

FAUNAL REMAINS FROM ANAU SOUTH TRENCH 5: A PRELIMINARY STUDY

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Abstract

Anau, Turkmenistan offers a lens into Central Asian cultural and societal development. Its continuous settlement through the Bronze Age has served to provide stratigraphic chronologies for the entire region. Via detailed observation of a previously unstudied assemblage of faunal remains, this paper seeks to build on our understanding of Central Asian archaeology. A taphonomy-based study yielded insight into the preparation and discard of animal materials. Aspects of cooking, scavenging, and post-depositional damage are discussed in detail.

Keywords: Turkmenistan, Central Asia, Bronze Age, archaeology, zooarchaeology, taphonomy

Faunal Remains from Anau South: A Preliminary Study

Archaeology, in both public and private realms, has historically had a much stronger connotation to the physical excavation rather than the subsequent analysis of materials (Frieman & Janz, 2018). One excavation season can generate thousands of specimens, yet they are largely worthless until properly identified and quantified. From an ethical standpoint, the exhumation of material history demands an onus to properly study and make use of what archaeologists have pulled from the earth. Nevertheless, time and resource constraints often limit the ability of researchers to offer the most complete reconstruction of the past. In many cases, there simply aren't enough bodies to do the necessary lab work. Pressures for professionals to publish data and move on to the next project can leave certain data underexamined or certain questions unanswered.

At the extreme, archaeologically recovered material may not be analyzed at all. These samples rest in storage boxes while context continues to erode as time moves forward. Any eventual interpretation of these assemblages is complicated by that lack of circumstantial information. Examining these residual legacy collections, however daunting, can provide the next frontier of archaeological study (Frieman & Janz, 2018). Paradigm shifts in the twentieth century have drawn museums away from voracious collection habits. Chiefly, cultural heritage laws now largely prohibit the archaeological export of materials. Evolutions in nondestructive geophysical survey have somewhat limited the need to excavate large swathes of land. With a decline in the accumulation of new material, it is logical for archaeologists to begin to look inward at what already exists for interpretation.

This paper examines one such legacy collection, with an aim to incorporate the data into a broader interpretation of its provenience. Specifically, this paper represents a preliminary zooarchaeological study of a previously untouched faunal assemblage from Anau South's 1993 and 1994 Harvard-IuTAKE Excavations. The research goals set out in this paper were to corroborate and potentially augment the interpretation by Moore et. al in their museum

monogram chapter of Anau North's most recent excavations in 1997 (Chapter 12 of Hiebert & Kurbansakhatov, 2011). Moreover, it will function as a literature review to accumulate a zooarchaeological understanding for examining similar deposits. Though much of the remains proved unidentifiable beyond class Mammalia, the taphonomic signature on the dataset can be used as a baseline for other Central Asian archaeological excavations.

Background

Anau Depe and the Kopet Dag Mountain Range

Anau, Turkmenistan has been studied for over a century by archaeologists searching for the origins of Central Asian civilization. Situated in the Kopet Dag foothills, next to the modern-day border between Turkmenistan and Iran, Anau is comprised of three "Tels" (North, South, and East). The three mounds, together, provide a timeline ranging from the early village period (5500-3000 BC) at the North Mound to a Central Asian Bronze Age (3000-1000 BC) at the South Mound (Hiebert & Kurbansakhatov, 2011).

The most recent publications concerning the archaeological site deal with excavations at the North Mound, conducted by the University of Pennsylvania Museum of Archaeology and Anthropology (UPMAA) in conjunction with the Institute of Cultural Heritage of Turkmenistan. This latest restudy was undertaken to refine and organize the chronology and stratigraphy at Anau. The focus of this paper, the Harvard-IuTAKE Excavations, took place at the South Mound in 1993 and 1994. While these excavations took place nearly 30 years ago, no documents concerning the excavated materials have been published. This, sadly, is the case for many legacy collections. Nevertheless, via the progress report and field notes, reconstruction of context and research goals is attainable.

The Harvard-IuTAKE Excavations opened six trenches (AS/1, 2, 3, 4, 5, test trench) with the intentions of excavating down to Bronze Age layers. In the progress report, most all forms of materials excavated were only analyzed in part. The remainder of the material sits separated from each other and its context. While the 1995 progress report states that most all excavated

materials were sent back to the Turkmenistan capital of Ashgabat, zooarchaeological remains now reside at the Penn Museum under the curation of Dr. Katherine Moore. Plant, phytolith, and faunal remains were loaned to Frederik Hiebert and the UPMAA as part of the Sampling and Analysis Materials Program (SAM) by the Turkmenistan government. All other materials, chiefly lithic, ceramic, and metal objects continue to reside in Ashgabat. The SAM loans occurred shortly after excavation. The subject of this study, faunal remains from Anau South Trench 5 (AS5), was loaned in 1997.

Anau is one of numerous sites that populate the foothills of the Central Asian mountain range that reach as far back in time as 6,100 BC (Hiebert, 2002). In terms of faunal remains, most every site indicates presence of caprine-based pastoralism. Even at the earliest site, Djeitun, evidence of sheep indicates that settled life included a pastoral component (Hiebert, 2002). Understanding aspects of nutrition and consumption thus necessitate an understanding of pastoralism on the Kopet Dag. Previous excavations like those of Anau North also indicate a strong presence of wild animal hunting as an auxiliary food source (Hiebert & Kurbansakhatov, 2011). Using the faunal data from that chapter, in conjunction with referencing *Mammals of the Soviet Union*, a full list of potential Mammalia species could be arranged (Heptner et al., 1988). While this information was pertinent during the initial analysis, the lack of diversity in AS5 was apparent. The AS5 sample size is quite small by zooarchaeological standards and only contains approximately half of the species identified at Anau North (Hiebert & Kurbansakhatov, 2011). A full list of identified taxa is available in Table 1, with additional species to consider in the methodology section of this paper.

Zooarchaeological Analysis

Zooarchaeology as a discipline plays a crucial role in understanding one of the major sources of archaeological evidence. It largely owes its origins to the beginnings of the processual era of archaeological theory in the mid-to-late twentieth century (Thomas, 1996). A major paradigm shift towards asking why, rather than what happened, led to the inclusion of more

scientific-based observational techniques. Archaeological offshoots such as archaeometallurgy, paleoethnobotany, and zooarchaeology became necessary during this period. This specialization was due to the increasingly complex nature of material analysis that each type of object underwent as archaeologists began to incorporate more advanced research technology (Landon, 2005). Lithics, ceramics, metals, plant, and bone remains all required specialized archaeologists to better interpret their *chaîne opératoire*. The techniques utilized have continually been refined by successive generations of researchers (Landon, 2005; Thomas, 1996). Today, we stand to identify and understand faunal remains better than ever before. Yet while the methods of analysis are regularly discussed and refined, little has been done to codify or standardize these methods. Understanding what these methods are, what problems remain, and how the discipline is evolving is crucial in completing the most up-to-date analysis of an assemblage.

Taxonomic Identification

Zooarchaeologists primarily work with faunal remains, in whatever capacity they present themselves. Most often, the fragmentary bones and skeletons of animals are subjected to analysis. While seemingly small in significance, there are a wide variety of tools at the zooarchaeologist's disposal to glean information from these bones. Observational data on both a macroscopic and microscopic level can provide ample knowledge about an individual animal's death and a broader human population's consumption habits. Beyond simply food, zooarchaeological data can be used to reconstruct aspects of culture and economy.

The most rudimentary problem concerning observation and understanding of faunal remains stems from the identification of various taxa. The skeleton is an inherently incomplete representation of an animal, something middling between diagnostic and indeterminate. The principal job of zooarchaeological interpretation is to make distinctions between faunal remains whenever able. This can take a variety of forms, depending on the individual specimen being investigated. Ideally, the specimen can be determined to be a particular skeletal element and belonging to a particular taxon (Landon, 2005). The chief facilitator in making those

distinctions is a comparative collection. Whether physical or via an atlas, zooarchaeologists rely on relating a given archaeological sample to a comparative modern or ancient specimen whose identification is certain (Landon, 2005; Thomas, 1996). The adage “Can it be? Must it be?” is of particular importance for the zooarchaeologist (Gifford-Gonzalez, 2018). Matching diagnostic features between a comparative specimen and an unknown, archaeologically recovered remain is the only macroscopic solution for generating taxonomic information.

This process is immeasurably complicated by the similarities between closely related species. The classic example, at both Anau depe and abroad, is the distinctions, or lack thereof, between *Ovis* (sheep) and *Capra* (goat) skeletons. Atlases, scholarly articles, and comparative collections can provide guidelines for discerning slight morphological differences in similar taxa. Unfortunately, diagnostic markers are not guaranteed to survive the archaeological record or even resemble comparative specimens. Pathological, genetic, and ecological forces all impact the appearance and morphology of a skeleton. Diagnostic features might be clouded in these variations, especially concerning the distinction between two biologically similar domesticate species that likely existed at the same time in the same place. In many cases, a taxonomic identification cannot be achieved. Furthermore, a bone’s postmortem taphonomic history can complicate identification. A bone marred beyond all recognition, void of diagnostic markers, will likely fall into a category of indeterminate class of animal. In short, even with the correct skeletal elements, identification is not guaranteed.

Driver (2011) cautions against the overidentification of nondiagnostic specimens. Bones alone must be the source of identification, not any inkling about the presumed distribution or presence of species. Propensity to assuming an ancient species range is analogous to their modern, for instance, can limit or restrict researchers from ever reinterpreting past animal ranges (O’Connor, 1996). Undiagnostic fragments are certainly less useful interpretatively than diagnostic ones. They are a necessary component, however. While much interpretative analysis relies on taxonomic distinctions (for instance, Hiebert & Kurbansakhatov, 2011; MacKinnon,

2004; Zeder & Arter, 2008), using unidentified fragments can still help researchers understand taphonomic forces at play in a given assemblage.

