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Animal Management at Tell Leilan in the Fourth Millenia, BCE: Faunal Data from the Operation 1 Step Trench

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INTRODUCTION
The fourth millennium in the Ancient Near East was a period of dynamic interregional contact between the polities of Southern Mesopotamia and those of Northern Mesopotamia and Anatolia. Several different models have been suggested to explain these relationships. All include some form of economic exchange between Southern Mesopotamian trading communities and local northern settlements with access to resource unavailable to the south. In the context of this ongoing discourse on the nature of contact and interaction between northern communities and Southern Mesopotamians, this paper seeks to explore the nature of contemporaneous local Late Chalcolithic culture at the site of Tell Leilin, Syria. Through an analysis of faunal remains from the fourth millennium at Leilin, I will contribute to a broader understanding of local animal management strategies and uses, and what they may indicate about local ecology, political economy and culture. These data add to an investigation into the nature of political complexity in Northern Mesopotamian Late Chalcolithic culture during the fourth millennium, and serve as a point of comparison between indigenous communities and communities with high populations of Southern Mesopotamians.

The Utility of Faunal Analysis
Analyses of faunal materials recovered from archaeological excavations are important data sets that contribute to a larger picture of the political economy and society of the culture in question. Animal remains indicate which taxa were important to the economy of the people who lived at the sites. Different patterns of faunal remains indicate different types of subsistence strategies, food preferences, traction requirements and even different ideological orientations. While written records frequently only address the concerns and practices of the upper echelons of ancient society, the faunal record can elucidate the subsistence strategies of all levels of society. The importance of zooarchaeological analyses as a method of exploring the past is an underlying principle of this thesis, which seeks to use faunal analysis to explore local late Chalcolithic culture at Tell Leilin.

Tell Leilin
Tell Leilin is a multi-period settlement located in northeastern Syria. Since 1978 the Yale University Tell Leilin Project, under the auspices of Dr. Harvey Weiss, has undertaken large-scale survey and excavation of the site. Research at Tell Leilin has largely focused on the rise of urbanization, its subsequent collapse and its resettlement during the third and second millennia B.C.E. During this period Tell Leilin evolved from a small town comprising less than 15 hectares located on the site’s acropolis to a 90-hectare city in the mid third millennium B.C.E. At its height the city was known as both Şehna and Šubat-Enlil (Weiss, 1985, 1988, 2007).

Situated along the Wadi Jarrah, a perennial stream of the Habur River, Tell Leilin is located within the Habur Plains in the area known as the Jezira, the plains which comprise parts of modern Syria, Iraq and Turkey (Algaze 2005, Wilkinson 1993, 2003). An environment of mixed steppe country and fertile alluvial valleys characterizes the
area. Rainfall in the area in general ranges from approximately 600 mm to 200 mm annually. Tell Leilan receives between 400 to 450 mm on average, allowing inhabitants to successfully and reliably practice extensive dry-farming of cereals and other crops and pastoralism, a subsistence system attested to in modern historical times (Weiss 1986,1988, Stein and Wattenmaker 1990).

Operation 1 at Tell Leilan
Data for this study came from the Operation I step trench excavated in 1979 and 1980. Dr. Glenn Schwartz was primarily responsible for supervising the excavation as part of his doctoral dissertation. The 36.15 meter by 4.5 meter trench was dug on the northwest slope of the site’s acropolis. The trench was partitioned into Areas A through I, with each letter signifying a step within the trench. At its greatest depth, the trench measured 13.75 meters and comprised 61 distinct strata (Schwartz 1988: 1). Weiss notes that while excavations were concluded after sixty-one strata, this does not represent the end of cultural material at the Leilan acropolis. Rather, several strata most likely remain below the exposed area (Weiss 1985: p. 1988).

The excavation goal of the trench was to define the history of settlement at Tell Leilan from circa 5500 to ca. 1800 and to establish a ceramic chronology for the site (Weiss 1988: XVI). Schwartz notes that while the trench comprises only a small portion of the site at its greatest size during the third and second millennia B.C.E., the sounding is still a reliable source of chronological data. This is due to the fact that the trench represents “a larger sample of the fifteen-hectare acropolis, the sole site of occupation prior to the later third millennium,” (Schwartz 1988:1).

Schwartz’s research focused on the analysis of ceramic material excavated from the trench. This analysis establishes the site-specific chronology of Tell Leilan and links it to the chronological periods found at neighboring sites. On the basis of his investigation, Schwartz defines six major settlement periods — Leilan VI through I. Leilan VI, the earliest level, is attributed to the late Northern Ubaid period. Periods V and IV are attributed to the early and late Uruk periods respectively. Leilan III spanned the late fourth to mid third millennium B.C.E. This period began either during the Late Uruk or Jemdet Nasr period and lasted until the mid third millennium (Schwarz 1988: 68; Senior 1998). Leilan II comprises the mid to late third millennium settlement, contemporaneous with the late Early Dynastic, Akkadian and Ur III periods in southern Mesopotamia (Akkermans and Schwartz, p. 236).

NORTHERN MESOPOTAMIA IN THE FOURTH MILLENNIUM B.C.E.

Ironically, the hallmark of late fourth millennium B.C.E. material culture in Northern Mesopotamia is not northern Mesopotamian in origin. Rather, the presence of material culture from southern Mesopotamia has emerged as a defining characteristic of this time period, known as the period of Uruk Expansion. The presence of Southern Mesopotamian material culture, architecture, and urban planning models has been interpreted as representing varying levels of economic, social and political presence of Southern Mesopotamians in Northern Mesopotamia and Anatolia, from minimal economic contact...
to outright colonization (e.g. Akkermans and Schwartz 2003; Algaze 1989, 2005; Johnson 1988-89; Stein 1999, 2002).

The period immediately preceding the Early Uruk period is not well researched in Northern Mesopotamia. Nevertheless, Akkermans and Schwartz do note the existence of certain overarching characteristics of this post-Ubaid, late Chalcolithic culture. Specifically, they point to the evidence of increasing “urban-scale agglomeration and other hints of emerging socio-political complexity,” namely pottery and flint tools that appears to be mass-produced locally. Of particular importance is the presence of chaff-faced pottery found widely in ceramic assemblages throughout the region. This ware type is clearly indigenous to the area, and contrasts to Uruk-style pottery found later. Additionally, the persistence of complex settlements with urban characteristics from this time period, particularly Tell Brak, are important to note, as they influence Akkermans and Schwartz’s understanding of the succeeding Uruk Expansion (Akkermans and Schwartz 2003).

