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THE POLITICS OF PASTURE: THE ORGANIZATION OF PASTORAL PRACTICES AND POLITICAL AUTHORITY IN THE LATE BRONZE AGE IN THE SOUTH CAUCASUS

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For my sisters, by blood or by other means

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ABSTRACT

This dissertation investigates how human-animal relationships in pastoralism shaped the organization of political life in ancient pastoralist societies. This project uses zooarchaeological and isotopic analysis to outline the organization and political implications of pastoralist practices of production, circulation, and consumption in the mid-2nd millennium BCE in the South Caucasus through the material traces they left in archaeological faunal remains. This project approaches the question of the relationship between politics and pastoralism, not as a contradiction needing to be resolved, but as a project of understanding the affordances that pastoralist activities provide for the creation and maintenance of forms of political authority and subjectivity.

In doing so, the dissertation project considers how the specific ethological and material characteristics of domesticated herd animals and their relationships with humans gives them the ability to shape the form and content of political organization in pastoralist societies. It combines a theoretical approach to human-animal relationships based on scholarship from in animal studies and insights on the relationships between the material world, value, and politics from the anthropological and archaeological literature on materiality and value. Close attention is paid to how the particular 'material' characteristics of domesticated herd animals shaped pastoralist activities, and the suitability of such activities to participate in the creation and maintenance of particular forms of value.

These characteristics are the basis of the specific affordances of human-herd animal relationships, which shape the creation and stabilization of political subjectivity and authority. In order to build a synthetic account of the relationship between pastoralism and political organization in the mid-2nd millennium BCE in the South Caucasus, I analyze pastoralism as a set of practices that can be broken down into three aspects: 1) space, 2) seasonality, 3) distribution and consumption. This approach expands on recent

work rethinking the relationship between pastoralism and the political by focusing on aspects of pastoralism beyond geographic mobility. Analysis of strontium and oxygen isotopes contributes fine-grained data about the movement of individual animals across the landscape, in contrast to zooarchaeological data (which is based on aggregations of individuals). In order to integrate these different types of data, I re-work osteobiography (drawing on its use in bioarchaeology). This facilitates the interpretation of data that represents simultaneously a unique individual (the individual life history) and a member of certain populations (both biologically and socially).

The investigation of the organization of pastoralist production, distribution, and consumption through isotopic and zooarchaeological analysis reveals the complex organization of pastoralist labor based in species, age, and site location in the mid-2nd millennium BCE Tsaghkahovit Plain. While herd mobility was spatially limited within the plain itself, the analysis reveals that production was oriented both around the year-round provisioning of dairy, as well as prime-weight meat production. The analysis also reveals that much consumption of domesticated herd animals took place off site, through practices that circulated partial skeletal remains post-mortem.

Late Bronze Age pastoralist practices, grounded in human-animal relationships, worked to produce both social cohesion and differentiation across a number of registers. The complex organization of pastoralist production, circulation, and consumption entailed a number of competing and conflicting objectives, practices, and orientations. These disjunctures required negotiation and intervention, around which power and authority were both in play and at stake. While the specific content of and engagement around these points of friction remains opaque, the archaeological evidence presented here suggests that Late Bronze Age political authorities were able to command and re-distribute certain resources, through practices and activities of consumption linked to fortress sites. However, these results also suggest that this organization was countered by other networks and activities that circulated both people and animals in other, potentially less regulated and centralized, ways.

CHAPTER 1

INTRODUCTION & STATEMENT OF THE PROBLEM

This dissertation examines how the human-animal relationships at the heart of pastoralism are fundamental to the so-called "problem" of pastoralism. It explores the potential that human-herd animal relationships had to shape the organization of social and political life in ancient pastoralist societies. The "problem" that pastoralism poses to classical anthropological theories of politics – the way it destabilizes narratives about the development of complex political forms and the nature of political authority (Sneath 2007; Porter 2012) – indicates that the impact may be considerable. If nothing else, these disjunctures suggest that traditional approaches may be inadequate to describing political organization in pastoralist societies. This project locates the impact of pastoralist human-animal relationships on social organization in the ways in which herd animals are simultaneously objects of labor and care, as well as produce and have value.

Societies in the South Caucasus in the Late Bronze Age (1500-1100 BCE) underwent dramatic changes in political organization – changes that, while clearly visible on the landscape in the form of cyclopean fortresses and associated cemeteries, are not well understood. Earlier Middle Bronze Age (2400-1500 BCE) societies in the region were predominately nomadic pastoralist and marked by social inequality. In the Late Bronze Age, this marked social hierarchy was transformed into a new form of political organization – one where newly emergent centers were loci for a suite of interlinked material practices, at once concentrated within the fortress walls and creating linkages beyond them (Badalyan et al. 2008; Smith et al. 2009; Lindsay et al. 2010; Lindsay and Greene 2013; Smith and Leon 2014; Badalyan et al. forthcoming). Despite the emergence of what appear to be stable, stratified communities linked to fortress sites, other evidence indicates that a large segment of the population remained mobile (Smith et al. 2009; Lindsay et al. 2010).

What roles pastoralist practices played in structuring these new social forms remains an open question. Despite wide agreement that pastoralism was a foundational component of societies in the Bronze Age in the region (Martirosian 1964; Khachatrian 1975; Kushnareva 1997; Chernykh 1992), little work has been done to characterize pastoral practices in detail (Monahan 2007; 2012 are an exception).

This project was designed to address two outstanding questions about the new forms of social and political organization that arose in the Late Bronze Age in the South Caucasus. First, how were pastoralists and their herds integrated into the new forms of social and political organization centered in the Late Bronze Age fortresses? The second question, necessarily intertwined with the first, is: how might have pastoral practices structured new forms of authority in the Late Bronze Age? In order to answer these questions archaeologically, pastoralist organization is broken down into three aspects: 1) space, 2) seasonality, 3) distribution and consumption. Space encompasses both the distances traveled by herds and herders, as well as the scale and manner in which pastoral mobility is organized. Seasonality addresses the temporal aspect of pastoral mobility separately from its spatial organization. Lastly, distribution and consumption refer to the practices that move herd animals (of different species, ages, and sex) and their products (meat, milk, wool, blood, hides) into contexts of consumption and discard. This approach addresses pastoralist practices' specificity and potential capacities for the organization of political life. It is part of an ongoing conversation among scholars that are re-examining the relationship between pastoralism and politics (Sneath 2007; Frachetti 2009; Porter 2012; Frachetti 2012; Honeychurch 2015; Potts 2014).

New work on pastoralism in archaeology has focused on how pastoralist practices enable the construction of forms of political organization unique to pastoralist societies. Much of this literature has focused on mobility; however, unlike other accounts of politics and pastoralism in anthropology and archaeology (Lattimore 1940; Barth 1961; Khazanov

1984; Barfield 1993; Salzman 2004; Szuchman 2009), mobility is not seen as necessarily antithetical to the development of political complexity (Sneath 2007; Porter 2012; Frachetti 2012). In Eurasia, much of this discussion has focused on how the organization and logical entailments of pastoral mobility were key to the emergence of forms of political organization unique to the region. These network-based approaches argue that these forms of political organization arose out of the networks and nodes resulting from the seasonal mobility of pastoralists and their flocks (Frachetti 2009, 2012; Honeychurch et al. 2009; Honeychurch 2015). This approach provides useful insights into how pastoralist mobility itself provides the opportunity to construct political relationships, rather than taking mobility as a destabilizing force (cf. Khazanov 1984; Lees and Bates 1974; Cribb 1991). One of the strongest contributions of such approaches is their attention to spatial and temporal variables of mobility.

This project expands on these works by addressing two aspects of pastoralist practices obscured by the focus on networks. First, this dissertation considers how aspects of the organization of pastoralist practices other than geographic mobility may have contributed to the construction of authority and power in the past. Focusing on how pastoralist practices circulate animal bodies socially (not merely temporally or spatially) allows us to consider the impacts of pastoralism on politics outside the framework of territorialization and technologies of communication and interaction. Second, this approach considers the ways in which human-animal interactions shape social organization by means other than mobility. Defining mobility as the only factor by which pastoralism is unique or different risks flattening social landscapes in pastoralist societies. Network approaches tend to focus on the nodes in the networks and the materials that link them (such as horses, wagons, metals etc. [Frachetti 2012]). This dissertation is an attempt to make clear precisely what sorts of practices underlie the connections within and between the imagined 'nodes' in pastoralist networks, and what implications these practices had for the organization of political life. Close attention is paid to how the particular 'material' or ethological characteristics of animals shape the organization of pastoral activities, and how this organization might have structured organization of pastoral labor and the creation and circulation of particular forms of value.

1.1 Studying Pastoralism Materially: Research Design & Methods

In order to investigate the organization of pastoral practices, this dissertation draws on the in-depth analysis of zooarchaeological and isotopic data from Late Bronze Age sites in the Tsaghkahovit Plain, Armenia. The Tsaghkahovit Plain is an elevated plateau located between the northern slope of Mount Aragats and the southwestern slopes of the Pambak range, and it has been the site of sustained archaeological research by the Joint American-Armenian Project for the Archaeology and Geography of Ancient Transcaucasian Societies (Project ArAGATS) over the last 15 years (Avetisyan et al. 2000; Smith et al. 2004; Badalyan et al. 2008; Smith et al. 2009; Badalyan et al. forthcoming). A systematic regional survey, test excavations, and in-depth excavations at the fortresses of Tsaghkahovit and Gegharot have established that the Tsaghkahovit Plain appears to have been a multi-centered polity with a religious center at the site of Gegharot, which served to anchor an integrated network of fortified sites of varying sizes. These sites were connected through networks of ceramic production and exchange, and linked to other fortresses in the region through the exchange of materials (e.g. obsidian [Badalyan et al. 2003:157]), as well as similar architectural and material styles.

Excavations of Late Bronze Age contexts has been carried out within the walls of the fortresses of Gegharot and Tsaghkahovit (as well as smaller excavations undertaken at the fortress of Aragatsiberd), at the Tsaghkahovit Residential Complex (an extra-mural settlement near the fortress of Tsaghkahovit), and at burial clusters near Tsaghkahovit and

Gegharot. This sustained research program has produced an extensive assemblage of faunal remains (over 100,000 coded specimens), a first for this time period in the region. Faunal remains – material residues of the lives of herded animals and the 'social life' of their products after death – represent a powerful and under-utilized archaeological dataset for the investigation of how pastoralists and their flocks figured into the reorganized social and political life of the Late Bronze Age Tsaghkahovit Plain.

This research combines the analysis of the faunal assemblages from these two extensively excavated fortress sites in the Tsaghkahovit Plain with radiogenic strontium and stable oxygen isotope analysis of enamel from faunal teeth. The methods of analysis used in this dissertation provide complementary data to address the three aspects of pastoralist organization outlined above. Zooarchaeological analysis produces data about the distribution and consumption of herd animals and their products, based on patterning seen in the species, age, sex, body part representation, and butchery patterns. The analysis of radiogenic strontium isotopes from faunal remains directly addresses the geographic mobility of animals, and oxygen stable isotope analysis provides information on birth seasonality and seasonal mobility. Isotope analysis allows this project to more adequately investigate space and seasonality as aspects of pastoralist organization.

For this dissertation, I developed an innovative method of sampling faunal assemblages for large-scale isotopic investigations of pastoralism in the past.[1] This new method incorporates age at death as a critical variable (see Chapter 3) in the isotopic analysis of pastoralism. Sampling was done across age classes – as the age at death is a key component of different life trajectories for herd animals (Payne 1973; Dahl and Hjort 1976; Cribb 1987;

1. This dissertation contributes to the relatively recent extension of isotope analysis to faunal remains to study herd animal mobility (Noe-Nygaard et al. 2005; Makarewicz and Tuross 2006; Meiggs 2009; Henton 2010; Viner et al. 2010; Thornton et al. 2011; Henton et al. 2014; Makarewicz 2015), building from a longer history of use in bioarchaeological research (e.g. Schoeninger 1995; Kohn and Cerling 2002). It is the first to focus on the Late Bronze Age in the South Caucasus.

Redding 1984; Greenfield 2010). This is a novel approach and differs from many of the previous larger-scale studies of herd animal mobility and seasonality, which generally have been diachronic studies focusing on change over time, rather than an in-depth analysis of a particular period (e.g. Meiggs 2009; Henton 2010). In part, this new method for sampling was made possible by the embarrassment of riches that is the Project ArAGATS faunal collections. For this project, the limiting factor was the money available for analysis, rather than the number of specimens suitable for isotopic analysis (cf. Meiggs 2009; Henton 2010). Furthermore, the research design maximizes the information collected over the lifetime of the individual, rather than maximizing the number of individuals sampled,[2] by combining incremental stable oxygen and radiogenic isotopic analysis of the teeth of individual animals. Both of these features help to situate the data collected through radiogenic strontium and stable oxygen isotope analysis within the larger framework of osteobiography (see below).

Zooarchaeological and isotopic analyses produce very different kinds of data, and integrating them in not necessarily simple or straightforward. Analysis of strontium and oxygen isotopes contributes fine-grained data about the movement of individual animals across the landscape that is rarely visible in zooarchaeological data (which consists of datasets that represent the aggregations of individuals, often over considerable amounts of time). Nevertheless, zooarchaeological analysis of large faunal datasets still provides invaluable data about the social lives of animals (both living and dead) across the entire range of their pre- and post-mortem social lives, in contrast to isotopic analyses. Zooarchaeology provides a macro-scale perspective, based in the analysis of aggregated

2. It is worth noting that the sample size for this project is still quite large for archaeological isotopic datasets, especially for analyses of faunal remains. While a large-scale program of isotopic analysis focused on a single element (e.g. strontium) could potentially produce a statistically robust dataset that could be directly compared with zooarchaeological datasets, the preliminary nature of isotopic research (on both human and animal remains) and the lack of background isotopic data for the region ruled that approach out for this project.

populations (across both time and space) that represent, at least initially, the results of social practices of circulation, consumption, and deposition of the physical remains of animal bodies. Isotope analysis, in contrast, provides micro-scale data and is intimately tied to the biographies of individual animals across their lifetime.

In order to integrate these different analytical approaches into a single research project, the research design I developed for this project addresses this problem in two distinct ways. First, this project uses taphonomic analysis, centered on the contexts of deposition from which faunal remains are recovered, as an analytical method to bridge between different methodological techniques, as well as between Late Bronze Age social lives and practices of archaeological knowledge production (see Chapter 4).[3] This approach contextualizes the necessarily selective set of faunal remains used for isotopic analysis, clarifying their relationship to the wider picture and reducing the potential for misleading interpretations based on a narrow sampling.

For zooarchaeological analysis of faunal assemblages, this means that the assemblages are analyzed at the level of discrete contexts of deposition (floors, pits, deposits, hearths etc.), which are then compared both inter- and intra-site, rather than taking the site itself as the unit of analytical interest. While hardly a revolutionary intervention for contemporary archaeology, it is important to stress that such approaches greatly increase the power and resolution of zooarchaeological techniques, moving beyond considerations of calories and efficiency, thereby increasing the adequacy of such analyses for answering questions about value and the political ramifications of pastoral practices (Marciniak 2006; Orton 2010b). Critically, this approach allows production and consumption to be considered separately, and does not assume that the practices associated with either will occur at the same spatial

3. This aspect of the research design builds on the traditional importance of taphonomic analysis to zooarchaeology (Lucas 2012:92) and on the tradition of contextual analysis in social zooarchaeology (Bulmer 1976; Meadow 1978; Zeder 1991; Marciniak 2006; cf. Hodder 1991).

or temporal scales. Furthermore, these comparisons highlight movement between contexts within sites, as well as specifying the kinds of contexts that are linked between sites as well.

Second, this dissertation uses the concept of osteobiography, borrowed from bioarchaeology (Saul 1972; Robb 2002; Stodder and Palkovich 2012) to to help integrate the disparate types of data produced by zooarchaeological and isotopic analysis (see Chapter 3). Traditional zooarchaeological analyses are done on datasets that aggregate many individuals. In most cases, these datasets provide information on a relatively macro scale and rely on large sample sizes to be able to develop interpretations through large-scale patterning. In contrast, stable isotope analysis is necessarily applied to specific individuals and the sample sizes are much lower (due to the expense and time involved). Osteobiography, in this analysis, is a method that starts at the level of the biological individual and expands outwards to increased levels of aggregation, in order to facilitate the interpretation of data that represents simultaneously a unique individual (the individual life history) and a member of certain populations (both biologically and socially). This project uses this approach to interpret the individual animals analyzed using isotopic methods and their relationship to the various faunal assemblages defined by context and other variables.

1.2 Pastoralism in the broader context

This dissertation is an attempt to analyze how pastoralist practices – the interactions between herders and herd animals as they moved in landscapes and through the seasons and the practices that circulated of meat, milk, and wool to fortresses, shrines, and into graves – formed the basis for an order that was both economic and political. In doing so, it interrogates the relationships between labor and value in pastoralist societies. I argue that the specificity of pastoralism is based in the necessary enlacement of human and animal needs and capacities, which structure (but do not strictly determine) the organization of human and animal labor and establish herd animals as both objects and generators of value.

In doing so, this work attempts to demonstrate that pastoralism is not a "problem" for political life – resisting the development of complex forms of political organization – but rather, a set of human-animal relationships that structure the form that political life takes. This approach to understanding the implications of pastoralist practices for political life is in conversation with two bodies of work within archaeology. On the one hand, like other analyses of the Bronze Age in the South Caucasus, this work explores the ways in which the development of new forms of political organization in the region appear to have taken a different path than classical models of Near Eastern states or steppe empires (e.g. Masson 1997; Badalyan et al. 2003; Lindsay and Greene 2013; Ristvet et al. 2012; Hammer 2014). On the other, it is one of a series of analyses undertaken by archaeologists and historians studying pastoralist societies in the Near East and Eurasia that re-examine the idea that pastoralism is inimical to political complexity (Sneath 2007; Porter 2012; Frachetti 2012; Honeychurch 2015). However, in this work, I suggest that reducing pastoralist practices to spatial mobility may obscure other unique structuring elements – ones that are at work for both the classical nomadic pastoralists of the Eurasian steppes but also for more sedentary agropastoralists.

More broadly, this dissertation contributes to the growing literature on material affordances within archaeology, anthropology and related disciplines. In the Western intellectual tradition, animals sit in the blurry middle of the division between subjects and objects.[4] In this light, pastoralism can be viewed as a set of sustained relationships that entwine humans and not-quite subjects/objects. By using the concept of affordances,

4. This is an inheritance from the forms of Cartesian dualism that permeate Western thought – an inheritance that is, increasingly, coming under fire.

originally developed to describe human-thing interactions, this work explores the ways in which scholarly approaches to material objects and animals could be usefully brought together, beyond merely noting their co-location on one side of the Cartesian divide. Furthermore, this dissertation, by analyzing the political entailments of human-animal relationships in ancient pastoralist societies, is situated within a larger conversation about human-animal relationships and the ontological turn across the social sciences. By carefully considering human-animal relationships in the past, this study also attempts to destabilize narratives about ontology, ecology, and the species-beings of animals that are put to work in the present (cf. Bessire and Bond 2014:441-2), by showing their historical contingency, as well as how they are folded into contemporary academic practice. While this work focuses on the particular affordances of human-herd animals relationships within pastoralism, pushing against reductive and determinist understandings that characterize Western views of pastoralism generally, it also contributes to a larger conversation about human-animal relationships in general.

In doing so, this research works to historicize the 'flattened' ontologies of some of the current anthropological discussions, questioning the link some authors have drawn between our contemporary ontological questions and the Anthropocene (eg. Kohn (2015), see Fowles (2016) for a critique). While some authors working on questions of contemporary human-animal relationships do engage with histories (at varyingly deep time-scales) (e.g. Haraway 2003; Tsing 2005; Franklin 2007; Haraway 2008; Fijn 2011), the relative absence of archaeologists from this debate means that the gap between origins (domestication) and the contemporary moment often evades scholarly notice. This research inserts itself into that gap by re-thinking pastoralism through the human-animal relationships at its heart, in a context that is neither the originary process of domestication nor a contemporary set of human-animal relationships.

1.3 Organization of the Dissertation

Chapter 2 begins with a discussion of the role that pastoralism played in the Late Bronze Age in the South Caucasus, presenting current archaeological knowledge and contextualizing research done on Late Bronze Age sites in the Tsaghkahovit Plain within the region. As part of this, I include a summary and discussion of previous zooarchaeological research on the Late Bronze Age in the South Caucasus, focusing on the work undertaken by Armenian scholars at the NAS Institute of Zoology. The second half of the chapter presents an analysis of previous and current theoretical approaches to the relationship between pastoralism and politics in anthropology and archaeology. As part of this discussion, I engage with the growing recent literature in Near Eastern and Eurasian archaeology that seeks to re-think how politics is theorized in the study of ancient pastoralist societies.

The next chapter, Chapter 3, explores how approaching human-herd animal relationships as a form of companion species (Haraway 2003, 2008) suggests a new way of exploring the impact that pastoralist practices might have on political organization. In it, I argue that an expanded and re-tooled understanding of the concept of affordances is necessary in order to produce an adequate account of the effects that human-herd animal relationships have on the organization of pastoralists practices, and consequently, the organization of political life. This new approach to affordances combines insights on the importance of the material properties of objects from the anthropological literatures on value and on materiality/new materialisms with an expanded understanding of ethology drawn from animal studies. In doing so, I offer a preliminary account of how this approach reconceptualizes the relationship between labor, value, and the political in pastoralist practices.

In the second half of the chapter, I analyze how previous zooarchaeological models of the relationships between political organization and pastoralist practices tacitly rely on different, narrowly-defined understandings of the affordances of herd animals. Following this, I present a new analytic for studying pastoralists practices archaeologically, one that more fully incorporates the range of affordances made possible by human-herd animal relationships. This framework incorporates both quotidian and extra-ordinary uses of herd animals and their products into the analysis of the the political implications of the organization of pastoralist practices of production, circulation, and consumption. At the end of the chapter, I introduce the concept of osteobiography, its origin as a method for the interpretation of human osteological data, and my adaptation of it in order to scale between zooarchaeological and isotopic data from archaeological faunal remains.

Chapter 4 uses the framing of 'contexts of deposition' to begin my analysis of the archaeological data in *media res*, at the (conceptual) interface between the living and lively animals of Late Bronze Age societies in the Tsaghkahovit Plain and the dead and dusty bones that are the objects of zooarchaeological and isotopic analysis. This chapter describes the various contexts where animal remains were deposited in the past and then encountered subsequently through excavations over the past decade. It explores the contrasts and similarities between 'everyday' and 'special' contexts of deposition (burials, ritual spaces). In addition, the results of the taphonomic analysis of the available faunal assemblages are used to assess the potential (as well as the limitations) of the zooarchaeological and isotopic analyses presented in the subsequent chapters to provide information about the social lives of Bronze Age herd animals. As part of this chapter, I present the results of the excavations of Gegharot Kurgan 2, a Late Bronze Age burial mound (see Appendix C for a more detailed account).

Across the following two chapters, I present the results and interpretation of the zooarchaeological and isotopic analysis of faunal remains from Late Bronze Age sites in the Tsaghkahovit Plain, Armenia. More detailed technical discussions of the methods used and the results of zooarchaeological and isotopic analyses can be found in Appendix A and B, respectively. Chapter 5 presents the isotopic evidence for spatial and seasonal mobility, based on on radiogenic strontium and stable oxygen isotope analysis. These analyses suggest that most of the animals analyzed were born in the Tsaghkahovit Plain, or another isotopically indistinguishable region, but the incremental oxygen isotope analysis indicates that there may have been some highland-lowland mobility, particularly for cattle. Moreover, the incremental analysis of stable oxygen isotopes in tooth enamel provides information on birth seasonality in herds. This analysis indicates that pastoralist production was organized towards two different goals – prime weight meat and year-round dairy – which necessitated a complex organization of pastoralist labor across different groups of herd animals.

In Chapter 6, I present the results of the zooarchaeological analysis of faunal remains from Late Bronze Age sites in the Tsaghkahovit Plain. The chapter begins with a discussion of Late Bronze Age culling practices, exploring how demographic factors such as age and sex, as well as other factors such as context of deposition, shaped the transition between living animal and post-mortem material object. From there, the chapter turns to a discussion of the representation of skeletal elements in Late Bronze Age contexts, developing an account of the organization of systems of distribution and practices of consumption of animals and their products.

The analysis reveals that much consumption of domesticated herd animals took place offsite, through practices that circulated partial skeletal remains post-mortem. This research suggests that the emplaced political activities present in fortress sites and mortuary monuments were matched by other practices that involved mobile pastoralists and occurred primarily offsite. In second half of the chapter, I present the osteobiographic analysis of the individual animals with unusual biographies (both pre- and post-mortem), combining the living biographies established through isotopic analysis with an account of their ongoing social lives after death.

In the final chapter, I construct an overall picture of the human-animal relationships that form the basis of pastoral practices in the Tsaghkahovit Plain in the Late Bronze Age. Pastoralist practices (grounded in human-animal relationships) produced both social cohesion and differentiation across a number of registers. Second, the complex organization of pastoralist production, circulation, and consumption entailed a number of competing and conflicting objectives, practices, and orientations. These disjunctures required negotiation and intervention, points at which power and authority were likely both in play and at stake. While the specific content of and engagement around these points of friction remains opaque, the archaeological evidence presented in this dissertation suggests that Late Bronze Age political authorities were able to command and re-distribute certain resources, through practices and activities of consumption linked (in part) to fortress sites. However, there is evidence that also suggests that this organization was countered by other networks and activities that circulated both people and animals in other, potentially less regulated and centralized, ways.

CHAPTER 2

FIRST BITES: PASTORALISM AND POLITICS

2.1 The Bronze Age in the South Caucasus

2.1.1 Setting the scene: Geography & climate

The South Caucasus is geographically defined by the Great Caucasus range, which divides the southern Eurasian steppes from the highlands of southwestern Eurasia. Today, the South Caucasus consists of three independent republics – Georgia, Armenia, and Azerbaijan, as well as three contested regions – Nagorno-Karabakh, Abkhazia, and South Ossetia. While demarcated by contentious and emotionally-charged modern political borders, topographically there is no clear break between the South Caucasus and the Armenian Highland. Geographic, as well as archaeological, imaginaries of the Caucasus tend to view the region as either a margin or a corridor, separating or linking the Eurasian steppes and the Near East.

Though the South Caucasus (due to its many and impressive mountain ranges) is often assumed to be sparse and mountainous, in reality, the region encompasses a wide range of elevations and climatic regimes. Smith et al. (2009:5) further subdivide the South Caucasus into four geographic provinces, each with distinct climatic and topographic differences – ranging between wet sub-tropical forest along the Black Sea coast, 4000-meter alpine zones, lower volcanic foothills, intermontane plains, and steppe grasslands in Azerbaijan. Rainfall varies greatly, from annual averages of 2,500 mm in Western Caucasia to less than 200 mm in Eastern Caucausia (Smith et al. 2009:5). Unfortunately, little work has been done to determine how the current and past environmental conditions in the region may have differed.

2.1.1.1 Location and Context of the Work: The Tsaghkahovit Plain, Armenia

The Tsaghkahovit Plain (Figure 1) is an elevated plateau located between the northern slope of Mount Aragats (4,090 masl) and the southwestern slopes of the Pambak range in central Armenia. The headwaters of the Kasakh River originate from the flanks of the Pambak on the northeastern edge of plain. The river then flows southeast, exiting the plain and continuing through the Aparan valley, towards its confluences with the Araks River on the Ararat Plain (Smith et al. 2009:95-96). The Tsaghkahovit Plain is the smallest and highest (2,000 masl) of the three plains flanking Mt. Aragats, and is linked to the surrounding regions (Lori and Debed valleys, the Shirak plain, and the Aparan valley) through mountain passes and roads passing through topographic 'choke points' produced by the area's mountainous terrain. The slopes of the Pambak are more arid than those of Mt. Aragats, despite being the source of the Kasakh river, as they lack the permanent snow pack of Mt. Aragats and rarely receive precipitation from storms that move west to east through the plain in the summer months (Smith et al. 2009:96).