In spite of Driver's (2011) warning, there are instances of unidentifiable fragments serving as not only taphonomic indicators, but still contributing to interpretative analysis. Sites with little diversity in mammals, especially those containing domesticated animals, stand to benefit from unidentified remains. Contexts such as Anau, where the sheer majority of identified specimens belong to a domesticated species, can utilize indeterminate fragments to track overall trends in proportions between these animals. Zeder outlines this phenomenon in a case study of Tal-e Malyan (Zeder, 1988). In this study, Zeder was able to track shifts in the proportion of large mammals to medium mammals to interpret changes in the pastoral herd makeup of this settlement. The relationship between *Bos* and caprine mammals within a herd yields enormous insight into the economic, environmental, and political makeup of a civilization. Zeder's point about the usefulness of indeterminate fragments highlights the necessity for zooarchaeological research to be grounded in the local environment and taxonomic distribution (Zeder, 1988). Knowing what potential species could appear in a faunal assemblage is essential in determining proper identifications and interpreting assemblage makeup.

Aging, Sexing, and Advanced Identification

Landon (2005) highlights that identification can and does go beyond simply naming a species. To bolster any interpretations, the ages and sexes of specimens should be identified. Herd structure, consumption habits, and environmental data can all be studied via these additional observations (Dincauze, 2000; Landon, 2005; MacKinnon, 2004; Thomas, 1996). Comparative collections and atlases, like with simple taxonomic identification, provide the chief aids in divining this information. Patterns of skeletal growth and wear, as well as sexual dimorphism between male and female specimens, serve as the primary avenues for further observation and identification.

Stages of growth are most prominently marked through one of two distinctions: juvenile-adult or continuous (MacKinnon, 2004). The former focuses on the fusion of epiphyses in bones. In humans and other animals, bones continue to grow after birth. This process is facilitated by the epiphyseal (or growth) plates. As an animal matures, the epiphyseal ends of bones fuse to their diaphyseal shaft. That fusion leaves a diagnostic scar on the long bone and makes the taphonomic separation of epiphyses from the element a nonfactor (Landon, 2005; MacKinnon, 2004). Epiphyseal fusion marks the juvenile to adult distinction for a given specimen, which can be useful for determining age. An animal does not fuse every element at the same time, meaning each fused or unfused element marks a different age distinction. Nevertheless, an assemblage of both fused and unfused elements can be explored to bolster minimum number of individual (MNI) calculations, as unfused elements might preclude specimens from being considered the same as another fused body part. Another category of juvenile-adult distinction lies with the dentition patterns of different species. Teeth offer concrete age ranges, as the development of deciduous and permanent teeth is fairly standard across a species. Though not every taxon grows at the same rate, researchers have compiled species-specific data for both epiphyseal fusion of elements and the shedding of deciduous teeth in a wide range of archaeologically prevalent species using modern, analogous relatives (MacKinnon, 2004; Wilson et al., 1982).

Continuous distinction determines relative age of an individual (MacKinnon, 2004; Wilson et al., 1982). However, rather than look at the growth of a bone or eruption of a tooth, continuous distinction looks primarily at dental decay. Observations pertaining to the average wear of a set of teeth indicates relative age, especially within a taxonomic group inside an assemblage. Like the former category of age distinction, this is primarily accomplished through the compilation of modern, analogous species data (Payne, 1985; Wilson et al., 1982; Zeder & Pilaar, 2010). These age distinctions are much more specific to a given assemblage. The rate of wear on teeth is determined by the food consumed. A gritty, tough material diet will result in the

accelerated wear of teeth. Thus, while helpful to identify age, these observations must be made within the confines of a given assemblage and in tandem with the more reliable dental eruption data.

Additionally, premortem bone trauma might be an indicator of both domestication and relative age. Pathologies associated with old age and long mileage can mark a relative adult distinction, as well as the added human element of care. Additional, unnatural bone growth indicates the animal lives well into adulthood (Baker & Brothwell, 1980; International Council for Archaeozoology & Bartosiewicz, 2018). This is not only limited to extreme cases such as hip dysplasia or some form of advanced arthritis, but merely an additional allocation or reorientation of exterior lamellar bone. An animal featuring additional bone growth has been afforded the opportunity to survive well into adulthood and likely past its natural lifespan as a wild animal. A healed bone break, for instance, suggests human care for the animal while the break healed (Baker & Brothwell, 1980; International Council for Archaeozoology & Bartosiewicz, 2018). These pathologies serve as an additional, though in many cases redundant, juvenile-adult distinction. It would likely be too large of a logical leap to guarantee that a non-diagnostic bone with a null fusion status is adult or juvenile based purely on the presence of osteological reorganization. Nevertheless, they continue to be powerful markers of taphonomic history and human interference in animal life.

The last major category of identification that zooarchaeologists employ in the efforts to glean information from faunal remains is that of biological sex. This technique relies on the natural sexual dimorphism between two species (MacKinnon 2004). For example, examining the pelvis of male and female cattle or the medullary bone of birds, when present in the archaeological record, can help quantify the sex ratio of different species (MacKinnon, 2004; Wilson et al., 1982). Jones and Sadler (2013) point out that these distinctions in sex are imperative in interpretative analyses of herds (See also MacKinnon, 2004). Unlike aging characteristics, sexual identification is not always tied to the most survivable bones in the

archaeological record. This renders sexing specimens severely limited as a tool, as it can usually only apply to a fraction of the remains recovered (Landon, 2005). Moreover, they vary from species to species. Curating the correct references is therefore essential to understanding what bones matter in which context. It is the most difficult and problematic subset of identification, due to the narrow variety of samples that would be visible to the archaeologist (MacKinnon, 2004).

Within the last decades, the advent and inclusion of ancient DNA might have also impacted zooarchaeologists ability to identify sex. The presence of a Y chromosome on male specimens makes them unique and easily identifiable, when searching for the correct genomic information. However, using this method purely for the filling in the sexual population of an assemblage does not appear in any texts surveyed. Instead, pre-identified males are used to trace Y chromosome lineage across time (Hofreiter et al., 2012). It remains unclear whether the continued evolution of microscopic identification will eventually lend itself to accurately depicting the male/female split of domestic populations. If possible, it would provide a powerful tool in the quantification and interpretation of herd structure.

Taphonomic Forces

Without question, when a bone is first unearthed, it does not look as it did when it was within its owner; bones undergo drastic destructive forces (e.g., bite marks, marrow harvesting, extreme heat). The culmination and summation of all the destructive forces on a bone postmortem is considered its taphonomic history. Taphonomy is the study of processes that affect an organism after death (Gifford-Gonzalez, 2018; Landon, 2005; Lyman, 2001). The taphonomic history of a bone and assemblages as a whole affect our understanding of taxonomic representation, skeletal attrition, age profiles, and various other patterns within the record (Landon, 2005).

Chiefly, taphonomic forces are an obstacle to understanding an assemblage as a whole record of human activity. If certain bones do not survive the destructive forces received, their

data is forever lost. This is perhaps the clearest indication of why a collection of faunal remains is considered an assemblage, not a population. Bone breaks down and is not guaranteed to be recovered during excavation. One of the most common phenomena associated with taphonomic history is density-mediated attrition (Landon, 2005). Put simply, this phenomenon dictates that the low-density bones are more likely to be destroyed than the high-density. Taxa with frailer bones are thus lost at a disproportionate rate (Binford, 1981; Landon, 2005). As an example, a society that slaughters sheep young, but cattle old, will have an overrepresentation of cattle bones. Delineation of this and other taphonomic processes, Landon (2005) argues, is essential to building a strong interpretive basis for any zooarchaeological assemblage. It is only after demonstrating what types of taphonomic processes affected an assemblage that a zooarchaeologist can begin to quantify the assemblage size and taxonomic proportions of fauna.

Archaeologists, no matter their subdiscipline, only deal with recovered material in its final state. Thus, untangling the various forces exerted on an artifact is of utmost importance for correctly acquiring the most information possible. A deposited stone tool, for instance, has gone through unknown cycles of crafting, use, discard, refinement, and reuse. This principle extends to bone remains and its taphonomic history. Often, subsequent forces can mask or entirely superimpose upon an earlier (Gifford-Gonzalez, 2018). This makes deciphering every moment in a taphonomic history difficult. Zooarchaeologists must grapple with the loss of information associated with these moments (Gifford-Gonzalez, 2018; Landon, 2005).

Questions of truthful representation of data have long been asked by zooarchaeologists examining taphonomy (Redding, 2002). Arguments stem from the point that faunal remains have been marred by the physical conditions of burial and excavation and thus cannot function as an appropriate source of interpretative data. Richard Redding (2002) coined the language “depressed taphonomist” and “taphonomic optimist” in response to these arguments. In many ways, this language is apt. The approach a zooarchaeologist takes in interpreting the taphonomy of an assemblage demands attention to detail and acknowledgement of what information has

been lost (Redding, 2002). Nevertheless, these taphonomic signatures are capable of retelling aspects of environment and human culture. Butchering marks indicate how humans disarticulate and cook skeletal elements (Gifford-Gonzalez, 2018; Redding, 2002). Scavenger damage, while destructive to a given specimen, details presence of commensal mammals. Understanding how bones decay in open air versus a subterranean environment can lend insight into how ancient humans discarded waste.

While comparative collections continue to be an integral asset to the zooarchaeologist for identifying different taphonomic signatures, experimental archaeology has transformed the researcher's ability to detect what happened to a bone. Modern lab work and experiments have provided examples of taphonomic markers that can be extrapolated backward. Butchering techniques with different tools yields insight into different types of cut marks that stone and metal tools might make. Analyzing fracture patterns on fresh, buried, and fossilized bone can inform how recent a break might be. Feeding bones to a family dog and recollecting the samples shows what a digestive tract does to trabecular bone. No matter the experiment, by creating a proxy for the archaeological record, zooarchaeologists have collectively homed in on the various agents of destruction. Following is a brief description of taphonomic forces. While in their entirety, such an endeavor would comprise an encyclopedia, the purpose of including a list of forces is to communicate the principles of acknowledging the many destructive agents impacting taphonomy.

Perhaps the force that zooarchaeologists are most interested in, the human evidence of bone manipulation is generally stark. Various butchering marks, percussive breaking of bones, and fire damage are unmistakably human (Gifford-Gonzalez, 2018). The human impact on bone most directly tells the story of production and consumption concerning a faunal assemblage. Butcher marks detail how animal parts might have been disarticulated and consumed. Burning can indicate patterns of both cooking and discard. In some societies, the use of bone as a material for tools informs aspect of both culture and environment.