In order to understand fourth millennium B.C.E. developments within Northern Mesopotamia, it is first essential to note the contemporaneous developments occurring in Southern Mesopotamia. The fourth millennium B.C.E. saw the rise of complex urban polities within southern Mesopotamia. These city-states were characterized by increasing social hierarchy, extensive public building—which implies centralization and economic specialization, and the adoption of writing and other administrative and bureaucratic practices (Akkermans and Schwartz, 2003: p. 184). These practices are illustrated archaeologically by the presence of cylinder seals and bullae among artifact assemblages (Sürenhagen 1985: p. 10; Akkermans and Schwartz 2003: p. 183).

The nature of the relationship between Southern and Northern Mesopotamia at this time is not entirely understood, but it is clear that there was a great degree of contact and perhaps even migration from south to north. This relationship is not consistently documented, however, at all Northern Mesopotamian sites. This indicates that a heterogeneous sociopolitical landscape existed throughout the greater region.

One influential interpretation of the presence of Southern Mesopotamian Uruk culture in Northern Mesopotamia in the fourth millennium B.C.E. is the asymmetrical trade model articulated by Guillermo Algaze (1989, 2005). Algaze applies Immanuel Wallerstein’s World Systems Theory to explain the presence of Southern Mesopotamian material culture in the north. He interprets this material culture as indicative of a system of asymmetrical exchange. Southern Mesopotamia imported raw materials in high demand during this period of increasing urban expansion and social complexity that were naturally unavailable in the southern alluvium. Algaze asserts that these resources fall within two groups:

“[1] essential unprocessed resources necessary for the day-to-day operation of complex social organizations in the resource-poor alluvium and [2] nonutilitarian, prestige commodities necessary for the consolidation and maintenance of social and political relationships within elite groups,” (1989: 580).
Wood, metals (especially copper), bitumen and stone would, according to Algaze, have been the primary resources that Southern Mesopotamian polities sought. In exchange, Southern Mesopotamians probably exported manufactured goods like surplus cereals, dried fish, and leather to Northern Mesopotamian communities.

Algaze argues that Southern Mesopotamians established colonies within Northern Mesopotamia, Anatolia and Western Iran in order to facilitate the exchange of goods. Sites that have a large amount of Southern Mesopotamian material culture, or exhibit organizational behavioral characteristics of Southern Mesopotamia are considered to be colonies. These behaviors are interpreted from the presence of artifacts associated with administrative practices, and architectural and city-planning features associated with Southern Mesopotamian styles. These settlements frequently were established in areas where no settlements previously existed, with the exception of Tell Brak and Godin Tepe. These expatriate colonial communities do not represent a cohesive push by one Southern Mesopotamian power to establish trade in the north, but rather should be viewed as:

- part of an organic process of action and counteraction, with individual Uruk city-states founding specific enclaves or outposts in an attempt to position themselves on (and exclude their rivals from) the critical lines of communication through which resources were obtained. (Algaze 1989: 589)

Algaze specifically argues for three types of colonies, differing considerably in size, from largest to smallest: enclaves, stations and outposts. All three types of colonies were typically located along important north-south waterways and/or junctures of overland trade. Akkermans and Schwartz also point to sites that appear to be expatriate communities that are located near strategic points of resource extraction (e.g. Buccellati’s interpretation of Qraya as a salt processing facility, Akkermans and Schwartz 2003: p. 197).

The perennial example of a colonial enclave is that of Habuba Kabira-South. Sürenhagen points to the presence of Southern Mesopotamian pottery types, glyptics, architectural styles, and centralized city planning as evidence that the site was established by migrant Southern Mesopotamians (Sürenhagen 1986). The site was founded on land not previously settled by indigenous communities, and was inhabited only briefly (Sürenhagen speculates at most 150 years) before it was abandoned, but not destroyed. There is evidence of town planning and drainage systems that preceded any building activities. This implies the presence of a centralized authority that oversaw the settlement’s foundation. The large public buildings also attest to some sort of overarching authority (Sürenhagen 1986: p. 19). Further, houses exhibit “tripartite” architectural plan and employ brick building materials, both characteristic of architecture in Southern Mesopotamia.

A range of small finds exhibiting southern Mesopotamian characteristics are found in great numbers at Habuba-Kabira-South. Sürenhagen highlights artifacts that he feels indicate that, “long distance trade and handicrafts... [were] important activities,” (Sürenhagen 1986: p. 10). Among these items are epigraphic artifacts including numerical tablets, and glyptics. Sürenhagen also notes the presence of local Amuq F chaff-faced pottery:
In several cases these vessels contained remains of grains and, probably, dried-out oil. These are important evidence of local exchange, showing that agricultural products were provided by people from the countryside, but only in small quantities. (Sürenhagen 2986: p. 21)

These ceramics contrast sharply with the characteristic Uruk pottery found in association with many of the houses at Habuba Kabira (Akkermans and Schwartz 2003: p. 193). According to Akkermans and Schwartz, Uruk period Southern Mesopotamian pottery is “characterized by an emphasis on mass production, specialization, and minimal decoration,” (Akkermans and Schwartz, p. 193). The most ubiquitous types are beveled-rim bowls, coarse flower pots, conical cups with string-cut bases, tall water bottles with bent spouts, red-slipped four-lugged jars, reserved-slip pottery, four-lugged jars with incised decorations, and miniature vessels (Sürenhagen 1986: pp, 9-10).

Communities like Habuba Kabira-South, founded on land where no local community had lived previously and displaying a material and stylistic culture predominantly Southern Mesopotamian in origin, are thought to have been composed largely of Southern Mesopotamians who migrated northward to facilitate long distance trade. Tell Brak, in contrast, illustrates that such interpretations are not always clear. Algaze cites Tell Brak as another Southern Mesopotamian enclave, due to the high portion of Uruk pottery found there as well as the tripartite plan of the Eye temple, an immense public religious structure (Algaze, 1989: 578; 2005). Akkermans and Schwartz, however, posit that Tell Brak may be an example of an indigenous community, in contact with but not under the domination of Southern Mesopotamians. They point to the fact that Tell Brak served as an important regional center well before the Uruk period. They admit an “unmistakable,” southern influence in the tripartite design of the Eye Temple, but suggest that “its eastern wing with narrow storage rooms suggest a local modification to the tripartite arrangement,” (2003: 198). They note the high percentage of Uruk pottery at Tell Brak as well, but they do not attribute it necessarily to Southern Mesopotamian colonists. In the final analysis, they are unresolved on how to interpret Tell Brak:

The late to fourth millennium data from Tell Brak disclose a heady mix of local and southern material culture. It is safe to conclude that Brak does not qualify as a ‘colony’ such as Habbuba-Kabira, because it was not established as a new settlement and has substantial evidence of local Syrian material culture. The question we confront, then... is whether the presence of southern Mesopotamian material culture implies the presence of southern Mesopotamian people (Akkermans and Schwartz, 2003: 200, emphasis in the original text).