The plain is geologically differentiated, resulting isotopic variation between bedrock (and therefore groundwater) on either side of the plain. The slopes of Mt. Aragats consist of volcanic basalts. In contrast, the Pambak range is composed of Cretaceous limestones and poryphirites, Middle Jurassic volcanogenic sedimentary rocks, and a lower Cretaceous granitoid intrusion (Smith et al. 2009:96). The southern flank of the plain, bounded by the Tsaghkunyats range, is marked by metamorphic slates, amphibolites, Paleozoic diabases, Cretaceous and Jurassic limestones, and Middle Upper Jurassic plagiogranites (Smith et al. 2009:96). Ongoing isotopic analysis of human remains from the Tsaghkahovit Plain has established a geological baseline and demonstrated the possibility of distinguishing between the plain and surrounding regions (Marshall 2014).

2.1.2 The Late Bronze Age: Previous work & ongoing issues

The Middle Bronze Age (2400-1500 BCE) in the South Caucasus is marked by the abandonment of settled village communities, which characterized the preceding Kura-Araxes archaeological culture of the Early Bronze Age (3500-2400 BCE). Piotrovskii (1955:6) argued that this transition was a result of over-specialization in stockbreeding, which resulted in the development of pastoral mobility and eventually – following a Soviet historical materialist framework – social hierarchy. Other researchers have suggested that the shift was caused by forest clearance for pasture or other environmental degradation caused by Kura-Araxes agricultural practices (Kikvidze 1988; Areshian 1991; Dolukhanov 1979). Without more environmental research, these claims remain fairly speculative. In any event, in the Middle Bronze Age, societies in the South Caucasus became predominately mobile and pastoralist. Even at the small number of Middle Bronze Age settlements excavated, there is a strong focus on pastoralism (e.g. Kushnareva 1997).

The Middle Bronze Age in the South Caucasus can be divided into three phases. The Early Kurgan phase (2400-2150 BCE) is primarily defined by the appearance of kurgan burials – pit and stone cyst tombs that are covered by rock and earthen mounds. The following phase, the Trialeti-Vanadzor phase (ca. 2150-1750 BCE) is defined on the basis of large cemetery sites, such as Trialeti (Kuftin 1941; Djaparidze 1969) and Lori-Berd (Devejyan 1981, 2006). These cemeteries are particularly noteworthy for the practice of rich 'kingly' burials, often including carts and wagons, along with horse and ox sacrifices. This differentiation in mortuary practices is evidence of well-developed social stratification in Middle Bronze Age societies (Badalyan et al. 2003; Smith et al. 2009; Burney and Lang 1971; Kohl 1992).

Burials from this period are also remarkable for the large number of bronze weapons they contain. The depictions of violence found on the Karashamb goblet (Rubinson 2003;

Smith 2001), suggest the existence of a politically ordered violence that was undoubtedly related to the highly visible social hierarchy expressed in kurgan burials of this period. The final period, Middle Bronze III (1750-1500 BCE) is marked by fragmentation into regional (but interlacing) styles of pottery (Karmirberd, Karmir Vank, and Sevan-Uzerlik) (Smith et al. 2009:28). Interestingly, the conspicuous wealth of funerary goods moderated during this period, a trend that continued into the Late Bronze Age.

The archaeological data from the Middle Bronze Age suggests a strong connection between herding and mobility and political authority. The inclusions of horses, carts, and large quantities of animals in exceptionally rich kurgan burials during this period is evidence of a link being drawn in mortuary practices between power and authority and particular kinds of practices involving animals (horse-riding, bullock carts, feasting). Such links likely drew upon the value of such animals, shifting it to the people interred. These mortuary practices took place within a context of charismatic, military forms of authority that arose in this era (Badalyan et al. 2003:152). It is likely that such leaders, in addition to their role in the politically-ordered violence and social stratification of the period, also shaped the social landscape by controlling the movement of groups within the landscape (see Barth 1961 for an ethnographic comparison).

The Late Bronze Age (1500-1100 BCE) in the South Caucasus is marked by a return to permanent settlements, new ceramic types (which replace the painted Middle Bronze Age types), and new forms of metallurgical production. This period also may have seen the development of large-scale irrigation (Kalantar 1994). The Lchashen-Metsamor horizon, which spans the Late Bronze Age and Early Iron Age, is defined by black-burnished incised pottery, and an increase in the scale and intensity of metallurgical production, as well as the use of both open work and lost wax casting (Gevorkyan 1982). The transition to the Iron Age is marked by increasing use of iron, without dramatic changes in the rest of the material repertoire (Smith et al. 2009:29). In current periodization, the Late Bonze Age is divided into three periods. The first, Late Bronze I (1550-1450 BCE), is the period of rapid transition between the Middle and Late Bronze Ages, marked by the absence of painted pottery and the earliest development of Lchashen-Metsamor styles. The Late Bronze II period (1450-1250 BCE) is marked by the proliferation of Lchashen-Metsamor type ceramics and metal artifacts (Martirosian 1964). It is also notable for the increased level of violence suggested by the repeated destruction of the fortress of Gegharot in the period (Smith et al. 2009:30). The final period, Late Bronze III (1250-1150 BCE), is defined primarily by the development of some additional ceramic and metal forms.

In the Late Bronze Age, there was a shift in burial practices. Cromlech burials – a pit or stone-lined cist burial with a smaller above ground construction – are added to the repertoire, and there is a general increase in the number of burials. While the construction of fortresses is a marked departure from the Middle Bronze Age (with its paucity of settlements), traditions of pastoralism and mobility continued into the Late Bronze Age (see below). However, it is difficult to gauge the extent of continuity between the periods or to understand the organization of pastoralist practices due to the lack of settlement data available for both the Middle and Late Bronze Ages. Forming part of this lacuna is the limited nature of zooarchaeological investigations of Late Bronze Age faunal assemblages.

2.1.2.1 Previous zooarchaeological research

Zooarchaeological research on the Late Bronze Age in the South Caucasus has been very limited, and while recent international projects in the region are incorporating zooarchaeological data into their research programs, currently little information exists about the faunal remains found in archaeological sites. Consequently, not much is known about the actual organization of animal husbandry or the forms that other human-animal relationships took, especially in the Late Bronze Age. In part, this is a result of the orientation of archaeozoological research in Armenia, which has primarily focused on questions of domestication and morphology. A small number of scholars, affiliated with the Institute of Zoology (NAS) in Yerevan and trained primarily as zoologists, have analyzed faunal remains from excavations across Armenia.

One early such work is *Paleofauna epokh eneolita bronzy i zheleza na territorii Armenii* (Mezhlumyan 1972). This book is primarily concerned with evaluating the evidence for the development and evolution of domesticated animals in Armenia, with a primary emphasis on cattle and horses. Mezhlumyan considers the cranial morphology of specimens collected from archaeological excavations spanning the Neolithic to the Iron Age. On the basis of these materials, she concludes that cattle were likely locally domesticated but that horses may have arrived from elsewhere (Mezhlumyan 1972:160). While the book is generally concerned with skeletal morphology and processes of genetic change, there are occasional references to information that might inform on other questions of archaeological interest, such as her note that the faunal remains recovered from Lchashen included horses and pigs, whereas those from Trialeti did not (Mezhlumyan 1972:160).

Ninna Manaseryan, along with her students, have continued this tradition of research. Manaseryan has published a number of articles in English & Russian: summaries by period (Manaseryan 2004; Mirzoyan and Manaseryan 2013; Manaseryan 1991, 1997), by species (horses: Manaseryan and Mirzoyan 2000; Manaseryan 2006, birds: Manaseryan 2010, dogs: Manaseryan and Antonian (2000), boars: Manaseryan 2013), and by site (Manaseryan and Mirzoyan 2003; Mirzoyan and Manaseryan 2008). Her research program has continued the focus on skeletal morphology (Manaseryan 1972, 1984, 2006; Gyondjyan and Manaseryan 2014). Late Bronze Age materials comprise a small part of the published corpus. In an early publication, Manaseryan (1972) identified a trend of more small stock (i.e. sheep/goats) in earlier periods, across the samples she had studied (though sample sizes were small across the sites included). At Shirakavan, she notes that in the materials from the 1st millennium BC, that the most numerous species in the sample is cattle, followed by horses and then sheep/goats (Mirzoyan and Manaseryan 2008). However, this study had very small sample sizes.

In addition to the work done by Armenian archaeozoologists on Late Bronze Age materials, in recent years Project ArAGATS has published the results of the ongoing analysis of the considerable faunal assemblages from excavations at Gegharot and Tsaghkahovit (Badalyan et al. 2008; Monahan 2012; Badalyan et al. forthcoming). Caprines are the dominant species in most contexts, except for the assemblage from the Tsaghkahovit Residential Complex, which has more cattle. Wild animals are very rare in the assemblages from sites in the Tsaghkahovit Plain, they comprise less than 1% of the NISP (Badalyan et al. forthcoming). As of yet, there is no clear interpretation for these differences in species between these contexts.

Analyses of the Project ArAGATS materials have provided evidence for different herding strategies for cattle and caprines and systems of exchange, which appear to have provided the fortresses with young animals, but through mechanisms that are not yet clear (Badalyan et al. forthcoming; Monahan 2012; Chazin 2011). Interestingly, the kill-off patterns for cattle at Gegharot and Tsaghkahovit differ from those for caprines from all the assemblages analyzed (Badalyan et al. forthcoming; Chazin 2011), which may indicate that herding practices varied by species. The mortality patterns for caprines suggest that none of the assemblages represent a self-sustaining herd (Monahan 2012; Badalyan et al. forthcoming). The patterning suggests that caprines were circulating within and between sites – either ‘on the hoof’ or as packages of meat – perhaps as part of a system of redistribution (Monahan 2012; Chazin 2011).

The situation of zooarchaeological studies of Late Bronze Age materials in Georgia is similar to Armenia (Kathryn Weber, pers. comm.). There have been some recent zooarchaeological publications from a German team working with excavated materials from sites in the Alazani valley (Uerpmann and Uerpmann 2008; Knipper et al. 2008). Uerpmann and Uerpmann (2008) analyzed the faunal remains from excavations at Didi-gora and Tqisbolo-gora. While analysis of the assemblage from Tqisbolo-gora focused on the presence of equids and wild species, a more in-depth analysis was done for the assemblages at Didi-gora. Unfortunately, the Late Bronze Age (LBA) and Early Iron Age (EIA) contexts at Didi-gora had comparatively smaller sample sizes. This work focused mainly on environmental questions and morphological characterization of the remains (in order to identify possible wild and domestic equids and cattle).

In the EIA faunal assemblage at Didi-gora, cattle remains dominated and Uerpmann and Uerpmann (2008:204) note that the mortality data for EIA cattle shows less kill-off of young animals than in the MBA assemblage. They interpret this as a sign of expansive herd growth and speculate it may have been in order to pay tribute in cattle. They suggested the steeper kill-off of young cattle in the MBA may indicate dairying. For sheep and goats, they note a 'normal' survivorship curve for both the MBA and the EIA (Uerpmann and Uerpmann 2008:211). As part of this research, a very small sample of teeth from the excavations were analyzed for strontium and oxygen isotopes, in order to address questions about pastoralist mobility (Knipper et al. 2008). The results of the analysis could not conclusively identify any seasonal mobility, but given the limited sample, it is not possible to exclude it either.

To my knowledge, there are no published English language analyses of faunal remains from archaeological sites in Azerbaijan. The Naxicvan Archaeological Project (Ristvet et al. 2011, 2012) has zooarchaeological assemblages that are currently being analyzed, with an initial report on the fauna remains from Oğlanqala published in Ristvet et al. (2012). However, none of the assemblages analyzed came from the initial Early Iron Age occupation of the site. Further afield, a detailed study was done on the Early Iron Age faunal assemblages from two sites in northeastern Turkey (Sos Hoyuk and Buyuktepe:

Howell-Meurs 2001b,a). At the moment, given the limited nature of zooarchaeological research in the region (especially for the Late Bronze Age), it is difficult to assess theoretical arguments about the role of pastoralism in the history of the Bronze Age (see below), to make comparison between faunal and other types of archaeological data, or compare faunal assemblages across the region. Hopefully, ongoing efforts will make it possible to begin to compare and assess the organization of pastoralist production, circulation, and consumption at sites in the region.

2.1.2.2 Political archaeology in the Late Bronze Age South Caucasus

As noted above, the transition from the Middle to Late Bronze Age in the South Caucasus is marked materially by changes in architecture, ceramics, and metallurgy. It is also marked conceptually as a moment of great importance for the development of political complexity in the region, both in terms of its visible departure from the Middle Bronze Age and its newly acknowledged role as the origin of the regional political forms that would later be incorporated into the Urartian empire (Smith 2005b:230, 268; Smith et al. 2009:7). Late Bronze Age fortresses have long been interpreted as signs of social evolution (Martirosian 1964; Diakonoff 1984; Burney and Lang 1971; Kushnareva 1997).

More recent scholarship on the Late Bronze Age in the South Caucasus – coming out of international projects in Armenia and Naxicvan – has begun to suggest that the Caucasus may represent a different model for the development of political complexity, rather than being a pale reflection of the rise of the ancient state in the Near East. Badalyan et al. (2003:165) have suggested that the Late Bronze Age in the South Caucasus represents the earliest stages of the development of a local model for political organization that eventually was incorporated into the Urartian state – one that relies on the tight integration of economics, politics, and religion, in contrast to the palace, temple, and marketplace of classical Near Eastern models. Lindsay and Greene (2013) suggest that classical Near Eastern models of the development of political complexity are inappropriate for the region, with its rich and vital pastoral tradition, because they are premised on the idea that pastoralism is antithetical to political complexity.

Similarly, in a discussion of their ongoing work in Naxcivan, Ristvet et al. (2012:321) argue that the archaeology of the South Caucasus in the Bronze and Iron Ages mixes theoretical challenges to Near Eastern orthodoxies with a historical record of political interaction and challenges between polities in the Caucasus and the Near East. Other authors have forwarded models that suggest that the Late Bronze Age fortresses in the region are the residences of military aristocracies, heading up 'non-urban' complex societies (Hammer 2014:758; Masson 1997:127-32). Yet, despite this long-standing idea of a major chronological and social transition, until recently, there had been a limited number of intensive excavations of Late Bronze Age sites (Smith et al. 2009:30) in the region. Currently, it is not well understood how the material trends (and periodization) discussed above relate to the production of power and authority in Late Bronze Age societies. Nevertheless, on-going research in the Tsaghkahovit Plain is beginning to shed light on the new forms of political authority that arose in the Late Bronze Age along with the construction of fortresses, as well providing evidence for possible links to the practices of pastoralism that continued in the period.

2.1.2.3 The Late Bronze Age in the Tsaghkahovit Plain, Armenia

The Tsaghkahovit Plain has been the site of intensive survey and excavation by the Joint American-Armenian Project for the Archaeology and Geography of Ancient Transcaucasian Societies (Project ArAGATS), which has produced one of the most robust outlines of the new political developments in the Late Bronze Age in the South

Caucasus. While the earliest documented occupation of the Tsaghkahovit Plain consists of lithic scatters dating to the pre-pottery Neolithic, the earliest permanent communities in the plain date to the Early Bronze Age (Smith et al. 2009:393). The Project ArAGATS survey located ten stone fortresses with Late Bronze Age occupations and nearly 200 burial clusters that were typologically assigned to the Late Bronze Age (Smith et al. 2009:396). Systematic archaeological survey of the plain failed to produce any unambiguous evidence for a Middle Bronze Age occupation in the plain. No Middle Bronze Age settlement remains were discovered, and while the survey did locate kurgans, this type of mortuary construction persisted into the Late Bronze Age, so it is impossible to determine with precision the period to which a kurgan dates without excavation. Given the evidence for a substantial Late Bronze Age population inhabiting the Tsaghkahovit Plain, it is likely that many of the kurgans date to the Late Bronze Age.

Ongoing excavations at two of the Late Bronze Age fortresses in the Tsaghkahovit Plain – Gegharot and Tsaghkahovit – are beginning to illuminate some of the dynamics of the social, economic, and political organization of the Late Bronze Age inhabitants. This research has identified four major loci in the Late Bronze Age South Caucasus: 1) fortresses 2) shrines, 3) settlements (exemplified by the Tsaghkahovit Residential Complex, an extra-mural settlement area near the fortress of Tsaghkahovit), and 4) burials. The fortresses represent spaces where political authority was both spatialized but also practiced. The imposition of the large-scale constructions within the landscape of plain created a new form of political landscape (Smith 2003) that was highly visible, even to the portion of the population that may not have had access to the inner spaces of these sites. But the fortresses also were loci within the movements of materials and goods in the Late Bronze Age. Evidence for the manufacture of 'tertiary goods' such as jewelry, wool, and textiles at the fortress of Gegharot (Smith et al. 2004:22; Badalyan et al. 2008:65-69), contrasts with inflow of other products (seen archaeologically in the in-flow of ceramic containers [Greene

2013]). Studies of ceramics indicate that while production sites were located across the plain, the clay sources on the slopes of Mt. Aragats produced the vast majority of pottery circulating in the plain, even as the sites of Gegharot and Aragatsiberd were the main recipients (Smith et al. 2004:37-38; Lindsay et al. 2008:1680-1).

Adding a new dimension to these issues, excavations at the fortress of Gegharot have uncovered three Late Bronze Age shrines (Badalyan et al. 2008:65-72, Badalyan et al. forthcoming). Broadly, these contexts consist of rooms whose inventories – consisting of particular ceramic forms (highly decorated pots and bowls, ceramic pots stands/idols, stamps, manghals), objects of personal adornment, and curated deposits of animal bones, as well as features such as basins and altars (Badalyan et al. forthcoming) – suggest an altogether non-quotidian function and are consistent with other assemblages from the region that have been labeled shrines (Smith and Leon 2014). Initial interpretations propose that the shrines were key sites in the creation and maintenance of new, hieratic forms of authority in the Late Bronze Age (Badalyan et al. forthcoming; Smith and Leon 2014). Their presence suggests that these shrines may have been sites of pilgrimage for (portions of?) the Late Bronze Age population, or at the very least, loci for the intensive circulation of goods. The presence of the shrines as Gegharot may explain why the site received such a high proportion of ceramics (as containers for different items) from other locales.

Across the plain from Gegharot, Project ArAGATS has excavated an intermittently occupied settlement area outside the citadel walls of the fortress of Tsaghkahovit, which has been labeled the Tsaghkahovit Residential Complex[1] (TRC) (see Lindsay 2006). While the leveling of bedrock beneath structures represents a considerable investment of energy, architectural remodeling as well as stratified floor levels (with associated radiocarbon dates) support the interpretation of intermittent occupation of the structures by mobile groups

1. In previous publications, this area was called the South Lower Town.

(Lindsay and Greene 2013). Burials, the last of the four loci of Bronze Age social life, are the least well studied in terms of archaeological research in the Tsaghkahovit Plain. A single kurgan (burial mound) was excavated in a cemetery to the southeast of the fortress of Gegharot in 2005 (Badalyan et al. 2008:59-61). Additionally, Maureen Marshall has excavated and analyzed a number of Late Bronze Age burials from a burial cluster near the site of Tsaghkahovit (2014). These limited excavations suggest that, similar to the Middle Bronze Age, mortuary ritual in the Late Bronze Age functioned to link political authority and domesticated herd animals. In order to expand this dataset, which is crucial for understanding the full range of human-herd animal relationships in the Late Bronze Age, on 2013 and 2014, Ruben Badalyan and I excavated an additional burial mound near the site of Gegharot (see Appendix C).[2]

Within the context of the new forms of political life that developed in the Late Bronze Age Tsaghkahovit Plain, there is mounting evidence that mobile pastoralism continued to be a major component of Late Bronze Age life. Excavations at the Tsaghkahovit Residential Complex have revealed that the structures in this area of the site, used for production and storage, were intermittently occupied over a very short time-scale (Lindsay and Greene 2013:703-706). The presence of stone enclosures to the east of the TRC, which had much lower artifact densities than the nearby room blocks, also suggest the ability to pen large numbers of animals there as well (Alan Greene, personal communication). This complex appears to have been a place where mobile portions of the Late Bronze Age populations settled for short periods of time, likely in order to participate in practices taking place in the fortresses citadels and the shrines. Similarly, the imbalance between increased number of mortuary monuments in the Late Bronze Age and the limited evidence for residential spaces within and around the hilltop sites (Smith et al. 2009:398; Lindsay

2. The faunal remains recovered from burials in the Tsaghkahovit Plain are discussed in greater detail in Chapter 4.

and Greene 2013:701-703; Lindsay et al. 2010:26), has been taken as an indication that much of the Late Bronze Age population remained mobile pastoralists.

These (non-faunal) data suggest that there may have been some level of continuity – primarily, in the reliance on pastoralism as a productive activity and the paucity of permanent settlements – in the organization of daily life between the Middle and Late Bronze Ages. Whether or not the pastoralist practices of the Late Bronze Age are a point of continuity or rupture from the preceding centuries, the accumulating evidence suggests pastoralism played an important role within the organization of LBA political and social life. Herd animals were interred in mortuary monuments in the Tsaghkahovit Plain, both as whole individuals and as items of consumption (either as 'meat packets' or vessel contents) (Marshall 2014:208). The three shrines at Gegharot contained caches of sheep, goat, and cattle astragali, some of them purposively striated (Smith and Leon 2014; Badalyan et al. forthcoming). The presence and participation of herd animals in non-quotidian practices centered in the shrines and mortuary monuments suggests that pastoralist activities were also likely key to shaping the material semiotics of political authority (see Chapter 3).

2.1.2.4 Pastoralism & Politics: More questions than answers

There is growing evidence that mobile pastoralists comprised a large part of the Late Bronze Age population in the Tsaghkahovit Plain. This suggests that we need to account for the ways in which pastoralist practices were integrated into, and were integral to, the newly developed forms of social and political organization in the Late Bronze Age South Caucasus. Yet, pastoralism in the Late Bronze Age in the South Caucasus remains very under-studied. In part, this is because discussions of mobile pastoralism in the Caucasus have often focused on the Middle Bronze Age (Kushnareva 1997; Burney and Lang 1971). Mobility – archaeologically manifested as a lack of settlements and proliferation of mortuary landscapes (including cart burials) – is taken as one of the key features the Middle Bronze Age social and political organization. In contrast, it has a tendency to drop out of discussions of the Late Bronze Age. This is in spite of the emphasis placed by Soviet archaeologists on the role that the evolutionary development of productive forces (cultivation and pastoralism) played in the development of political complexity (Martirosian 1964; Khachatrian 1975; Kushnareva 1997; Chernykh 1992). What remains to be seen is how pastoralism – now materially evident in the archaeological record of the Late Bronze Age South Caucasus – fits into theories of political development and organization.

2.2 Pastoralism & Politics: Previous Approaches

Two questions are threaded through the previous work on the the archaeology of the Late Bronze Age in the South Caucasus reviewed above. First, the nature of the new forms of political organization that appear to have emerged between the Middle and Late Bronze Ages remains in question. While recent work in Tsaghkahovit Plain, Armenia has substantially increased knowledge about the material and spatial organization of Late Bronze Age societies – and the discovery of the shrines at Gegharot hints at a major transformation in ritual practices – the practices that shaped political authority and subjectivities in this period have yet to be described. Similarly, the growing evidence that mobile pastoralists continued to comprise a large component of Late Bronze Age societies in the South Caucasus confronts the limited understanding of how (mobile) pastoralists were integrated into, and may have shaped, Late Bronze Age forms of political organization.

These questions resonate with themes found in previous anthropological and archaeological studies of pastoralism. In the review of the anthropological scholarship on pastoralism I present here, I focus on how scholars have understood the relationship between pastoralism as a mode of living and the form of political organization in pastoralist societies. To start, I discuss the relationship between the anthropological theory of segmentary societies and studies of pastoralism, beginning with Fortes and Evans-Pritchard's (1940) *African Political Systems*. From there, I review how various studies have understood the form that political domination takes in pastoralist societies, as well as the connection between pastoralism (viewed as an economic or subsistence activity) and the form of political organization in pastoralist societies. This scholarship forms the background to the current interventions being made by archaeologists and historians in the question of the relationship between pastoralism and politics. At the end of the chapter, I discuss recent work by scholars that are re-thinking assumptions about the political capacities and entailments of pastoralism. These critiques inform my own attempts to re-think pastoralism by placing human-animal relationships at the forefront.

2.2.1 Segmentary societies and pastoralism

> "The perfect example of the ideal-typical pastoral nomadic society, composed of egalitarian clans of fierce and free tribesmen, organized by the principles of segmentary opposition, was like any good mythical beast: no one had actually seen it themselves, but everyone seemed to have it on excellent authority that someone else had." (Sneath 2007:156)

Fortes and Evans-Pritchard's seminal work in political anthropology, *African Political Systems* (1940), had an outsized impact on the political anthropology of pastoralist societies in particular. In the volume, they introduced a typology of political systems, based on a survey of African societies reviewed in the edited volume. They drew a contrast between Group A (primitive states) and Group B (stateless societies) (Fortes and Evans-Pritchard 1940:5). Group B political systems were defined by the absence of the “centralized authority, administrative machinery, and constituted judicial institutions” and the “sharp division of rank, status, or wealth” seen in Group A political systems (Fortes and Evans-Pritchard 1940:5). Moreover, the two groups are divided by the role that kinship plays in political organization. In Group B systems, either kinship and politics are identical (as in very small societies) or the “lineage structure is the framework of the political system” (Fortes and Evans-Pritchard 1940:7). In contrast, for Group A systems, “an administrative organization is the framework of the political structure” (Fortes and Evans-Pritchard 1940:7), not kinship. These divisions fit comfortably into previous work on typologizing different societies in the early social sciences – by Morgan (1877), Tönnies (2001), Durkheim (1997), and Weber (1978) – continuing the emphasis on the distinction between kinship and other modes of social or political organization.

In their initial presentation, Fortes and Evans-Pritchard stress that these differences in political structures are not directly relatable to differences in “mode of livelihood” (Fortes and Evans-Pritchard 1940:8) and pastoralists were included as examples of both types. Nevertheless, Evans-Pritchard’s description of the “ordered anarchy” of the Nuer had an outsized impact on anthropological studies of pastoralism. Two of the major concepts in his short presentation of his study of the Nuer remain widely prevalent in later writings on pastoralists. First, Evans-Pritchard’s discussion of the Nuer’s tribal system emphasized the role of the tribe in establishing a boundary between insider and outsider:

> “The simplest definition states that a tribe is the largest community which considers that disputes between members should be settled by arbitration and that it ought to combine against other communities of the same kind and against foreigners. In these two respects there is no larger political group than the tribe and all smaller political groups are sections of it.” (1940:278)

This understanding of the political nature of the tribe has heavily shaped how anthropologists and archaeologists have understood the political organization of pastoralist groups, by linking kinship and politics and by emphasizing the tribe-not tribe boundary as politically salient (e.g. Rowton 1974; Lees and Bates 1974; Salzman 2008, but see Porter (2012) for a critique of this phenomenon).

Moreover, within the general argument for how lineage systems managed to produce and maintain a stable social order in the absence of centralized administrative and political organization in segmentary societies, Evans-Pritchard's discussion of the Nuer also introduced the idea of processes of segmentary fission and fusion as the way that pastoralist societies (as segmentary societies) maintain order. He writes, "fission and fusion are two aspects of the same segmentary principle and the Nuer tribe and its divisions are to be understood as a relation between these two contradictory, yet complementary, tendencies." (Evans-Pritchard 1940:284). This idea of a cycling that produces a (relatively) stable order crops up repeatedly in the literature on pastoralists groups, even after the rejection and modification of the structural-functionalist framework it was developed for originally (e.g. Barth 1961; Khazanov 1984).