Characteristics of the environment in which the bones were deposited largely influence the post-human taphonomic signature of an assemblage. Thus, it is necessary to understand what biotic and abiotic factors might impact a bone's survival. The majority of taphonomic damage a bone receives happens prior to its burial. Gnawing, piercing, and digestive damage consistent with whatever scavengers were present in the ancient environment should be expected (Gifford-Gonzalez, 2018). Weather can also impact the ability of bone to survive the archaeological record. Moisture levels, wind, and temperature all impact the appearance of bone prior to its burial (Gifford-Gonzalez, 2018). Active taphonomic agents such as scavengers and decomposers extract nutrients from the bone. If left unburied, these biotic agents often cause the complete disappearance of bone (Gifford-Gonzalez, 2018; Lyman, 2001)

The taphonomic history of an artifact does not stop with burial. Subterranean forces continue to act on the bone prior to its excavation. Decomposition of bone continues as burrowing mammals, insects, and underground fungus and bacteria harvest what little organic material they can discover. Rodents, whose biology demands constant chewing, find bone and continue to gnaw long after burial (Gifford-Gonzalez, 2018). Accumulation of stains and minerals as the bone rests obscure other taphonomic marks and complicate the identification process further.

Finally, a bone continues to be affected during and post-excavation. Breakage during recovery, destruction during cleaning, or bonding agents to mend breaks all represent the final chapter of taphonomic history. These forces are easiest to ignore but have value in retelling how excavation occurred and what avenues of preservation were taken. Over the long history of archaeology, these signatures have changed. Thus, it acts as one final impact on the bone and adds chronological data to its history.

Quantification

After an assemblage has been examined and catalogued, the zooarchaeologist is confronted with how to represent the data. The choices made on how to exhibit an assemblage

depends largely on the questions asked. There are numerous different methodologies, though the few outlined below remain the most common (Gifford-Gonzalez, 2018; Landon, 2005).

Most simple, bone fragments analyzed can be counted as individual units. The Number of Identified Specimens Present (NISP) displays the bulk count of an assemblage. No matter how small or fragmentary a single specimen might be, it receives equal quantitative weight to the largest specimens. Under certain analytical frameworks, counting by NISP is preferable (Zeder, 1988). Indeed, it does not leave any specimens out of the picture. It represents, arguably, the most truthful interpretation of an assemblage.

NISP's shortcomings stem from the issue of overrepresentation. Highly fragmentary bones are weighted heavily in comparison to intact, large specimens. Moreover, the NISP of an assemblage might favor taxa with more bones that do not necessarily correspond to more value. In terms of displaying the perceived cultural and economic significance of a species, NISP has the potential to misrepresent their importance.

The struggles associated with NISP have led to other calculated values that can augment or entirely supplant NISP figures in zooarchaeological literature. The most prevalent NISP companion (and sometimes replacement) is Minimum Number of Individuals (MNI), which attempts to sort fragments into hypothetical bodies. Anatomically identified elements are quantified. From those figures, a minimum number of individuals required to fit the assemblage's anatomical constraints is assembled. For instance, an assemblage with three left distal femur fragments and five right distal femur fragments would have an MNI value of five individuals. The most common element that must be placed in the same anatomical position determines the number of minimum individuals. MNI also has the potential to differentiate individuals based on age, due to the epiphyseal fusion of elements. If, for example, in the assemblage of eight distal femur fragments, all the right-sided fragments were fused and two of the left-sided fragments were unfused, then the MNI would be seven to reflect the quantities of both adults and juveniles.

MNI suffers due to its reliance on identified specimens. If a sample cannot be identified taxonomically or worse yet anatomically, it renders that specimen useless in MNI calculation. Thus, MNI is practically guaranteed to underrepresent a given assemblage. In this regard, NISP allows for a greater flexibility of data. While not to the same degree, indeterminate fragments can still be useful in interpreting a site. This is especially true in cases where options within a class size of mammal or vertebrate is largely singular. Thus, MNI and NISP are regularly presented alongside each other for comparison.

While anatomical and taxonomical information are identified from the bone and often form the basis of calculations, other physical qualities of faunal remains can also be used to quantify an assemblage. Weighing elements allows the researcher to break down an assemblage by size without having to provide measurements for each specimen. In this manner, large and complete bones have more significance than smaller, fragmented specimens. Interpretations based on percent weight of an assemblage can provide a rudimentary map for the value each bone might have represented in terms of food. Weighing also deflates the significance of more common bodily elements, like vertebrae or phalanx, in comparison to long bones.

The drawbacks to this methodology is mostly time-based. In large faunal samples, weighing every individual specimen adds immeasurable time to the analysis process that might not be worth the trouble. This issue can be circumnavigated in part by determining an average weight per element, then weighing bulk samples. If the assemblage has an equal mix of large, medium, and small vertebrates, the weight calculations could also stand to overrepresent large mammals in some interpretative structures.

Zooarchaeologists have these and many other quantitative methodologies at their disposal. Largely, these choices hinge on pragmatics of application and research goals. A sample of 500,000 long bone shafts might be dealt with best via rough size distinctions and bulk weighing, whereas a small assemblage of intact remains can be interpreted via a calculated MNI. For this paper, all three aforementioned quantification methods were employed. However, only

two were used in discussion of results. This exemplifies the variability that exists within the zooarchaeological field and the means by which quantification is used to transform data to fit a researcher's goals.

Materials and Methods

The Harvard-IuTAKE Excavation of the Anau South complex dug multiple trenches over their consecutive excavation seasons. Faunal remains were collected through either hand-picking by excavators, soil screening through a 1/4 inch (5 mm) mesh metal sieve, or water-screening using a 1/16 inch (2 mm) fiberglass sieve (Hiebert et al., 1995). Researchers from the Anau South progress report indicate while not ideal, hand-picking provided an adequate sample of small, medium, and large mammal bone (Hiebert et al., 1995). Specimens were collected, washed in water, and left to dry before being bagged with inside locus tags. Mandibles received special treatment to preserve their integrity and chemical information. The option to preform phytolith and isotope study of the teeth on mandibles was not lost on the excavation team, so mandibles were wrapped in tin foil and not washed, to prevent any ancient plant context from being eradicated.

The preliminary results, carried out by Dr. Katherine Moore with contributions from Erika Evasdottir and Sharri Clark, focused on the first three of six operations (AS/1, 2, 3). Results are discussed below in comparison to the results from this investigation. As stated above, this paper analyzes the faunal remains collected from only one of those trenches (AS5). In comparison to the work already completed by Moore et. al, AS5 has approximately the one third the quantity of both specimens and loci. Bones from AS4 and AS5 were originally left in Ashgabat, according to the progress report (Hiebert et al., 1995). However, the SAM identification number indicates they were loaned to the UPMAA in 1997. Since then, the unanalyzed bones have remained in their original bags for over 30 years.

In total, AS5 faunal remains numbered 1,246 specimens over 54 loci. Due to a lack of context, the assemblage can only be separated into two separate strata. The first grouping of loci

is comprised of a midden layer resting on top of an abandoned structure (AS5/4, 5, 7, 8, 9, 10, 11, 12, 14). All the other loci come beneath these, representing both the interior and exterior of the structure. Given the lack of context to the other 46 loci, it is unable to be seen if this structure was in a state of occupancy, or merely being used as a refuse area before being completely buried. For this paper, the strata will be divided into this midden layer and an underlying room layer. Moving forward, there is an opportunity to further comb individual field journals and notes collected in archives to divine a more exact understanding of the stratigraphy. Doing so might reveal unseen trends in the accumulation and discard habits of populations living at Anau as the space changed.

Lab work was conducted in 2022 from January to April to identify and catalogue the bones. This project being the first experience I have had with observing and cataloguing faunal remains, the progress was slow at first. The UPMAA's zooarchaeological comparative collection played a crucial role in my ability to identify the AS5 fragments; there are undoubtedly very few places in North America with access to a comparative *Equus hemionus* (onager) specimen. In total, this survey relied on both modern and archaeological *Bos* (cattle), *Ovis* (sheep), *Capra* (goat), *Gazella* (wild gazelle), and *Sus* (pig). Additional resources such as modern onager, *Equus caballus* (horse), *Hemiechinus auritus* (hedgehog), and various *Aves* and *Rodentia* (bird and rodent) skeletons also aided in the identification. These comparative specimens formed the basis for much of the identification process.

Examination of the assemblage consisted of cleaning the bones when necessary for identification, logging taxonomic and taphonomic identifications, measurement, weighing, and bagging in heavy-plastic bags with inside tags. No bones were marked with ink pending any future investigation. Dry brushing and rinsing with a half alcohol, half water solution were the two methods utilized for cleaning. The latter was only used when dry brushing failed, as a means to preserve the integrity of the bone structure. To avoid loss of microscopic context, mandibles

were only dry brushed enough to reveal the necessary life history and taphonomic markers. Element and taxa identifications were made once apparent.

Recording of data began using pencil and paper but shifted halfway through the study to directly logging data digitally. This shift was mainly for the purpose of time conservation. Despite shifting to a digital recording method, observations of dental age continued to be made on paper following Payne's aging sequences (Payne, 1985). This ensured that depicting aging patterns could still be achieved when necessary. Measurements were taken with dial calipers accurate to 0.1 millimeter whenever appropriate using von den Driesch's Peabody Museum standardization (Driesch, 1976). While measurement might eventually prove helpful in a larger analysis of Anau South material, there was not a large enough sample size of any given element that lent itself to further interpretation.

To understand the life history of these specimens, notes were made on any surface features of the bone that indicated a relative age or pathology. Most commonly, the presence of muscle and tendon attachment points were noted. However, unnatural bone growth, reorganization of lamellar bone, presence of dental calculus, and other markers of stress and age were noted.