Thus the same evidence can be read to indicate two different types of relationships between the inhabitants of Tell Brak and those of Southern Mesopotamia.

While Algaze’s model is an influential explanation for Uruk expansion and intrusion in Northern Mesopotamia, Anatolia and Western Iran in the fourth millennium, it is not without critique. Commentators have cited the paucity of traded commodities that have been located in the archaeological record and noted that certain resources could have been obtained locally, and thus long distance trade would not have been an absolute necessity as Algaze posits. Weiss, for example, cites local sources of limestone and bitumen in Southern Mesopotamia that could have furnished cities with the building
materials they needed (Algaze et al. 1989: 597). Akkermans and Schwartz also point out that few manufactured products of Mesopotamian origin have been found in assemblages in Northern Mesopotamia, Anatolia, or Western Iran (2003: 204) Further, they observe that:

More recent research, often aimed specifically at testing Algaze’s model, has revealed an impressive degree of economic and social complexity in the periphery, weakening the argument for an asymmetric relationship between Mesopotamia and its surrounding territories, (2003: 204).

These reservations have not discounted the idea that long-distance trade was the impetus for the Uruk expansion in to Northern Mesopotamia, but rather suggest that a more nuanced model is in order. Other theories regarding the Uruk expansion include a hypothesized demographic crisis in Southern Mesopotamia (Johnson 1988), and the importance of the textile industry and the need for finding pastoral grounds for Southern Mesopotamian state economies (McCorriston 1997, Wright in Algaze et al. 1989).

Gil Stein offers another influential interpretation of the relationship between Southern Mesopotamia and Northern Mesopotamia during the period of Uruk Expansion. Stein critiques the application of World Systems Theory to premodern historical and archaeological data, arguing that it is not applicable outside of the 16th-century European colonial model it was developed to explain. Theories that place foreign asymmetric relationships (be they economic, political or ideological) at their heart are flawed in that they:

[overemphasize] the importance of interregional interaction as a primary cause of social evolutionary change. By privileging external dynamics of change, [researchers] have often downplayed or ignored the transformational importance of internal social, political and economic processes in their attempts to explain development and functioning of complex societies. At the same time, anthropological models of interaction have taken on a misplaced directionality, so that power relationships, economic influences, or ideological forms of hegemony have been seen as one-way flows from more complex states to less developed polities. (Stein 2002: p. 903)

Wallerstein’s World Systems Theory is specifically flawed in that it assumes “core dominance, asymmetric exchange, and interregional trade as the determinants of peripheral political economy,” (Stein, 1999: 24) which are not always true even in the modern European colonial case studies the model was developed to explain. Attempts to modify Wallerstein’s model to explain the premodern historical and archaeological record more accurately are equally flawed in that “the construct becomes so broad and amorphous that it loses any kind of analytical power except as a generalized philosophical outlook,” without modifying the underlying issue of an overemphasis on external relationships as the major agent of social change (Stein 2002: p. 904).

Stein proposes that two complementary models of interaction between separate societies offer a more accurate view of foreign interaction historically and archeologically. He suggests that the Trade-Diaspora Model of Interaction and the Distance-Parity Model of Interaction can be used in concert with one another to explore and understand cultural interaction throughout time. Stein posits that interregional interaction is an important
agent of social change, while not conceding its primacy as the World Systems Theory does. He charges that such interaction must be examined on all levels of society, from the local level up rather than from a broader, regional perspective.

The Trade-Diaspora model is based on the work of Ronald Cohen. Stein defines Trade Diasporas as:

interregional trade networks composed of spatially dispersed specialized merchant groups that are culturally distinct, organizationally cohesive, and socially independent from their host communities while maintaining a high level of economic and social ties with related communities who define themselves in terms of the same general cultural identity. (2002: 908)

Trade-Diaspora communities can take a variety of forms, though Stein specifically highlights three “points along this continuum… (1) diaspora marginality, (2) diaspora social autonomy, and, in the extreme case, (3) diaspora dominance over the host community,” (Ibid). These three forms describe the relationship between the trade-diaspora community and its host. In situations of diaspora marginality, the foreign community is tolerated but marginalized within the host community. In the second permutation, diaspora social autonomy, the foreign group is protected and autonomous within the host community, and autonomous from its homeland. In the extreme case of diaspora dominance over the host community, the host community is controlled by the diaspora community, which may or may not be controlled by its homeland. Stein considers cases that fit into Wallerstein’s World Systems Theory to fall under this third group.

The Distance-Parity model is a direct critique of three problematic assumptions that Stein identifies in Wallerstein’s model. The Distance-Parity model suggests “the core’s ability to exercise hegemonic power decays with distance, thereby leading to increasing parity or symmetry in economic and political relations with the increasingly distant peripheries” (1999: p. 62). Ease of transport, specifically of goods or military force, is identified as the most important variable in this model, followed by differences in technology, demographics and ecology between the two regions in question. This model can be used in concert with the trade-diaspora model. The two models are especially important in that they acknowledge the myriad different types of relationships that can exist between cultures in a system of exchange, be it economic, political, or ideological. Further, they offer more agency to local actors from both cultures in that different parts of each society are understood to have correspondingly different relationship to the other culture. For example, the relationship between elites in host communities and foreign trade diaspora communities within their territories is perceived to be different than the relationship between foreign trade diaspora communities and the rest of the population. Such flexibility supplies the nuance frequently decried as lacking in World Systems Theory. Finally, such models are understood to have identifiable archaeological correlates that can be tested.

Stein focuses on Hacinebi Tepe, located in modern Turkey, a site that would be understood as a colonial outpost under Algaze’s model, but can be better interpreted as a trade diaspora community. Hacinebi Tepe is an indigenous settlement in western
Anatolia that displays evidence of interaction with Uruk Southern Mesopotamia in the fourth millennium, B.C.E. Uruk ceramics, architecture, and imported bitumen have been found during the Hacinebi B2 phase, dating to approximately 3700-3300 BCE. There is also evidence of Southern Mesopotamian administrative practices and faunal evidence indicating dietary patterns that resemble those of Southern Mesopotamia and differ from local consumption habits (Stein 2002: 910-11). These characteristics of Southern Mesopotamian culture exist in concert with persistent and corresponding local cultural types. Ultimately, Stein suggests that Hacinebi Tepe was most likely a socially autonomous trade diaspora, which neither controlled the local community nor was controlled directly by its homeland. He cites the lack of evidence of conflict at the site, and the persistence of local culture at all levels of society as evidence that the foreign community did not control the local Anatolian people.

Tell Leilan in the Fourth Millennium B.C.E.