Another key text in political anthropology, Aidan Southall's *Alur Society: a study in processes and types of domination* (1956) expanded on Evans-Pritchard's notion of segmentation and its relationship to political organization. In this work, Southall attempts to account for how immigrants come to occupy dominant political and social positions within societies. He argues that "under certain conditions, the interaction of diverse ethnic groups of contrasted social structure may predispose them to coalesce into a composite structure of dominance and subjection out of which state forms develop."(Southall 1956:245). For Southall, this process is not reducible to conquest – depending merely on superior force or coercion – but rather develops from a specific imbalance in political organization. This imbalance is both in terms of degree of violence and nature of political authority, leading to a process whereby a loosely organized, violent group led by charismatic leaders is grafted onto the stable, wider scale political organization of the other group, emerging as leaders whose charismatic leadership is rapidly routinized (Southall 1956:245, building from Weber's (1984) work on authority). Southall makes clear, however, the domination achieved by the Alur was not on the basis of coercion or violence, but rather through the positive appeal and legibility of the Alur's structure of political authority (based in a segmentary lineage system) to the groups they incorporated.

In his conclusion, he elaborates on the the Group A and B typology developed in *African Political Systems* (Southall 1956:241), adding a third category: 'segmentary states'. Building from Weber's definition of the state, he argues that societies like the Alur (as well as the Tallensi discussed by Fortes), are actually states, not stateless societies. Unlike other states, however, these states are segmentary and thus power is distributed pyramidically, not hierarchically. By this, he means that "within any one segment, at any level of the pyramidal structure, there is at any one moment a certain degree of monopoly of political power, development of administrative staff and definition of territorial limits" – all criteria for the state in Weber's framework – "whereas, within the system as a whole, the political relations of the various segments are determined by much the same factors as in the case of segmentary societies which have no political specialisation at all." (Southall 1956:252).

Southall's new concept attempts to account for historical change – both in terms of the development of segmentary states, as well as their transition to unitary states – addressing a gap in the original typology developed in *African Political Systems* (and the structural-functionalist approach in general). However, it retains the emphasis on insider/outsider boundary seen in the formulation of the tribe, as the component parts of the segmentary state is "ultimately defined by their joint opposition to adjacent unrelated groups." (1956:260). Ultimately, Southall's expansion and critique of the typology laid out by Fortes and Evans-Pritchard doesn't fundamentally shift how political organization is understood. Political organization remains a question of maintaining social order outside of state systems of bureaucratic administration. While the concept of segmentary states reduces the distance between state and non-state societies, it accepts the division between kinship and the state. Nevertheless, Southall's work on the Alur introduced another theme that has shaped anthropological discussions of the relationship between pastoralism and politics: the question of domination and how it functions.

2.2.2 Consent and Coercion

In moving beyond the structural-functionalist accounts of how segmentary lineages structured political order in non-state societies (some of them pastoralist), some authors engaged with the question of how political authority functioned and was legitimated in pastoralist societies. In contrast to Southall's concern with how domination works between groups, Frederik Barth's study of the Basseri (1961) and Talal Asad's study of the Kababish Arabs (1970) explore how domination functions within the tribal structure itself.

Barth starts from a very different theoretical orientation than Southall's. His analysis in anchored in "the possibilities and restrictions implied in a pastoral adaptation in the South Persian environment." (Barth 1961:ii). Thus, for Barth, the main dynamic driving social and political organization among the Basseri is the need to maintain a balance between the available pasture, animal populations, and the human populations (Barth 1961:124). He argues that population balance is only possible if pastoralists avoid consuming too many animals while attempting to accommodate a growing human population. He claims that this feature of pastoralism necessitates the private ownership of herd animals, which then makes it possible for individual households to remove themselves from the system through the process of sedentarization. The removal of individual herders through sedentarization maintains the balance between human and animal populations for those who remain in the tribe. In the case of the Basseri, this takes the form of rich herders investing in land as well as poor herders involuntarily becoming agricultural peasants.

For Barth, the private ownership of the herds explains the political organization of pastoralist societies. The processes of sedentarization among the Basseri produce a homogenous camp, in which individuals are economically unconnected to one another, and as a result “no strong leaders, or crystallized factions, emerge within them.” (Barth 1961:127). The chief is endowed with an autocratic power, who derives its source from external sources of authority, and whose political role is limited to mediating relations with people outside of the tribe. Barth contrasts the Basseri to the Qashqai, who do not lose wealthy leaders to sedentarization, linking these differences to ecological factors in their respective territories. He argues that “considerable differences in status and power would develop in the camp” as wealthy herders hire impoverished ones to labor for them. This development of a social hierarchy within the group would result in the central leader needing “to develop certain coercive organs to support this authority” (Barth 1961:128).

Unlike the model of segmentary societies, Barth’s account grounds the political dynamics in the ecological necessities of pastoralism. For Barth, the Malthusian imperatives for human and herds shape the organization of economic activity and necessitate the private ownership of herds, enabling differential outcomes across the group. That differential can produce either sedentarization – maintaining equality among those that remain – or engender the development of hierarchies. Barth’s account of cycling among the Basseri echoes the fission and fusion presented in the earlier segmentary models. In contrast, however, the basis for this first form of cycling is primarily ecological. Barth’s understanding of the role of higher level political authority is contractarian in nature, relying on the idea that the chief’s authority, as autocratic as it is, is accepted due to its utility to other members of the tribe (cf. Asad 1972). Any larger political formations are only possible inasmuch as they provide utility for individual households and groups in interfacing with other groups, either administratively or for activities such as trade or warfare. Barth provides a very atomistic and determinist model of the political implications of pastoralist practices. In doing so, however, he moves beyond the question of state vs. non-state societies and engages with the specificity of pastoralism as a mode of living.

Talal Asad's study of the Kababish (1970) also engages with the question of domination within pastoralist societies, but arrives at a very different set of conclusions. Asad writes, "My main aim initially was to make a study of the pastoral ecology and kinship system of the Kababish" but his experiences during field work – specifically, the sharp contrast between the day-to-day "assertive independence" of individuals and the "self-denigrating attitude in relation to their rulers" – led him to consider how "the political elite is able to maintain its exclusive privilege and dominant authority" (1970:xv). He argues that domination and political authority among the Kababish was neither about consent or coercion (Asad 1970:1). Rather, Asad details how the contemporary political situation among the Kababish was the result of an historical process whereby one group was able to acquire, and subsequently maintain, a monopoly of political power (1970:237-8). Thus, political dominance "is not based on any noticeable exercise of repression, still less on the voluntary exchange of political power for the right to invoke certain obligations in the future" (Asad 1970:237).

Subsequent to his work on the Kababish, Asad wrote a piece (1979) arguing against anthropological models of how politics worked among pastoralist groups. In it, he critiques the common assumption that most pastoralist nomads are free and egalitarian (Asad 1979:420) and the equation of nomadic pastoralism and segmentary political organization (Asad 1979:423). He argues that the idea that nomadic pastoralists are relatively immune to being exploited relies on a "confusion between economic exploitation and political incorporation" (Asad 1979:423). He also rejects the idea that pastoralism as mode of subsistence or economic production has much explanatory power in understanding the political organization of pastoralist societies. Instead, he asserts a close affinity between pastoralists and agricultural peasants, forcefully rejecting the view that pastoralists interact with other groups from 'outside' (Asad 1979:424). In this, Asad is working within a Marxist framework rather than a contractarian understanding of political authority.

Asad and Barth present very different accounts of how political authority functions and is legitimated in their respective accounts. Barth draws a distinction between the way authority functions within the tribe (limited hierarchy and control) and in the interactions between the tribe and other groups (autocratic power). For him, this distinction is based in the ecological and demographic factors of pastoralism as a mode of subsistence. In contrast, for Asad, the legitimation of authority is not based on consent or coercion, but rather results from historical struggles for political authority that shape the current arrangements of power and how subjects relate to them. Furthermore, contra Barth, he argues that the nature of political organization in pastoralist societies has little to do with the 'technical' problems of the organization of pastoralist production (Asad 1979).

2.2.3 Politics and pastoralism as a mode of subsistence

Out of the contrasting accounts that Asad and Barth provide, the question of the relationship between pastoralism as an economic or subsistence activity and the nature of political organization in pastoralist groups arises as a key issue. While the earlier structural-functionalist accounts of segmentary societies had rejected any mechanistic link between mode of subsistence and the type of political system, by the mid-twentieth century, a strong strain of ecological determinism had developed in studies of pastoralism.

The most common framing presents pastoralism as an adaptation to specificities of grassland ecologies (Browman 1974; Smith 1992, 2005a; Barfield 1993; Hole 2009). These approaches highlight various characteristics of grasslands that are imagined to render it ‘difficult’ to support human subsistence. For Barfield (1993:12), it is the seasonal availability of grass that gives pastoralism its status as a unique social form.[3] For Smith, pastoralism is an adaptation to the aridity of grasslands (rendering them unsuitable to dryland agriculture) (e.g. Smith 1992; 2005a). Hole views pastoralism as an adaptation to the aridity and uncertainty of grassland ecologies, and argues that the whole historical trajectory of pastoralism in the Near East is a history of co-evolution within that ecologically-determined space (2009:262, 268). Some authors frame pastoralist mobility as a response to the ecological necessities of pastoralist life, usually defined as herds’ needs for food or water (e.g. Spooner 1972; Barfield 1993; Frachetti 2009).[4] As we have seen, Barth (1961) argues that herd population dynamics ultimately determine human population dynamics, seeing sedentarization as a necessary consequence of this ecological situation.

In part, this ecological and adaptive view of pastoralism was shaped by the development of theoretical models of population dynamics in rangeland ecology, including those that argued for a specific carrying capacity for grasslands (Hardin 1968; cf. Sayre 2008). This view of pastoralism as primary an ecological adaptation stimulated necessary and detailed research into the specific practices of herding (e.g. Dahl and Hjort 1976; Smith 1992). However, this approach also led to the sense that rangeland ecology was both limiting and fragile, which heightened the sense of precarity of pastoralist lifeways. This sense of marginality and precarity – heightened by the tendency of nation-states and colonial powers to forcibly relocate and sedentarize nomads in marginal environments (Turner 1998; Sayre 2008; Duvall 2010) – led some authors to see environmental determinants as not only shaping pastoralist societies, but strongly constraining and limiting them.

3. This formulation raises the question of how this is any different than cereal-based agriculture, which is also only seasonally available (at least in temperate climes).

4. Even Khazanov, who is generally skeptical of ecological explanations, sees the initial development of “pure nomadism” (marked by high levels of mobility) as arising primarily from ecological factors (1984:117).

Goldschmidt (1979:15, 17) argues that ecology is determinative of the social order in pastoralist groups, leading to what he perceived as a homogeneity of social forms among pastoralist societies. Similarly, Dahl and Hjort (1976:17) see nomadic societies as being limited by their ecology. They argue that the distinctive features of the African cattle complex, rather than determining pastoralist activities, are instead determined by the inherent instability of pastoralist production. Irons (1979) developed a theoretical model of pastoralist societies, in which he argued that the two "ecological concomitants" of pastoralism (geographic mobility and low population density) prevent the development of institutionalized political hierarchy. These approaches contributed to (though they did not originate) the widespread idea that nomadic pastoralism cannot generate wealth (e.g. Lattimore 1940; Childe 1951; Gellner 1984:xv; Barfield 1993; see Asad 1979:420 for a critique). This view of the difficult and precarity of pastoralist production became entangled with ideas about the development of the state (and inequality more generally). Accordingly, pastoralism's assumed inability to ensure a consistent surplus was seen as limiting the political complexity of pastoralist societies (e.g. Khazanov 1984:71-76; Salzman 2004:68; Hole 2009:270).

The presumed instability of pastoralism as an economic and/or subsistence activity, and its unsuitability for the generation of surplus, rendered the historical Inner Asian empires (particularly the Mongol Empire) an historical enigma. Interestingly, this was true in both the English and Soviet literatures. As Gellner (1984) notes, in the English-language literature pastoralists are seen as being especially egalitarian in comparison to other societies. The view of pastoralists as egalitarian was generally framed through the opposition between segmentary and state societies, which led to interpretations that diminished the level of complexity attributed steppe polities in the historical record (Sneath 2007). In contrast, for the Soviets, pastoralists showed a troubling tendency to be less egalitarian than would be expected from Marxist ideas about primitive communism (Gellner 1984:xii).

In Soviet anthropology, the question of how to explain nomadic states and empires was part of a wider debate about where pastoralist nomads fit in historical-materialist evolutionary schemes. One of the key debates in this discussion centered on the question of nomadic feudalism. Early Soviet scholars had identified pastoralist groups as feudal, on the basis of the existence of hierarchies based in wealth and status, as well as practices of slave-owning (Sneath 2007:124). But this determination sat uneasily with the sense that pastoralist nomads weren't really as advanced as agricultural aristocracies traditionally associated with feudalism. This issue was also tied up with sensitive political questions relating to the position of the Central Asian soviet republics in the Stalinist era (Sneath 2007:125). Out of this debate came a group of Soviet scholars who argued that pastoralists were definitely not feudalists and that pastoralism was not conducive to social evolution (Gellner 1984:xxii-xxiv).[5]

Anatoly Khazanov's *Nomads and the Outside World* (1984) is the most widely known Soviet work on pastoralism, having been translated into English and cited widely in both anthropology and archaeology. Khazanov starts with a historical paradox:

> "societies based on one of the most specialized types of food-producing economy, in which technology is relatively conservative and has changed little with time, have exercised an essential and, indeed, multifarious influence on the social and political functioning and evolution of non-nomadic societies in which the economy is more diversified and technology more advanced."(1984:3)

5. This position was in greater harmony with contemporaneous Western approaches to pastoralism than the previous positions (Sneath 2007:126).

For Khazanov, the key issue is pastoralism nomadism's lack of economic autarky, especially among "pure" nomads. This inability to be economically self-sufficient is what drives the particular relationship between pastoralist groups and settled states. On its own, Khazanov argues, pastoral nomadism is doomed to stagnation because "its economy is extensive and allows no permanent solution to the problem of balance at the expense of intensification of production." (1984:71, also 76).

Unlike some other authors, Khazanov does identify mechanisms for social differentiation among nomadic pastoralists. He argues that increases in the number of livestock or positions of leadership can contribute to property inequality and lead to differentiation (Khazanov 1984:152). He links the origins of this power to situations where "a distinct political power" is needed, either for "internal organizational-managerial needs" or for interaction with other societies (nomadic and settled) (Khazanov 1984:161). However, he argues that these differences are unstable (due to the fundamental instability of pastoralist production) and without interaction with outside states, this cannot result in a state (Khazanov 1984:162). At the heart of this, is a contradiction between the imposition of restrictions by political authority and the need for independent households to have freedom of action and independence (Khazanov 1984:152). Thus, while Khazanov considers the tribe a political unit, it is one that is built on a contradiction, and it is this contradiction that explains the ephemeral nature of nomadic states. On the whole, Khazanov's arguments are quite similar to those that Barth makes, despite the seemingly different approaches to the relationship between pastoralism as subsistence and political organization. Nevertheless, both Barth and Khazanov agree that pastoralist practices[6] are linked to the organization of political life, resulting in their differing attempts to understand

6. Both Barth and Khazanov focus mainly on production, as a way of generating wealth and social differentiation. Barth's focus on demographics results in a narrowly defined interest in pastoralist practices of consumption.

political activity as a response to material realities. Underlying both accounts is a sense of the inflexibility and precarity of pastoralist production.

2.3 Re-thinking pastoralist politics

Over the latter half of the twentieth century, a number of themes emerged through the consideration of pastoralism and politics within anthropological studies of pastoralism. First, there was a durable connection made between pastoralist groups (qua tribes) and segmentary lineage systems (as non-state forms of political organization). Over time, this link was hardened, erasing the caveats from the original structural-functionalist approaches that did not seek to link subsistence mode and political system. This changes was, in part, due to growing interest in the ecological entailments of pastoralist production. Pastoralist production came to be seen as fundamentally precarious and unstable. At the same time, pastoralism as a subsistence activity was imagined to require economic independence at the household level, which was counterposed to the need to form larger political units. The impetus to form larger units was generally identified as instances in which pastoralists were required to interact with other, larger organized groups (states, etc.) and was seen as contradictory to the primary (often economic) independence of the pastoralist household. For a number of authors, this essential contradiction rendered cycling (either economic or political) as a general feature of nomadic pastoralist societies.[7]

Over time, in the last decades of the twentieth century, there was a noticeable shift in the questions being in asked in ethnographic studies of pastoralism. The change can be indexed by looking at the titles of *Annual Review of Anthropology* articles on pastoralism. In 1980, Rada and Neville Dyson-Hudson published a review titled "Nomadic

7. In addition to these themes, there was also much discussion over how to bound and typologize the category of nomadic pastoralist (see below), partially as a result of an explicitly comparative approach (e.g. Tapper 1979a,b; Dyson-Hudson and Dyson-Hudson 1980; Khazanov 1984).

Pastoralism" (1980), which covered many of the themes raised in this discussion, including the connection between ecology and social organization and the interaction of nomadic pastoralist societies with other groups. Later reviews about pastoralism focused on contemporary issues surrounding the status of pastoralists within nation-states and the need for economic development: Fratkin's (1997) "Pastoralism: Governance and Development Issues" and Galvin's (2009) "Transitions: Pastoralists Living with Change". In contrast, the relationship between pastoralism as a mode of subsistence and the potential for the development of political complexity remained a question of interest in archaeological and historical studies of pastoralism in the Eurasian steppes and the Near East.

This has resulted in a number of new works that re-consider previous approaches to the relationship between pastoralism and politics and question the established wisdom about the political potentials of pastoralist practices. In doing so, they also re-engage with the question of how the specificity of pastoralist practices shapes political organization. Instead of working within a frame defined by ecological determinism, these scholars consider the positive potentials afforded by pastoralist mobility. Perhaps unsurprisingly, archaeologists working on the prehistory of the Eurasian steppes have remained interested in studying the political entailments of pastoralism. Investigations and theorizations of the transfer of material culture and technology (including domesticated herd animals) drives many of the archaeological investigations of the early prehistory of the steppe – including works dedicated to analyzing how and where mobile pastoralism originated and spread across Eurasia (e.g. Kohl 2007; Anthony 2007). Moreover, the question of how steppe states and empires flourished and declined remains of great interest.

In *Pastoralist Landscapes and Social Interaction in Bronze Age Eurasia* (2009), Michael Frachetti tries to account for the widespread similarities in material culture across the Eurasian steppes in the Bronze Age by developing a model of pastoralist interaction. His model complicates dominant narratives of social and cultural homogeneity across the steppes and also provides a explanation for the spread of material culture and social organization that is not based on the migration of people. He bases his model of interaction in what he calls 'pastoralist landscapes'. For Frachetti, pastoralism's requirement for mobility (grounded in the ecology of grassland environments in the steppe) shapes networks of interaction:

> "Early mobile pastoralist economies were essential to the formation of extensive networks of interaction across Eurasia and along the IAMC because the ecological demands of their pastoralist strategies—moving herds across restricted environments—conditioned arenas of exchange among neighboring communities." (Frachetti 2012:17).

For Frachetti, interaction and communication shape both local and global structures, in the form of networks. Local concerns related to pastoralist production also shaped pastoralists participation in wider networks that moved ideas and technology across the steppe (Frachetti 2009:174).

Developing these ideas further, Frachetti (2012) introduces the idea of non-uniform institutional complexity as a way of explaining the trajectories of the development of political complexity and the spread of material culture across the steppes. The 'non-uniformity' of steppe complexity refers to the way in which different 'institutions' – defined as "the organizational and ideological norms that shape practical interactions of agents and communities" (Frachetti 2012:5) – can be aligned at different geographical scales. As an example of this, he contrasts the different scales and orientations of the spread of wheeled vehicles and burial practices and the development of metallurgical technologies which also diffused across the steppes.

Frachetti defines complexity as the (uneven) scaling up of "institutional indexes from specific to general and from local or regional to interregional" (Frachetti 2012:20). He argues, “The association among wheeled vehicles, burial ritual, horses, and eventually political aggrandizement can be seen as a growing alignment in the institutions of political power” (Frachetti 2012:17-18). His model attempts to account for interaction and shared practices across the steppe, outside of a shared social identity or political framework. In this way, his work parallels the attempt to account for social organization outside of the state – but unlike structural-functionalist accounts of segmentary societies – he is less concerned with the maintenance of social order than the transmission of ideas and material technologies through time and space. As a result, Frachetti’s account defines mechanisms for interaction – grounding it in pastoralist practices – but he does not specify how these institutions were organized, how they incorporated people, and what form authority took and how it was legitimized.

More recently, Bill Honeychurch has attempted a more detailed account of how pastoralism might have shaped the form of political organization. In his book, *Inner Asia and the Spatial Politics of Empire* (2015), he is concerned with understanding the unique forms of political organization in Inner Asian pastoralists societies, without taking pastoralism as a set of practices that are fundamentally lacking. He, like Frachetti, grounds his analysis of the potentials of pastoralism in mobility, which:

> “created social and productive expertise in socio-spatial dynamics and movement that included ways of binding together and maintaining human communities in the face of geographic dispersal. I argue that this capacity gave a unique spatial and temporal foundation for social relationships among Inner Asian nomads, and as a result, we should expect that politics and statehood assumed quite different configurations from those of sedentary and agricultural peoples.” (Honeychurch 2015:12)

Honeychurch introduces the idea of ‘spatial politics’ to account for these different configurations. His account, again like Frachetti’s, places emphasis on interregional interaction, though in Honeychurch’s model, it is a means to get away from models of politics that focus on centralization (Honeychurch 2015:18, 31). More interestingly, he argues that human co-community with herds, as well as the mobility that this engenders is what makes pastoralism unique in terms of its political entailments (2015:63). Despite this assertion, his examples do not engage very deeply or specifically with how this co-community shapes political organization.

Honeychurch defines politics as “a venue of social negotiation that contests the social makeup of distinctions and affiliations (i.e., differentiated groups) and the allotment of privileges and limitations across those respective social differences.”(2015:36). He argues that interregional interactions in Inner Asia are shaped by uncertainty as a key political factor (Honeychurch 2015:39). In response to this uncertainty, processes of “upscaling” re-shape networks shifting them towards “a more encompassing collective scale and a new political identity” (Honeychurch 2015:41). He writes:

> “A regional-scale political community is not held together by an established statecraft of formalized relations, beliefs, or institutions, rather, it is precisely informal, fluid, and dynamic conditions that motivate diverse peoples to participate as a way to negotiate their own outcomes in the midst of an unpredictable but undeniably critical social event.” (Honeychurch 2015:42)

Thus, unlike Frachetti, Honeychurch sees these interactions as resulting in new forms of identity and community, rather than just alignment across institutions. In this sense, it has more in common with Adam T. Smith’s idea of the civilization machine (2015), however the trajectory for the development of political complexity that Honeychurch proposes is very different from Smith’s. Honeychurch sees these new identities and scales of organization arising out of consensus, comparing them to social movements. His approach emphasizes a political identity shaped by participation and shared interests, not by subjection to a political authority (cf. Smith 2011, 2015).

Continuing, Honeychurch identifies these larger-scale political communities as the preliminary structure on which the Xiongnu steppe empire expanded (2015:252). In his account of the Xiongnu, he returns to the question of why nomadic pastoralists (as self-sufficient entities) would accept inequality and political domination (Honeychurch 2015:261). He concludes:

> "Sustaining statehood among nomads could not be accomplished by coercion or strategizing alone, but required a combination of other factors including belief, symbolism, and prosperity, and most importantly, by forms of power-sharing. In this sense, the real work of state formation was not about centralizing authority, building a bureaucracy, or controlling populations and resources, but rather about how to enfranchise various power holders just enough to strike an unstable but tolerated political consensus that was sufficient to hold together a large and complex organization." (Honeychurch 2015:262)

If Frachetti's account of interregional interaction and communication remains agnostic to the form and content of political organization among steppe groups, Honeychurch's model anchors them in a form of consent and participation that echoes previous ideas about the free and egalitarian nomad (e.g. Goldschmidt 1979; Salzman 2004; Dyson-Hudson 1972; Asad 1970). However, unlike previous approaches, that is not grounds for dismissing the possibility of nomadic states *sui generis*, but rather the source of their unique organizational form. In doing so, Honeychurch is explicitly writing against models of political complexity based on political economy and the accumulation of wealth, and instead, he stresses the importance of social relations and other political concerns (2015:149, 299).

Outside of the network and interaction approaches being developed in the archaeology of the Eurasian steppes, other authors are revisiting the state/non-state dichotomy and the role of kinship in understanding political order. In *Mobile pastoralism and the formation of Near Eastern civilizations: weaving together society* (2012), Anne Porter mounts an argument against the idea that pastoralism is inimical to political complexity. She provides an account of how anthropological studies of pastoralists and approaches to political anthropology were taken up in studies of pastoralists in the ancient Near East, leading to the understanding that pastoralists and agriculturalists – and consequently, pastoralists and the state – were fundamentally opposed.[8] Instead, Porter suggests that new approaches to kinship in anthropology can help archaeologists re-imagine the role of kinship in ancient polities.

In her re-examination of the role of pastoralism in the history of the ancient Near East, which covers the Uruk expansion and collapse and the relationship between neo-Sumerian rulers and those people known as the Amorrites in the 2nd millennium BC, she identifies two fundamental relationships. Porter argues that the dynamics of Near Eastern history can be located in the relationship between mobile and sedentary groups within an ancestral group and the relationship between ancestral groups and the state itself, rather than an opposition between the steppe and the sown or the state and the tribe. Her approach suggests that ritual activity played an important and evolving role in maintaining these relationships. In doing so, she downplays the conflict between mobile pastoralists and sedentary agriculturalists identified by other authors (Rowton 1974; Lees and Bates 1974; Szuchman 2009). Porter argues that kinship was particularly important to pastoralists –

8. This concept has a very long history (Khazanov 1984:1-2, Sneath 2007).

not because they are, by nature, tribal – but because "the practices of kinship, among other things, facilitate the extension of both time and space so that those who are physically apart may remain conceptually together." (2012:63). Rather than a way of constituting a political order outside of the administrative apparatus of centralized government, kinship is re-considered as a potential political tool, but one that is contingently enrolled in various forms of political work (Porter 2012:58).

In contrast to Porter's emphasis on the potential for kinship as a way of mediating and sustaining social ties across space and time, David Sneath in *The Headless State: aristocratic orders, kinship society, & misrepresentations of nomadic Inner Asia* (2007), suggests that kinship can also be used a tool for social differentiation and maintenance of political authority and domination. Sneath develops an account of how the theoretical preoccupations and colonial context of social scientific (including anthropological) studies of pastoral nomadism in Inner Asia led to a mis-understanding and mis-representation of the history of states and empires in Inner Asia.[9] Similar to Porter's discussion of the problem of pastoralism, he connects this misunderstanding to the tradition of research on politics in anthropology that connected pastoralism to the tribe (as a form of segmentary lineage system) and placed pastoralist groups outside the state.

Re-reading the historical record of Inner Asia, Sneath re-interprets kinship relations as a political tool. Building from Levi-Strauss' idea of the 'house society', Sneath argues that kinship (for the aristocracies of Inner Asian polities) was "a field of power relations expressed in the idiom of descent" (2007:112). He presents an account of the history of Inner Asian polities, from the Xiongnu onwards, where nobles were able to control production and monopolize coercive force on the basis of aristocratic orders, enabling the formation of larger states and empires (Sneath 2007:196). For Sneath, kinship and

9. One important dynamic that Sneath notes is the tendency to push the location of 'purely' tribal nomadic groups further and further back in time when the historical evidence fails to conform to the theoretical models.

descent figure as "enduring techniques of power and aspects of stratification rather than their antithesis." (2007:195). In Sneath's account, however, there is no consideration of how pastoralism as set of practices shapes the potential for kinship as a political tool – except in his rejection of previous scholarly attempts to make arguments that limited the political capacities of pastoralist societies. Partially, this is due to his re-thinking the state as a "social relation", which moves the aristocratic orders of Inner Asian steppe polities closer to the models of political authority and subjection in other polities (Sneath 2007:203). Sneath's focus on aristocratic strategies elides any consideration of the way in which pastoralist practices might contribute to the use of descent and kinship as a political tool, a subject that I will address in Chapter 3.