As mentioned above, taphonomic forces were identified and logged. The taphonomy of these Anau bones was complex enough to warrant many subcategories of each force. In total, each fragment was checked for evidence of butchering, burning, scavenger damage, staining, mineral accumulation, weathering, and biotic etching. Additionally, bones featuring recovery breakage were noted to determine how archaeologists interacted with these specimens as they were unearthed, cleaned, and stored. Staining was judged by a progressive scale from minimal to dark, though uneven staining was recorded as the lightest designation present with an additional note on its variable condition. Subcategories of weathering included digestion, parallel cracking of lamellar bone, erosion, flaking of exterior surface, and variable staining conditions. Only one tag was assigned to a given specimen based on the most substantial

weathering component, though signs of multiple were noted when appropriate. It was through this noting of an additional component that biotic etching was separated into a distinct category. Biotic etching has a wide range of potential causes, ranging from fungal to root based. Due to time and lack of literature pertaining to these differences, etching marks were grouped together and tallied when present. Scavenger damage was subdivided between rodent and indeterminate carnivore, which was done to help determine canine and commensal mammal presence from post-depositional scavenger damage by intrusive burrowing mammals. Specimens clearly digested were also marked as having carnivore damage, even if no specific puncture or breakage could corroborate. Different stages of bone charring were marked, ranging from partial burns to pure calcine white. Cut marks were simply recorded as present or not present, with additional notes taken on the location and number. Pre-depositional hack marks were included as cuts but noted to be hack marks. Mineral accumulation largely pertained to retaining of salt or soil on the exterior of the bone post-cleaning.

Archaeological recovery breakage was somewhat common, so effort was allocated to the refitting of bones that showed new breakage with varied success. While time-consuming, these efforts aided in preventing an overinflation of NISP values and proper representation of taxonomic proportions. There were also cases in which multiple elements from an individual animal were found across one or neighboring loci. In a similar fashion to refitting fragmented bones, these elements were noted as being of a satisfactory fit. However, they were logged separately to ensure proper element proportions and differing taphonomic history. Some discussion can be made of these skeletal units, which overwhelmingly feature cut marks across the unit. Butchering and deposition of specific body elements in tandem indicate patterns of consumption that yield more specific interpretation.

In terms of quantification, it was mentioned that elements were also weighed during analysis. Thus, this survey operates with two main vehicles of statistical analysis: NISP and weight. Elements were given both a broad, size-based identification and a more specific

taxonomic identification if possible. For interpretation, certain body regions are quantified and referenced. Distal limb elements were defined as phalanges, metapodials, and the tarsal/carpal bones. Throughout the assemblage, only one verifiable sesamoid bone was identified. This sample was excluded in the distal limb element calculations. Additionally, distinctions between cranial, axial, and limb regions of the body were calculated. All vertebra, sternum, and pelvis fragments were grouped to form the axial portion. Teeth, mandibles, and cranium fragments were grouped into the skull or cranial portion of the animal. Limbs follow the same anatomical groupings as the more specific forelimbs and hindlimbs, which are discussed both in tandem and comparatively. The forelimb starts at the shoulder (scapula) and extends to the phalanges. The hindlimb starts with the femur and continues to the phalanges.

In the case of sheep and goat, the comparative specimens were often not substantial enough on their own to validate distinctions. Thus, resources concerning specific elements were consulted to further discern bone fragments (Payne, 1985; Prummel & Frisch, 1986; Zeder & Lapham, 2010; Zeder & Pilaar, 2010). The most consistent identifiable elements were distal limbs, especially the phalanges. Mandibular teeth feature diagnostic morphology, allowing for most teeth to be identified to a taxonomic level (Payne, 1985; Zeder & Pilaar, 2010). Epiphyses of long bones are also diagnostic but did not survive at the same rate as bone shaft fragments. Certain fragments, especially axial, could be ruled as either sheep or goat via size or morphology. These identifications were made using multiple published sources in addition to the UPMAA's comparative collection (Payne, 1985; Prummel & Frisch, 1986; Zeder & Lapham, 2010; Zeder & Pilaar, 2010). For an exhaustive list of identified elements, see the Table 5 in the appendix. Taphonomy certainly impacted which bones were able to be identified. Furthermore, presence of other medium-sized mammals like gazelle complicated the identification of these shafts as verifiably sheep or goat. Thus, the true proportion of sheep and goat bones in this assemblage is likely higher than this data shows.

There were also troubles in discerning between various potential equid species that might have been present at Anau. The UPMAA does have access to multiple horse and one partial onager skeleton. However, the extant literature on distinguishing those taxa and the comparative collection did not offer convincing diagnostic evidence beyond equid. Previous Anau literature cites Bronze Age evidence, however rare, of domestic horse (Hiebert & Kurbansakhatov, 2011). That, combined with potential presence of both wild onager and wild ass left the few equid specimens stuck at the genus level.

In fact, due to species variation and limitations on the comparative collections, most all identifications were left at the level of genus. A highly specified comparative collection might succeed in yielding species, especially regarding the equid and small vertebrate remains. Moreover, a full-scale investigation of all faunal remains at Anau South might provide enough variation to discern any presence of wild sheep (*Ovis ammon*) or bezoar goat (*Capra aegagrus*) from the domesticated herd (Heptner et al., 1988; Hiebert & Kurbansakhatov, 2011). While there was no clear sign of either wild species being present in this assemblage, wild sheep and goat were found at Anau North (Hiebert & Kurbansakhatov, 2011). Their lack of presence in AS5 and potentially all of Anau South would indicate a shift in hunting practices or the availability of these wild taxa. Specimens might also be sent to a lab for ancient DNA sequencing, bolstering the taxonomic specificity of the study. Future avenues of study are thus available for this assemblage, both as an individual trench and as part of the Anau South larger excavation.

Data and Discussion

The AS5 faunal assemblage yielded a spread of species consistent with previous Anau depe studies (Hiebert et al., 1995; Hiebert & Kurbansakhatov, 2011). Overwhelming numbers of indeterminate medium mammal fragments shade the remainder of the assemblage. Nevertheless, the specimens that could be identified provide interesting context to human activity at the site. The overall taxonomic representation shows a strong prevalence of sheep and goat consumption. Other domesticates *Bos* and *Sus* comprise a remaining 10% of domesticated

fauna. Wild animals such as gazelle and onager are believed to be present as a periphery dietary option, though due to a lack of proper comparative specimens, the separation of onager from other equids was not made. Intrusive burrowing vertebrates (a turtle, hedgehog, and multiple rodents) were found in some of the deeper loci. *Aves* bone was identified in small quantities, though the UPMAA's comparative collection did not allow for satisfactory identification, save for one specimen. A set of two large mammal pelvis fragments are believed to be camelid, but no proper comparative material could be utilized to verify that hypothesis.

In terms of elements, there is an even display of symmetry. Forelimb and hindlimb elements number in roughly the same amounts. The number of left and right sided elements are approximately even. The vertebrae elements are in roughly correct anatomical proportions; the thoracic are most numerous, followed by cervical and then lumbar. These statistics indicate an indiscriminate consumption pattern, though that might be contested when elements are broken into taxonomic identifications. 64% of the skeletal elements were able to be identified, with another 36% accounting for shaft fragments and indeterminate bone fragments. Many cranial and vertebral fragments, as well as practically all rib and shaft fragments, were most often left at an indeterminate taxonomic identification, though filtered by size when possible.

Figure 2 details the anatomical distribution of the medium mammal size category of taxa. Including identified sheep, goat, gazelle, and pig, this category comprised the vast majority of NISP (1118 specimens). For this diagram, "Other Fragments" includes indeterminate bone, as well as categories too few to represent on their own: ten sternum fragments and two patella fragments. As stated above, distal limb elements are comprised of phalanges, tarsals, carpals, and metapodials. For a complete tabulation of elements identified for all three class sizes of vertebrate, see Tables 8, 9, and 10 in the appendix.

Table 1. Vertebrate Remains, Anau South 5.

<u>Species ID</u>	<u>Count (NISP)</u>	<u>%NISP</u>	<u>Wt (g)</u>	<u>%Total Wt</u>	<u>MNI</u>	<u>%MNI</u>
Bos	14	1.1	392.3	7.6	1	3.7
Equid	10	0.8	475	9.3	2	7.4
Bovid	1	0.1	4.1	0.1	-	
Sheep/Goat	167	13.4	1270.26	24.8	11	40.7
Ovis	51	4.1	618.85	12.1		
Capra	32	2.6	339.27	6.6		
Pig	7	0.6	103.2	2.0	2	7.4
Gazelle	10	0.8	31.3	0.6	2	7.4
Aves	5	0.4	1.5	<0.1	2	7.4
Hemiechinus sp.	1	0.1	0.6	<0.1	1	3.7
Testudo sp.	6	0.5	0.67	<0.1	1	3.7
Rodent	34	2.7	3.07	0.1	5	18.5
Lar. Mam. INDT.	27	2.2	395.75	7.7	-	
Lar./Med. Mam. INDT.	8	0.6	22.2	0.4	-	
Med. Mam. INDT.	851	68.3	1454.06	28.4	-	
Mam. INDT.	21	1.7	16.17	0.3	-	
Sm. Mam. INDT.	1	0.1	0.07	<0.1		
Total	1246	100%	5128.4	100%	27	100%