Tell Leilan in the fourth millennium B.C.E., like Tell Brak as understood by Akkermans and Schwartz, appears to represent an indigenous community that has had contact with Southern Mesopotamian expatriates but was not a colony. This relationship is illustrated in the ceramic assemblages derived from the Operation 1 excavations. Schwartz particularly highlights the presence of beveled rim bowls in the Uruk expansion periods at Tell Leilan. Phases 5 and 4 are separated from one another based on the presence and quantity of beveled rim bowls, among other diagnostic types (for a complete list see Schwartz 1988: 51). Schwartz observes that, “While beveled rim bowls are found in this period alone, they occupy only a very small portion of the Period IV sherd sample,” (Schwartz 1988: 52). Both Leilan IV and V ceramic assemblages are characterized by a majority of undecorated coarse and medium straw-tempered handmade wares. This type, Schwartz notes, first appears at Tell Leilan in the upper strata of Leilan VI, “attesting to continuity of material culture from Ubaid to post-Ubaid times.” Similar wares are also found at other Habur Plains sites. Leilan V is distinguished from the proceeding period VI material by its generally smaller percentage of painted ceramics (Schwartz, 1988: p. 55).

Thus, the ceramic assemblage from the Uruk Period found in the Operation 1 trench suggests that the local indigenous community persisted throughout the fourth millennium. This community appears to have had varying levels of contact with Southern Mesopotamian communities during the fourth millennium, with contact increasing markedly during the latter portion of the Uruk period contemporaneous with Leilan Period IV. Weiss posits that:

Leilan V might represent the initial intrusion of southern economic influences and interests, as opposed to personnel, onto the Habur plains. Ranking within such a society should have intensified along with both centralization and intensification of agricultural production in support of economic interests. The appearance of southern ceramics in Leilan IV may represent a second stage of southern intrusion: the arrival of southern administrators or surrogate institutional forms upon the Habur Plains at sites such as Brak and Hamoukar (1988: XVII).

Such a relationship fits plausibly within both Alzage’s overarching model of asymmetrical trade and economic intrusion and Stein’s model of a trade diaspora/distance
parity relationship between Southern and Northern Mesopotamia. In both models, Leilan can be understood as a local settlement with limited, but persistent interaction with Southern Mesopotamian traders in the area. The site was certainly locally controlled. During this time period it was mostly likely a permanently settled village reliant on agriculture. While residents at Leilan perhaps traded with Southern Mesopotamians in the area, they were not under their rule, nor did they experience any intense influence. This site offers a window into local Northern Mesopotamian late Chalcolithic culture, where residents existed with only minimal interaction with the Southern Mesopotamians in the region.

METHODS
The nature of the local Chalcolithic Northern Mesopotamian culture is explored here through the analysis of the faunal collection associated with the Operation 1 Trench. My objective while analyzing this collection was to identify all skeletal elements and teeth to a specific taxonomic level whenever possible. When pieces were too fragmentary they were classified by larger categories defined by order, family or body size, depending on what morphological characteristics were present. Skeletal element categories were defined using Meadow’s “Bonecode” (Meadow 1978b). This code defined the categories for which each specimen was evaluated, and the terminology used to describe it. I made a few specific choices regarding terminology, which I define below. Further, due to the nature of the samples, many categories did not yield any data and were thus ignored.

Animal Identification
Meadow’s bone code defines two different sizes of medium mammals. Medium Mammal 1 is defined as “medium dog-sized to medium sheep-sized,” and Medium Mammal 2 is “medium dog-sized to wild boar-sized,” (Meadow 1978b:174). In most cases I was unable to discern to which category a medium mammal fragment specifically belonged. Instead, medium mammal fragments were all labeled Medium Mammal 2, the more inclusive of the two categories, to provide a more conservative analysis. Similarly, Meadow defines two categories of medium to large mammals, called “Large to Medium” and “Medium to Large” respectively. In these cases, I used only the “Medium to Large” category.

Domestication
Given both the nature of my sample and my novice experience with zooarchaeology, I did not categorize specimens in this category. I think that most of the taxa present are domesticates, but I did not evaluate this category in order to make this claim formally. Specifically, I am fairly certain that the Sus specimens and most of the Ovis/Capra and Bos elements represent domestic taxa. These taxa would have been domesticated by the 7th millennium B.C.E. (Clutton-Brock, 1981: 51). The gazelle fragments recovered from the excavation are certainly from wild species (though Legge 1972, 1977 suggests they may have been “tamed”).

Fragments
Fragments that could be crossmended were counted as one, while other fragments, although it appears likely they were part of the same element, were counted separately.
This was done to offer a more conservative estimate of number of identifiable specimens (NISP) and minimum number of individuals (MNI) during the analysis by stratum.

**Weight**
Specimens were weighed to the nearest tenth of a gram using a digital lab scale.

**Tooth Wear**
Tooth wear was evaluated using Payne’s wear stages for *Ovis* and *Capra* mandible teeth, and Grant’s system for *Sus* and *Bos* teeth (Payne 1973, 1982; Grant 1975, 1982). Maxillary teeth were evaluated using the criteria defined in Meadow’s Bone Code, but these teeth were not used for age of death estimates.

**Measurements**
Measurements were taken whenever possible using the categories defined by von den Driesch (1976). All measurements were taken in millimeters using dial calipers accurate to one-tenth of a millimeter.

**Reference Collection**
All identifications were made utilizing the reference collection at the University of Pennsylvania’s Museum Applied Science Center for Archaeology. This collection contained numerous *Sus*, *Ovis*, *Bos* and canine specimens, as well as one each of equid, gazelle, roe deer, among other specimens. The collection lacked, however, a complete *Capra* specimen (only a few select bones were available), thus making it difficult to assess if specific pieces were *Ovis* or *Capra* rather than *Ovis/Capra*. The majority of pieces were defined and categorized as *Ovis/Capra* unless specific defining morphological characteristics were clearly present that showed they were *Ovis* or *Capra*. These characteristics were gleamed from a variety of reference sources (Boessneck 1970, Hildebrand 1955, Prummel and Frisch 1986, Ford 1990, Helmer and Rocheateau, 1994). Additionally, horncores were not available for reference from either *Ovis* or *Capra* specimens.

**Oversight**
All of my identifications were evaluated by either Dr. Jill Weber or Dr. Katherine Moore. Both are experienced zooarchaeologists. No specimen was included without their approval. Dr. Kathleen Ryan provided additional support throughout this process.

**Sample Description**
The sample is not very large, as it was collected while excavating a deep stratigraphic sounding on the acropolis (4.5 meters wide and 36.15 meters long). The stratum evaluated here represent “a sequence of surfaces (Stratum 52-43) with thin deposits of occupational trash amassed on top of them and little architectural evidence,” (Schwartz 1988: 12). As a consequence, statistical data, especially regarding age class, is unlikely to be very informative. Unfortunately, not all of the material from Leilan IV could be analyzed as the collection is split among several institutions.
The material was excavated with the help of laborers using picks, shovels and hand collection. Excavators sieved only a minimal amount of material, and the sieved material is comprised almost exclusively of fractured bone matter that broke off large pieces during excavation. This material was not systematically sorted as it was clear from an initial analysis that it would not provide enough useful information to justify the time expenditure.