Both Porter and Sneath present new ways of thinking about how kinship might function in shaping and enabling political organization – moving away from the simplistic equation of pastoralism and segmentary societies. In contrast to Porter and Honeychurch, who stress the affiliative aspects of social relationships and ritual practices, Sneath highlights how the same idioms could be used to divide the body politic and enable domination. These two accounts also move us away from previous ideas about the nature of authority and consent in pastoralist societies, which linked *a priori* theoretical understandings of the economic/ecological constraints of pastoralism to the nature of political authority in pastoralist societies (e.g. Barth 1961; Khazanov 1984). Porter and Sneath's detailed accounts, along with earlier work by Talal Asad (1970), suggest how we might re-imagine the ways in which consent and authority are constructed through pastoralist politics.

2.4 Pastoralism as human-animal relations

The new approaches to pastoralism discussed in the previous section emphasized the flexibility and potential that pastoralist practices have to support various forms of political organization. In the various examples presented by those authors, the connections within and between groups, the transfer of material technologies and ideological systems, seasonal and spatial mobility, etc. are argued to have important roles in the organization of political life in pastoralist societies. This project aims to contribute to this ongoing reassessment of the potentials of pastoralist practices in shaping political organization, but in doing so, I seek to shift the orientation of this discussion slightly.

The question of defining and typologizing pastoralism – and the more restrictive subset of 'nomadic pastoralism' – appears in many place in the literature on pastoralism (e.g. Tapper 1979b,a; Dyson-Hudson and Dyson-Hudson 1980; Khazanov 1984; Barfield 1993; Salzman 2002; Szuchman 2009; Frachetti 2009; Potts 2014). This is particularly true of work that seeks to ground the features of pastoralist social organization in pastoralism as a mode of subsistence. Dyson-Hudson noted that an attempt to define nomadic pastoralism "breaks down immediately into different sets of phenomena – livestock rearing and spatial mobility." (Dyson-Hudson 1972:24). Generally, definitions of nomadic pastoralism consider (either separately or together) the relative dependence on pastoralist products for subsistence and the relative degree (and kind) of mobility (cf. Dyson-Hudson and Dyson-Hudson 1980; Khazanov 1984; Salzman 2002).[10] Nevertheless, for many of the authors discussed here, what remains distinctive about pastoralist practices are the degree to which they encourage or require a mobility not seen in people engaged in sedentary

10. For some archaeologists, especially in Eurasia and the Near East, the distinction between pastoralism and nomadic pastoralism has become a question of understanding the origins of 'true' nomadic pastoralism as specialized form of social organization. Some authors have suggested that the classic, mounted forms of nomadic pastoralism appear later than was previously thought. Two recent synthetic works have considered this question with regard to the spread of mobile pastoralism in Bronze Age Eurasia (Anthony 2007; Kohl 2007), generally arguing that the mobile pastoralism in the Bronze Age differed from the classic mounted nomadic pastoralism of Iron Age steppe societies. Similarly, Daniel Potts' in *Nomadism in Iran* (2014) takes archaeologists to task for uncritically projecting historical accounts of Iranian nomadic pastoralism onto the archaeological record, arguing that nomadic pastoralism was a relatively late development.

agriculture. These models consider how pastoralist mobility is either managed through or engenders particular forms of political organization.

In the new literature on pastoralism in archaeology, there is comparatively little focus on the other aspect of nomadic pastoralism identified by Dyson-Hudson: livestock rearing. Frachetti's (2009; 2012) model of pastoralist interaction tacitly links human-herd animal relationships to the mobility that structures larger scales of integration, but bases this connection in the ecology of pastoralist landscapes. Honeychurch (2015) calls attention to the co-community of humans and herds and indicates that it shapes the unique political potential of steppe pastoralist societies. However, neither author engages with the specifics of human-herd animal relationships in their models.

In earlier studies of pastoralism, this second aspect of defining mobile pastoralism was framed in the relative integration of pastoralist activities with other forms of food production (either in terms of 'mixed' forms of agropastoralism or pastoralists' relative dependence on trade with agriculturalists). Here I want to suggest that another way of approaching this aspect of defining pastoralism is to consider the relative importance of human-herd animal relationships, not merely in terms of subsistence, but also in other aspects of social life. This moves away from considering human-herd animal relationships as being ecologically determined, towards considering what potential these relationships might afford political practices in pastoralist societies.

Despite the re-orientation, the themes of mobility and kinship as a positive resources for building and maintaining practices of political organization and authorization remain firmly in focus. In particular, the emphasis on pastoralism as a form of human-animal relationship shifts the way mobility is understood. Mobility is co-produced by human and herd animals and is variable through time and space. This moves us away from ideal-typical understandings of 'pure' nomadism and instead asks how and why mobility is structured in certain ways in specific historical contexts. Above all, as I discuss in the next chapter, considering pastoralism as fundamentally grounded in human-herd animal relationships recontextualizes questions about how pastoralist practices enable and constrain features like: inclusion and exclusion within and between groups at various scales; the generation, legitimation, and maintenance of political authority and power; and the role that quotidian 'economic' and marked 'ritual' practices have in shaping political organization.

CHAPTER 3

WHAT IS A POLITICAL ANIMAL? RE-THINKING PASTORALISM

> *"the auto-maton is the one who is moved by itself, and only by itself, that is the one who will not be moved, put into motion by others."*
>
> (Vinciane Despret, 2004, "The body we care for", p. 118)

This dissertation examines how beginning with the human-herd animal relationships at the heart of pastoralism enables archaeologists to think differently about how pastoralist practices enabled the organization of political life in the past. In doing so, it recasts pastoralist practices as forms of what Vinciane Despret calls *anthropo-zoo-genetic practice*, "a practice that constructs animal and human" (Despret 2004:122). The routine, mutual labor of reproduction of herd and herder – their movements through time and space, their entangled needs and desire for nourishment, their affective connections and relations – are grounded in and provide a grounding for politics from the bottom up and from the top down.

To do so, I draw on Donna Haraway's work on companion species (2003; 2008). Branching out from the term companion animal, she knots together a number of themes underlying both 'companion' and 'species', to sketch out what is and might be at stake in understanding humans' and animals' relationships with one another. From companion she draws a series of connections: deriving from the Latin *cum panis* (with bread), which she transmutes into 'messmates', she highlights comrades ("political companions"), literary companions (*vade mecum*), the political and military tones of company, and finally, "As a verb, to *companion* is "to consort, to keep company" with sexual and generative connotations always ready to erupt." (Haraway 2008:17). Similarly, for species, she draws links to that Latin *specere* (to look), to the logical, scientific, and conservation uses of species and its reproductive connotations ("*Species* reeks of race and sex"), and to the political weight of specie, "alert to all its filth and glitter" (Haraway 2008:17-18).

In this tangling, Haraway highlights the way in which humans' relationships with non-humans consist of, and constantly mingle, mundane encounters and sustained relationships between humans and animals, representations and ideologies of those relationships, and the generation of wealth and processes of material destruction. Haraway shows that companion species is sex, war, politics, money, as well as love – and that it may not be so easy to neatly distinguish between them. While Haraway's original manifesto (2003) is focused on dogs as a companion species,[1] I argue that pastoralist herd animals are a form of companion species *par excellence*. Herd animals draw together the various reproductive, political, economic, biological, and semiotic threads of companion species in a way that renders their connections clear. The connections constituting herd animals as companion species are different from those that Haraway details for dogs. The specificity of the human-herd animal relationship within pastoralism is centered in the close, co-constitution of reproduction and consumption (or predation?) within the human-animal collectivity of the herd.

One similar approach to what I am proposing here is the etho-ethnographic work done by Fijn (2011) on human-animal relationships in contemporary Mongolian pastoralism. She develops the concept of 'co-domestication', defining it as "the social adaptation of animals in association with human beings by means of mutual cross-species interaction and social engagement" (Fijn 2011:19). Fijn, in proposing the term, is aiming to move away from models of domestication which presume human dominance and control over animals or that assume domesticated animals are merely commodities (Fijn 2011:19). In

1. In the subsequent book (2008), Haraway develops a number of wide-ranging contemporary examples, involving many different animals.

her account, Fijn focuses on the mutual socialization of humans and animals, and the co-constitution of the 'ecosocial sphere' of the herding encampment, presenting a textured depiction of daily life and the seasonal round for both herds and herder.

Fijn's idea of 'co-domestication' is is somewhat akin to what I am trying to develop through thinking with Haraway's companion species for domesticated herd animals. The focus on the sustained, mutual relationships of labor and care in herding that she presents is immensely helpful for thinking about the potentialities of human-herd animal relationships in ancient pastoralist societies. However, I disagree with her assertion that Haraway's companion species does not apply beyond "one-to-one partnership with a particular dog, horse, or cat and is not applicable to whole herds of animals" (Fijn 2011:19). Rather, one of the virtues of Haraway's approach (which is not terribly programmatic) is that it scales between individual dyadic human-animal relationships and the wider groupings that situate those dyadic pairings. In *When Species Meet* (2008), Haraway begins with a story about encountering dogs at a dog beach in Santa Cruz, described by their owners as "half wolf", leading into the story of a group of North American wolves exported to apartheid South Africa. These wolves were brought in by the state to breed more aggressive attack-dogs. Haraway details the failures of the program (the resulting hybrids were insufficiently independent) and the difficult status of these animals post-apartheid. She writes:

> "Which histories must we live? A short list includes the racial discourses endemic to the history of both biology and the nation; the collision of endangered species worlds, with their conservation apparatuses, and security discourse worlds, with their criminality and terrorist apparatuses; the actual lives and deaths of differentially situated human beings and animals shaped by these knots; contending popular and professional narratives about wolves and dogs and their consequences for who lives and dies and how; the coshaped

histories of human social welfare and animal welfare organizations; the class-saturated funding apparatuses of private and public animal–human worlds; the development of the categories to contain those, human and nonhuman, who are disposable and killable; the inextricable tie between North America and South Africa in all these matters; and the stories and actual practices that continue to produce wolf–dog hybrids in unlivable knots, even on a romping-dog beach in Santa Cruz, California." (2008:37-38)

This example demonstrates how thinking about companion species means thinking about both individuals and groups (and how their histories interdigitate).[2]

Furthermore, I am sympathetic to Fijn's critique of older approaches to domestication and her suspicion towards the origin stories that they entail (Fijn 2011:22). Her response is to collapse the temporality of domestication, highlighting it as an ongoing, individualized process that is never complete. As a result, her work highlights the necessary ongoing work of socialization ('taming') that is required among domesticated herd animals, long after being 'domesticated' (Fijn 2011:129-150). However, for the purposes of this analysis, I am making a different temporal move.

Rather than collapsing domestication into an ever-present 'becoming', this analytic approach is oriented towards three overlapping, interpenetrating temporal scales. In *The Companion Species Manifesto*, histories of dogs as companion species are giving at three 'time-space' scales. First, "evolutionary time, at the level of the planet earth and its naturalcultural species", second "face-to-face time at the scale of mortal bodies and

2. I am also wary of the division she draws between the 'co-domestication' in Mongolian pastoralism and contemporary factory farming. She states that 'co-domestication' is distinct from the "intensive, consumer-driven animal husbandry techniques used with "domesticated" animals on Western farms" (Fijn 2011:19). As Blanchette's (2013) work on factory farming shows, even the most brutal of modern meat production still relies on "mutual cross-species interaction and social engagement" (Fijn 2011:19), perverse as it may be.

individual lifetimes", and third, "on the scale of decades, centuries, populations, regions, and nations" (Haraway 2003:63). For this research, the first scale is most relevant to how archaeologists have understood the process of domestication and the long-term history that domesticated ungulates have within the South Caucasus, as well as the reliance on species as an organizing construction in zooarchaeology (cf. Hamilakis and Overton 2013). However, processes at these scales also shape individual face-to-face human-animal relationships (though not deterministically, as I discuss below).

In many ways, this study is mostly concerned with the last time scale. In part, this is a particular outcome due to the exigencies of archaeological (and particularly zooarchaeological) data. However, it is also a studied move to suggest that animals, as well as people, shape histories on that time-scale as well. In doing so, it moves pastoralism away from being a timeless, unchanging mode of subsistence and poses the question of how pastoralist practices (as sets of human-animal relationships) were organized in different times and places. The incorporation of isotopic analysis keep the scale of 'face-to-face' within the peripheral vision of this analytical approach.

3.0.1 Thinking animals

Re-thinking pastoralism as a set of practices grounded in human-herd animal relationships also requires re-engaging with how we think about animals. When viewed through the lens of Cartesian dualism, animals can seem to blur the lines between subject and object, depending on from what standpoint and direction the division is viewed.[3] The uncertainty of this divide is also thrown into relief by ongoing scientific work that steadily shifts the criteria for defining "the human" and assigning various traits and abilities (such as abstraction, planning, language, personality) to a wider and wider range of animals.

3. See Agamben (2003) for a brief review of this issue in Western philosophy.

Within this Cartesian instability is the question of what role instinct plays in animals' being in the world. The traditional, behaviorist account of animal action is that it is rote, that animals are automatons driven by instinct (stimulus-response), as established through the inexorable process of natural selection. In place of this assumption of animal 'nature' as marked by constraint, I argue that instinct can be re-thought as a substrate that enables engagement with the world that is not limited to a rote stimulus-response mechanism, nor entirely subsumed within the framework of reproductive fitness. In order to do so, I draw on Brian Massumi's account of instinct and intuition in *What Animals Teach Us About Politics* (2014).

Massumi, drawing from Bergson, argues that instinct is a form of intuition, and that instinct and cognition are two forms of consciousness. In the first, thinking and doing are one and the same: "Instinct is a mode of thinking, one with doing." (Massumi 2014:31). In the latter, thinking and doing are separated, and cognition is "an intuition that is represented rather than lived." (Massumi 2014:31). This is one of many moves within the text that works to collapse the conceptual distinction between humans and animals.[4] However, for my purposes, what is important in this approach to instinct is that it allows for instinct to have a plasticity, allowing it to get beyond rote reaction. He continues, "In the case of instinct, corporeality comes in the inherited form of a genetic memory of the adaptive imperatives of past situations, triggered into reactivation by a present perception."(Massumi 2014:32). For Massumi, instinctive reactions are shaped by genetic inheritances, called out through a material context in the present. However, this 'reactivation' is not the response of an automaton, scripted in advance.

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4. I am sympathetic to Massumi's overall political project and receptive to his approach to collapsing the Cartesian divide in all of its forms. However, reading with Donna Haraway, I am still skeptical of the liberatory potential of a politics based in the Deleuzian framework of Becoming-animal. See Haraway (2008:314-5) for her critique of Deleuze and Guattari, and see Massumi (2014:116) for his take on the matter.

Rather, instinct is "a living thinking-doing of the open-ended movement of expression, anchored in the situation, right down to its core, but leading tendentially beyond what is presently given in it" (Massumi 2014:33). The first major point of Massumi's intervention is that instinct is not rote or static – it is a form of action that can result in something new. The second important point Massumi makes is that this form of action is taken within a context, and it is a context that has a history. This history may consist of, as the quote above suggests, genetic inheritances – but thinking more broadly, it may also be determined by local histories that link humans and animals, including an individual's previous experiences.

This plastic sense of instinct makes space for considering how animals might act in the world, without reducing their actions to merely anthropomorphic forms (cf. Smith 2015:29, 49-50). This (rather abstract) approach to re-theorizing the animal aligns with the development of an new approach to ethology (fortuitously returning the thread of this discussion to herd animals, specifically sheep). Thelma Rowell's work with Soay sheep[5] has sharply shifted ethologists' understandings of sheep behavior and cognitive capacities and has sparked a number of discussions of how humans can study (and perhaps learn to live better with) non-human animals (Despret 2006; Haraway 2008).

At the center of this revolution in thinking about animal behavior is the deceptively simple practice of setting out twenty-three bowls of food for twenty-two sheep. In Despret's (2006) account of this practice, she notes that sheep have been the victims of a 'hierarchical' scandal in ethology. The scandal is that charismatic ape species have been studied in ways that give them "a chance" to be interesting (2006:367). In contrast, for other animals, the focus had been primarily on feeding behaviors. Rowell's extra bowl, and extra attention,

5. Notably, Soay sheep as a so-called 'primitive' breed are routinely used as analogues for pre-modern sheep in archaeological studies.

gives her sheep a chance to do something interesting and, as a result, for us to learn something interesting (see also Despret (2004)).

Both Massumi's re-theorization of instinct and Rowell's re-imagining of ethology lead me to consider what plasticity, what potential for transformation – beyond the original sin of domestication – lies in human-herd animal relationships? How can we imagine this generative potential, neither reducing it to the imposition of human interests on brute beasts, nor ignoring the power differentials at play between humans and between humans and animals? This problem takes on an added difficulty in zooarchaeology, where inferential logics are deeply bound up with uniformitarian approaches (Gifford-Gonzalez 1991) that assume the static nature of animal species (and species-beings) (see Hamilakis and Overton (2013) for a critique of zooarchaeology along similar lines). In other words, how can archaeologists give long-dead sheep, goats, and cattle a chance to be interesting? The approach I take here is to consider how herd animals – as a unique form of companion species – have certain affordances that shape the human-animal relationships at the heart of pastoralist practices. In the following section, I develop an analytic approach that considers how herd animals, in their pre- and post-mortem social lives, provide affordances that shape pastoralist practices.

3.1 Herd animals as companion species: Affordances

> "Not all animals are alike; their specificity – of kind and of individual – matter." (Haraway 2003:52).

In order to think herd animals as companion species, it is necessary to develop a framework for thinking about the specificity of animals, as not all companion species relations are equivalent. Here, I suggest that the idea of affordances, coming out of psychology (Gibson 1979) and taken up recently in archaeology (Knappett 2004, 2005; Malafouris 2008;

Hodder 2012), offers one way of thinking about the specificity of animals, and how that specificity shapes their relationships with people as companion species. However, thinking about affordances within the framework of a companion species approach to human-animal relationships requires shifting how archaeologists think about affordances. It requires re-imagining the way affordances as an analytic relate to the wider questions about human social life that archaeologists seek to answer.

Carl Knappett is one of the major proponents of using affordances to think through questions of materiality in archaeology (2004; 2005). His major concern is to understand what meanings objects have and to develop an analytical approach that would allow archaeologists to access those meanings through the study of artifacts. He uses concepts and approaches from cognitive science to understand how people perceive and understand the material objects with which they interact. As part of his turn to cognitive psychology, Knappett discusses Gibson's idea of affordances (2004, 2005). In the original formulation (Gibson 1979), affordances was developed to describe human cognitive perception of objects and their function. Gibson's ecological approach offered a different answer to the question of "how do we know what things are when we see them?", one that stressed the importance of the material properties of the object, rather than prior cognitive structures (see Knappett 2005 for an extended discussion of the history of objects in cognitive psychology and Gibson's intervention). Gibson argued that the material form of an object, a chair for instance, suggests to the perceiver a possible function (the action of sitting), rather than the perceiver identifying the object as a chair (via a sign relation) and then connecting it mentally to the action of sitting.

For Knappett, the key aspects of affordances are their *relationality* and *transparency*. Affordances are "neither solely an independent property of the object itself, nor is it exclusively an intentional state within the mind of the person engaging with it, but a relational property shared between object and agent." (Knappett 2004:46). As a result, that relationality is shaped by both the specificity of the object and of the 'agent' (or perceiver) as well. While, Knappett's is generally concerned with humans and objects, affordances (in their relationality) are not limited to human perceptions: "Gibson argues, for example, that grass affords eating insofar as there are grazing animals. Grass does not afford eating to humans, no more than chairs afford sitting to grazing animals." (Knappett 2005:48). Second, Knappett is concerned with the relative transparency of affordances. An affordance is transparent if a culturally 'naive' perceiver would perceive an object's affordance. While the affordance of a chair for sitting might be quite transparent, the affordances of a mailbox are likely not readily apparent without other contextual knowledge.

Ian Hodder, in *Entangled* (2012), builds from Knappett's discussions of affordances, fitting it into (and subordinating it) to his own framework (entanglement) for understanding the way objects act in the world and how humans relate to them. For Hodder, in a general way, affordances refer the ways in which things and people work together physically in the world: "Handles of pots fit our hands or lugs on pots afford the potential to tie a string so the pot can hang from a beam...There is a generality to these potentials, though always instantiated in particular networks in particular ways." (2012:49-50). More concretely, he returns to affordances in his discussion of two other sets of concepts he introduces to explain the way people and things interact.

Hodder argues that human dependence on objects takes two forms: one that is generally enabling (dependence) and one that is constraining (dependency) (2012:17-18). In his estimation, affordances fails to take into consideration the difference between the enabling dependence of potential uses and the constraining dependency of a tightly organized material assemblage. Hodder uses the example of a small threaded pin that is crucial to the functioning of a sail boat (2012:51) as an example of this type of constraining sets of material affordances between things. Similarly, Hodder defines the concept of "fittingness" to cover both "the ability to function" and the "coherence of assembly" (2012:113). In his schema, affordance refers to the first type of fit and he introduces a second term, *coherence*, to describe the second. Both of these dyads are ways of describing and understanding the various dynamics at play in the ways that humans and objects interact, co-exist, and mutually entail.

Both Knappett's and Hodder's approaches to affordances highlights a few features that make it a useful analytic to work with, within the framework of a companion species approach to pastoralism. First, the concept of affordances establishes that the answer to the mind/matter distinction is 'both/and' (Knappett 2004; Nagy and Neff 2015), which aligns it well with the process philosophies underlying the theoretical framework of companion species (Haraway 2003:6, 2008), as well as the account of instinct developed by Massumi (2014). Moreover, as the example of grass suggests, affordances have the potential to avoid, or at least reduce, our analytical anthropocentrism. The insistence that affordances are relational – that is, located in the interaction between object and perceiver – and situational is critical to making analytical space for considering how humans and herd animals shape each other through pastoralist practices. This helps us to think about how human-herd animal relationships are not merely the imposition of human will and imagination on 'dumb' animals. Additionally, Knappett's consideration of relative transparency and Hodder's distinctions between dependence and dependency and coherence and affordance draw our attention to the ways in which not all affordances are equal (or stable).

Hodder's attempt to narrow the scope of affordance draws our attention to the relationality between objects, which can often be outside the perception of human beings. Nagy and Neff (2015) suggest that affordances also encompass things that go on without our perception (or under our mis-perception). In their discussion of the use of affordances in the communication technology studies literature, they emphasize that affordances are not limited to either users' perceptions or designers' intentions. They use the selective algorithms undergirding Facebook's News Feed as an example of an affordance that is not actively perceived by users, but deeply shapes their experiences interacting with and through that medium. This works to decouple the effects of human-object or human-animal interactions from human intentions or interpretations (cf. Bennett 2009).

However, one problem with affordances as a concept is its emphasis on a perceptual dyad,[6] and a relative agnosticism towards the wider context within which this perception takes place. This is inherited from the original formulation of the concept within psychology, and as Knappett notes, "This is an aspect that Gibson barely elaborated, and his formulation of affordances can certainly be criticized for being asocial." (2004:46). Knappett's response to this issue is to draw a distinction between the affordances of objects and the associations between objects; a distinction he characterizes as the difference between "the "vertical" connections that exist among brain, body, and object" and the "horizontal" associations "that connect any given object with innumerable others." (Knappett 2005:64). This allows him to go on to consider how network theories can help elucidate the meaning that objects have.

Hodder's response to this problem is different, in part because he is asking a wider set of questions about the relationships between humans and objects. Hodder is concerned with the nature of the relationships that connect the points in Knappett's networks and vertical connections, that is to say, the types and textures of human-thing relationships. As a result, Hodder addresses the issue of perception by distinguishing between affordance and coherence. Affordance, in Hodder's restricted sense, refers to the materiality capacities of objects to interrelate with other objects and human bodies (handle and lug on a jar). Coherence refers to whether a thing coheres within the wider context: "whether it seems appropriate within a phenomenal world of concepts, emotions, and feelings"

6. Another wrinkle in the legacy of perception in shaping the concept of affordances is the absence of a consideration of a perceptual dyad in which perceiving goes both ways. When you look at an animal, the animal can look back at you. In the case of sheep, research has shows that they are highly attuned to individual faces (Kendrick et al. 2001).

(Hodder 2012:113). Hodder argues that the relationality of affordances is both nested and multi-scalar (2012:114). However, his distinction between coherence and affordance re-introduces a mind-matter distinction – one where affordances are located (albeit relationally) between material objects and coherences are located in the perception of perceiving individual or collective.[7]

Despite this, affordances remain a valuable approach to re-thinking human animal relationships as a form of companion species. Companion species as a framework alerts us to the importance of relationality in human-animal relationships and it brings the questions of history and of power to front and center. Affordances provide an analytic for thinking about the specificity "of kind and of individual" (Haraway 2003:52) of different companion species. It re-capitulates the emphasis on relationality, but as the work of Hodder and Knappett demonstrate, it also makes it possible to consider the various ways in which not all affordances are equal, nor are they static. This moves us away from dyadic perception into action in the world, into what Haraway calls 'becoming with'. Critically for thinking about herd animals as companion species, this shift puts questions of reproduction and predation back on the table, as affordances of herd animals that are essential to human-herd animals relations, but do not fit neatly into the framework of perception.

To illustrate, I present an example from Timothy Mitchell's "Can the Mosquito Speak?" (2002). While Mitchell does not use the term affordances, his discussion of the role that nitrates and mosquitoes played in shaping Egypt's experiences in World War II illustrates the way in which I see affordances and companion species as complementary analytical projects. He weaves together an account of how "a war, an epidemic, and a famine

7. It is interesting that Hodder's discussion of operational and behavioral chains is in a section on dependence vs. dependency. In contrast, Lechtman's (1977) discussion of the development of Andean metallurgy is an example where both coherence and affordance are taken together within the bounds of what Lectmann calls technological style. The material properties of metals enable the development of a wide array of alloying techniques, even as the development of these techniques is constrained by the coherence of the internal incorporation of gold and silver within Andean cosmologies and statecraft.

depended on the connections between rivers, dams, fertilizers, food webs ... They were not just separate historical events affecting one another at the social level. The linkages among them were hydraulic, chemical, military, political, etiological, and mechanical." (Mitchell 2002:27). Most strikingly, however, is the central role that the chemical properties of ammonium nitrates and the ethological characteristics of mosquitoes play in the narrative:

> "War in the Mediterranean diverted attention and resources from an epidemic arriving from the south, brought by mosquitoes that took advantage of wartime traffic. The insect also moved with the aid of prewar irrigation projects and the ecological transformations those brought about. The irrigation works made water available for industrial crops but left agriculture dependent upon artificial fertilizers. The ammonium nitrate used on the soil was the main ingredient in the manufacture of explosives and was diverted for needs to war. Deprived of fertilizer, the field produced less food, so the parasite carried by the mosquito found its human hosts malnourished and killed them at the rate of hundred a day." (p. 27)

At each step in this process, Mitchell clearly documents that this arrangement of animals, things, people, and landscapes was shaped by politics (both within Egypt and internationally) and that its effects were unevenly distributed.

The chain of cause and effect was not simply a matter of the determinism of the material world, nor was it merely political actors acting on a blank slate. As Mitchell writes, "Ammonium nitrate provided the main ingredient for two chemically similar but socially different processes, each concerned with life and death: the fertilizing of crops and the making of high explosives." (2002:25). Mitchell meticulously documents how the technical properties of ammonium nitrate, the uneven distribution of their natural deposits and the location of factories that could synthesize them, the political allegiances of different powers in World War II, and the ethological characteristics of the *Anopheles gambiae* all came together to produce the devastation seen in the Egyptian countryside in 1942-1944. Power mattered, lives were at stake, but this chain of events was deeply dependent (in both of Hodder's senses) on the material characteristics of things, animals, and landscapes.