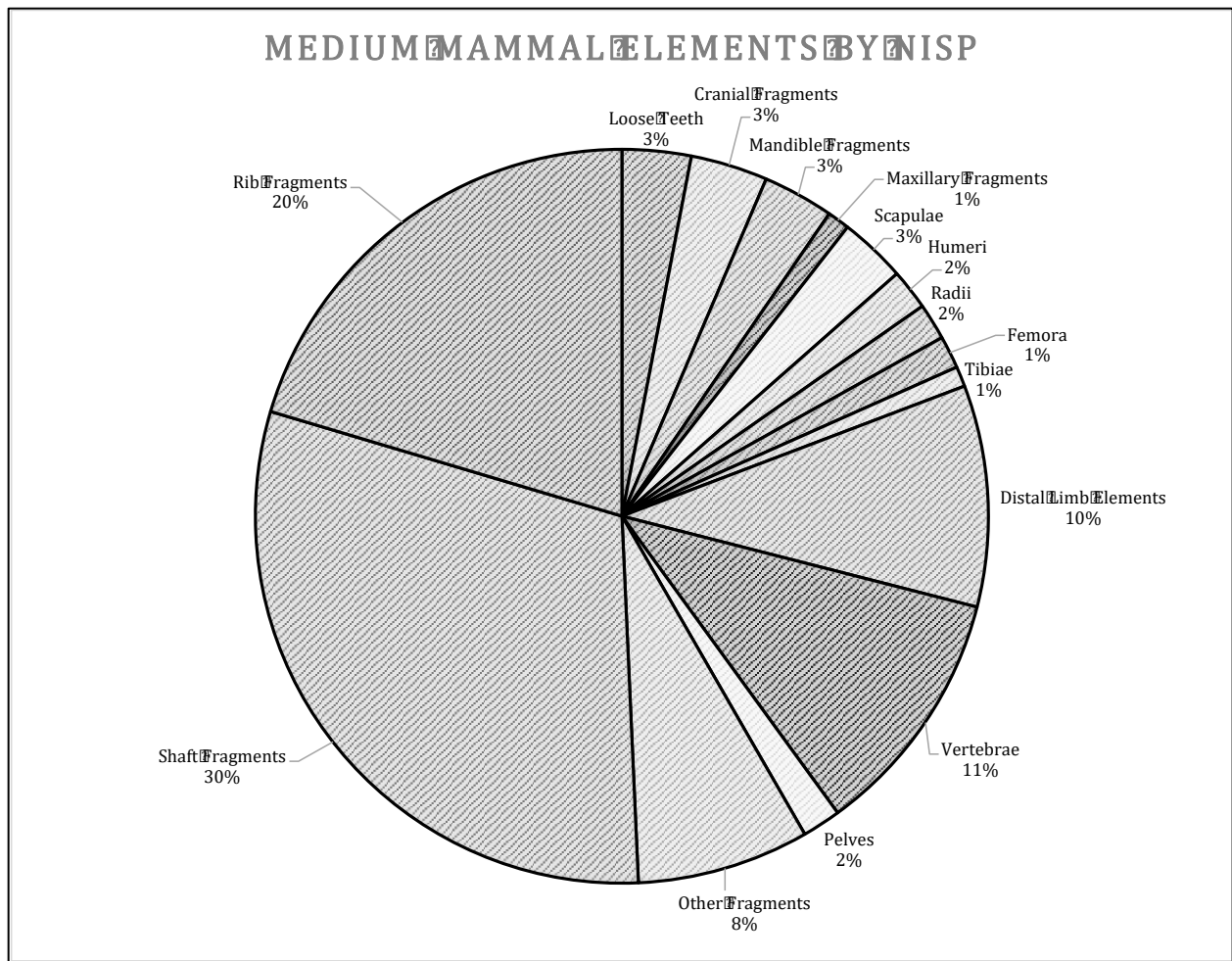


Figure 1. Medium Mammal Skeletal Parts, Anau South 5.

Cattle

The presence of domestic cattle Moore et al. found at Anau North continues to be represented here at AS5, though at a markedly smaller proportion (Hiebert & Kurbansakhatov, 2011). Anau South's stratigraphy being that of a later time period than Anau North and other Kopet Dag sites in which domesticated cattle have been identified indicates a continuity of familiar pastoral herd structure (Hiebert & Kurbansakhatov, 2011).

Over three quarters of the cattle recovered from AS5 stem from the room context underneath excavated midden. The bulk of the *Bos* specimens stem from a single butchering unit found at locus 24. A collection of carpal bones, a metacarpal, and first phalanx exhibit cut

marks that stretch across bones (see Figure 2). Rib fragments and two heavily worn teeth were also identified. Cattle bones are outnumbered to a large degree by the domesticated caprid species, though provided more meat per element. In terms of weight, the cattle bones account for approximately 14% of identified domesticate bones. However, that figure drops to around 9% when caprine sized indeterminate bones are included. No matter the case, it appears that at least in AS5, the prevalence of cattle is significantly lower than at Anau North (Hiebert & Kurbansakhatov, 2011).



Figure 2. Carpals and metacarpal of Bos sp., AS5/24.

Sheep and Goat

Caprine pastoralism undoubtedly served as the primary element of animal production at Anau and in the Kopet Dag region. Despite offering different economic and ecologic niches, their biological similarities and similar environmental ranges make them hard to separate. Combined, they account for almost 90% of domesticates and approximately 20% of all specimens. These figures increase drastically with the inclusion of indeterminate medium mammal bones. While these fragments showed no diagnostic features consistent with sheep or goat, given the historical prevalence of other medium-sized mammals, it is a somewhat safe assumption that many of the “Med. Mam. INDT.” fragments belong to the caprine subset.

The proportion of sheep to goat has the capability to inform researchers about the decision making of herd management. In this sample, identified *Ovis* outnumbered *Capra* ~3:2. That ratio jibes with the known Anau assemblage proportions, with Anau North sheep ranging from 64-88% more common than goat and the previously studied Anau South faunal remains only identifying three specimens per taxa at AS3 locus 37 (Hiebert et al., 1995; Hiebert & Kurbandsakhatov, 2011).

In terms of the two identified strata, the midden episode accounts for 12% of the sheep/goat elements if indeterminate medium mammal fragments are assumed to be sheep or goat. This hypothetical figure meshes with the overall ratio of elements in the two strata (midden accounts for 13% of all NISP). Comparisons of elements also yields roughly symmetrical proportions. There is a slightly higher prevalence of forelimb elements; humeri and radii both outnumber the counterpart femora and tibiae. The number of specimens is not substantial enough to conduct a full-scale investigation of element measurements, though it should be noted there is a wide range of variability, to the point that presence of one or multiple wild individuals should be considered.



Figure 3. Refitted distal limb element and cervical vertebrae, *Ovis*, AS5/46.

Many of the distal limb elements, especially the tarsals, carpals, and phalanx, show evidence of digestion. There is also evidence of butchering units in both strata, with axial and limb elements within a locus fitting together (see Figure 3). Cut marks were found on 18% of

identified caprine remains. The butcher marks appear indiscriminately by type of element, though the placement of cuts appears somewhat standardized. A further study of butchering habits could likely be constructed from AS5 in tandem with the faunal remains from the other Anau South trenches.

Pig

In Anau South 5, pig appears the least of the domesticated animals. They account for a meager 2.5% of all domesticated animals and less than 1% of the NISP. Because it falls into the size category of medium mammal, the count of pig elements might be underrepresented. Nevertheless, the identifiable pig fragments number in the single digits. These statistics are vastly lower than that of the Anau North deposit, which identifies an MNI of 73 domestic pigs across their loci (Hiebert & Kurbansakhatov, 2011). Because of the confined context of AS5, it remains unclear if pig had so heavily declined in popularity as a food source or merely did not make it to this trench for deposit in high quantity. The Harvard-IuTAKE progress report found pig remains in analyzed AS1 assemblages, but not in analyzed AS2 or AS3 collections (Hiebert et al., 1995).

Of the elements recovered from AS5, a majority are axial. Cervical and thoracic vertebrae account for five of the seven identified pig remains. The prevalence of those elements might indicate that while pigs were not being eaten in full at AS5, butchered segments of spine and ribs made their way to AS5. Since no ribs were categorically identified as pig, this interpretation is remains tenuous.

Wild Animals at Anau

Wild animals at AS5 serve as a largely periphery influence on the faunal assemblage. Both gazelle and equid remains are found in this assemblage. While the equid remains could not be verified as strictly onager, the rarity of domesticated horse at this assemblage practically guarantees that these animals were hunted, taxon aside (Hiebert et al., 1995; Hiebert & Kurbansakhatov, 2011). In total, 20 remains of nonintrusive wild mammals have been

identified, accounting for less than 2% of the NISP. Again, this number has the potential to be underrepresented through gazelle shaft fragments being grouped with medium mammals and equid shaft fragments being grouped with large mammals. Nevertheless, this data jibes with other parts of the Anau assemblage. These two animals are the wild taxa most commonly found at Anau North (Hiebert & Kurbansakhatov, 2011).

Curiously, there are large strata differences between the midden episode and occupation period. Equids in the much smaller midden episode outnumber the other strata 4:1. Gazelles are found across those two strata at an even 1:1 ratio, despite the room strata being 6.5 times the size in terms of NISP. It would appear that AS5's use as a midden deposit came with a greatly increased discard rate of wild animals. Analysis on whether this trend holds for more trenches across Anau South could yield interesting insight into the consumption and discard habits of wild animals at Anau. It is also clear to see that these animals were killed to be consumed. While obviously part of a small sample size, these bones exhibit the highest rates of cut and burn marks (see Table 2).

Small Animals

There was a total of 47 bones (3.8%) that belonged to small vertebrates in the AS5 assemblage. A vast majority of those (72%) belonged to either a rat or mouse sized rodent. Except for the five *Aves* bones, these remains were intrusive to the context they were occupying. None of the rodent, turtle, or hedgehog bones displayed any of the taphonomic signatures consistent with this deposit. Indeed, most rodent gnawing present in this assemblage superimposes previous taphonomic signatures, indicating a post-burial intrusion (see Figure 6). These intrusive vertebrates cannot be interpreted as part of the Bronze Age assemblage but can be interpreted as a taphonomic agent on that assemblage. However, the five bird bones found in AS5 are likely archaeological in nature. One specimen is burned and another swallowed, both indicating a non-intrusive deposit. Only two elements were identified, a humerus and first phalanx. While taxonomic identifications could not be made based on the comparative

specimens and documents consulted, the humerus was able to be identified as not part of the order Passeriformes.

It is worth noting that while a screen bias cannot be detected in the medium and large mammal specimens, the locus clusters of small taxa are likely indicative of hand-picking. Indeed, small vertebrate remains were only found in 20 of the 54 loci. Their small size and clustered recovery translate to many remains likely lost during screening.

Taphonomy

This study closely watched the various taphonomic forces to which each bone was subjected. The human damage to bones has been discussed to some degree above but not concerning the entire assemblage. A total of 76 bones (6.1%) featured verifiable cut marks. While not divided into an additional category, five of those specimens featured hack marks as a sign of butchering. Three of those five also featured cut marks. Additionally, a total of 137 bones (11.0%) possessed some degree of burning. The burns are subdivided into four states of char coinciding with the requisite temperature required to produce that mark. More than half the bones were subjected to low heat incapable of turning the color of the bone white (see Figure 5). Eight bones across the assemblage featured both burn and cut marks.

The midden layer contains a higher proportion of human-impacted bone (either burned or cut) at 21.1% of samples. This is markedly higher than the 13.5% of human-interacted bones found in the room layer, especially given that the layers are so different in size (166 fragments in the midden to 1080 in the room). There are countless hypotheses as to the discrepancy between layers. Most pertinent to previous conversation in this paper, the inclusion of more wild animals with clear human food preparation marks in the midden layer might be the culprit. When the eight wild animal fragments with human taphonomic signatures are removed from the midden assemblage, the midden layer's new percentage of human-interacted bones drops to 16.3%. If the indeterminate shaft fragments are believed to be overinflated, this might further reflect an accurate proportion.