Due to the goals and methodology of the excavation, the sample is heavily biased toward larger remains. Very few small mammal parts were identified, and no bird bones were found. Most strata contained one or two shell fragments. Thus, this analysis likely does not reflect the full range of taxa exploited at Tell Leilan during periods V and IV, but rather offers a view of some of the medium and large taxa that were important at the time. It is interesting to note, however, that there was no significant amount of smaller fauna in the sieved material. Due to the lack of sieving it is likely that fragments of modified bone and whole tools may have been lost during excavation as well (Choyke 2005). Additionally, there are few whole, or even measurable specimens, and the majority of bones show some modern break. Comparatively few showed exclusively pre-depositional break.

The material at the University of Pennsylvania had not been cleaned, mended or labeled, with the exception of Stratum 50. Overall the bones retained the grayish color of the fill they had been deposited in, with only a few showing heavier staining. The bones from Stratum 50 had been labeled and glued back together when possible. Bones were labeled with an identification number consisting of the stratum, lot, and bone number. A small number of these bones had been identified and placed in individual paper envelopes. I numbered the rest of the samples using the same system and glued bones back together whenever possible using Duco Cement. All of the material was analyzed for cut marks and were recorded with the aid of a 10x loupe.

A basic taphonomic scan shows that the material was moderately well preserved. Evidence from some post-depositional forces are present, specifically from trampling, carnivores, and, most plentifully, from excavation. The overall integrity of the deposit is low, due to the relatively low proportion of bones that could be mended, but this is likely to be the result of excavation. There are a few clear instances that demonstrate that the trash deposits experienced little disturbance after deposition. For example, in Stratum 43 an unfused Bos metapodial was recovered with its distal epiphyses cemented to it with carbonized soil. On some of the fragments, a few percussion impact cones show the intensity of breakage before deposition, despite the amount of modern breakage.
DATA BY STRATUM

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Figure 1a — Raw counts of NISP by Taxon per stratum

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<th></th>
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Figure 2b — Percentage of NISP by Taxon per stratum

**Stratum 52**

Stratum 52 represents the earliest level of Leilan period V. This particular stratum was described as “rich in sherds and animal bones discarded into the midden strata. The fill was gray and of medium texture,” (Schwartz 1988: 12). The Number of Identifiable Specimens (NISP) from the stratum was 107.

*Sus* elements represent the majority of identifiable elements from this stratum, comprising 81 specimens, or 75.7%. Most of these elements represent cranial elements, including several whole and fragmented teeth. One *Sus* incisor, a lower third premolar that was slightly worn, and a lower third molar that exhibited “b” wear (Grant, 1982) were identified. A fragment of *Sus* maxilla containing part of a moderately worn fourth premolar was also recovered. Other cranial elements include portions of cranium and maxilla. Post-cranial elements that were identified include an unfused right tibia and distal epiphysis, a fragment of pelvis, and a humerus that was marked by 2 parallel cut marks on the distal end. The unfused state of the tibia in this assemblage allows us to
estimate the age of death for that individual pig. The distal epiphysis in pig tibias typically fuses around 2 years of age (Silver, 170), indicating an age of death after that time.

Specimens identified as *Ovis/Capra* comprise 14% of the NISP with 15 fragments. These fragments include a left humerus that is fused at the proximal end, two deciduous maxillary teeth (one third deciduous and one fourth deciduous tooth) and an assortment of maxillary teeth fragments. The two deciduous teeth were moderately worn and fit together suggesting they form a tooth row. In sheep and goats the proximal end of the humerus fuses between 3 and 3.5, thus the individual to whom the recovered humerus belonged was at least three years old when it died. Two elements (1.9% of the NISP) were identified as specifically belonging to *Ovis*. These include a complete astragalus and a complete, fused first phalanx.

*Bos* elements account for 8.4% of the assemblage, with nine identified specimens. These include material from what appears to be at minimum two third phalanges. One of these phalanges could reconstructed, while the other is highly fragmented.

This stratum contained a metapodial of a medium mammal, likely sheep or goat, that showed evidence of modification. It appeared to be refuse from toolmaking.

**Stratum 51**
The floor of this level included the stump of a wall, which protruded from the east balk of the trench. Schwartz describes the wall as, “36 centimeters wide and three bricks high; the bricks were 7 centimeters thick,” (Schwartz 1988:12). Faunal remains interpreted as one deposit were recovered from either side of the wall. Overall the stratum was characterized by “light gray occupational trash of medium consistency.”

The faunal deposit from this stratum yielded a relatively large NISP of 285 elements, but the majority of these elements were fragments of *Sus* skull, including mandible and teeth. The remains of a minimum number of individuals (MNI) of two *Sus* were recovered. This is indicated by the presence of 3 occipital condyles, 3 auditory bullae, and other duplicate and triplicate cranial elements. Additionally, two maxillae with teeth were recovered and one mandible. An assortment of maxillary and mandibular tooth fragments and fragments of an unerupted lower third molar were also collected. Three post-cranial *Sus* elements were also identified, one unfused tibia, and two ulnas (one right and one left in symmetry). Overall *Sus* specimens composed 99% of the NISP for this stratum with 282 fragments.

*Bos* and *Ovis/Capra* made up 0.7% and 0.3% of the NISP for this stratum respectively. *Bos* elements included one right fused metacarpus fragment, and a fragment from an indeterminate metapodial. The *Ovis/Capra* category was represented by one fragment of scapula.
One medium mammal long bone shaft fragment showed evidence of processing, perhaps for the purpose of meat consumption. The fragment was carbonized, and showed evidence of having been cleaved.

One bone tool was recovered, an awl-like instrument that is quite polished. This element was made from the metapodial of a medium-sized artiodactyl, likely an *Ovis/Capra*.

![Image of tool from Stratum 51](image_url)

**Stratum 50**
The excavator noted that the northeast corner of this level was covered by small stones, which he interpreted a pavement. A burial in a covered pot was recovered from this floor. The debris above the surface was characterized by "more light gray fill," (Schwartz 1988). The faunal assemblage from this stratum had NISP of 108.

*Sus* elements comprised 74.0% of the stratum NISP with a total of 80 specimens. A large portion of these elements were cranial pieces, including fragments of both maxillae and mandibles. From the skull remains it is clear that there is an MNI of two *Sus* for this stratum because two portions of fused occipital and parietal bones were found. One specimen was complete for both the right and left sides of the occipital bone and the parietals. In the other specimen, only the right side was present. This specimen was burnt at the anterior tip. A fragment of maxilla was also recovered with evidence of an erupting cheek tooth (a molar or premolar) in a crypt. Unfortunately, the maxilla was too fragmentary to establish the specific tooth.