This narrative – just like Haraway's discussion of the wolves brought to South Africa (2008, see Haraway (2003) for other such histories involving other dogs) – not only accounts for the way in which humans relate to the things that fill their world, but do so in such a way that centers both history and politics. In both of these examples, what is key is that affordances are not primarily about dyadic perception, but rather are a way of accounting for the complex way in which people, things, animals and landscapes assemble (as a dynamic process, not static relationship). This sort of approach highlights the importance that history plays in shaping the context of affordances, as well as the role that contingency might have in the interplay of affordances. But above all, this shift in emphasis moves the question of politics to the forefront.

3.2 Herd animals as companion species: Political implications

In this section, I analyze how centering human-animal relationships, within a companion species framework, shapes how we might understand their political potentialities theoretically. This is in contrast to the approaches discussed in Chapter 2, which took pastoralism as a form of human social and/or economic organization as their starting point for understanding its political implications. This shift allows me to consider three (overlapping) analytical modes in which human-animal relationships shape the potential for pastoralist practices as political. The first considers the status of herd animals within relations of authority or power with humans. The second explores the political implications of the status of herd animals as an objects of both labor and care. The last analyzes how the role of herd animals as valuable items (in terms of production, distribution, and consumption) shape the political potentialities of pastoralist practices. In considering these three modes, I also explicate how the affordances of herd animals shape these three modes.

3.2.1 Trust or domination?

The first mode interrogates the status of herd animals with pastoralist human-animal relationships. This issue has been the subject of a lively debate in anthropology in recent years (Ingold 2000; Armstrong Oma 2010; Orton 2010a), and has subsequently been taken up into discussions about the nature of domestication (Russell 2002, 2007; Franklin 2007; Fijn 2011). The opening salvo of the debate was "From trust to domination: An alternative history of human-animal relations" by Tim Ingold (2000). In the piece, he contrasts the relationships between hunters and the animals they hunt and those between herders and their herd animals. He recasts hunting as an activity that requires trust between humans and animals – a trust that is defined by a simultaneous autonomy and dependency (Ingold 2000:69). In contrast, domestication represents a shift in the 'terms of engagement' between humans and animals – from trust to domination.

In order to explicate this shift, Ingold argues that the dominance of herders over herd animals is akin to the relationship between master and slave, which he notes is a *social* relation between subject-persons (not object-things) (2000:74-75). He writes: "It is the herdsman who takes life-or-death decisions concerning what are now 'his' animals, and who controls every other aspect of their welfare, acting as he does as both protector, guardian, and executioner." (Ingold 2000:71). Previously Ingold (1988) had argued, drawing on ethnographic research in Siberia, that the different human-animal relationships in hunting and herding are a result of the biological characteristics of the reindeer themselves (migration patterns, foraging requirements, reproductive cycles, etc.).

In that book, Ingold demonstrates how these different relationships between humans and reindeer underlie different aspects of social organization: meat sharing practices, household organization, and ideas of property and ownership. Thus, in his account, different modes of human-animal relationships shape not only the productive economy, but also relationships of power and authority. Ingold is quick to note, however, that despite the loaded nature of the terms he uses, neither trust nor domination is "in any sense more of less advanced than the other", nor is trust intrinsically good and domination bad (2000:75).

Kristen Oma Armstrong's response to Ingold's assertion that human-animal relationships in domestication is to counter that the "intimacy that is formed in the proximity between humans and domestic animals is highly dependent upon trust." (2010:177). She also critiques his assertion that hunting requires or enables trust, essentially flipping the terms of Ingold's argument. Instead, she suggests that the relationships between humans and herd animals are better understood as a 'social contract', drawing on its use in gender research and organic farming (Armstrong Oma 2010:178). She argues that a social contract is necessarily asymmetrical, but involves both trust and reciprocity (Armstrong Oma 2010:177-8). In the rest of the piece, she discusses the concept of human-animal intra-action, made possible through bonds of trust, using the examples of milking, horse riding, and the shared domestic space of the Bronze Age Scandinavian longhouse.

David Orton's (2010a) contribution to the debate stakes out a middle ground by describing herd animals as sentient property, both subject and object. He writes: "despite being incorporated as 'objects' into property relations between humans they remain subjects whose social world overlaps with that of humans" (Orton 2010a:188). He also notes that viewing animals as property is not a straightforward characterization of the relationship between humans and herd animals (Orton 2010a:191), rather it is one that opens up a field of questions about how these relationships change in time and space. In the piece, he argues that larger communities were stabilized in the Vinca period in the Balkans through complex human/animal kinship networks that were materially embodied through herds. He links this development to the affordances of cattle: “The large size and hence high individual value of cattle is likely to have promoted a role in competitive exchange, while their low fecundity, relatively long life span and herd social structure confer particular potential for cattle kinship to become interlinked with that of humans.” (Orton 2010a:194).

All three of these authors, despite their differences, raise questions about the ways in which domesticated animals are both ‘subject to’ and uniquely intimate with humans. In the two pictures of domestication presented by Ingold and Armstrong, there is a tension between the question of the status of herd animals as living beings that are either autonomous or subject to a (human) authority and the intimacy of the shared daily life of herd animal and herder. This debate highlights the ambiguity of subjection, oscillating between the two poles of the rights-bearing subject (of the Western philosophical and legal traditions) and the subjugated, slavish beast. Further complication is added by the fact that pastoral practices often provide a rich symbolic vocabulary for authority and power, often in the form of the articulation of the sovereign body with the body of the animal (Brotherston 1989) but also in the equation of the slave and the herd animals (Ingold 2000:73-4).[8] In this mode, pastoral relations between humans and herd animals serve as an example of the appropriate form for relations of authority and power between people.

Ingold’s presentation of domination invites us to think with Agamben (2003) about the possible configurations of death and inclusion/exclusion within and across human-animal interactions. However, it downplays the issues of trust and bodily intimacy

8. A similar logic underlies Frederic Engels’ suggestion in “The Origins of the Family, Private Property, and the State” that the connection drawn between herd animal reproduction and human reproduction inspired patriachical control of human reproduction within the family, leading to “the world historical defeat of the female sex” (Engels 1978:736).

that Armstrong's account centers. Contrastingly, Armstrong's idea of the social contract and her emphasis on intimacy ignores the imbrication power and intimacy.[9] As Russell (2007) perceptively outlines, human-animal relationships under domestication parallel that of human kinship. They draw together intimacy, power and property, and the regulation of reproduction. Orton's position suggests that we can have it both ways, animals as both subject and object. I would argue that he, along with Russell, are on the right track. What is key is to begin to understand how power and intimacy, kinship and property, are laminated together in human-herd animal relationships, mediated via the body of herd animals.

3.2.2 Labor & Care

The second mode in which herd animals shape the potential for pastoralist political organization is through their position as objects of labor and/or care. Despite the idea that pastoralist's herds are a form of self-reproducing wealth (due to the animal's fecundity), having herds requires work on the part of herders (including various forms of care for animals). Anna Tsing, writing about crop domestication and its relationship to labor and politics, perceptively notes:

> "The grains selected through domestication had big, high-carbohydrate seeds; high carbohydrate diets allowed women to have more children. Instead of working to limit fertility, as most foragers do, people suddenly wanted as many children as possible—not only because of the fetish of fertility but also because the family needed more labour for the cereals. The cereals did not care whether family or non-family labour raised them, and there was no dearth of

9. Pálsson (1996) glosses a similar distinction between orientalist and paternalist approaches to human-environmental relationships, both of which presume human difference and mastery over non-humans, but characterize the relationships as domination or protection, respectively. He contrasts them with a third approach, communalism, which does not presume a separate between humans and the environment.

> people; but state-supported property encouraged labour inside the family, i.e., children." (2012:146)

Here we see how the affordances of specific plants – in this case, cereals – shape the contours of human labor. Tsing's account of the twining of cereal, labor, and power was inspired by Frederic Engel's account of the origins of private property (bringing us back to herds!). Unlike Engels' just-so story, which rests on an analogy drawn between women and herd animals, Tsing's brief account highlights the arrangement of labor entailed by the characteristics of plants, as they became domesticated. Importantly, Tsing's example (and the intellectual traditions of Marx (1977) and Meillassoux (1981)) draw our attention to the fact that the organization of that labor is a matter of politics.

Daily and seasonal mobility, foddering, care for pregnant and newborn animals, care for sick and injured animals, repair of corrals and byres, etc. are some of the many forms of labor that may be necessary parts of raising herd animals. These tasks are not equally apportioned between individuals; differences in age and gender shape the organization of labor in pastoralist societies (Claude Lefébure 1979:9) and may be a source of inequality (cf. the discussion of gender in Dyson-Hudson & Dyson-Hudson's (1980) Annual Review article). The attachment of poor herders to the household of rich herders in a variety of forms of clientship, and the cycling out of both poor and rich herders from mobile pastoralism described by Barth (1961), are both instances in which the necessary labor of caring for herds has an obvious political dimension (cf. Asad 1972, 1978).

The use of secondary products shifts the nature of labor required for pastoralist production. Dairying requires daily, intimate contact between herders and lactating animals; engendering a new dimension of intimacy and developing different forms of social relations between humans and animals (Tapper 1988:53; Orton 2010a; Fijn 2011). This form of intimate and daily labor may shift the nature of power within the human-herd animal relationship (as discussed in the previous section). Allentuck (2015) argues that the shift to secondary products in the ancient Near East shifted the temporality of human-herd animal relationships. He argues that "the potential for intimate human–livestock relations was only made possible when the lives of animals were extended with the advent of secondary products exploitation" (2015:109). I would argue, instead, that the difference between primary and secondary products exploitation (between different forms of secondary product exploitation) is that different groups of animals live into adulthood, potentially forming intimate relationships with human herders.

What is more, the post-mortem the labor entailed in the processing and consumption of herd animals shapes animals' role in commensal politics. These roles are mediated by the physical size of animals and the interplay between size and technologies of food preparation and preservation. Finbar McCormick (2002) argues that the reciprocal feasting required by medieval Irish law was related to need the cull cattle in the late winter/early spring (a time of fodder shortage). The sheer size of cattle – too large for a single household to consume before spoiling (in the absence of the cold weather and salt to preserve large quantities of meat) – led to practices of feasting that brought together elites and non-elites. Though they brought people together across lines of social division, these feasts also reinforced social hierarchies through differential consumption based on a hierarchy of body parts.

Similarly, Knight's (2001) discussion of the use of pigs at Danebury notes that roasting a whole pig takes a long time (which might encourage the gradual removal of cooked meat from the carcass) and that a large group would be needed to consume an entire adult pig. Whether large or small, the physical size of animals (and the relative balance of meat, fat, and bones) has direct bearing on the social practices they participate in. Moreover, the labor needed to prepare food – communal vs. individual or female vs. male – has political implications (Hastorf 1996; Bray 2003; White 2005).

More broadly, there is the oft-repeated idea that the mobility of pastoralists, both enabled and potentially required by herd animals, renders them unsuitable as subjects of centralized, territorial states. In its simplistic forms, this proposition is a weak assumption, and as Talal Asad notes, often represents "a confusion between economic exploitation and political incorporation" (Asad 1979:423). However, as the works by Frachetti (2009; 2012), Porter (2012), and Honeychurch (2015) discussed in Chapter 2 all suggest, the relative levels and forms of mobility undertaken by pastoralists and their herds does shape the political potentials of pastoralist groups. As these different examples demonstrate, while there is a range of flexibility in the possible arrangement of pastoralist labor (across production and consumption), the specifics of those arrangements are not to be taken for granted, but rather to be analyzed in an attempt to account for the connections between political organization and production and consumption activities (see below).

3.2.3 Objects of value

As the connection Haraway draws between *species* and *specie* suggests,[10] herd animals' role as items of value and a critical form of wealth in pastoralist societies is integral to the way in which they shape the potential for political organization. In addition to herd animals' immediately apparent value(s) as 'self-reproducing' and 'self-transporting' sources of comestibles (meat, milk, blood) and raw materials (hides, fibers, bones, sinews), herd animals' particular material characteristics shape their potential to mediate certain kinds of human social relationships. This is another way of considering their status as items of value, beyond (or at least, in addition to) cash and calories.

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10. As does Sarah Franklin's nuanced account of the links between sheep and money (via the terms stock and capital) in English history and contemporary bioscience in the book *Dolly Mixtures* (2007).

Ethnographic and ethnoarchaeological work in Africa and the Near East indicates how practices of lending animals through networks of kinship and political patronage creates relations between borrower and lender, shaping the form power and authority took in pastoral societies (Barth 1961; Asad 1979; Reid 1996; Comaroff and Comaroff 1990, 2005). Jean and John Comaroff describe this process for the Tshidi:

> "In principle, Tshidi distinguished sharply between animals belonging to the chiefship and those possessed by the office-holder; in practice, it was hard to separate the two. But there was nothing ambiguous about the part they played in the exercise of power. Not only did they sustain the people who actually husbanded them, the royal servants who performed a wide range of productive and political tasks for the ruler. They could also be given away in return for support and submission. Such distributions took various forms: outright transfers to loyal followers, sometimes along with appointment to newly created headmanships; long-term loans (mahisa), in which the recipient might use the milk of the cows and keep a heifer, and reciprocate by giving their owner "support in public life" (cf. Schapera 1938:214); payments to specialists, such as rainmakers, who, in assuring communal well-being (pula; also "rain"), reinforced the legitimacy of the chief; sacrifices to the ancestors to ensure their protection; and the despatch of gifts to other sovereigns. As everywhere in precolonial southern Africa, then, "cattle [were] converted into fealty and political support" (Sansom 1974:163)." (Comaroff and Comaroff 1990:205)

In these instances, the value of herd animals is in their ability to create particular sorts of social relationships between giver and taker, mediated via the physical body and reproductive capacity of the animal itself (see below for a more in-depth discussion of this phenomenon). But even as these sorts of loans could work to knit together individuals, through ties of kinship or other social bonds, they also held the potential to be exploitative. As the Comaroffs remark, comparing money and cattle in southern Africa, both have a "peculiar aptitude for abstracting and congealing wealth, for making and breaking meaningful associations, and for permitting some human beings to live off the backs of others." (Comaroff and Comaroff 1990:211).

In order to theorize this aspect of the value of herd animals, I draw on Nancy Munn's analysis of kula in Gawa in *The Fame of Gawa* (1992). Her account places kula in the context of other social actions, including the preparation and consumption of food, drawing together practices of exchange and Gawan ideas about lightness and heaviness. Critically, she presents an account of value that is focused on action, actions that create particular intersubjective spacetimes. She writes,

> "value may be characterized in terms of differential levels of *spatiotemporal transformation* – more specifically, in terms of an act's relative capacity to extend or expand what I call *intersubjective spacetime* – a spacetime of self-other relationships formed in and through acts and practices." (Munn 1992:9)

Munn further elaborates that these intersubjective spacetimes rely on the subjects who interact, as well as "the qualities of properties of certain entities involved in a given set of practices. These entities can be material (for example, Gawan food, canoes, and gardens) or nonmaterial (for example, fame) media and products" (Munn 1992:10). Much of her account is focused on how creative action, involving subjects and things, yields certain types of spatiotemporal transformations, that is to say, value transformations.

Approaching value as based in action (that is fundamentally anchored in the material world), as Graeber notes, Munn's approach threads an analytical path between gift and commodity:

> "Rather than having to choose between the desirability of objects and the importance of human relations, one can now see both as refractions of the same thing. Commodities have to be produced (and yes, they also have to be moved around, exchanged, and consumed...), social relations have to be created and maintained; all of this requires an investment of human time and energy" (Graeber 2001:45)

Approaching the question of the value of herd animals in this way leaves theoretical space for their alienability as (perishable and consumable) commodities (cf. Zeder 1988) as well as their intense individualization as unique and highly valued possessions (cf. Comaroff and Comaroff 2005).

Munn's work points to the role that the material affordances have in establishing value, that is to say, enabling forms of action in the world. Other scholars working on the question of the relationship between value and materiality have explored different ways that the material qualities of objects shapes their values. Webb Keane (2005) argues that the bundling of material qualities within objects is a critical part of establishing their value – and their potential for value transformations. He argues that a particular material quality of an object (in his example, 'redness'):

> "cannot be manifest without some embodiment that inescapably binds it to some other qualities as well, which can become contingent but real factors in its social life. Bundling is one of the conditions of possibility for what Kopytoff (1986) and Appadurai (1986) called the biography of things, as the qualities

> bundled together in any object will shift in their relative salience, value utility, and relevance across contexts." (Keane 2005:188)

The various and varied material qualities of objects allows for multiple interpretations of a single object or type of object (Keane 2010:70) and allows for the creation of gradations between comparable objects, which Lesure (1999:29) has argued allows for the creation of hierarchies that ranks both people and objects.

One very salient example of these material properties is the elaborate vocabularies and ranking systems developed to describe cattle in southern Africa: "A highly nuanced vocabulary existed in Setswana to describe variations in colour, marking, disposition, horns and reproductive status (Lichtenstein 1973, 81; Sandilands 1953, 342). Named and praised, they were creatures of distinction." (Comaroff and Comaroff 2005:114; see also Fijn 2011 for this type of system in Inner Asia). The specific affordances of herd animals (both pre- and post-mortem) shape their potential as objects of value, and thus the political potentialities of human-herd animals relationships. In section 3.3, I address more concretely how to construct an archaeologically-oriented analytic that considers how the material affordances of herd animals might shape the political potentials of pastoralist practices.

3.2.3.1 Reconciling the quotidian and extra-ordinary

Munn's recognition that materially-based action is at the heart of value and value transformation also enabled her to connect everyday and special forms of action. Her account links the quotidian practices of food-making to the decidedly extra-ordinary practices of kula exchange – using Gawan theories of value to bridge them. Here, I consider how to link together everyday and ritual uses of herd animals, specifically in archaeological studies of pastoralist practices. In doing so, I draw inspiration from Severin Fowles' (2012) discussion of religion and politics in the ancient Puebloan world.

Building from Fowles' insightful analysis of the politics of Puebloan 'doings', I argue that it is useful to consider how pastoral practices assemble people, things, and animals in landscapes, and what the political stakes are in both everyday and extraordinary assemblings. Here I use assembling (cf. Miller Bonney et al. 2016; Chazin 2016), rather than assemblage, to emphasize the actions and activities that bring together people, animals, things, and landscapes.[11]

For Fowles, religion is not a stable, isolated domain – consisting of a set of objects and activities – but rather an action taken, an argument skillfully and forcefully made. Fowles argues that Puebloan rituals:

> do not necessarily integrate society...they are instead a kind of exegesis on worldly interconnection in which claims are made about the order of things, claims that may sometimes be designed to end quarrels but that are nevertheless always open to dispute, rejection, or revision. Doings, in other words, are explicit efforts to both mirror and assert structure, but they themselves are not structure. They are, more accurately, a discourse about structure, which is why they are also a discourse of power. (2012:151)

For Fowles, the main point is not that things are assembled in religious contexts, for in truth, things are assembled in much more quotidian practices as well. Rather, what is special about Puebloan religious 'doings' is that they are assemblings that draw heightened

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11. Assembling at its simplest is the interaction of people, animals, organisms, landscapes, and things in time and space. As such, however, assemblings necessarily involve intersecting and entwining histories and may introduce ruptures and disjunctures. They are never fully intentional – due to both the affordances and intractability of people, animals, organisms, objects, and landscapes as well as to the contingencies of histories, a result of the mingling of processes and practices at overlapping and intersecting timescales. See Chazin (2016) for a fuller discussion of considering pastoralism through the lens of assembling.

focus on particular forms of relationality. Fowles describes “ a kind of gradient of consciousness extending from the largely unreflective use of objects in workaday activities to the heightened meditations on the radical interpenetration of things that characterized certain special contexts – contexts often referred to by archaeologists as ‘religious”’ (2012:176).

I would suggest that this gradient between the remarkable and unremarkable reflects the operation of two different forms or modes of power and authority. First, countless assemblings produce the background of everyday, unremarkable practices of production, consumption and exchange – Fowles’ “largely unreflective use of objects in workaday activities”. It is these assemblings that I refer to as *unmarked*. Unmarked, however, should not be mistaken for apolitical, even if they are, for the most part tacitly understood and undertaken. As modes of power, these sorts of assemblings function precisely through their unremarkableness, shaping actions and imaginaries, but without betraying (or even actively erasing) the source or the history of such assemblings (cf. Foucault 1978; Wolf 1990; Butler 2006).

What I am getting at here is different from *doxa* (Bourdieu 1977). Unmarked assemblings are not “activities that are taken for granted, those so thoroughly regularized that their pursuit cannot be considered agency as they are deprived of intention.” (Smith 2001:158-9). Rather they are assemblings that are not intended to be arguments about how the world is ordered, but that may be consciously oriented towards other intentions. Thus, unmarked assemblings should be thought of as “a field of possible courses of action” (Smith 2001:158) rather than a fixed point. While assemblings in this mode are not themselves a site of heightened, directed attention, the confluences of places, people, things, animals provide still function to direct the actions, senses, and sensibilities of participants in particular ways and moreover, they are skillful actions towards other, more quotidian ends.

Other assemblings, which I refer to as *marked*, are key to producing material, semiotic narratives of how things (and people) should be, that is, the production of discourses of power (Fowles 2012:151). Fowles' description of Puebloan doings is an example of this second mode of assembling, one that produces a conscious 'discourse about structure', an argument about the everyday ordering of the world. In contrast to the 'unreflective' assemblings, these materially- and kinesthetically-expressed cosmological arguments rely on their 'remarkableness' to function as a technique of power or mode of authority, to make a persuasive (and visible) argument about how things should be.

In both cases, the efficacy of such assemblings comes from "what they hide and in what, by this process of obliteration, they allow to emerge" (Foucault 1994:137). The successful construction of political authority, and its active maintenance over time, requires both modes of power. It is precisely through the interplay of these two aspects of assembling, unremarked and remarkable, that herd animals come to play a variety of roles – contingent and possibly contested ones – in creating and maintaining political authority. In essence, in distinguishing between these two different modes of assembling, marked and unremarked, we are better able to understand the specificity of pastoralist political organization by considering both the quotidian and extra-ordinary human-animal relationships that undergird political authority. The inclusion of herd animal remains in the shrine and mortuary contexts in the Late Bronze Age Tsaghkahovit Plain are materially-formed arguments, at least in part, about the correct organization of the world (cf. Smith and Leon 2014), that are only legible against the background of everyday interaction with and use of herd animals.

3.3 Modeling the politics of pastoralism in the past

Focusing on how affordances shape the human-animal relationships at the base of pastoralist practices allows us to re-think how we approach politics in ancient pastoralist societies. Having established an analytical framework that draws together companion species and the concept of affordances, and explored how this changes how we see the political implications of pastoralist practices, I now turn to consider how we might build new models that bridge between theorizations of the political and archaeological data, especially faunal remains. First, I show how two major middle range theorizations of the politics of pastoralist practices (Near Eastern provisioning approaches and African cattle complex models) already contain considerations of herd animal affordances and link them to different models of political organization. Then I present my own approach to studying the relationship between the organization of pastoralist practices and political life, which centers affordances and their potential to structure the construction and maintenance of political authority, incorporating the strengths of previous approaches.

3.3.1 Affordances and Near Eastern models

A number of zooarchaeologists working in the Near East have developed middle range theory that addresses the integration of pastoralist production and pastoralist subjects within urban economies and states in the ancient Near East.[12] These approaches are oriented theoretically towards questions about the rise of urbanism, the development of economic specialization, and the control of mobile populations by centralized polities. In order to

12. In other regions, particular in Mesoamerica and South America, models of animal resources and their role in the development of political complexity are somewhat different (for example, Yacobaccio 2007; Miller and Burger 1995; White et al. 2001; Thornton 2011; see deFrance 2009 for an overview of political-economic approaches in zooarchaeology in different regions) due to both the different array of domesticated and wild species present, but also due to differential regional histories that have produced other research orientations and models for the development of political complexity.

answer these questions, a number of scholars have developed models that connect these questions to the faunal data from excavations at a number of sites in the Near East. These models draw on certain functionalist ideas about the affordances of different herd animals, in order to assess the relationship between economic production and political centralization.

Gil Stein's article on pastoralist production at Gritille seeks to understand what degree of political and economic control ancient states exercised over rural production (1987). In the article, he draws a distinction between maximizing strategies (which he connects with urban centers) and resilient strategies of production (which he associates with rural hinterlands). Stein argues that the development of urban economies necessitates specialization. In his model, culling strategies that reflect emphasis on the the production of secondary products such as wool or dairy or the inter-site exchange of prime-weight animals are evidence of specialization, building from Payne's (1973) ethnographic models of sheep and goat culling. Analyzing caprine survivorship curves from sites in the Karababa basin, he argues that sites at the bottom of the settlement hierarchy pursued resilient strategies, where as major centers had specialized systems of pastoralist production. He further suggests that Southall's (1956) model of segmentary states, where the level of territorial integration is lower than in unitary states, is a "useful way to characterize the organization of the Karababa basin in the mid to late third millennium BC" (Stein 1987:109).

Wapnish and Hesse's (1988) analysis of Tell Jemmeh in the Middle Bronze Age is similarly concerned with both urbanism and economic specialization, which they connect explicitly to the development of political complexity (p. 81). Wapnish and Hesse, like Stein, define specialization as production oriented towards secondary products or inter-site exchange of prime weight animals. They develop a more elaborate model, distinguishing between self-contained production and consumption, producing economies, and consuming economies (Wapnish and Hesse 1988:84). In addition to considering survivorship curves, they consider the range of domesticated species present on site. Likewise, Wattenmaker's (1998) study of craft specialization in Upper Mesopotamia uses very similar models to considers the relationship between political centralization and craft specialization across a number of materials, including faunal remains.

Another form of economic specialization considered in the Near Eastern literature is the development of systems of provisioning. Zeder's (1988; 1991) work on provisioning and the pastoral economy at Tel Malayan in Iran is the definitive work on this topic. Zeder explicitly examines the links between the social processes in the state and the "material spatial manifestations associated with urbanism" (Zeder 1988:2). In her work, the state is defined as a centralized decision making process, plus a specialized economy (which is generated by the centralized decision making process). Zeder characterizes the former as a flow of information and the latter as a flow of material (1988:2-3). She builds a model of direct versus indirect provisioning, which is based on the analysis of species, age and sex selection, and butchery and distribution patterns within various sectors of the site. She also considers changes in these patterns through the different phases of occupation at the site.

Many other authors have taken up this model for different regions and time periods in the Near East (e.g. Wattenmaker 1998; Arbuckle 2012). In addition to being concerned with centralized decision-making and economic specialization, Zeder's and other subsequent work on direct versus indirect provisioning is concerned with the question of centralized authorities control over (potentially) mobile pastoralists. Evidence for indirect provisioning is read as a centralized authority's inability to compel pastoralists to provide the highest quality of meat for provisioning urban residents (e.g. Zeder 1988:12, 29; Arbuckle 2012:470). This line of argument, at least partially, results from the emphasis on the relationships between mobile pastoralists and settled agriculturalists in Near Eastern prehistory – driven by both ancient textual sources as well as ethnographic observations of contemporary village life in the region (e.g. Rowton 1974; Szuchman 2009; Hammer 2012; Arbuckle 2012).

The focus on centralized administration, economic specialization, and the control of mobile subjects in these models is partially driven by the existence of Near Eastern textual archives that describe the functioning of systems for provisioning urban dwellers with meat from pastoralist flocks, in particular, the Drehem texts from the Ur III period (Zeder 1988; Arbuckle 2012). It is also motivated by a theoretical framework that posits a trajectory of development from baseline subsistence production (in the absence of a centralized authority) towards more specialized forms of production which require centralized support and control. It presumes that politics and pastoralism exist separately at first, and then at a later point, through actions of the centralized polity, the political intervenes in the previously apolitical pastoralism. This framework treats pastoralist herds as a source of raw materials (in the form of surplus production beyond individual subsistence) and pastoralists as potentially difficult to administer subjects, de-emphasizing the role that pastoral practices might play in shaping political organization in early Near Eastern polities (but see Porter (2012) for a different approach to pastoralism in the ancient Near East).