Table 2. Cut and burn marks by taxa, Anau South 5

<u>Species ID</u>	<u>Cuts</u>	<u>%NISP Cut</u>	<u>Burned</u>	<u>%NISP Burned</u>
Bos	4	28.6	2	14.3
Equid	4	40.0	0	0.0
Bovid	0	0.0	0	0.0
Sheep/Goat	31	18.6	15	9.0
Ovis	9	17.6	4	7.8
Capra	6	18.8	2	6.3
Sus	1	14.3	0	0.0
Gazelle	2	20.0	4	40.0
Aves	1	20.0	0	0.0
Carnivore	0	0.0	0	0.0
Testudo sp.	0	0.0	0	0.0
Rodent	0	0.0	0	0.0
Lar. Mam. INDT.	1	3.7	1	20.0
Lar./Med. Mam. INDT.	0	0.0	0	0.0
Med. Mam. INDT.	17	2.0	87	10.2
Mam. INDT.	1	4.8	4	19.0
Sm. Mam. INDT.	0	0.0	0	0.0

The presence of human-based damage does not seem to favor any elements at overtly higher proportions than their %NISP. The most cut element was the mandible, with eight of the 44 featuring at least one mark. However, the element with the highest proportion of cut marks in relation to total NISP was the atlas. Out of the five atlases identified, three had cut marks. Other elements with relatively high proportions include hyoids (cut at a rate of 50%), astragali (cut at a rate of 44.4%), and axes (cut at a rate of 42.9%). Concerning burn marks, debate can be had over whether to tally each state of destruction as a standalone condition. While that data can be calculated, here it is simpler to discuss all stages of burn wear together. The most burned element were ribs, with 39 of the 238 rib fragments exhibiting some state of burn damage. Like cut marks, a different element had the highest percentage of NISP with burn damage. In this case, it was the 35.1% of indeterminate vertebrae that were burned. When all vertebrae are

counted together, 18.0% of the 133 specimens were burned. Other highly burned elements were all very low in bulk NISP, such as the one out of four horn cores (25%) that were burnt and the one out of five calcanei (20%). While these figures are included, no noticeable trends in terms of body regions stood out for either burning or cutting. Included below is a diagram of the cut marks found on sheep and goats placed on an anatomically correct model. While the model shown is a goat, the cut marks are counted from the “*Ovis*”, “*Capra*”, and “Sheep/Goat” categories of identification. This was done to match Table 1’s MNI estimation for sheep and goats, which was a total of 11 individuals compiled using all three aforementioned categories. Phalanx were only cut once on sheep and goat identified specimens, but it should be noted that no side data (left, right, forelimb, hindlimb) was generated for this particular specimen.

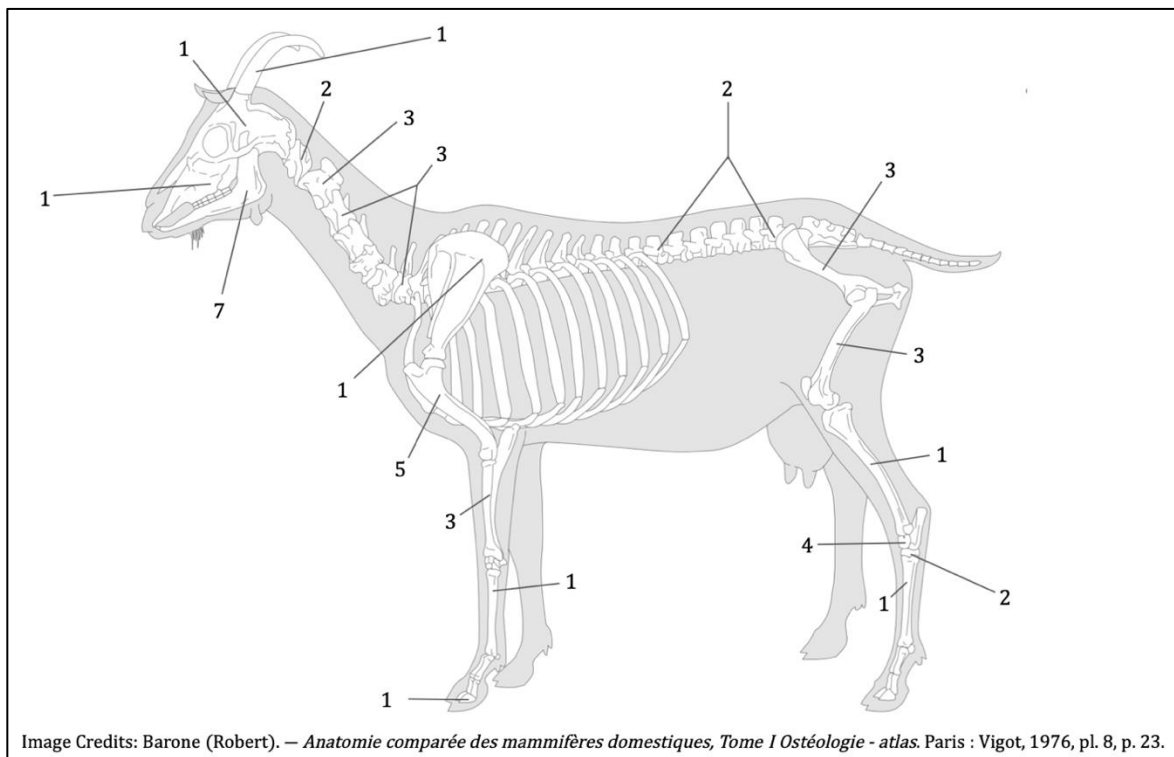


Figure 4. Count of cut marks organized anatomically on *Ovis* and *Capra*, Anau South 5.



Figure 5. (Left) Collection of specimens burned to various conditions, AS5/34. (Right) Collection of cut specimens, AS5/13.

Scavenger damage affected 217 specimens (17.4%). Breaking that figure down into the two respective categories of analysis, rodent damage was present on 140 specimens and carnivore damage on 100 specimens. A total of 23 fragments featured both carnivore and rodent damage. This damage can be plainly described as gnaw marks, piercing damage, or non-human breakage. Carnivore damage numbers were augmented by the inclusion of digested samples with no direct sign of gnawing, piercing, or non-human breakage. Assumption of all digested bone as animal-based and not human-based might stand to inflate the carnivore damage statistics, though only seven fragments of the 100 with perceived carnivore damage were logged in this manner.

Again, the midden layer has a steep edge in the percentage of affected specimens (27.1% to 16.0%). However, the explanation for this discrepancy appears more straightforward. The

midden layer scavenger damage was mostly caused by rodents at a ratio of nearly 3:2, whereas the room layer was about equal in terms of types of scavenger damage. If a refuse dump is interpreted as a more readily rodent-infested habitat than a human-occupied structure, a higher prevalence of rodent damage is expected to follow.

Elements affected by scavengers at the highest rate were shaft fragments and ribs for both rodents and carnivores. In total, 37 shaft fragments and 35 rib fragments were affected by rodents while carnivores inflicted damage on 22 shaft fragments and 8 rib fragments. Notable elements with high percentages of rodent damages were the ulna shaft fragments (75.0%), the atlases (60.0%), and the sacrum fragments (50.0%). While these percentages may seem high, the total NISP of each aforementioned element category did not exceed five specimens. In terms of high percentage elements with carnivore damage, a specific body region emerges. Distal limb elements, especially phalanx, display three of the four highest propensities for this taphonomic force. 30.9% of the phalanx bones were logged with carnivore damage. The element with the highest percentage of carnivore damage was the astragalus. In bulk, the metapodials, tarsals, carpals, phalanges, astragali, and calcanei were damaged at a rate of 23.0% and account for 28.0% of the elements damaged by carnivores. Rates of digestion are even more stark. Distal limb elements account for nearly half of digested samples (46.5%).



Figure 6. Rodent gnawing on indeterminate bone fragment, AS5/7. No scale was generated for this sample, though the sample is known to weigh 5.0 grams.

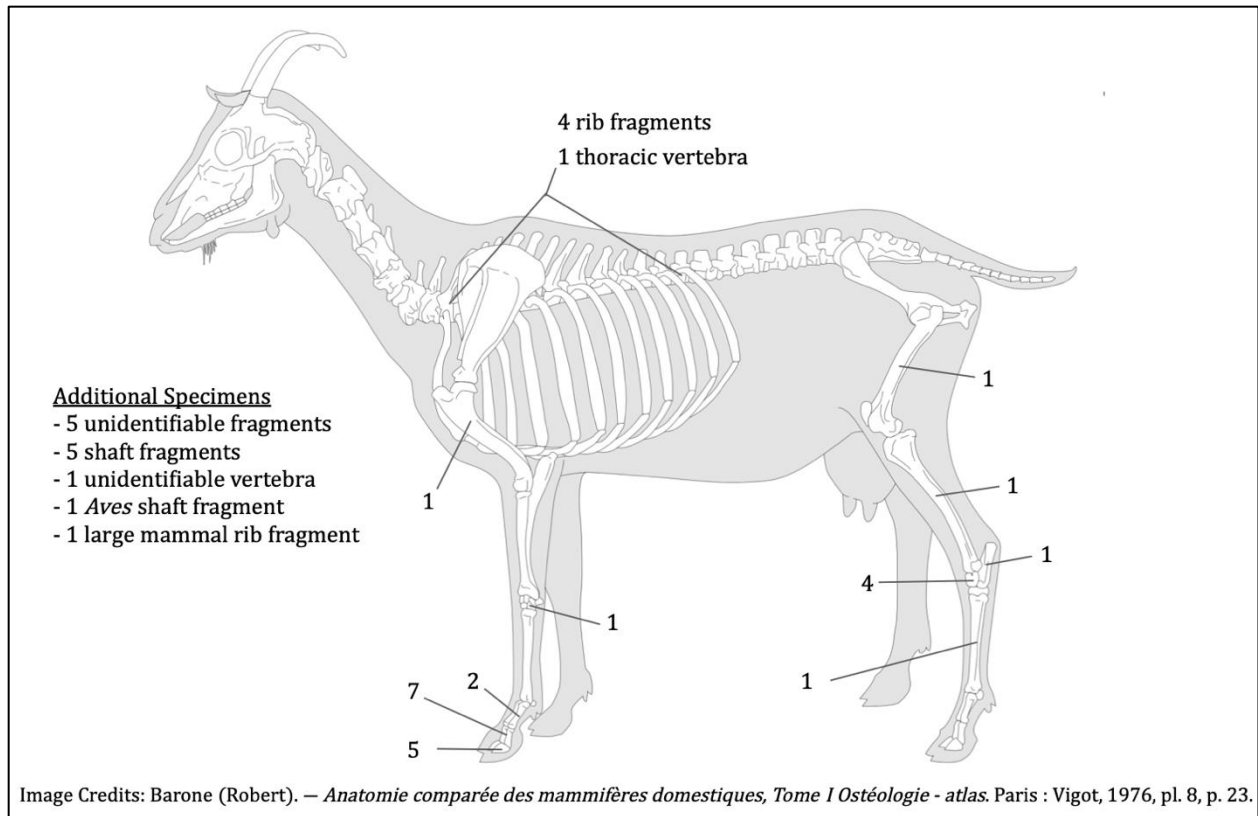


Figure 7. Count of digested specimens organized anatomically on *Ovis* and *Capra*, Anau South
5. Indeterminate and non-caprine digested specimens also listed.



