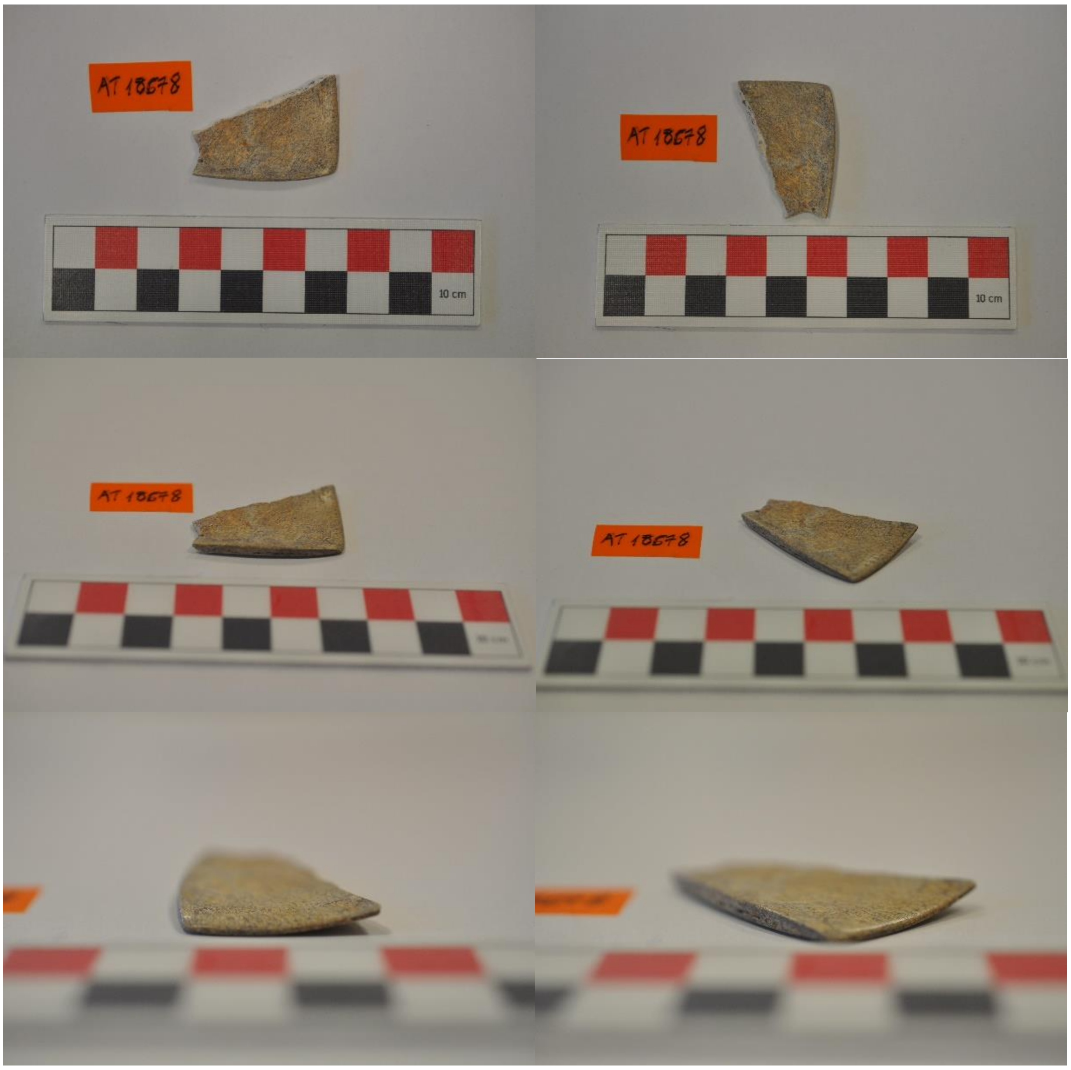

Figure 43 Bone Tool (*Spatula?*) from AT

AT number	AT 18678
Square and LP	45.44 LP5
Locus and Lot	L.140 Lot 662
Element	Scapula
Taxon/Animal Size	Sheep size

Comments

Extremely polished and rounded.