Nevertheless, the middle range theory employed in these models is highly attentive to the affordances of different herd animals and the impact those different affordances have on the organization of pastoralist practices, and consequently, the organization of political life. Discussions of economic specialization in pastoralist economies, which is equated with production strategies oriented towards secondary products, focuses on the different affordances of secondary products such as milk and wool. Milk's relative perishability is seen as liability, since it makes it difficult to both transport over distances or store for the long term (Zeder 1988:10; Wapnish and Hesse 1988:94). In contrast, wool's lack of perishability makes it easier to store, and thus more suitable for centralized distribution (Zeder 1988:10). Similarly, herd animals' ability to store meat 'on the hoof' and serve as its means of transport makes them especially suitable for tribute according to Wattenmaker (1998:176), and makes them a “suitable commodity for regulated distribution” in Zeder’s model (1988:10).

The literature on the organization of urban provisioning is also concerned with the relative affordances of different part of animals’ bodies post-mortem. A number of these studies attempt to interpret the relative patterning of skeletal elements within and between sites as evidence of preferential distribution of meatier elements, as well as standardization of butchery practices. Zeder argues that indirect provisioning should result in only meat-bearing elements being present in the garbage from consumer areas of the site (1988:12). Wattenmaker (1998)uses a similar model in her work, and Arbuckle (2012) presents evidence for a centralized abattoir at Acemhoyuk and systems of distribution, which then disappears during the final phase of occupation at the site.

Differences in the affordances provided by different species of herd animals are also highly relevant to these models. First, the relative difficulty (and lack of necessity) of moving pigs means that they are commonly used as an index for the relative sedentism of site occupants (e.g. Wapnish and Hesse 1988; Wattenmaker 1998). More importantly, the relative capacity for daily movement, and needs for pasture and water are used to understand different patterns in the relative frequency of the major domesticated bovids: cattle, sheep, and goats. Zeder argues that cattle’s need for fodder and water limit their mobility, rendering them more suitable to central administration (1991:28-9). She also suggests that cattle more intensively compete with agricultural production, necessitating higher level administration (1988:9).

Differences in affordances between species and between animals of different ages and sexes are critical to the distinctions drawn between producers (pastoralists) and consumers (urban centers) and between specialization and herd security in these models. Generally, this distinction hinges on a division between production oriented towards the maximization of prime weight meat or secondary products or the maximization of herd demographic growth and stability. This distinction pivots on two sets of affordances: 1) the differential reproductive potential between male and female animals and 2) the relative cost/benefit of slaughtering animals at different ages (which impacts meat weight and reproductive potential simultaneously). Following Payne (1973), production for herd stability calls for the off-take of males once they reach maturity and then females once they are no longer able to breed. In contrast, specialized production strategies lead to either earlier culls of males (in dairy production) or later culling of both males and females (in wool production). Consumer and producer sites have should have complementary culling pattens. Almost all of the studies I am discussing consider the impact of age and sex in culling decisions (Stein 1987; Wapnish and Hesse 1988; Zeder 1988, 1991; Wattenmaker 1998; Arbuckle 2012). This is because age and sex inform Payne's (1973) models of pastoralist production, which in turn are used in the models of economic specialization (discussed above).[13]

Different affordances of different species also shape models of economic specialization. Zeder argues that cattle are superior to sheep (which are superior to goats) in terms of meat production, whereas the series is reversed if you consider reproductive potential (1988:12, 29). Wattenmaker (1998:162) distinguishes between cattle, sheep, and goats in terms of the amounts of milk and meat they provide, as well as their relative reproductive rates and the amount of labor needed to herd them. Both Arbuckle (2012:470) and Zeder (1988:29) argue that the provisioning of older caprines is evidence that pastoralists had the upper hand in negotiating with the centralized provisioning authority, assuming that the meat from older animals was less desirable. Wattenmaker (1998:163) argues that pigs would be a bad choice for specialization since they are hard to manage in large numbers.

13. As I discuss in Chapter 6, age is more frequently incorporated into zooarchaeological analyses than sex because age is much more easily determined for faunal remains.

3.3.2 Affordances and African models

A different model has been developed by researchers working on the rise and spread of the 'cattle complex' in Africa. The initial theoretical framework was proposed by Hall (1986). He argued that both the structuralist and historical materialist explanations of the African 'cattle complex' were unsatisfactory for their inability to account for change over time and the transition to agropastoralism. Hall critiqued structuralist approaches for their reliance on the idea of a 'cognitive system' and noted that "is difficult to see how such an evolution could have taken place within the rules of the cattle pattern, for its attributes form a tight, mutually dependent set."(1986:83). While the historical materialist approach resolved the issue of historical change, Hall critiques it both for the difficulty in applying it to archaeological contexts and the theoretical unsuitability of the 'lineage mode of production' "(1986:84).

In an attempt to overcome these difficulties, Hall suggested that Giddens' (1984) theory of structuration resolves the issues he identified in both the structuralist and historical materialist approaches. In particular, his brief discussion highlights two parts of Giddens' work. First, he notes that for Giddens', power is "not seen as a resource but rather as a class of action; the ability of the individual to affect other people and objects" (Hall 1986:84). Second, he introduces Giddens' analytical distinction between authoritative and allocative resources, noting that for cattle, allocative resources would be "the hides, milk and meat of cattle" and authoritative resources would be "cattle, as part of marriage transactions and in securing rights-in-people" (Hall 1986:84).[14]

14. This distinction is implicitly, though not explicitly in either Hall or Reid's discussion, in conversation with the literature on "wealth in people" in Africa, which can be glossed as "a shorthand for many syndromes of inter-personal dependency and social network-building that clearly involve strategizing, investing and otherwise cultivating interpersonal ties at the expense of personal wealth in material things." (Guyer and Belinga 1995:106, see also Guyer (1995)).

Somewhat ironically, Hall takes the position that this new approach to wealth and cattle renders zooarchaeology of little use for studying the politics of African cattle pastoralism in the past (1986:83). However, Reid (1996) in a subsequent article, argues that zooarchaeology can be of use in identifying and distinguishing between the use of cattle as authoritative and allocative resources. In this piece, Reid is concerned with arguing against traditional interpretations of the high levels of juvenile mortality seen in cattle remains from complex societies in southern Africa. Previously, this pattern had been argued to reflect wasteful and exploitative off-take of animals by centralized authorities (Reid 1996:48). However, Reid's re-analysis of the data, taking into account both contextual information as well as the conceptual model, suggests that the high level of mortality represents the targeted distribution and management of cattle, rather than waste.[15]

In Giddens' original schema, allocative resources were "forms of transformative capacity – generating command over objects, goods or material phenomena" and authoritative resources were "types of transformative capacity generating command over persons or actors"(Giddens 1984:33). In Giddens' larger argument, allocative and authoritative were two categories of domination, mapping onto the economic and the political respectively (1984:31, 33). However, Hall does not delve into the specifics of structuration theory, he merely notes that it "takes little more than a semantic twist to transform the Bantu Cattle Pattern and the Lineage Mode of Production into a demonstration of the centrality of cattle as both allocative and authoritative resources through the second millennium in southern Africa" (1986:84). However, in Hall's (1986) and Reid's (1996) analyses, the distinction between allocative and authoritative resources is transmuted from a broad analytical distinction between the control over things and the control over people into a schema for understanding the different roles that cattle had in

15. Reid's analysis is similar in some regards to the Near Eastern provisioning models, though they are not cited directly.

creating and maintaining systems of political authority in southern Africa. In the African 'cattle complex' model, the political is defined by social relationships between people and by rulers' control over subjects, both of which are mediated through animals' bodies.

This model of the use of cattle as a resource for the consolidation of political power is directly tied to the consideration of affordances. Rather than stressing the differences between domesticate species, this model emphasizes the different affordances of the bodies of male and female animals. Reid elaborates on Hall's initial observation of the difference between authoritative and allocative uses of cattle, and links them to differences in age and sex, noting that young male cattle are essentially allocative (due to their lower relative reproductive necessity) and that female cattle are essentially authoritative resources (due to their future reproductive potential) (1996:50). One essential difference between these modes, at least where herd animals are concerned, is the temporality inherent to the processes of consumption versus reproduction. But, importantly, both are means to creating and maintaining social relationships between people – authority is generated through the effective use of animals as both allocative and authoritative resources.

3.3.3 A new approach to studying pastoralism archaeologically

In the previous sections, I have shown how conceptualizations of the affordances of different herd animals (both living and dead) are at the heart of two major models of the relationship between political organization and pastoralist practices. Affordances, as an analytic, is flexible enough to address both the arrangement and distribution of material wealth and the generation of inequalities, as well as questions about the different sorts of social relationships (which go beyond the narrowly economic) engendered through the material medium of animal bodies. Moreover, by focusing on the role that animals play in pastoralist practices, this approach engages with the inferential logic of zooarchaeological middle range theory.

Grounding an analysis of pastoralist practices in the affordances of herd animals highlights the need to consider both the pre- and post-mortem social lives of herd animals. As is clear from the discussion of Near Eastern and African models, different affordances are critical in shaping the organization of herd mobility, culling, and the circulation and consumption of animal bodies. Similarly, the critical importance of age and sex in defining the different affordances of animals within the herd, and as factors shaping the reproduction of the herd as a biological and social unit comes out of both the Near Eastern and African models. These differential affordances impact the organization of labor and production considerably, and suggest further that seasonal and spatial mobility need to be separated analytically in order to more adequately assess differences in biographies within herds.

In order to anchor my approach to pastoralist human-animal relationships to the data from the zooarchaeological and isotopic analysis of faunal remains, this project focuses on the organization of pastoralist practices, which I have broken down into three aspects: 1) space, 2) seasonality, 3) distribution and consumption. Space encompasses both the distances traveled by herds and herders as well as the scale and manner is which pastoral mobility is organized. The category of seasonality takes the temporal aspect of pastoral mobility separately from its spatial organization. Lastly, distribution and consumption refers to the practices that move herd animals and their products (meat, milk, wool, blood, hides) into contexts of consumption and discard.

On the one hand, this approach retains the ability to use standard zooarchaeological and isotopic methods of data analysis, while rejecting the problematic assumptions inherent in previous models. Comparison of relative proportions of taxa, body part representation, mortality, sex, age, butchery patterns, etc. remain critical tools for the analysis of zooarchaeological data. Similarly, the quantitative methods of analysis for the stable oxygen and radiogenic strontium data are not wildly different. What is different is the scope of interpretation made possible by reconfiguring our understanding of animals' capacities and relationships to humans in general, and the affordances provided by domesticated herd animals in particular.

The approach I am outlining allows for a consideration of practices of production, circulation, and consumption, which is critical to understanding how value (in the material form of herd animals and their products) is produced and circulated. It also focuses attention on the different affordances that herd animals provide for practices of production, circulation, and consumption. As part of this, this method of studying pastoralism encourages that we focus our attention on the necessary arrangements of materials, landscapes, and human labor which underlie such practices. Moreover, this detailed focus on the organization of pastoralist practices also heightens the capacity to compare and contrast the quotidian and extra-ordinary human-animal relationships, highlighting the role that herd animals plays in marked and unmarked aspects of political authority. By breaking down pastoralism into the organization of its component practices, we are better able to understand how 'complex' institutions are built from the organization of pastoral practices and their intersection with other sets of economic, political, and religious practices.

3.3.3.1 Osteobiographies: Integrating isotopic and zooarchaeological data

Building from animals' blurring of Cartesian binaries, I use the concept of *osteobiography* as a methodological intervention that supports the analytical approach outlined above. In archaeology, both things and people have been the subject of biographical analysis (for example, Gosden and Marshall 1999; Joy 2009; Kopytoff 1986; Robb 2002; Boutin 2012). Both biographical approaches stress the relationship between the individual object or person and larger populations or groups of objects. Moreover, both attempt to mediate between the the pre- and post-mortem biographies of individuals or things, though the implications of the “post-mortem” are analytically disparate between things and people. Animal osteobiographies share with object biographies the ability to analyze animals’ participation in practices of production, circulation, and consumption and their ability to move between different cultural categories and modes of value (such as between commodity and heirloom) (Kopytoff 1986). However, animal osteobiographies, like human ones, rely on the particular embodied biographical information recorded in osteological remains. Animals biographies also are parts of genealogies based in the entwining of biological and social reproduction (Orton 2010a:194).

Beyond this, an osteobiographical approach has a special methodological importance for this study. In its emphasis on scaling analysis between the individual and the population, osteobiography allows for the integration of the different types of data produced through the isotopic analysis and traditional zooarchaeological analysis of faunal remains. Traditional zooarchaeological analyses are done on data sets that aggregate many individuals. In most cases, these datasets provide information on a relatively macro scale and rely on large sample sizes to develop interpretations based on large-scale patterning. In contrast, stable isotope analysis is necessarily applied to specific individuals and (due to the expense and time involved) the sample sizes are generally much lower.

The inferences drawn from traditional zooarchaeological analysis remain at the level of the population, since it is applied to datasets that are aggregates of many individuals. In most cases, the patterns are a palimpsest of different processes and activities across varying amounts of time. Stable isotope analysis of teeth and bones, in contrast, provides information about specific biological individuals, allowing the construction of relatively detailed individual life histories (Balasse 2002; Balasse et al. 2003; Zazzo et al. 2005, 2006). Importantly for studies of pastoralism, such analyses provide information about the movement of particular animals as well as herding practices more generally.

The very different nature of these two forms of analysis and the types of data they produce means that considerable care is required to integrate the information from each approach into archaeological analysis. Osteobiography, adapting from its use in bioarchaeology (Saul 1972; Robb 2002) allows for this integration. As a method of analysis, it starts at the level of the biological individual and expands outwards to greater and greater scales and increased levels of aggregation. This scaling facilitates the interpretation of data that represents simultaneously a unique individual (the individual life history) and a member of certain populations (both biologically and socially).

While this technique has been expanded in bioarchaeology to include the production of robust fictional narratives of individual biographies (for example, Boutin 2012), my use of the term here hews more closely to Saul's (1972) original formulation. By keeping both the individual and the population in view, this approach maximizes the integration of data across scales. In the case of faunal analysis, it also facilitates the process of contextualizing and interpreting individuals' isotopic results in light of the analysis of various faunal assemblages defined by context and other variables (see Chapter 4).

CHAPTER 4

CONTEXTS OF DEPOSITION: MATERIALIZING ANIMALS FROM THE LATE BRONZE AGE IN THE TSAGHKAHOVIT PLAIN

This chapter presents the various contexts where faunal remains have been recovered during the Project ArAGATS excavations in the Tsaghkahovit Plain over the past decade. After a short discussion of the role of depositional contexts in mediating our understanding of the pre- and post-mortem social lives of animals, I introduce the types of contexts of deposition for faunal remains in the Tsaghkahovit Plain. From there, I develop a more detailed and extended analysis of three of them: middens, burial contexts, and the 'shrine' deposits at the site of Gegharot. As part of this, I summarize the results of the excavations that I conducted with Ruben Badalyan during 2013 and 2014 at a large *kurgan* (burial mound) near Gegharot (see Appendix C for a complete description of the excavation results), as well as briefly characterize the faunal assemblages recovered from the ongoing Project ArAGATS excavations at the sites of Gegharot and Tsaghkahovit and adjacent burial clusters (Smith et al. 2004; Badalyan et al. 2008; Marshall 2014; Badalyan et al. forthcoming). The discussion of depositional contexts in this chapter also serves to contextualize the samples selected for isotopic analysis (see Appendix B).

Paying close attention to the contexts of deposition is important for understanding both the way that practices of excavation shape the resulting assemblage of faunal remains, as well as for understanding the relationship between Late Bronze Age practices of deposition and other aspects of Late Bronze Age social life that are of interest to archaeologists. As discussed in a previous chapter, this project aims to analyze how the material affordances of animals and their bodies shape their participation in pastoralist practices. This includes both the care for and interaction with living animals (their pre-mortem social lives) as well as the disposition of their material remains after their slaughter (post-mortem social lives).

Zooarchaeological analysis aims to unravel how those pre- and post-mortem aspects of an animal's social life can be understood, but the composition of archaeological assemblages for faunal remains is necessarily shaped by the practices of deposition that are one of the last stages in the post-mortem social life of animals' physical remains.[1] In order to be able to analyze and describe prior moments in the production, circulation, and consumption of herd animals, we must pay close attention to how the faunal assemblage is formed, both through practices of deposition in the past and practices of excavation in the present.

The focus on the archaeological contexts where faunal remains were deposited and then recovered helps to bridge between the process of aggregating and generalizing that drives zooarchaeological analysis and the particularity of the isotopic individual. For zooarchaeology, the patterning seen between and within contexts of deposition and their variable histories provides important information about past social dynamics (both pre- and post-mortem). Moreover, the archaeological context can provide a way of identifying traces of movements and activities between death and final deposition which are of archaeological interest and gives clues to the present absences contained within faunal datasets.

For isotopic analysis, the archaeological context matters because the individuals sampled had a social context that shapes how archaeologists might interpret their individual biographies in the narratives they produce about the past. The patterns seen in isotopic analysis depend on the small group of individuals that are sampled – this group is shaped by both post-depositional taphonomy (what individuals' remains survived intact enough to sample) and archaeologists' sampling decisions. In any event, every individual is not the

1. In addition to site formation processes across a variety of time scales.

same nor is equally representative and the archaeological context is critical to determining what ways in which the individuals tested isotopically are, and are not, representative of the social dynamics under study. Simultaneously, the results of isotopic analysis need to be contextualized within the biography of the individual – both as living herd animal and its post-mortem social life.

Thus, this chapter starts from the middle of the story: at the end of the Late Bronze Age 'social lives' of animals and their physical remains and at the beginning of the contemporary, archaeological social life of faunal remains as artifacts. This conceptual and physical space, of the mirrored practices of deposition and excavation, is also a point of interface for methodological and interpretive concerns about the formation of zooarchaeological assemblages. It is where archaeologists' ideas about living animals and (literally) disembodied bones meet. In the sections that follow, I present an analysis of the archaeological contexts in which Late Bronze Age faunal remains were recovered. This analysis approaches contexts of deposition from two directions: 1) What Late Bronze Age social practices deposited what kinds of faunal remains and where? and 2) What factors have shaped these deposits through time (both in terms of post-depositional taphonomy and archaeological recovery)?

4.1 Trashing the Place: Contexts of deposition across the Tsaghkahovit Plain

Faunal remains, as objects of archaeological interest, come into being through practices of discard. In these practices, the bones (and remaining flesh and sinews) of animals that have been killed (or died) and then reduced into component parts – as part of the practices and processes of food preparation and consumption or the production of objects using animal bones, sinews, furs, and hides – end up being deposited through (intentional and unintentional) actions in a variety of places. It is here that the analytical anxiety over ‘loss’ of information is anchored in the archaeological imagination (Lucas 2012). As I discuss in greater detail in my general analysis of faunal remains (Appendix A), the bones from Late Bronze Age domesticated animals at sites in the Tsaghkahovit Plain were deposited (by human action and other processes) in a variety of contexts that I have grouped into the following categories: middens, pits, intra-mural trash, cultural fill of architectural spaces, destruction debris, wash, along with smaller numbers of faunal remains deposited in vessels, special architectural features, and burials.

This system of categorization of archaeological loci attempts to account for different temporal and spatial patterning in activities of discard, as well as site formation processes, involving faunal remains. Studies utilize different systems of classification to characterize and typologize practices of deposition differently, depending on the aims and orientations of their analysis. For example, Reitz & Wing (2008:120-121) develop a schema that combines the spatial locations and aim of processing/depositional activity, separating deposition into residential refuse, kill-sites, and intentional deposits. In contrast, this system uses categories that are based on both the time-frame of deposition and the relationships between deposited materials and the built environment within the fortress sites.[2] As such, the categories in use track the differences in site formation processes that categorize the common distinction between primary (in-situ), secondary (redeposited but temporally distinct), and tertiary (redeposited and temporally mixed) deposits used by many zooarchaeologists working in the Near East (Meadow 1978; Zeder 1991; Russell and Martin 2005). In addition, the schema used for the Project ArAGATS materials includes a

2. The categorization schema is grounded in everyday, general archaeological intuitions about depositional contexts, in order to accommodate the post-hoc assignment of loci to these categories (at times, years after excavation). See Appendix A for further information.

category (destruction debris) that reflects the episodes of destruction and reconstruction in the Late Bronze Age.

The first two categories – middens and pits – suggest delimited spaces in which relatively large numbers of faunal remains are deposited in a relatively constrained amount of time.[3] Intramural trash is a more intermediate category, suggesting a relatively delimited space and span of deposition. In contrast, cultural fill and wash are contexts where faunal remains accumulate in small quantities, sometimes over a long period of time. These contexts will likely provide the most general picture of waste disposal. Destruction debris is separated out, both due to the specific temporal aspects of those contexts (accumulated over a variable period of time but then abruptly sealed) and the unique taphonomic factors linked to the destruction events. Smaller numbers of faunal remains were deposited in vessels and other special architectural features. Table 4.1 shows the relative distribution of faunal remains between these categories.

The majority of Late Bronze Age faunal remains[4] included in this study come from two areas: the site of Gegharot (n = 44,676) and the Tsaghkahovit Residential Complex (n = 14, 452), a residential sector in the Late Bronze Age occupation at the site of Tsaghkahovit. The citadel at Tsaghkahovit produced a sightly smaller assemblage (n = 10, 389), and one that was heavily impacted by subsequent construction in later periods. A much smaller assemblage (n = 1,808) was recovered from the West Settlement (WST) at Tsaghkahovit, most comprising of Late Bronze Age pits found underneath Iron III floors. As such,

3. Due to the lack of radiocarbon dating for these contexts, it is difficult to know exactly how long a midden was in use. However, the relative condition of the bones (vis a vis processes of weathering, carnivore and rodent gnawing, and other sources of fragmentation) can suggest how frequently trash was added to a particular site.

4. The majority of the Project ArAGATS faunal remains were identified and catalogued by Dr. Belinda Monahan, the Project ArAGATS faunal analyst. The author identified and catalogue a portion of the remains from Late Bronze Age contexts from the Tsaghkahovit Residential Complex, Aragatsiberd, as well as all of the fauna from the Gegharot Kurgan 2 excavations.

	Gegharot		Tsagh. Resid. Complex		Tsagh. Citadel		WST		Total Late Bronze	
Cultural Fill	4,768	10.67%	2,884	19.96%	1,339	12.89%	12	0.66%	9,003	12.62%
Destruction Layer	4,450	9.96%	-	-	325	3.13%	216	11.95%	4,991	7.00%
Floor	1,224	2.74%	1,601	11.08%	4,943	47.58%	230	12.72%	7,998	11.21%
Midden	13,810	30.91%	4,658	32.23%	-	-	-	-	18,468	25.89%
Intramural Trash	2,166	4.85%	277	1.92%	-	-	-	-	2,443	3.43%
Wash	4,220	9.45%	4,207	29.11%	2,144	20.64%	-	-	10,571	14.82%
Pits	5,540	12.40%	766	5.30%	139	1.34%	1,018	56.31%	7,463	10.46%
Hearth	124	0.28%	58	0.40%	-	-	-	-	182	0.26%
Special Features	1,047	2.34%	-	-	10	0.10%	-	-	1,057	1.48%
Vessel	595	1.33%	-	-	-	-	-	-	595	0.83%
Indeterminate	6,732	15.07%	1	0.01%	1,489	14.33%	332	18.36%	8,554	11.99%
Total	44,676	-	10,389	-	14,452	-	1,808	-	71,325	-

Table 4.1: Number (NISP) and proportion of faunal remains by context of deposition.

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel	West Settlement
Cultural Fill	32.30%	29.58%	24.05%	50.00%
Destruction Layer	24.47%	-	39.08%	21.76%
Floor	33.50%	22.74%	33.36%	37.39%
Hearth	40.32%	32.76%	-	-
Intramural Trash	41.92%	13.00%	-	-
Midden	41.27%	31.92%	-	-
Pit	33.25%	26.50%	30.94%	23.08%
Special Feature	32.19%	-	20.00%	
Indeterminate	28.86%	0.00%	18.00%	23.80%
Vessel	17.65%	-	-	-
Wash	29.34%	21.32%	33.82%	
Total	**33.94%**	**26.70%**	**30.19%**	**25.06%**

Table 4.2: Percentage of remains identified to the level of genus or better.

most of the analysis I undertake here focuses on the assemblages from Gegharot and the Tsaghkahovit Residential Complex.

Most of the Late Bronze Age faunal remains from the Project ArAGATS excavations came from the site of Gegharot, from a wide range of depositional contexts. The majority of the faunal remains from Gegharot come from middens, followed by cultural fill, wash, pits, and destruction layer contexts. The Tsaghkahovit Residential Complex, an extra-mural settlement area located downslope from the citadel of the Late Bronze Age, had the next largest assemblage. Most of the faunal remains from this sector come either from wash or midden contexts, followed by floor and cultural fill contexts. There are no destruction layer contexts at the TRC. The assemblage from the Tsaghkahovit citadel is unusual, as it is dominated by floor contexts. At the West Settlement, an area downslope form the citadel at Tsaghkahovit and dominated by later Iron Age occupations, is primarily from Late Bronze Age pits found beneath Iron III floors.

Taphonomic analyses of the remains from these different contexts of deposition reveal different histories of practices and processes, beginning in the Late Bronze Age and continuing to the present. Two measures were used to assess the relative level of fragmentation and the physical deterioration (due to weathering, processing, or other processes) of bones. The first measure is the percentage of bones that can be identified to the taphonomic level of genus or higher (Table 4.2).[5] The other measure of the relative level of fragmentation of faunal remains is the proportion of remains that are identified as being <1/4 complete, 1/4-1/2 complete, 1/2-3/4 complete, 3/4-complete, or complete.

At the site of Gegharot, middens and intramural trash deposits have higher percentages of remains identified to the level of genus or better, in contrast to remains from destruction layer contexts and recovered from inside of vessels. Potentially, this is difference is related to the particular processes and practices that define these contexts (fire and structural collapse and butchery and cooking, respectively). Similarly, the destruction layer, vessel, and wash contexts have higher proportion of remains that were less than 1/4 complete. At the Tsaghkahovit Residential Complex, the pattern is different, with floor and wash contexts showing lower percentages of remains identified to the level of genus or better. Similarly, all the contexts from the TRC show a higher percentage of remains that are less than 1/4 complete. An initial hypothesis is that this patterning may reflect the history of less-intensive, intermittent occupation of these residential spaces in the Late Bronze Age (Lindsay et al. 2010; Lindsay and Greene 2013; Greene and Lindsay 2012). Generally, the Tsaghkahovit citadel assemblage resembles the assemblage from Gegharot, with the exception that wash contexts from the citadel at Tsaghkahovit have comparatively more complete remains. At the West Settlement, the pits show a lower percentage of remains identified to the level of genus or better than the assemblages from other site sectors.

5. More fragmented or deteriorated bones are harder to identify, though skeletal element, species, and the skill of the analyst also impact the relative identifiability of a particular specimen.

Assessment of the fragmentation of carpals and tarsals (see Appendix A) suggests, however, that most of the fragmentation seen in the faunal assemblages from the Tsaghkahovit Plain is a result of human activity, rather than post-depositional processes. Rates of gnawing are very low across the assemblage, with little evidence of extensive carnivore-mediated destruction of faunal remains, suggesting that remains were buried quickly or that dogs had limited access to areas where trash was deposited. Rates of burning were generally low across the assemblage (<10%), however, Gegharot consistently had higher levels of burning. While this is to be expected in the destruction layer contexts, it also extends to most other contexts of deposition at Gegharot. However, it must be noted that analyses of fragmentation and relative levels of identification are influenced by the particular practices of screening during excavation that shaped these assemblages – practices that appear to have had a relatively counterintuitive impact on sample recovery.