Figure 8. Carnivore puncture marks on anterior and posterior aspects of distal radius, AS5/50.



Figure 9. Equid metapodial with signs of carnivore gnawing on distal end, AS5/15. Note also linear stains on shaft believed to be etching.

Biotic etching is somewhat hard to parse, due to the numerous potential causal agents. The characteristic markings that “comprise” etching could be caused by bacteria, insects, fungi, and plants - or something else entirely. Little research has been done to attempt to differentiate markers made by fungi, grasping roots, or microbial decomposers. It remains to be seen if specimens can be parsed further than broadband “etching,” though the manifestation of this condition contains considerable variety. Almost one fifth of all NISP was affected by etching to some degree. In total, 247 elements (19.8%) of specimens had etching damage. Notably, only 7 (16.3%) of digested specimens also harbored etching marks. This would indicate that the digestive tract, by and large, is not a potential culprit for etching and instead be a separate taphonomic event. Nearly three quarters (72.9%) of specimens with etching had no other form of weathering associated with it.

Across taxa and strata, etching damage is largely indiscriminate. The midden layer etching rate (21.1%) is within 2% of the room layer (19.6%). Eliminating categories with ten or less total NISP, all remaining taxa are within 14% of the assemblage counts. In eliminating those taxa, the etching rate jumps to 20.7%. However, it appears that larger taxa are affected at a higher rate: *Bos* at 28.6%, *Equus spp.* at 40%, and indeterminate large mammals at 33.3%. Additionally, elements most affected were all long bones (radii, humeri, and metapodials).

Elements with larger surface areas seem most likely to be affected; other high rates of etching can be found on ribs, pelves, and mandibles. A potential comparison concerning available surface area of a bone and rate of etching might be fruitful in the future.



Figure 10. Distal *Capra* femur exhibiting etching, AS5/87.

The most common taphonomic force exhibited on the AS5 assemblage was staining of the bone exterior. This occurred, to some degree, on a total of 88.0% of NISP. The staining was logged on being either minimal, light, medium, or dark in color. This scale was designed somewhat arbitrarily and only conducted via eye testing. While inexact, the point of doing so was to log the destruction of bone over time. Precisely what environmental agent causes staining of this degree, specifically in Anau's context, remains unknown. Nevertheless, logging this taphonomic signature and its relative frequency may prove beneficial for future studies. Over half of the NISP fell into either a light or medium level of staining (30.7% and 31.5%, respectively). Another 16.1% fell into the category of dark staining and 9.6% exhibited minimal staining.

While more is made of these stains in the conclusions, it should be mentioned that an additional "Uneven Dark Stains" category is in Table 6 in the appendix. This staining was tallied as a separate weathering phenomenon. It occurs simultaneously to the minimal-light-medium-dark scale and was used to mark an uneven staining pattern that featured darker splotches of

stains. Only 6.7% of samples featured this taphonomic signature, but it was stark enough to make a note. It can be seen on Figures 2, 5, and 9.

In terms of how these stains were distributed, it appears taxonomically and anatomically random. No noticeable trends emerge. The same is mostly true of stratigraphic differences. The midden layer does have a higher proportion of specimens without any staining (22% as opposed to 10% in the other layer). However, this is likely related to the burn taphonomy. All samples burned to either a blackened or calcined stage with no remaining uncharred surface area were designated as not stained. Since midden had a higher level of burn marks, this discrepancy is not noteworthy.

While etching and scavenger damage represent the biotic taphonomic agents, the effects of weathering are abiotic. Moisture levels, sunlight, wind, and other factors all impact the structural integrity of the bone and can lead to decay. In a harsh context like Anau, understanding the frequency of these taphonomic signatures is essential to grasping what might be missing from the assemblage. Four main abiotic signatures were identified: dark uneven stains, parallel cracking, flaking, and erosion of the exterior. These destructive markers cumulatively affected 22.8% of the assemblage.

Between the strata, there was little variation in any of the four signatures. There were, however, certain categories of anatomical significance. Erosion, for instance, is on an axial element in 21 out of the 42 cases. Erosion strikes axial elements at three times the rate other fragments display it. Flaking appears inverse for this assemblage, with cranial and limb elements (45.5% and 31.8%, respectively) exhibiting this feature at more than double the rate of axial elements (14.1%). Dark spots and parallel cracking have rates across anatomical sections within 10% of the mean, indicating these taphonomic forces are more indiscriminate. The quantification of these rates can be seen in the raw NISP counts of Table 3.

Table 3. Count of total NISP affected by major weathering categories, Anau South 5.

<u>Elements</u>	<u>Dark Spots</u>	<u>Erosion</u>	<u>Flaking</u>	<u>Parallel Cracking</u>	<u>Microbial Smoothing</u>	<u>Grand Total</u>
Cranial Fragments	7	2	10	3		22
Axial Fragments	19	21	10	14	7	71
Limb Elements	55	18	56	16	31	176
Other Fragments	3	1	3	3	5	15
Grand Total	84	42	79	36	43	284

The final category of taphonomy covered in this survey is mineral accumulation. While the most common individual taphonomic signature, this likely means the least in terms of interpretable data. Over two thirds (67.7%) of NISP had salt or dirt stuck to the exterior of the bone. While effort was made to clean them, time did not permit for each bone to be wiped entirely clean. All mineral and soil accumulation was not guaranteed to be removed. Thus, any bone that entered the new locus bag with soil or minerals still stuck to the exterior was marked as having salt accumulation.

The makeup and significance of this salt will be discussed in more detail in the concluding remarks, but it should be noted that there was little difference in strata, anatomy, or taxa in terms of the salt. Every major category by which this data can be broken up was within 7% of the mean. This taphonomic signature is indiscriminate.

Conclusions

This assemblage represents only a very partial image of Anau South's full faunal data set. Nevertheless, if the data in this trench are indicative of larger trends at Anau, then much has changed from Anau North (Hiebert & Kurbansakhatov, 2011). Pastoral herd makeup is drastically different than the earlier North context, with cattle and pig almost an afterthought. This departure would represent some sort of change by Anau residents from the North to the South context.

During the lab work portion of this research, the hypothesis that stood among the rest was that AS5 represented a context of a consumer, not a producer. At this location, the

pastoralist bulk processing and consumption of animals does not appear to be the norm (Zeder, 1988). The disproportionate anatomical distribution of all domesticates shown in Table 7 of the appendix indicates a *standardization* of butchering practices (Zeder, 1988). In this regard, all that a *standardization* refers to is a higher than natural prevalence of the meat-bearing parts of the body (Gifford-Gonzalez, 2018; Zeder, 1988; Zeder & Arter, 2008). Using other Anau South trenches to verify or contradict the trends of this unit might yield additional insight into Anau South as being comprised of consumers or part of an era of time in which some domesticated species were greatly reduced in number. Nevertheless, the consumer/producer hypothesis remains the most convincing without demanding further analysis of Anau South trenches.

Alternatively, cattle and pig require more water than their caprine cousins (Dincauze, 2000; Gifford-Gonzalez, 2018; Zeder, 1988). The decline of pig and cattle NISP could thus represent a shift by animal owners in response to some external environmental constraint. A long drought or a shift towards more intensive agricultural practices would certainly force pastoralists to rethink their model of animal husbandry. Being so close to the Kara Kum desert, water allocation likely played a large role in the cost-benefit analysis of raising animals.

This latter theory begs the question of who was making the decisions regarding herd composition. Drawing species proportion and anatomical representation data together, Zeder (1988) has set out a predictive model for the level of urbanization at a given site. Specialized decision-making and specialized economic production, Zeder argues, are two of the major components of a state or urban governing system (Zeder, 1988). Under her model, AS5 would indicate a certain level of indirect consumer relationships and therefore an urban situation. The presence of anatomically incorrect skeletal portions, combined with a historic presence of cattle and pig still verified to exist in this context, are zooarchaeological predictors of an urban setting (Zeder, 1988). The missing component is age and sex data. Sexing this assemblage proved largely impossible, save for one or two likely female sheep elements. Age data was somewhat abundant in terms of fusion states and teeth, especially for caprid specimens. However, time

constraints of this project – in classic archaeological fashion – have led to this aspect of research not being included. Nevertheless, the data exists and was logged. Therefore, incorporating age data would likely be pertinent in any future study of Anau South and AS5.