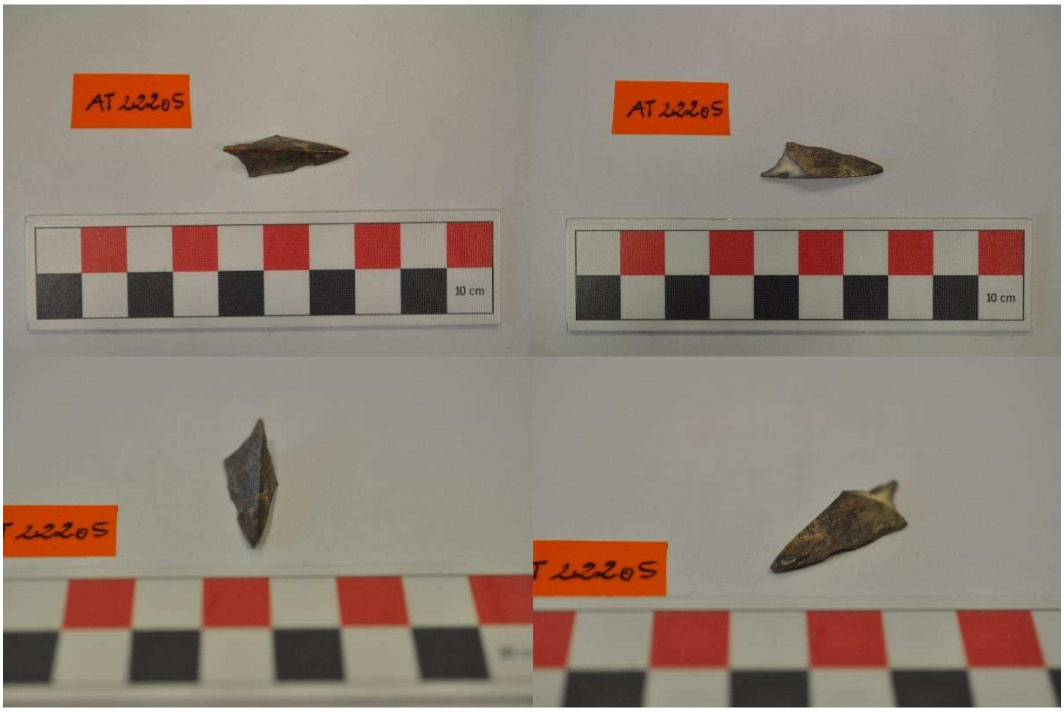

Figure 44 Point-ended Tool from AT

AT number	AT 22205
Square and LP	33.32 LP4
Locus and Lot	L.107 Lot 352
Element	Long bone
Taxon/Animal Size	Cattle size

Comments

Uncertain function.

E. Appendix E: Statistical Analyses

Chi-squared Test

The NISP of these taxa: Caprines, Cattle, Pigs, Dogs/Wolves, Mollusks, Birds, Fish, and Turtles were used. Taxa with NISP values under 5 were not included.

Results

Rows, columns: 8, 2   Degrees freedom: 7
Chi2: 428.2   p (no assoc.):<0.000001
Monte Carlo p: 0.001

p-values

	TPH	AT
Caprines	6.4354E-41	6.4354E-41
Cattle	0.40096	0.40096
Pigs	7.3591E-36	7.3591E-36
Dogs/Wolves	0.65774	0.65774
Mollusks	1.5178E-15	1.5178E-15
Birds	1.1503E-27	1.1503E-27
Fish	0.49589	0.49589
Turtles	6.6771E-07	6.6771E-07

Correspondence Analysis

Axis	Eigenvalue	% of total	Cumulative
1	0.158867	43.711	43.711
2	0.0810562	22.302	66.013
3	0.0594421	16.355	82.367
4	0.0288295	7.9322	90.3
5	0.0217287	5.9784	96.278
6	0.00878633	2.4175	98.696
7	0.00474113	1.3045	100