4.1.1 Screening and its impacts on Late Bronze Age faunal assemblages

Across the Project ArAGATS excavations, the decision to screen any particular loci is left up to the excavator, though as a general rule, only non-mixed cultural deposits are selected for screening. As a result, the assemblage of remains from screened deposits is not evenly distributed across site sectors (Table 4.3). At both Gegharot and the Tsaghkahovit Residential Complex, ~40% of faunal remains are from screened loci. In contrast, at the citadel at Tsaghkahovit, only ~10% of remains are from screened loci. Moreover, the distribution of remains from screened contexts does not match the overall distribution of faunal remains between deposition context types (Table 4.4). At Gegharot, nearly 2/3 of the screened materials comes from midden contexts, followed by pit and destruction layer contexts. In contrast, wash, fill, and floor contexts are comparatively under-screened. At the Tsaghkahovit Residential Complex, over 3/4 of the screened materials are from

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel
Cultural Fill	16.80%	18.86%	12.25%
Destruction Layer	35.42%	-	0.00%
Floor	16.09%	22.49%	0.00%
Hearth	0.00%	0.00%	-
Intramural Trash	0.00%	0.00%	-
Midden	82.62%	88.34%	-
Pit	46.06%	49.09%	0.00%
Special Feature	6.21%	-	0.00%
Indeterminate	2.11%	0.00%	63.06%
Vessel	1.85%	-	-
Wash	11.80%	0.00%	0.00%

Table 4.3: Percentage of remains from screened loci by context of deposition.

midden contexts, whereas fill, floor, and pit contexts are comparatively under-screened. At the Tsaghkahovit citadel, most (~85%) of the screened remains come from indeterminate contexts, even though floor contexts make up most of the assemblage.

This patterning, in part, helps to explain the counter-intuitive pattern where screening has differential effects between site sectors and contexts of deposition. As discussed in Appendix A, overall screening appears to have a negligible effects on the percentage of remains identified to the level of genus or better, especially at Gegharot and the TRC, which have the highest levels of screening. However, screening does appear to have an effect on the relative proportion of indeterminate remains (not assignable to any taphonomic specificity beyond "mammal") and body size classes (large, medium, and small mammal) (Table 4.5). However, this effect is not consistent across the site sectors or between types of depositional contexts (see Appendix A).

At Gegharot, counter-intuitively, screened contexts have a lower percentage of remains identified as 'indeterminate' than unscreened ones and screening has no effect on the relative proportion of body sizes in recovered remains. At the Tsaghkahovit

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel
Cultural Fill	4.64%	10.08%	14.87%
Destruction Layer	9.14%	-	0.00%
Floor	1.14%	6.67%	0.00%
Hearth	0.00%	0.00%	-
Intramural Trash	0.00%	0.00%	-
Midden	66.14%	76.27%	-
Pit	14.79%	6.97%	0.00%
Special Feature	0.38%	-	0.00%
Indeterminate	0.82%	0.00%	85.13%
Vessel	0.06%	-	-
Wash	2.89%	0.00%	0.00%

Table 4.4: Relative proportion of screened remains by deposition context.

Residential Complex, screening also decreases the proportion of indeterminate remains but also slightly increases the proportion of medium-sized mammals. For the citadel at Tsaghkahovit, screening significantly decreases the proportion of large mammal sized remains and increases the percentage of indeterminate remains. In contrast, at the Tsaghkahovit citadel, screened deposits have a higher proportion of indeterminate remains and a lower proportion of large mammal sized remains (as a result of the increase in indeterminate remains). These differences are likely a result of both different taphonomic histories as well as different practices of screening during excavation.

The effects of screening on body size at Gegharot and the TRC are mostly replicated across the different contexts of deposition, the only exceptions being that in destruction layer contexts at Gegharot, screening increases the proportion of medium-mammal sized remains (while still reducing the percentage of indeterminate remains). In the other context types, the impact of screening is more evenly shared across body size categories. At the Tsaghkahovit Residential Complex, the overall pattern is mostly driven by midden contexts (where screening increases the proportion of medium-sized mammals and

	Screened	Unscreened	Screened	Unscreened
Gegharot				
Large Mammal	5556	7639	32.20%	27.86%
Medium Mammal	8198	11572	47.52%	42.20%
Small Mammal	189	330	1.10%	1.20%
Indeterminate	3303	7736	19.15%	28.21%
Tsagh. Residential Complex				
Large Mammal	2152	2830	39.89%	31.25%
Medium Mammal	2072	2391	38.41%	26.40%
Small Mammal	96	83	1.78%	0.92%
Indeterminate	1065	3689	19.74%	40.73%
Tsagh. Citadel				
Large Mammal	152	3111	13.78%	33.50%
Medium Mammal	460	4638	41.70%	49.95%
Small Mammal	15	99	1.36%	1.07%
Indeterminate	476	1431	43.16%	15.41%

Table 4.5: Impact of screening on recovery of faunal remains (by body size).

decreases indeterminate). Cultural fill and floor contexts only partially show this effect (decreased indeterminate remains and increased medium mammal, respectively).

Another way of assessing sample recovery is the ratio of first to second phalanges. These elements occur in the body in equal number and have similar densities, but second phalanges are smaller than first phalanges, so differential recovery of these two elements should indicate whether smaller materials are being lost when remains are hand-collected. Similarly, any differences in the ratios between cattle and sheep/goats also indicates the loss of smaller materials, as sheep/goat phalanges are smaller than cattle phalanges. Overall, screening does not have an impact on the recovery of cattle second phalanges, and it has a very slight impact on the recovery of sheep/goat second phalanges at Gegharot but not at the Tsaghkahovit Residential Complex (see Appendix A). Thus, screening appears to have impacts beyond recovery of smaller or fragmented materials, and is intersecting with the depositional and taphonomic histories of deposits in complicated ways.

4.1.2 *Preliminary assessment of contexts of deposition in the Late Bronze Age Tsaghkahovit Plain*

Previous analyses of the faunal remains from the Tsaghkahovit Plain (Badalyan et al. 2008; Chazin 2011; Monahan 2012; Badalyan et al. forthcoming) have revealed patterning that was difficult to interpret at the level of the site or site sector. Analysis of these units of aggregation revealed patterns that suggest the circulation of animal bodies both within and between sites and site sectors, without illuminating the paths or dynamics of this circulation. Ideally, the finer scale of these categories and their attention to both Late Bronze Age social practices of deposition and use of architectural space will allow for the identification of patterns of circulation which can be linked to practices of circulation and consumption. In addition, the use of these category will help to identify any differential post-depositional histories that have shaped the datasets. Thus, an overarching question for this analysis is whether the distinction between contexts of deposition provides the necessary analytical widow to identify and trace the practices that shaped the organization of labor and the circulation of value in the Late Bronze Age Tsaghkahovit Plain.

Preliminarily, the answer to this question is a partial yes. Much of the patterning seen in the faunal remains is broadly shared across contexts of deposition (both within sites and between sites and burials). The extremely narrow emphasis on sheep, goats, and cattle is universal, and the relative balance between these taxa seems to vary only at the level of the site. There are also broad patterns in body part representation that are widely shared, as I discuss in Chapter 5. However, within this broad similarity, there is evidence of practices that distinguish different contexts of deposition from each other. For example, analysis revealed that for the Tsaghkahovit Plain, midden and intramural trash contexts (as well as to a lesser extent, wash contexts) showed similar patterning in element representation for both cattle and sheep/goat, even as the balance of taxa between these two species varies between site sector. This suggests that the different social lives of the major taxa (see Chapters 5 & 6) were not distinguished by practices linked to deposition in different context types, but rather by differential spatial patterning across and between sites.

4.1.3 Sample selection for isotopic analysis

While the analysis of the distribution and consumption of animals and their products examines faunal remains recovered from across a myriad of contexts at Late Bronze Age sites and burials, the isotopic analysis of herd animal teeth is focused on two types of depositional context: 1) burials and 'shrine' installations 2) and spatially distinct garbage accumulations (middens and intramural trash deposits). These contexts were chosen for two reasons. First, both sets of contexts seemed to have relatively simple post-depositional taphonomic histories, hopefully making it easier to understand the processes and practices they participated in prior to deposition. Second, they seem to represent different ends of a spectrum of depositional practices in the Late Bronze Age – the first being curated and intentionally semiotic, and the second being accumulated by less marked social practices (see Chazin 2016). The selection of these two groups of contexts is not meant to reify an *a priori* separation of 'ritual' or 'religious' from 'non-ritual' or 'secular' activities (Fowles 2012), but rather to explore the full range of activities that resulted in the collection of animal remains in LBA spaces.

The samples selected for isotopic analysis excludes the faunal remains that were deposited in other ways and in other places. The sampling strategy employed produces two absences. First, none of the samples selected for isotopic analysis come from refuse that collected in abandoned built spaces at the sites of Tsaghkahovit and Gegharot (which comprises ~15% of Late Bronze Age faunal remains collected during excavations) or from deposits clearly linked to destruction events (which comprise ~10% of the LB faunal remains from Gegharot) (see Table 4.1). These contexts were excluded from the analysis, due to the complexity of the practices of deposition that led to their creation, linked in part to the history of violent destruction at the site of Gegharot (Badalyan et al. 2008:69). These deposits were poorly understood at the time that I selected samples for analysis, and in general, it is harder to identify remains from particular individuals in such deposits (see Appendix A for a detailed taphonomic analysis of these deposits). Deposits from other types of contexts of deposition contained too few mandibles to provide the necessary sample sizes.

Second, this analysis cannot address faunal remains produced through butchery and consumption activities that took place off-site or rubbish from butchery and consumption activities that took place on-site, but where the rubbish was deposited outside of areas of archaeological investigation. Given the spatially dispersed picture of Late Bronze Age social life that is emerging from current research, it is quite likely that this means that site-based faunal assemblages do not provide information on a range of pastoralist practices that engaged with animal bodies outside of the walls of sites.

4.2 Middens

From the perspective of the analysis of Late Bronze Age faunal remains, the large middens excavated at Gegharot and the Tsaghkahovit Residential Complex (TRC) are an incredibly rich source of information about human-animal relationships and pastoralist practices. Marked by very high concentrations of animal remains, which likely accumulated over a relative short period of time, they provide a relatively bounded window on Late Bronze Age animal bodies, and their participation in pastoralist practices of production, distribution, and consumption (see Chapter 6). As such, they represent an ideal location for an in-depth study (using isotopic analysis) of individual animals' life trajectories. Two middens from

Gegharot and one from the TRC were selected to be used in the isotopic analysis component of this research.

The first of these middens (T2 Locus 23) is a dense concentration of animal bones (over 1,200) deposited between two walls on the western citadel at Gegharot, near the western terrace shrine. This midden occupies the space between the terrace walls and rooms built inside of it (Smith et al. 2004:22). The second midden (T19) is a deep deposit of well-preserved Late Bronze Age faunal remains (around 11,000 specimens) located on the western terrace, to the north of the terrace shrine. It is located inside the large terrace wall, but away from the living areas located to the south, on the other side of a curvilinear wall. This midden is located beneath the Late Bronze Age destruction layer, and consists of a number of layers of deposition with an impressive amount of animal bones, along with ceramic sherds and lithic debitage. The midden deposits are above a packed clay floor (dating to the LBA on the basis of the recovered ceramics). It appears that part of the area occupied by the midden may have been used as an activity area prior to the final LBA destruction event.

The third midden was a large deposit of animal bones (around 4,500), located in a clayey layer above a packed clay floor in trenches SLT 10 and SLT 14 in the Tsaghkahovit Residential Complex. The floor layers beneath this midden deposit were dated across both trenches to the Late Bronze Age II period (1425-1350 BCE). Given the paucity of grinding stones found in these operations, Ian Lindsay suggests that this space may have been used for storage prior to being utilized as a dumping site for garbage, forming the midden in later part of the Late Bronze Age occupation of the Tsaghkahovit Residential Complex (Ian Lindsay, pers. comm.).

4.2.1 Sampling for isotopic analysis

Since the number of mandibles suitable for isotopic analysis from these three middens was greater than could be analyzed, a sub-set was sampled on the basis of species and age-class. While sheep are the most numerous taxa in almost every Late Bronze Age context excavated at Gegharot and Tsaghkahovit (Monahan 2012; Chazin 2011), cattle and goats were also important. All three species were included in the analysis, but more sheep were sampled than cattle or goats. In addition to species, individuals were selected from three broadly defined age-classes: Age Class I (0-2 years), Age Class (2-4 years), and Age Class (4+ years) (cf. Russell and Martin 2005).[6] This was done to ensure that I could assess whether any trends in the data co-varied with age – which would not be unlikely given that herds are often divided into age groups for herding purposes, and their circulatory patterns might be quite different (Payne 1973; Dahl and Hjort 1976; Cribb 1987; Redding 1984; Greenfield 2010). For the main sample, second molars (M2s) were selected for analysis (in order to maximize comparability with previous isotope studies in the region [Meiggs 2009; Henton 2010]). But, in order to understand the life trajectories of the youngest animals, which are an extremely important age-class in terms of understanding meat and dairy production, first molars (M1s) were sampled if the mandible had a wear stage (Payne 1973, 1987; Grant 1975) placing it under 1 year of age.[7] These youngest animals are excluded from the oxygen analysis in order to avoid the impacts of weaning (Balasse et al. 2001; also Evans et al. 2007).

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6. In this instance, the same age classes were used for all three species, in contrast to the dental and post-cranial ageing system used in the zooarchaeological analysis (see Appendix A), which reflect the different lifespans of cattle and caprines. Thus for sheep and goats, Age Class I = infant+juvenile (0-2 years), Age Class II = sub-adult (2-4 years), and Age Class III = adult (4+ years). In contrast, for cattle, Age Class I = infant+ younger juvenile (0-2 years), Age Class II = older juvenile + sub-adult (2-4 years), and Age Class III = adult (4+ years).

7. First molars begin forming *in utero* and continue enamel formation for the first 6-9 of an animal's life (Meiggs 2009:113).

First, I identified the mandibles from these contexts that had complete M1s or M2s and could be securely placed in one of the three age classes. For M2s, teeth were further selected to have a crown height greater than 20 mm for sheep and 25 mm for cattle, as the pilot study I conducted suggested that teeth with less than half of the original length of the tooth worn away were necessary to ensure a sufficient number of samples (~10 samples/individual) to interpret the shape of the annual curve and identify birth seasonality. The initial list of mandibles with complete M1s or M2s from the three middens (T2, T19, and SLT10/14) gave a set of M2s that differed from the overall demographic patterns seen across the LBA assemblage (Badalyan et al. forthcoming; Monahan 2012; Chazin 2011). In particular, there were fewer cattle teeth than would be expected given their representation in the total faunal assemblage, and within that group there were more young animals than would have been expected (and no sub-adult (3-4 years) cattle), given the kill off patterns seen in the zooarchaeological analyses. Due to this, the sampling for oxygen analysis is focused on sheep, with more limited sampling from cattle and goats to provide context.

Samples from sheep were stratified first by archaeological context (T2, T19, and SLT10/14), and then by age class, weighted on the basis on demographic data from faunal analysis (hence twice as many individuals were sampled from age class II as from Age Classes I and III for sheep and goats, but were sampled evenly across age classes for cattle – see Table 4.6). The exception to this is GeT2 (which had an unusually large number of very young animals) where four individuals were sampled from Age Class I, and one each from Age Classes II and III. Similarly, only one individual from Age Class III was sampled for SLT10/14, because no other suitable mandible was recovered from that context. Samples for cattle and goats were stratified only by age class, given the small number of possible individuals. Lastly, a group of very young individuals (n = 10: 6 sheep, 2 goats, and 2 cattle) were selected for bulk radiogenic strontium analysis on the M1.

	Ovis aries			*Bos taurus*	*Capra hircus*
	GeT2	T19	SLT10/14		
Age Class I	4	2	2	2	1
Age Class II	1	4	4	2	2
Age Class III	1	2	1	2	1
Total	*6*	*8*	*7*	*6*	*4*

Table 4.6: Number of individual animals sampled for incremental radiogenic strontium and stable oxygen isotope analysis from middens.

4.3 Burial Contexts

Burials are probably the least well-understood locus of archaeological investigation in the Tsaghkahovit Plain, despite the long history of mortuary excavations in Armenia and Soviet Union more generally (Lindsay and Smith 2006; Smith et al. 2009:9-20; Marshall 2014). Burials in the Tsaghkahovit Plain can be loosely grouped into two types: kurgan and cromlech burials. The term '*kurgan'* refers to a large tumulus constructed of rocks or earth, often containing a stone cromlech underneath (Smith et al. 2009:106). *Cromlech* refers to a large circle of stones surrounding a subterranean burial chamber, though they come in a wide variety of forms (Smith et al. 2009:106). In reality, there is considerable overlap between the two categories, as taphonomic processes may remove the earthen mound covering a kurgan, leaving a cromlech behind. In 2006, the excavation of a large kurgan to the southeast of Gegharot gave the first evidence of the inclusion of animal bodies in mortuary practices in the Late Bronze Age Tsaghkahovit Plain. My excavation of a second kurgan adjacent to the first one was intended to explore to what extent the practices evidenced in Kurgan 1 were singular or part of a repeated set of mortuary practices for Late Bronze Age inhabitants of the Tsaghkahovit Plain. In addition, excavation by the Project ArAGATS bioarchaeologist Maureen Marshall (2014) at the Tsaghkahovit Burial Cluster 12 have added much needed depth to our understanding of Late Bronze Age mortuary practices in the Tsaghkahovit Plain, including the role that animals and their bodies played in such practices.

Marshall, in her analysis of the burials at Tsaghkahovit Burial Cluster 12, developed a schema for understanding the different ways that faunal remains get (purposively) incorporated into burials in the Tsaghkahovit Plain, either as: 1) whole, articulated individuals, 2) articulated remains representing butchery units, and 3) faunal remains from the inside of vessels deposited in the tombs (2014:208). Sheep and goat remains predominate in the mortuary assemblage from BC12, followed by cattle and a small amount of equid remains (Marshall 2014:207). This mirrors the assemblage from the Gegharot kurgan. It should be noted however that other Late Bronze Age tombs have contained different fauna: cattle at Gazanots, and sheep/goats, pigs, fox, and a Caucasian deer at Khojbagher, and horse, cattle, deer, fox, hare, and bird at Keti I (Badaljan and Avetisyan 2007:65, 95, 166, 176). Unfortunately, since faunal remains were often not included in discussions of excavated burials nor were they saved, it is difficult to know how prevalent any of these patterns were or how they might have varied spatially or temporally in the South Caucasus.

4.3.1 Tsaghkahovit Burial Cluster 12

Maureen Marshall excavated 11 cromlech burials in Burial Cluster 12 (TsBC 12), near the fortress of Tsaghkahovit (2014). Interestingly, the sheep and goats were mostly juvenile animals, whereas cattle and equids tended to be adult individuals, which also mirrors patterning seen in faunal data from the fortresses (Marshall 2014:207). As noted previously, the fauna recovered from the Burial Cluster 12 excavations could be separated into three categories: whole individuals, ‘meat units’, and faunal remains deposited in vessels. While interments of whole animals were only found in burials dated stylistically to the LB I period (including Kurgans 1 & 2), butchery units were recovered in burials dating to both the LB I and LB II periods. In fact, as Marshall notes, this practice was described in burials excavated in Armenia in the 19th century by Frederic Bayern (2014:257). For Burial Cluster 12, these butchery units were usually from sheep or goats, with some cattle also represented. The faunal remains found in vessels were from cattle, sheep, and goats, and they were recovered from a wide variety of vessel types (Marshall 2014:211). It is not entirely clear whether these remains were included in the vessel as prepared food or as 'raw' components. While it is too early to say whether the dead preferred their food '*tartare*', there is at least one example of prepared food that was included in a burial. Two vessels from Marshall's excavations at TsBC12 contained both grain and faunal remains, one of which contained a grain of emmer that showed clear traces of boiling (Marshall 2014:212). While faunal remains were included in most of burials excavated by Marshall, the faunal assemblage was dominated by post-cranial elements. However both Burial 2 and Burial 9 included teeth which could be sampled for isotopic analysis.

Burial 2 was a standard cromlech, approximately 7 m in diameter, containing an earthen pit covered by a basalt capstone. The individual interred, a 35-49 year old male, was laid on top of three juvenile caprines[8] and surrounded by 7 whole vessels (which date stylistically to the LB I period). According to the detailed osteobiography provided by Marshall (2014:239), the individual buried in this cromlech had been born locally and had eaten a mixed carnivore/herbivore diet (leaning more towards the herbivore end of the spectrum). This interment was unique at TsBC12 for its inclusion of whole animals (Marshall 2014:257), though the elements composing the pattern are found widely in both cromlech and kurgan burials across the Tsaghkahovit Plain. First molars were taken from the two younger sheep for radiogenic strontium analysis, and a second molar was taken

8. While the Marshall (2014) states that all three individual animals are sheep, re-analysis of the faunal remains as part of the isotopic study indicates that the older male was actually a goat.

from the slightly older goat for stable oxygen and radiogenic strontium isotope analysis. A first molar from this individual was used for a pilot study of radiogenic strontium analysis of faunal remains from the Tsaghkahovit Plain (Chazin, forthcoming).

Burial 9 was a paved cromlech (approximately 5 m in diameter), with two tightly interlocking capstones, containing a cist chamber constructed of basalt slabs. One individual was interred, along with 5 vessels (stylistically dated to the LBII period) in the southern corner of the chamber, two of which contained faunal remains. The skeleton was covered with clay (probably intentionally), and lying on top of this clay surface were scatted faunal remains: a left hindlimb of a cow, an equid lower limb, the forelimb of a sheep/goat, and the right half of a cattle skull. The skull came from an individual aged 15-30 months, and radiogenic strontium and stable oxygen isotope analysis was performed on the 2nd molar from this individual.

4.3.2 Gegharot Kurgans

Kurgans 1 and 2 are located in a burial cluster (Gegharot Kurgans Quadrant, Burial Cluster 1, see Smith et al. 2009:123) on the flat expanse of the Tsaghkahovit Plain between Gegharot and Vardablur, currently located among agricultural fields and pasture for grazing cattle, sheep, and goats. Kurgan 1 measured 11.5 m in diameter and the kurgan mound was 1.44 m high (Badalyan et al. 2008:59). It was excavated during the 2006 Project ArAGATS season by Maureen Marshall and Armine Harutyunyan, and the results of this excavation were published in 2008 (Badalyan et al. 2008:59-61). The kurgan consisted of a large stone circle (cromlech), containing 3 different chambers, covered by a mound of earth and rocks (tumulus). The materials in the interment date to the very beginning of the Late Bronze Age (Badalyan et al. 2008:59). The use of stones from the slopes of Mount Aragats (located across the plain, a considerable distance away) to build the burial chamber (Badalyan et al. 2008:59) indicates that the construction materials for this kurgan circulated across the plain.

The central chamber of the kurgan held the skeleton of a 35-45 year old male, fragmentary remains of a child, and various grave goods, including 'head and hoof' burials of horses, common in Bronze Age Eurasia (Piggott 1962; Anthony 1995). The northern chamber contained fragments of human remains and a single ceramic bowl. In the western chamber, a large group of ceramic vessels and four complete animal skeletons (four caprines[9]) were found. The ceramics from the western chamber are closest to the Sevan-Uzerlik 2 group, which are best known from contexts dated to the final phase of the Middle Bronze Age (Adam T. Smith, pers. comm.).[10] However, the interment in the central chamber dates to later in the Late Bronze Age and both chambers were constructed in a single episode. This suggests that the ceramics included in the western chamber were either curated heirlooms or that there was conservation of older stylistic traditions in ceramics used in burial rituals.

4.3.3 Kurgan 2

Gegharot Kurgan 2 is a large kurgan (diameter = 11 m) located just to the south of Gegharot Kurgan 1, on the lower slopes of Mt. Vardablur. This kurgan was excavated as part of the dissertation project in order to provide another example of a Late Bronze Age kurgan near Gegharot that could be compared to the first one excavated in 2005 (see Appendix C for

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9. Re-analysis of the mandibles from the western chamber by the author suggests that the interred animals consisted of two sheep and two goats, based on morphological criteria (Payne 1985; Halstead et al. 2002). Unfortunately, the contextual information linking cranial and post-cranial elements was not preserved, so it was not possible to confirm this using other diagnostic elements. However, in the original analysis, Monahan identified a right and left mandible as *Capra*, and size comparison of those elements clearly indicates that they are from different individuals, supporting the conclusion that there were two sheep and two goats.

10. A stylistically similar vessel was recovered from the western terrace at Gegharot (Badalyan et al. 2008:59).

a complete discussion of the excavation and its results). Kurgan 2 consisted of a single cromlech (circle of stones), topped by an earthen mound (0.9-1.0 m in height) (Figure 4.1). The cromlech was constructed of large pieces of basalt and granite, with slightly larger stones used to construct the northern half of the cromlech. No tuff stones were included in the cromlech, unlike in Kurgan 1 where the northern point of the circle was marked by a solitary red tuff stone. Outside of the circle of large boulders was an outer ring composed of smaller rocks that extended out roughly 0.5 m from the cromlech. Interestingly, pieces of white limestone were interspersed among the darker basalt and granite, creating a very striking visual effect.

The mound above the cromlech was covered with a layer of small stones (with the exception of a small area on the western edge of the circle, where the stones were absent at the surface). As with the outer ring, the distinctive white limestone cobbles were also placed on top of the mound. According to Arkady Karakhanian (pers. comm.), the slopes near Aragatsi Berd are the most likely source for such stones. The kurgan mound itself was nearly devoid of material, with the exception of a complete innominate (hip bone) from a red deer (*Cervus elaphus*) that was found in the northeastern part of the southeast quadrant. Underneath the mound, there were two chambers. The first, central chamber is a large pit that was later reinforced with cobble faces on the western and southern sides. The smaller, western chamber is a shallower pit that abuts the cromlech circle in the northwestern quadrant. Between these two chambers, a young child was buried in the kurgan mound at some point after the original funerary monument was constructed.[11]

The western chamber was surrounded by a semi-circular stone "fence" that encompassed the south, east, and north sides of the chamber, with the western boundary

11. This interment was capped by a large rectangular worked/dressed stone that was sitting just below the surface of the kurgan mound. Underneath the large stone was another layer of three stones covering the burial.