A number of postcranial *Sus* elements were recovered. Two separate fragments of left scapulae were identified, bolstering the MNI estimate of two individuals for this stratum. Fragments of the proximal end of a radius, an ulna, a calcaneus, and a right and a left pelvis were also recovered. One right humerus and a left humerus were identified. The left humerus was unfused and almost complete, missing only the proximal and distal epiphyses. Thus, from this evidence we can estimate the age of death of the individual to whom they belonged. In pigs the proximal and distal ends of the humerus fuse at 3.5 and
1 year respectively. As neither is fused, the age of death for this animal was under one year. A *Sus* tibia was found similarly complete — unfused and missing only the epiphyses. The distal ends of pig tibias typically fuse at 2 years of age, and the proximal at 3.5 years. Since the distal epiphysis is missing, we can estimate the age of death for this individual at less than two years of age. Finally, a complete astragalus was identified. It showed evidence of having been chewed, swallowed whole and excreted by a carnivore.

*Bos* elements represent the next largest percentage of the NISP with 11 fragments, or 10.2% of the assemblage. These specimens include a piece of a mandible and an adult third premolar. Additionally, the distal end of a calcaneus, pieces of either a first or second phalanx and fragments of a fused radius and ulna were identified. A caput femora that had visibly been cleaved was also recovered.

8.3% of the NISP was classified as *Ovis/Capra* specimens. These elements included the distal epiphysis of a humerus, a right humerus, and a fused first phalanx. Tooth fragments were also identified, including one that was either a first or second molar. One mandible, 0.9% of the assemblage, was classified as *Ovis/Capra/Gazelle*. Gazelle cranial fragments from two separate lots made up the remaining 6.5% of the assemblage.

Several elements in the assemblage showed evidence of some form of modification. In addition to the *Bos* caput femora, which had been cleaved, two separate medium mammal tibia fragments showed characteristics indicating they had been split. Additionally an indeterminate medium mammal long bone shaft fragment also appeared to have been worked. These three pieces can perhaps be interpreted as debitage from some sort of tool making or other deliberate bone modification activity. One indeterminate piece of bone had been burnt but not carbonized. Finally three bones showed evidence of carnivore chewing, one medium mammal tibia fragment and two medium mammal long bone shaft fragments.

**Stratum 49**

Stratum 49 was characterized by a “dark gray fill with much ash built up above the level’s surface (Schwartz 1988:12). The faunal assemblage from stratum 49 yielded an NISP of 16. 13 of these pieces — 81.25% of the assemblage — were *Ovis/Capra*. Of these 13 pieces, .2 pieces are likely part of one mandible. The mandible appears to be the left portion, with all three molars and a fourth premolar. The third molar is very slightly worn and the molars are increasingly worn as one moves medially down the tooth row. The fourth premolar is also only slightly worn. We can thus infer that the animal died relatively shortly after this tooth erupted, around 3 to 4 years in semi-wild, hill sheep (Silver, 1970). The remaining specimen was an unfused tibia. Gazelle comprised 12.5% of the assemblage with two pieces of first phalanx. It is likely that these pieces go together. One fragment of *Sus* pelvis, including the acetabulum, comprised the last 6.25% of the assemblage.
**Stratum 48**

Stratum 48 was marked by a lighter gray fill than the preceding stratum. Occupational trash was recovered from the Stratum 48 floor (Schwartz, 12). This level contained an NISP of 73, which were largely Sus specimens (a total of 61 specimens, or 83.5% of the NISP). Over half of these specimens include fragments of mandible and teeth fragments. Several teeth were identified including one complete unerupted lower third molar and fragments of another. Given that the third molar of this mandible has not yet erupted, we can estimate the age of death for this animal within the range before the third molar erupted. Silver records that the third molar generally erupts around when a Sus is between 17 and 22 months, although the range is highly variable, especially when wild boar are considered as well (Silver, 1970; Hilson, 2005: 234). Additionally, a mandible with an intact incisor, and a maxillary tooth row containing a first molar, a third premolar and a second premolar was recovered. All three teeth are only slightly worn, suggesting that the individual Sus died relatively soon after these three teeth erupted, between ages 12 and 16 months. Post-cranial elements include a left scapula, a left ulna, a right radius, and a right tibia. A very small humerus (Sd = 5.4) was also recovered, likely from a juvenile.

Elements identified as Bos make up 11% of the NISP with 8 specimens. These specimens include a complete right radial carpal, a centroquartal tarsal, and a fused C2/C3 right carpal that had been chopped. Fragments of a Bos lower molar was also recovered.

Ovis/Capra elements comprise the remaining 4 specimens (5.5%) of the NISP for this stratum. These elements include one right upper second molar and one left upper third molar, which was moderately worn. Additionally one left humerus and one tibia, which was fused distally, were recovered. In sheep and goats the distal end of the tibia fuses between 1.5 and 2 years of age, and thus we can posit that the animal was older than that when it died.

Two specimens identified as medium mammal long bone shaft fragments exhibited evidence of having been gnawed by carnivores. Additionally, one medium mammal long bone shaft fragment showed evidence of burning. A large mammal long bone shaft fragment appears to have been deliberately split and perhaps represents debitage from tool making.

**Stratum 47**

Stratum 47 yielded a NISP of 103, including a number of teeth. This stratum contained the end of a wall that ran north-south. Schwartz characterized the sediment as “light-brown fill of medium texture,” (1988: 12). In this level Sus comprised 53.4% of the identifiable specimens, while Ovis/Capra contributed 39.8%. Bos, Canid and Ovis provided 4.8%, 0.9% and 0.9% respectively.

Sus material included three scapulae with intact distal ends, two left scapulae and one right scapula. This indicates an MNI of two Sus for this surface. One of the left scapulae exhibits cut marks on its neck. Two distinctly separate portions of right pelvises were also recovered, further pointing to an MNI of two individuals for this sample. Additionally, a comparatively great number of Sus skull fragments, including portions
from both maxilla and mandibles were recovered. One mandible included a full tooth row, which contained an unerupted M3, M2 with “c” wear, an M1 with “e” wear, a P4 with “b” wear and a virtually unworn p3. Overall this mandible exhibits a wear stage (M.W.S.) of 19 according to Grant’s system (1982). The presence of an unerupted third molar suggests an age of death somewhere before approximately two years of age (Hilson 2005). Additionally, a right lower first molar exhibiting “f” stage wear reinforces the MNI count of two Sus for this stratum’s samples. This other individual had a relatively later age of death than that represented by the reconstructed mandible. Other recovered teeth include a lower canine, three incisors, one piece of mandible with an intact and moderately worn second premolar and one lower third premolar exhibiting heavy wear.