As stated above, there remains a distribution of wild animals recovered from AS5. The continuity of wild animals suggests that pastoralists were actively engaging with herds of herbivorous mammals. Their continued skeletal presence in human contexts indicates that Anau residents were aware of their life cycles, migration habits, or other ecological aspects that made hunting easy enough to continue. Moore et al. suggested in their chapter on Anau North that these wild animal hunting patterns could be indicative of opportunistic hunting on species that wander too close to caprine grazing grounds (Hiebert & Kurbansakhatov, 2011). In the same manner as water would be imperative in agricultural and husbandry decision-making, pastoralists knowing water stops for their herds very well could have forced them into contact with these wild animals. Like cattle and pig, however, the rates of consumption are significantly smaller than Anau North's prevalence data (Hiebert & Kurbansakhatov, 2011). The analyzed remains from AS/1, 2, and 3 rest somewhere between AS5 and Anau North's quantities of wild animals, indicating that a lack of wild animals in AS5 might be an aberration (Hiebert et al., 1995; Hiebert & Kurbansakhatov, 2011). Despite being less drastic than the cattle and pig drop-off, shifting food consumption habits of Anau people is certainly evident. Unfortunately, without analysis of the entire excavation, little can be posited on the basis of this single trench.

Sheep and goat remain the stalwart of Anau's domesticate assemblage. The proportion of sheep to goat drops slightly in comparison to Anau North, though still outnumber identified goats in both assemblages (Hiebert & Kurbansakhatov, 2011). Sheep outnumbering goats, in Zeder's (1988) case study of Tal-e Malyan, is indicative of indirect consumer relationships as pastoralists prize meat production over herd security. In essence, a goat is representative of herd security rather than economic production due to their higher reproductive rates and lower meat yields (Zeder, 1988). While sheep indeed outnumber goats at Anau, the region of Kopet Dag

lends itself better to sheep production, evident by the constant preponderance of sheep to goat (Hiebert, 2002; Hiebert et al., 1995; Hiebert & Kurbansakhatov, 2011). Djeitun, the earliest Kopet Dag settlement, features sheep faunal remains (Hiebert, 2002). Thus, the slight shift towards higher goat proportions could be marked as a decision made for the sake of herd security.

Perhaps the strongest single observation from AS5 was the patterns of carnivore digestion. There are clear skews in both carnivore damage and digestion degradation that would indicate distal limb elements, which do not bear the same meat as their proximal, long-bone counterparts, are being fed to dogs or tossed out where non-tame carnivores can scavenge (Gifford-Gonzalez, 2018). Dogs are known to exist at Anau (Hiebert & Kurbansakhatov, 2011). However, *Canis aureus* (jackal) and other carnivorous mammals did exist in the Kopet Dag during this time (Heptner et al., 1988). While total certainty that this was a domestic activity cannot be reached, these bones existing in the same context as human-impacted specimens is compelling. Certainly, experimental archaeology might be warranted to verify the survival rates of certain elements. Questions such as whether vertebrae survive canine digestive tracts at the same rate as phalanx would be informative into whether dogs were opportunistic or being purposefully fed distal limb elements.

Biotic etching is perhaps the most curious category of taphonomy. Samples exhibit a wide range of manifestations. In terms of potential culprits, plant etching is likely indeterminate damage caused by roots disrupting a buried assemblage. Why root structures would impact the coloration of a bone is beyond the scope of this paper but could be studied in the future using both experimental archaeology and a more thorough biological understanding of plant life, specifically the chemical reactions and changes surrounding root structures. The other culprits would be decomposers of various size. It is worth noting that all etching was found on stained samples. The highest rate of etching occurred on medium stained specimens (31.9%). In practically all cases, etching removed the coloration of this stain. What decomposers garner

nutritionally from these stained areas and why they do not affect an entire specimen is unknown. Etching represents an area requiring more study and biological knowledge beyond my scope.

The taphonomic sequence of AS5 is complex. The overlapping signatures, rates of intrusive vertebrates, and overall weathering conditions make discerning incomplete fragments difficult. Arid climates like Anau represent many observational challenges for the zooarchaeologist. Explaining the many causal agents would likely be subject for a paper this length or longer. However, the data logged for AS5 will continue to persist and can provide a baseline for the future study of the region. Detailing the many effects of the environment provides future researchers with a roadmap for appropriate identification of different signatures. This compounds down the line, with the hopeful conclusion of one day identifying the causal agents and understanding their effect on assemblage representation.

This legacy collection remains incompletely studied. Other Anau South trenches remain at the UPMAA, ready to be analyzed and eventually returned to Ashgabat to reside with the other Anau South material. The results of this survey do show sharp departures from previous eras of Anau occupancy, something worth investigating further to garner cultural, economic, and environmental information about what might have caused this change. AS5 faunal data has been digitally logged, cleaned, and prepared for future study. This paper has the potential to serve as a taphonomic baseline and reference for future study of Anau South, the larger Anau site, and the Kopet Dag region as a whole. Taphonomic signatures can continue to be better analyzed, differentiated, and understood. Age data from faunal remains can be incorporated into interpretative structures for Anau South. Archival work can yield more insight into the stratigraphy of AS5 and other Anau South trenches, potentially revealing unseen trends. In short, this paper is only a start to the restudy of Anau and with any luck, there will be more to come.

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Appendix

Table 5. Identified *Ovis*, *Capra*, and *Ovis/Capra* elements, Anau South 5.

<u>Skeletal Element</u>	<u>Ovis</u>	<u>Capra</u>	<u>Ovis/Capra</u>	<u>Grand Total</u>
Cranial Elements	5	9	44	58
Mandible	3	3	17	23
Maxilla	1		9	10
Cranium		2	4	6
Horn Core		2		2
Incisor			2	2
Mandibular P4			1	1
Mandibular M1		1		1
Mandibular M2			1	1
Mandibular M3		1		1
Mandibular Molar	1		6	7
Maxillar Molar			3	3
Fragmented Tooth			1	1
Axial Elements		1	54	55
Atlas		1	4	5
Axis			6	6
C1 Vert.			1	1
C. Vert.			9	9
T. Vert.			5	5
Rib			3	3
L. Vert.			9	9
Pelvis			7	7
Postsac. Vert.			2	2
Sternum			5	5
Indeterminate Vert.			3	3
Limb Elements	46	22	69	137
Scapula			12	12
Humerus	3	1	9	13
Radius + Ulna	3		3	6
Carpal			4	4
Femur	3	1	6	10
Patella			1	1
Tibia	5	2	3	10
Calcaneus	3		1	4
Astragalus	5	1	2	8
Tarsal	3		3	6

Metacarpal	3		3	6
Metatarsal	4		2	6
1 st Phalanx	6	6	3	15
2 nd Phalanx	6	10	1	17
3 rd Phalanx	1	1	3	5
Long Bone			1	1
Radius	1		4	5
Ulna			3	3
Metapodial			5	5
Grand Total	51	32	167	250

Table 6. Count of Total NISP affected by various taphonomic forces, Anau South 5.

<u>Taphonomic Force</u>	<u>NISP</u>	<u>%NISP</u>
Tool Marks		
Cuts	76	6.1
Scavengers		
Carnivore Destruction	100	8.0
Rodent Destruction	140	11.2
Burns		
Partial	22	1.8
Blackened	68	5.5
Calcine White + Black	29	2.3
Calcine White	18	1.4
Stains		
Minimal	120	9.6
Light	383	30.7
Medium	392	31.5
Dark	201	16.1
Uneven Dark Spots	83	6.7
Mineral Accumulation		
Salt	843	67.7
Weathering		
Parallel Cracking	36	2.9
Erosion	42	3.4
Flaking and Layer Breakage	115	9.2
Nonanimal Biotic Damage		
Etching	247	19.8
Digestion	43	3.5

Table 7. %NISP of domesticated taxa, distributed by anatomical region, Anau South 5.

<u>Anatomical Element</u>	<u>Bos</u>	<u>Ovis/Capra</u>	<u>Sus</u>
Cranial Fragments	21.4%	23.2%	-
Axial Fragments	21.4%	20.0%	71.4%
Limb Elements	57.1%	54.4%	28.6%
Other Fragments	-	2.4%	-

Table 8. Count of Large Mammal NISP by element, Anau South 5.

<u>Skeletal Element</u>	<u>NISP</u>
Loose Teeth	3
Incisor	1
Maxillary Premolar	1
Mandibular Molar	1
Cranial Fragments	4
Mandible Fragments	1
Humerus	1
Distal Limb Elements	12
Carpal	5
Metacarpal	2
Metapodial	1
1st Phalanx	2
2nd Phalanx	1
3rd Phalanx	1
Vertebrae	10
C. Vert.	2
T. Vert.	5
L. Vert.	1
Postsac. Vert.	1
Indeterminate Vert.	1
Pelves	3
Sesamoid	1
Rib Fragments	7
Shaft Fragments	17
Indeterminate Fragments	1
Grand Total	60

Table 9. Count of Medium Mammal NISP by element, Anau South 5.

Skeletal Element	<u>NISP</u>
Loose Teeth	35
Incisor	8
Mandibular P4	1
Mandibular M1	1
Mandibular M2	1
Mandibular M3	1
Maxillary Premolar	1
Mandibular Molar	12
Maxillary Molar	4
Fragmented Tooth	6
Cranial Fragments	39
Cranium	33
Horn Core	4
Hyoid	2
Mandible Fragments	36
Maxillary Fragments	11
Scapulae	33
Humerus	20
Radius and Ulna	18
Femora	17
Patella	2
Tibiae	10
Distal Limb Elements	109
Carpal	6
Calcaneus	5
Astragalus	9
Tarsal	7
Metacarpal	6
Metatarsal	7
Metapodial	19
1st Phalanx	21
2nd Phalanx	19
3rd Phalanx	10
Vertebrae	123
Atlas	5
Axis	7
C1 Vert.	1

C. Vert.	21
T. Vert.	24
L. Vert.	20
Postsac. Vert.	5
Sacrum	4
Indeterminate Vert.	36
Pelves	19
Sternum	10
Rib Fragments	229
Shaft Fragments	342
Indeterminate Fragments	86
Grand Total	1139

Table 10. Count of Small Vertebrate NISP by element, Anau South 5.

<u>Skeletal Element</u>	<u>Small Mammals and Vertebrates</u>
Mandible Fragments	7
Maxillary Fragments	1
Scapulae	1
Humerus	5
Radius and Ulna	1
Femora	6
Tibiae	5
Distal Limb Elements	1
1st Phalanx	1
Pelves	6
Shell	4
Rib Fragments	2
Shaft Fragments	6
Indeterminate Fragments	2
Grand Total	47



Figure 11. Ovis mandible, AS5/5. Exhibits cut marks, age data, and carnivore gnawing.

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