*Ovis/Capra* specimens comprise the second largest portion of the zooarchaeological material recovered in this sample. Aside from one patella, all of the elements recovered were associated with the skull. This sample included pieces of cranium, maxilla, mandible and teeth. All of the recovered teeth are maxillary. They include one deciduous fourth premolar, two left first molars, one right first molar, fragments of a second molar, and two right third molars. The two left first molars exhibit heavy wear. One of the two third molars is heavily worn, while the other’s wear is somewhat obscured by carbonate. The buccal and labial edges of the third molar appear almost unworn. There is a hole through the middle of the distal cusp that runs clear through to the root, as if the dentin had never formed. The duplicate first and third molars suggest an MNI for this stratum of two *Ovis/Capra* individuals. A horncore was also found and identified as *Ovis*.

Three pieces of *Bos* elements were represented in this stratum, including the shaft of both an ulna and of a radius and a metatarsus that shows evidence of modification. One dog canine was found in this assemblage.

Two medium mammal long bone shaft fragments and one medium mammal ulna were found with evidence of carnivore gnawing. Four specimens in this stratum showed evidence of alteration. One medium mammal long bone shaft fragment had been burnt to the point of carbonization. The *Bos* metatarsus described above, and 2 large mammal long bone shaft fragments showed evidence that they were deliberately split and could be debitage from tool making.

**Stratum 46**

This stratum in the Operation 1B area of the sounding consisted of a wall stump that extended out of the south balk 50 centimeters. It measured 50 centimeters across. Schwartz characterized the stratum sediment as “more light gray, medium-soft fill,” (1988: 12). No faunal material from this stratum was included in the collection I had access to.

**Stratum 45**

Stratum 45 was comprised of a surface “without any architectural remains evident except for Wall 37, built in Stratum 46.” Schwartz characterized the debris as “gray” and “ashy” (1988:12). This stratum yielded an NISP of 26. Proportionally *Bos* comprises the largest
portion, representing 50% of the identifiable specimens. *Sus, Ovis/Capra,* and *Ovis* constitute 27%, 15.4% and 7.6% respectively. The *Bos* remains include one fused first and one fused second phalanx, a radius fragment, the fused distal end of a scapula, and the fused diastema area of a mandible. *Sus* elements included a number of scapula fragments, including two fused distal ends, one right and one left. Additionally, a *Sus* ulna fragment, and a maxillary canine fragment were recovered. One ilium fragment, two humerus specimens, and one lower right third molar were identified as *Ovis/Capra.* The molar was only slightly worn, indicating an age of death relatively soon after they erupted, between 18 and 30 months of age (Silver, 1969). One element, a calcaneus was recovered in two pieces, which has been identified as *Ovis.*

Three specimens, which were unidentified by taxa, showed characteristics that suggest the use of the animal. One medium mammal long bone shaft fragment was fully carbonized, and another medium mammal shaft fragment displayed a cut mark. One interesting piece of indeterminate spongy bone showed evidence of a hyperostic lesion on the shaft, but the lesion obscured the morphology of the bone to the point where identification was not possible. This sort of lesion indicates that the animal’s bones had undergone prolonged use.

**Stratum 44**

This stratum marks the beginning of Leilan Period IV. Stratum 44 was a surface that contained both ash and organic material, which yielded samples for carbon-14 dating. Two stone formations were excavated from this stratum — one in the northeast corner, and one in the south. The stones in the south surrounded an *in situ* vessel.

This stratum contained an NISP of 5, all of which were *Bos* elements. These specimens include one left C2 and C3 fused carpal, one left intermediate carpal, one left ulna carpal, one left radial carpal and one left 4th carpal. With the exception of the intermediate carpal, all of these elements are complete.

One polished bone tool was found in this stratum. This awl-like instrument was made from the shaft of a long bone from a medium mammal.
Stratum 43
Stratum 43, which "consisted of grayish brown, ashy fill with some bricky inclusions," (Schwartz 1988: 12), yielded an NISP of 15. In this stratum *Bos* elements comprise 80% of the identifiable specimens. These *Bos* elements include an astragalus, calcaneus, a fused first phalanx, fragments of at least two metatarsus, one of which was unfused, and fragments of the proximal end of at least one femur. *Ovis* and *Ovis/Capra* comprise the other 20% of the NISP, which contributed 6.7% and 13% respectively. The single *Ovis* specimen comprised of one fused metatarsus. The *Ovis/Capra* specimens included a scapula and a metatarsus that could not clearly identified as either *Ovis* or *Capra*.

Three elements contained cut marks in this sample: the *Bos* astragalus, the unfused metatarsus, and a vertebra that was categorized as medium-large mammal. The Metatarsus was particularly interesting in that it was unfused, but cemented together by carbonate. The proximal epiphysis, where the cut marks were located on the medial/lateral, also contained a whole roughly 14.6 in length, shaped like a keyhole. This hole did not appear to be of clearly modern origin.

### SUMMARY BY PERIOD

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**Table 2 — Percentage of NISP by period**

The complete faunal assemblage analyzed here represents all of the material recovered from Leilan Period V during the excavation of the Operation I trench and from two of the four stratum of Leilan Period IV. It is not possible to make any conclusions regarding major changes in: animal management strategies between these two periods without the additional information to be gleamed by analyzing the faunal material recovered from strata 42 and 41. Perhaps the most valuable information gleaned from assessing the changes in the amount of each species show is that it indicates how poorly representative such a small sounding is for a large site such as this.

A comparison of the percentage each taxon contributed to the period NISP shows that there is a statistically significant difference in the amount of *Sus* and *Bos* fragments found in each period. Leilan V strata generally show a high percentage of *Sus* fragments compared with other taxon, with the exception of Stratum 44. No *Sus* specimens, however, were identified in the material from the Leilan IV strata analyzed here. The persistent exploitation of pigs is well documented during the early third millennium at Leilan (Zeder, 1998). This suggests that rather than a sudden halt in the exploitation of
pigs at Leilan during this period, the sample analyzed here is simply an incomplete representation of the range of animals utilized at Tell Leilan in the fourth millennium. Similarly, the high percentage of Bos fragments in the NISP for the portion of Leilan IV included in this sample is skewed by the fact that the faunal remains from Stratum 44 consisted of five Bos carps, possibly from the same individual. These five elements represent 25% of the NISP for period IV.

Overall, I think it is not surprising that there is a high percentage of both pigs and sheep and goats in this assemblage and a comparatively small percentage of cattle material, especially as we presume most if not all of these specimens are domesticates. Pigs are primarily kept to provide meat, though their skin and bones can be made into secondary products after butchering, such as tools. Sheep and goats provide meat, hide and the raw material for bone tools as well, but they also produce wool and milk while alive. Cattle are valued not only for their meat and dairy products, but for their traction. They reproduce less frequently than the other three major taxa exploited at Leilan, so they are more likely to be conserved for traction and perhaps dairying purposes as long as possible (Ashkar 1995). In an area where it is easy and profitable to raise pigs, it seems plausible that pigs would be the first to be butchered, and thus appear most plentifully in the faunal assemblage. Perhaps sheep and goats, who reproduce more quickly than cattle, would be slaughtered before cattle, but less frequently than pigs due to their valuable secondary products. Cattle would be the last animal chosen to be butchered; perhaps individual animals would only be slaughtered when they were no longer valued for its traction or dairy.

One striking aspect of the data here is the very small percentage of fauna that is certainly wild. There are only a few small gazelle fragments, for example. This raises several questions regarding whether the small taxa that are unrepresented in this sample would offer a different view. Further analysis of other contemporaneous areas of Leilan is necessary to elucidate the question of how much wild versus domestic fauna were exploited by the residents of Leilan. Presuming that most if not all of the pigs, sheep, goats, and cattle found at Leilan are domestic, then this low percentage of wild fauna is consistent with models of a permanent agrarian settlement during this period (Zeder 1994).

<table>
<thead>
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Total 2502
Table 3 — Number of Elements Present by Skeletal Portion, Stratum 52 – 43
Head refers to all skull elements including the mandible and teeth
Axial refers to the vertebrae, ribs, and pelvis
Limb refers to the fore and hind limbs
Metapodial refers to the metacarpals, metatarsals, carpals, tarsals and phalanges

The summary of identifiable faunal elements from strata 52 to 43 does not offer a complete view of the skeletal elements represented in this assemblage. Many fragments could not be identified by taxon; instead they were classified by size class. Specifically, limb and axial elements frequently could not be assigned to a specific taxonomic category, but their presence in the assemblage is important. They indicate that all aspects of the animals were being processed and utilized. The presence of limb and axial skeletal elements in all three size classes shows that the parts of the animals that are valuable for food were present as well. It is not uncommon at archaeological sites for these body parts to be too incomplete to be identified. A survey of the data may make it look as if there are many more skull elements in the assemblage than other skeletal elements. This is deceptive; the skull portions are more fragmentary than other skeletal elements, and more easily identified, thus skewing the NISP data to make it appear as if cranial elements are exploited more than other body parts. Cranial material represents only 33% of the assemblage by weight, not an unusually high percentage.

CONCLUSIONS
I believe the material analyzed from the Operation 1 trench appears to consist of refuse from the day-to-day domestic practices at Tell Leilan during the fourth millennium. There are no indications here of any sort of large scale or centralized animal use. This assemblage appears consistent to me with expedient, small-scale household consumption.

Unfortunately, the nature of the excavation and the small sample size examined here does not allow us make any broader interpretations regarding the animal management strategies employed at Tell Leilan in the fourth millennium BCE. Nevertheless, it does offer some interesting insights into the lives of the residents at Leilan in the fourth millennium and suggests some avenues for future research.

A Baseline for Local Chalcolithic Culture in Northern Mesopotamia
One value of the material analyzed from the Operation 1 trench is that it offers a chronological view of the animals exploited at Tell Leilan. The data presented here concretely shows the presence of Sus, Ovis/Capra, and Bos at the beginning of the fourth millennium BCE. This information could perhaps provide a baseline for what local culture may have looked like during this period in Northern Syria. This information would be useful for assessing whether other nearby sites show local food preferences or Southern Mesopotamian food preferences, for example

Information about the Ecology of Leilan
The large portion of Sus skeletal elements identified in this assemblage is consistent with our understanding of the ecology of the area around Leilan in the fourth millennium. Pigs yield a large amount of meat, but are only profitable under certain ecological conditions. They tolerate heat more poorly than other taxa and require a comparatively large amount
of water. They cannot be herded as sheep and goats are, but they fit quite nicely into a household where they are kept in close quarters and fed off scraps (Zeder 1991, 1998). Grigson estimates that pigs cannot be profitably exploited in areas that receive an average annual rainfall of 200 mm a year or less (1987). Leilan is well above that limit, receiving approximately 450 mm of rainfall a year. As one would expect, there is much more pig in the sample examined here than in contemporaneous samples at more arid sites (e.g. Weber, ND for Tell Brak). Further the amount of pig here is consistent with the higher proportions found in third millennium contexts (Zeder 1994), suggesting that this animal management strategy persisted for a long time at Leilan.

*Sedentism at Tell Leilan*

The amount of pig found in the Operation 1 material from Leilan V and IV is also consistent with models that suggest a sedentary, multi-seasonal settlement at the tell. Zeder interprets the presence of relatively high proportions of pig remains at Umm Qseir as evidence that the site was settled by a small group of farmers, rather than by nomadic pastoralists on a seasonal basis as previously thought. As both she and Grigson argue, pigs (when domesticated) are not often associated with mobile groups (Zeder 1994, Grigson 1987), but rather support an interpretation of sedentary agriculture. Thus the presence of large proportions of pig bones, exhibiting a range of age classes as found in this analysis is consistent with the interpretation of Leilan in the fourth millennium as a sedentary agricultural village. Further, unlike sheep and goats, pigs cannot be herded in any large scale manner. A high reliance on pigs as is suggested in this assemblage perhaps indicates that the residents at Tell Leilan were engaged in small-scale domestic farming rather than a larger, centralized agricultural system. The material analyzed here is consistent with this interpretation, though it cannot prove it.

*Tool Production at Tell Leilan*

Another interesting aspect of the assemblage is the material that appears to have been modified, either into a tool or perhaps as debitage from tool-making. Seven of the modified tools in this assemblage were derived from medium mammal fragments. Most of them are likely made from sheep or goats. Four of the twelve modified fragments came from large mammals, and one came from an animal that was identified as medium-to-large. I interpret this data as suggesting that the residents at Leilan chose bone tool material based on taxa availability and on the intended use of the tool rather than utilized a methodical and organized production favoring certain animals. It is, however, interesting that large mammals represent a slightly larger portion of the elements identified as modified than they do in the overall assemblage. This is probably because those bones are a practical choice for tool-making. These data may also represent recovery bias because the debitage pieces from medium mammals may have been too small to be noticed during excavation.

Additionally, if most of the medium mammal fragments are indeed sheep/goat elements, it would suggest a preference in sheep/goat bones for tools over pig bones, despite the significantly higher amount of pig found in the assemblage.

While this analysis does not offer a conclusive view of the animal management strategies employed at Tell Leilan in the fourth millennium, it still provides useful information.
about the behavior of the people who lived there. It will be interesting to see if these patterns hold true when other contemporaneous areas of the site are published.

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