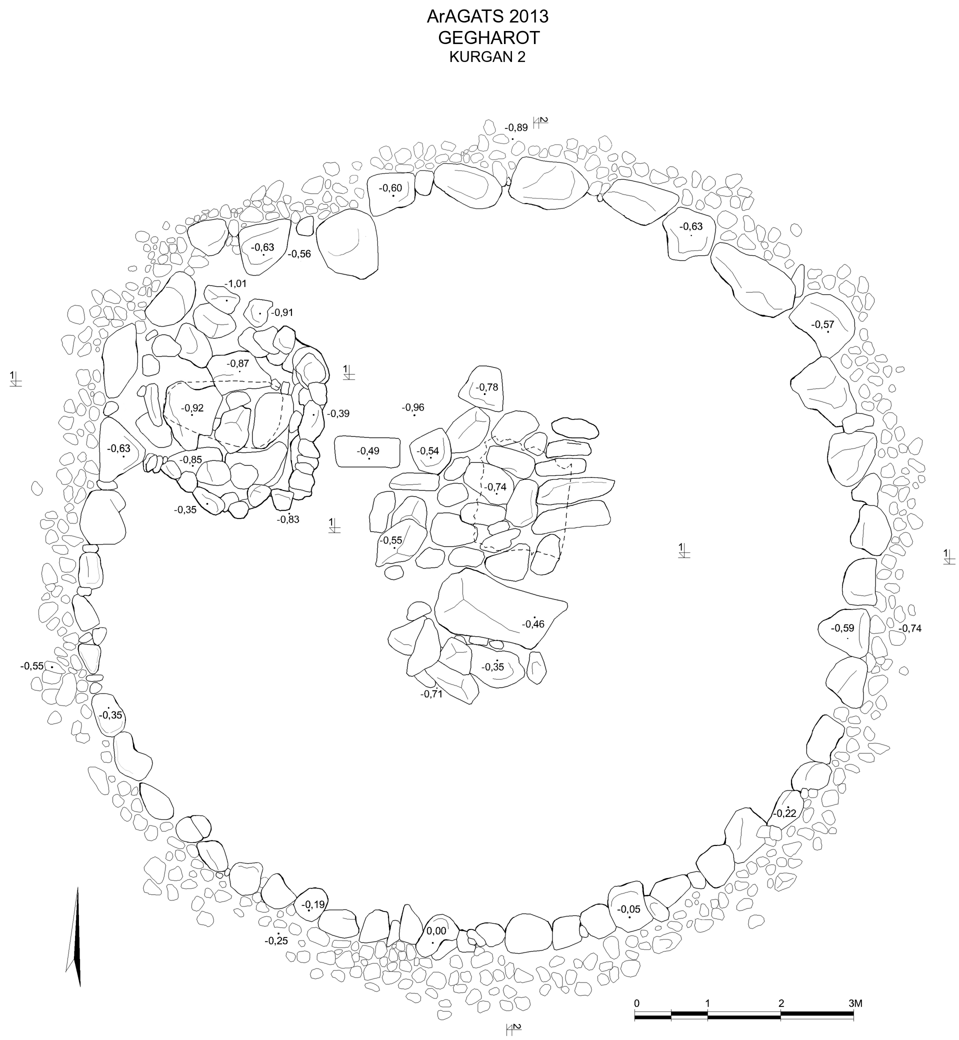

Figure 4.1. Drawing of the cromlech and chambers of Kurgan 2. Drawing by Lilit Ter-Minasyan, courtesy of Project ArAGATS.

of the chamber marked by the cromlech itself. The chamber was topped by a group of large capstones. Beneath the capstones were three layers of complete vessels, animal remains, and a variety of other artifacts – including a bronze sword[12] and a cache of obsidian projectile points. At the bottom of the chamber, along with two censers and a walnut-shaped vessel, were the bodies of two complete juvenile (8-12 months) sheep, arranged symmetrically in the western half of the chamber. While complete, the bodies of these animals had been partially disarticulated,[13], perhaps to make them more compact for burial. The majority of vessels recovered from the western chamber can be stylistically assigned to the "Sevan-Uzerlik 2" groups, which are assigned to the last phase of the Middle Bronze Age (see Smith et al. 2009:66-67, fig. 23). In contrast, the walnut-shaped vessel found in this chamber (see Appendix C) is assigned to the "Lchashen-Metsamor" ceramic horizon, which dates to the Late Bronze Age. This suggests that the assemblage dates from a transitional period between the Middle and Late Bronze Ages.[14]

Just to the northeast of the center of the kurgan, there was a pile of large, irregularly shaped stones, underneath which was the central chamber (Figure 4.2). A thick layer of clay surrounded the edge of the pit of the chamber. The chamber itself is a large, deep pit (1.4-1.55 m deep). The southern and western sides of the chamber were defined by walls of stone masonry (6-9 courses). In contrast, the other two edges of the chamber were marked only by the cut of the earthen pit. The sides and floor of the pit were lined with clay.

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12. This sword is a "Near Eastern-type" cast sword with a framed handle, and its closest comparanda is Group III (variant 1) of A. Piliposyan's (1999: 14-15, fig. 6) catalog of ancient daggers and swords (Adam T. Smith, pers. comm.).

13. The heads had been detached from the spinal column and placed on top of the proximal axial skeleton, and the right hind limb of the northern individual had been severed at the knee and the lower part of leg was placed beneath the innominate and the left leg.

14. A radiocarbon date from a wood sample from the hilt of the sword provided a date of 3320 ± 110 BP (1897 – 1391 cal BC at 94.9% confidence), which does not contradict the dating based on material styles.

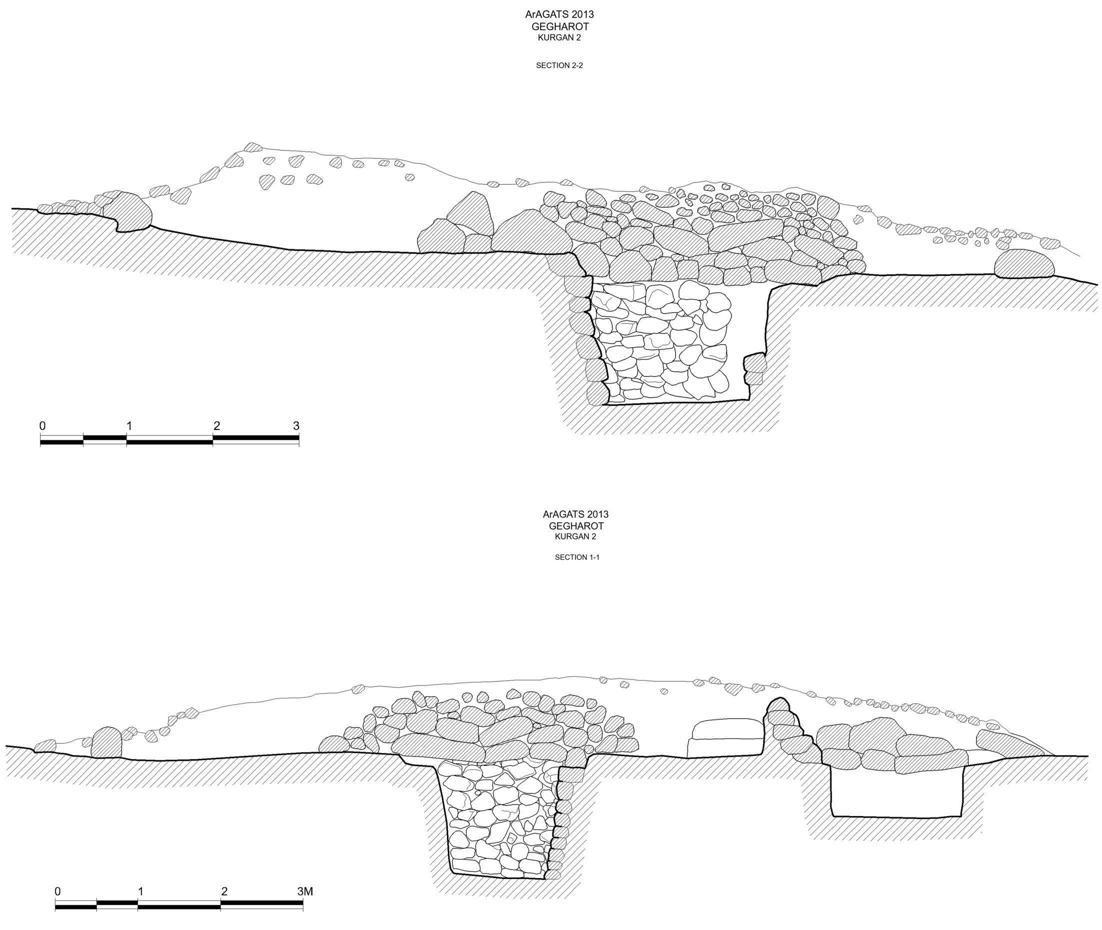

Figure 4.2. Section drawings of Gegharot Kurgan 2. a) N-S section. b) E-W section. Drawing by Lilit Ter-Minasyan, courtesy of Project ArAGATS.

In the pit, a young male (20-23 years old), was placed in the middle of the central chamber, oriented E-W. This individual was buried with a carnelian, bronze, and gold bead necklace and a bronze belt and dagger. In the northern half of the chamber, a whole sheep (2.5-3.5 years old), with its head and forelimbs removed, was placed in on its back, with its legs folded back and lying on top of the rib cage. Beneath this upper interment, in the southern half of the chamber, was the skeleton of a female over 50 years of age, oriented N-S, along with assorted vessels (dating stylistically to the early Iron Age), faunal remains, a bronze knife, bronze ring, and various other pieces of jewelry. In addition, large numbers of carnelian and paste beads were recovered from the soil surrounding the body, which suggests that the body may have been dressed in or covered by a beaded garment.

The materials recovered from the central chamber date stylistically to a different phase of the Lchashen-Metsamor ceramic horizon than those from the western chamber. The haphazard arrangements of the large capstones above the central chamber (in contrast to the regular arrangement of stones above the western chamber) suggests a later re-opening of the tomb. This is further strengthened by the radiocarbon dates from the two skeletons from the central chamber (1257-1034 B.C. and 1207-937 B.C., both at 95.4% confidence level). Their combined dates suggest that these materials date from 1207-1024 B.C. (with a very high likelihood of contemporaneity – 91.3%).

This suggests that there were three episodes of construction over the use life of Kurgan 2. In the first, the cromlech circle and western chamber were built sometime during the transition between Middle and Late Bronze Ages. It is also likely that the central chamber was also first dug (as a simple pit) at this point. Later, during the Iron 1a period (between the end of the 13th century and the mid-11th century), the central chamber's original construction was disturbed and the original interment removed. The cobble faces were added to the chamber and the two bodies with their mortuary assemblages were interred. At some later point, the infant was buried within the kurgan mound.

4.3.3.1 Late Bronze Age faunal remains in Gegharot Kurgan 2

The inclusion of faunal remains in the Late Bronze Age contexts from Gegharot Kurgan 2 broadly parallels the typological schema suggested by Marshall for the burials at Tsaghkahovit Burial Cluster 12. Fauna are included in the mortuary construction in three forms: as whole animals, as 'meat units', and in vessels. Further patterning can be seen within these groups. The two whole individuals were very young sheep, whereas the fauna comprising the bones in vessels and meat units included large mammals (most likely cattle), as well as both sheep and goats. In contrast to burials from other regions from this time period (Badaljan and Avetisyan 2007), only domesticated species were represented in the Late Bronze Age fauna included in Kurgan 2. This is consistent with the heavy emphasis on domesticate species in the more quotidian contexts at Tsaghkahovit and Gegharot.

None of the fauna from the western chamber of Kurgan 2 had any butchery marks or evidence of burning. An absence of evidence for gnawing or digestion means that these remains were likely deposited quickly after slaughter. The 'meat units' included in the western chamber are all from the axial skeleton or the forelimb, and the bones from the forelimb are only from the meatier upper half, bolstering the idea that these articulated sets of remains represent the inclusion of reasonably large amounts of meat 'on the bone'. There appears to be no preference for either side of the body, nor any strict patterning, as both sides of the body are represented. Similar to the 'meat units', the bones included in vessels came from cattle, sheep, and goats. In contrast, however, the remains from inside vessels were from the axial skeleton, fore- and hindlimb. However, all of the bones were from the upper, meatier portion of the fore- and hindlimb.

The parallels between the western chambers between Kurgan 1 and Kurgan 2 is highly intriguing, despite the different history of re-use seen in the central chamber of Kurgan 2.

The materials assembled in these chambers represent a repeated material practice where the bodies of young sheep and goats, as well as portion of meat and finely decorated and varied ceramic vessels, were deposited within the kurgan, adjacent to the internments of the people buried there, and in the case of Kurgan 1, in addition to the faunal remains included along with the human remains. Additionally, the placement of a skeletal element from a large wild animal (a red deer) in the mound of the kurgan itself raises interesting questions about the relationship of herd animals to other species in the Late Bronze Age world.

4.3.3.2 Isotopic Analysis

The inclusion of complete individual animals in the kurgans near Gegharot is an excellent opportunity for osteobiographic analysis, as a greater level of information can be obtained by analyzing the post-cranial skeleton along with the isotopic and age-related information provided from the mandibles. A previous pilot study analyzed the radiogenic strontium from one of the sheep and two of the goats interred in the western chamber of Gegharot Kurgan 1 (Chazin, forthcoming). In addition, radiogenic strontium isotope analysis was performed on the first molar from one of the horse skulls from the central chamber of Gegharot Kurgan 1 (Chazin, forthcoming). For this analysis, I selected teeth from the remaining sheep from the western chamber of Gegharot Kurgan 1 and both sheep from the western chamber of Gegharot Kurgan 2 for isotopic analysis. Given the young age of the animals included in these burials, only Sr analysis was done on a first molar (M1).

4.4 Shrine contexts at Gegharot

Excavations at the site of Gegharot have revealed a group of three, materially similar contexts whose use and role in Late Bronze Age social and political life is a source of lively interest and discussion. Broadly, these contexts consist of rooms whose inventories – consisting of particular ceramic forms (highly decorated pots and bowls, ceramic pots stands/idols, stamps, manghals), objects of personal adornment, and curated deposits of animal bones, as well as features such as basins and altars (Badalyan et al. forthcoming) – suggest an altogether non-quotidian function and are consistent with other assemblages from the region that have been labeled ‘shrines’ (Smith and Leon 2014). For Smith and Leon, the key features of these places are, first, their relatively small size (which would have precluded the presence of large numbers of people to either participate in or view any activities taking place inside those spaces) and second, the collection of object found in situ in these contexts, which they understand as constituting ‘esoteric’ and ‘consecrated’ space (2014:552). All three of these contexts date to the Late Bronze II period, after the initial destruction of the site sometime between the late 15th and early 13th century BCE (Badalyan et al. 2008:69).[15] The first shrine, located on the western terrace of the site, was excavated in 2003 (Badalyan et al. 2008). A second one was located in 2008 on the western citadel, and the third (and most elaborate) was excavated in 2010 on the eastern side of the citadel (Smith and Leon 2014; Badalyan et al. forthcoming).

These spaces are anchored by an installation of a basin, formed of packed clay, built on top of a clay platform. The basins were filled with ash and ceramic vessels. In all three cases, this feature was surrounded by a large corpus of whole vessels found in-situ, ranging in size from small cups and jars to large storage vessels. In the case of the eastern citadel example, some of the vessels found around the basin were identical in form and decoration to the ones found in the basin. While the precise activities and practices that occurred in these spaces remains obscure, it is clear that burning was a key part of the practices that unfolded around these spaces – as evidenced by the large deposits of ash

15. There is evidence that the western terrace shrine was a reconstruction of an earlier shrine that had been destroyed (Badalyan et al. 2008).

in the basins and nearby pits, as well as the presence of censers and ceramic installations where organic materials mights have been burned. Furthermore, botanical analysis of the contents of vessels recovered from the eastern citadel context suggested that those vessels took part in activities such as wheat storage and processing,[16] as well as wine consumption (Smith and Leon 2014:554).

There are strong links between the incorporation of animal remains in the kurgans and in the shrines. Animals were interred in the kurgans both as sacrifices and as feasting remains (Monahan 2012). The sacrificial deposits in the northern chamber consisted of complete skeletons of sheep and a goat, and the central chamber included 'head and hoof' deposits of horse bones (Monahan 2012:340; Badalyan et al. 2008:59). Similarly, the western chamber in the second kurgan contained two whole articulated individuals. Interestingly, the scant evidence from the Tsaghkahovit Plain suggests that this practice may have been limited to the early 15th millennium BC (the early part of the Late Bronze Age) (Marshall 2014:209-210). In contrast to the burials from TsBC12 at Tsaghkahovit, none of the numerous whole vessels recovered from the shrines contained animal remains. Similarly, there is no evidence for the deposition of 'meat packets' in these spaces.

However, a different type of 'ritual' deposit of animal bones was discovered in these contexts. The three shrines at Gegharot contained caches of sheep, goat, and cattle astragali, some of them purposively striated. The cache of astragali in the eastern citadel shrine was placed under a large groundstone near the altar and basin. In contrast, the caches from the western citadel and western terrace shrines were placed in pits outside of the main shrine areas, along with lithics, broken ceramics, and other bones. These caches contain more cattle than sheep and goat astragali, and while the sheep and goat astragali have a 1:1 ratio of left to right astragali, the cattle astragali have a 2:1 ratio of left to right astragali. This

16. The context on the eastern citadel also had a grinding installation near the basin (Smith and Leon 2014:554).

pattern (and its consistency across the three different contexts) in the cache bolsters its identification with ritual activity (Smith and Leon 2014; Badalyan et al. forthcoming). It is possible that such artifacts may have been used in practices of divination, and according to Smith & Leon (2014), such practices may have been important for producing religious forms of authority in the Late Bronze Age.

Unfortunately, the prevalence of post-cranial remains in the curated deposits found in these contexts limits the suitability of isotope analysis of faunal enamel. However, a small number of mandibles were found in the shrines and analyzed for radiogenic strontium and stable oxygen. First, the right mandible of a young sheep (1-2 years old at death) was recovered from Locus 60, excavated in 2010. Locus 60 is the clay platform along the western wall of the eastern citadel shrine (T27), from which a number of faunal remains were recovered. The bones recovered from this contexts were primarily sheep, and it is not unlikely that all of these remains are from a single individual (the MNI for this locus is 1).[17] Interestingly, the remains included the skull of a male sheep (aged 1-2 years), from which the tooth was taken for isotopic analysis, as well as a sheep metacarpal 3-4 (right) with associated first phalanxes and a sheep metatarsal 3-4 (left), and the distal epiphysis of a sheep/goat metapodial with associated first phalanxes. This recalls the practice of head and hoof burials of horses from Gegharot Kurgan 1 (and also Gegharot Kurgan 3). All three metapodials were unfused at the distal end, and those epiphyses fuse between 18-24 months in sheep (Silver 1969:252-253), which is further evidence that the skull and metapodials may be from the same individual. The only evidence of modification was a burnt caprine first phalanx, which was not associated with any of the metapodials.

17. The skeletal elements not identified as *Ovis aries* are all identified as caprine or medium mammal, and all of the bones identified as medium mammal-sized are skeletal elements (ribs, etc.) that are difficult, if not impossible to assign to the genus level or are of a very small size.

Additionally, teeth from two individuals (both sheep, 6-12 months and 2-3 years old) were recovered from Locus 16 in Trench 22. This locus, located to the south of the main shrine area on the eastern citadel, consisted of another clay basin containing seven whole vessels, an assortment of tools, and the sherd of a large pithoi, in addition to a fairly large number of faunal remains. The remains from this locus are more difficult to link back to the activities that Smith & Leon (2014) associate with the shrine spaces. The faunal assemblage from this locus was much more mixed than the deposit from the clay platform. Only 44.2% of the remains could be identified to the genus-level, though another 48.4% could be identified to body-size. The assemblage is mostly sheep/goat (MNI = 2 (*Ovis*), 1 (*Capra*); medium mammal was also the most numerous body size category), but there was also bones from cattle (MNI=2), red deer (*Cervus elaphus*), and a hare (*Lepus*). There was no clear patterning in the skeletal elements included, all major regions of the body (head, axial, fore-, and hindlimb) were represented. The overall assemblage was much more fragmented (48.85% of the elements identified were less than 1/4 complete), and a high percentage (11.98%) of the remains showed evidence of gnawing. This indicates that some of the remains were exposed for some time before being buried. Interestingly, the assemblage from Locus 16 included a fairly large number of astragali (n = 7), one cattle (left), two sheep (2 left and 2 right), one goat (left), and one sheep/goat (right). A number of the astragali had butchery marks, and one of the astragali was striated (which was also seen on astragali from other shrine-related contexts).

4.5 Conclusion

The variety of contexts where faunal remains were deposited at the ends of their social lives in the Late Bronze Age (and then recovered archaeologically in the present) in the Tsaghkahovit Plain reflect the wide variety of ways in herd animals circulated socially in life and death. The bones of sheep, goats, and cattle could end up interred whole in a burial with a deceased human being (as part of a rich variety of material items of aesthetic beauty and high value), partitioned and interred as prepared food (or the raw material for such) in the graves of human beings; as parts of ritualized activities relating to practices occurring around the 'shrines' at Gegharot, or as the raw material for food and tool production – to be deposited either in middens or in other more ephemeral deposits in unused spaces within the settlement. Undocumented materially, but dimly imaginable through present absences in zooarchaeological assessments, are the remains of animals that died or were killed, butchered, and eaten outside of the architectural spaces of sites.

Yet, within this variety, there are some large-scale commonalities. Across all of these contexts, the emphasis on three species of domesticated herd animals (sheep, goats, and cattle) to exclusion of the many wild taxa present in the foothills of the South Caucasus is striking. Furthermore, the numeric emphasis on sheep (above goats and cattle) in the general waste deposits is recalled in the interment of whole sheep in a variety of burials at both Gegharot and Tsaghkahovit.[18] Taphonomic traces of 'phantom limbs' and incomplete bodies indicate that there were a variety of paths – relating to different practices in the production, circulation, and consumption of herd animals. The specifics of these transformations and circulations are addressed more fully, and in the context of the analytical framework of this dissertation, in Chapters 5 & 6.

In Chapter 6, I use radiogenic strontium and stable oxygen isotope analysis to investigate how different animals (of different species, different ages) were incorporated into the pastoralist practices that moved and connected humans and animals in the Late Bronze Age. The isotopic analysis of individual animals attempts to highlight what kinds of lives (that is to say, what kinds of movement in time and space) preceded these paths that

18. It bears noting however, that this numerical superiority is not necessarily evidence that Late Bronze Age inhabitants of these sites ate more lamb and mutton than beef (see Chapter 5).

ended in burial, cache, or midden. Some of these paths were extraordinary, individualizing and potentially valorizing the bodies of animals through their own biographies and their participation in other human and object biographies. Others were utterly typical and offer a picture of the unremarkable everyday that formed a background to any special or unusual events (see Chazin 2016). Together, the quotidian and the extraordinary, formed a set of practices that were simultaneously fodder for and the basis of political authority.

CHAPTER 5

PASTORALIST PRACTICES I: SPACE & SEASONALITY

This chapter presents an account of how herds and herders travelled across the landscape of the Tsaghkahovit Plain (and surrounding regions) in the Late Bronze Age, based on the results of the analysis of radiogenic strontium and stable oxygen isotopes from sheep, goat, and cattle teeth. Through these analyses, pastoralist mobility is considered in both its spatial and temporal aspects, with an eye to understanding the scale and manner in which pastoralist mobility was organized. This analysis considers how biographical factors, such as age, species, and archaeological context of deposition, informed the organization of daily activities of grazing and movement, as well as practices related to reproduction and other aspects of pastoralist production.

Both radiogenic strontium and stable oxygen isotope analysis shed light on the mobility of herd animals. Analysis of the strontium signatures from tooth enamel from Late Bronze Age herd animals in the Tsaghkahovit Plain suggests that most animals were herded locally, within the boundaries of the plain (or in as yet unidentified isotopically-similar regions). Oxygen isotope analysis suggests that some animals may have been moved seasonally, possibly from lowland areas to the highlands. Moreover, the results of the oxygen isotope analysis indicate that pastoralists in the Late Bronze Age Tsaghkahovit Plain organized pastoralist production around two different groups of animals, distinguished by both the season of their birth and the age at which they were slaughtered. As part of this system, Late Bronze Age herders actively manipulated the reproductive potential of sheep (and possibly also goats), in order to produce both meat and milk.

5.1 Isotopic Analysis: A brief introduction

Radiogenic strontium ($^{87}Sr/^{86}Sr$) isotope analysis can provide important information about the movement of animals over their lifetimes. Strontium (from water consumed by the individual) is deposited in tooth enamel during its development early in an animal's life. The ratio of ^{87}Sr to ^{86}Sr reflects the local geology and can vary measurably over small distances, making it quite useful in archaeological analyses (Pate 1994; Bentley 2006). Consequently, differences in the ratio of strontium isotopes allows individuals to be identified as having been born in different locations, and gives evidence of migration and exchange in the past (Bendrey et al. 2009; Hollund et al. 2010; Knudson et al. 2012).

The ratio of oxygen isotopes ($\delta^{18}O$) deposited in teeth and bones reflects seasonal fluctuations in temperature, since the ratio of oxygen isotopes found in groundwater varies with the air temperature. Recent experiments have shown that by sampling at multiple locations along teeth, one can determine whether animals were born in different seasons by comparing the phase of the sine curves generated (Balasse et al. 2003; Towers et al. 2011; Tornero et al. 2013). Depending on the patterning seen and the climatic and geological context, such data has been used to argue for seasonal migration and/or multiple episodes of breeding (Balasse et al. 2003; Henton 2010; Mashkour et al. 2005; Tornero et al. 2013; Frémondeau et al. 2015), providing evidence for herding practices that would be difficult to identify otherwise.

Teeth were selected for radiogenic strontium and stable oxygen isotope analysis from a variety of Late Bronze Age contexts in the Tsaghkahovit Plain. Second molars were selected from 31 individual animals (21 sheep, 6 cattle, and 4 goats) for intra-tooth stable oxygen isotope analysis, in order to identify birth seasonality and potentially also movement in the landscape (though changes in inter-annual climatic patterning across the first year of life). These individuals, along with a set of first molars from animals too young to be included in the stable oxygen isotope study (n = 16)[1], were also analyzed for the ratio of radiogenic strontium isotopes in order to identify whether the animals were born in the Tsaghkahovit Plain or elsewhere, and to track movement over the first year of life. A detailed discussion of the sampling strategy is given in Chapter 4 and for an in-depth presentation of the technical methods and see Appendix B for a detailed presentation of methods and analysis of the isotopic data.

5.2 Space

5.2.1 Spatial mobility: Radiogenic strontium isotopes analysis

Teeth from fifty individuals were analyzed for radiogenic strontium isotopes ($^{87}Sr/^{86}Sr$). Forty-one of those individual animals were recovered from middens at Gegharot and the Tsaghkahovit Residential Complex. The remaining nine individuals came from either shrine or mortuary contexts. The majority of these animals were sheep (n = 35), with smaller numbers of goats (n = 7) and cattle (n = 8). The results of the radiogenic strontium isotope analysis (Figure 5.1) show that generally, most individuals in the study spent the first year of life grazing within the Tsaghkahovit Plain. Almost all of the measured $^{87}Sr/^{86}Sr$ values are within the isotopic baseline established by Marshall (2014) (though see Appendix B for a discussion of the limitations of this method).

There is one individual, ACL-6220, a sub-adult goat (*Capra hircus*) recovered from the midden in GeT2, which had a $^{87}Sr/^{86}Sr$ from the sample nearest to the cementum-enamel junction (CEJ) that was considerably lower (0.70675) than the baseline values for the Tsaghkahovit Plain. Thus, it appears that ACL-6220 was likely born in the Tsaghkahovit Plain (or in an isotopically-similar region), but it spent the latter part of its first year of life

1. Of the 16, ten were samples randomly selected from midden contexts and six were individuals from special contexts (burials and shrines) – for a total of 11 sheep, 2 goats, and 3 cattle.

outside of it. An earlier pilot analysis identified one other likely “non-local” individual. ACL-4868 was a young (6-12 months) cow interred in the cist of a Late Bronze Age tomb in a burial cluster near the site of Tsaghkahovit (Marshall 2014). The $^{87}Sr/^{86}Sr$ ratio from ACL-4868 (0.70640) was also lower than the baseline established for the plain. While it is impossible to say precisely where these individuals may have spent time outside of the Tsaghkahovit Plain, a faunal sample from the Shirak Plain to the south (which is geologically distinct) has shown a lower $^{87}Sr/^{86}Sr$ value (0.706669).

Considering the variation within the baseline range established for the Tsaghkahovit Plain, this study suggests that sheep, goats, and cattle are not grazing on plants with markedly different $^{87}Sr/^{86}Sr$.[2] Analysis of sheep separately suggests that trends in variation by age class and by archaeological context primarily (but not exclusively) reflect the experiences of sheep. The smaller samples of goats and cattle suggest that their biographies (with regard to Sr input into the diet over the first year of life) are not especially different from sheep, but further work is required to fully understand differences between the major species of herd animals.

Similarly, differences in age at death do not explain the variation seen in $^{87}Sr/^{86}Sr$. While animals in Age Class II (sub-adults, 2-4 years) has a slightly lower mean, the means across the four groups are not significantly different. However, animals from Age Class Ia (infants, 0-12 months) have a much smaller range of variation in $^{87}Sr/^{86}Sr$ than the other age classes. Moreover, analysis of samples of enamel formed during the same time span (0-6 months) from animals that lived past the first year of life revealed that the individuals from Age Class Ia showed a noticeably smaller range of $^{87}Sr/^{86}Sr$ values (Figure 5.2).

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2. There is tentative evidence that goats’ grazing habits, which are different than sheep and cattle (this distinction is glossed as the difference between grazers and browsers), may be visible in the $^{87}Sr/^{86}Sr$ results. Goats have a narrower range of variation in $^{87}Sr/^{86}Sr$ than sheep/cattle but a bimodal distribution of intra-individual ranges. Given the small sample size, and the lack of modern reference data, this possibility remains suggestive at best.

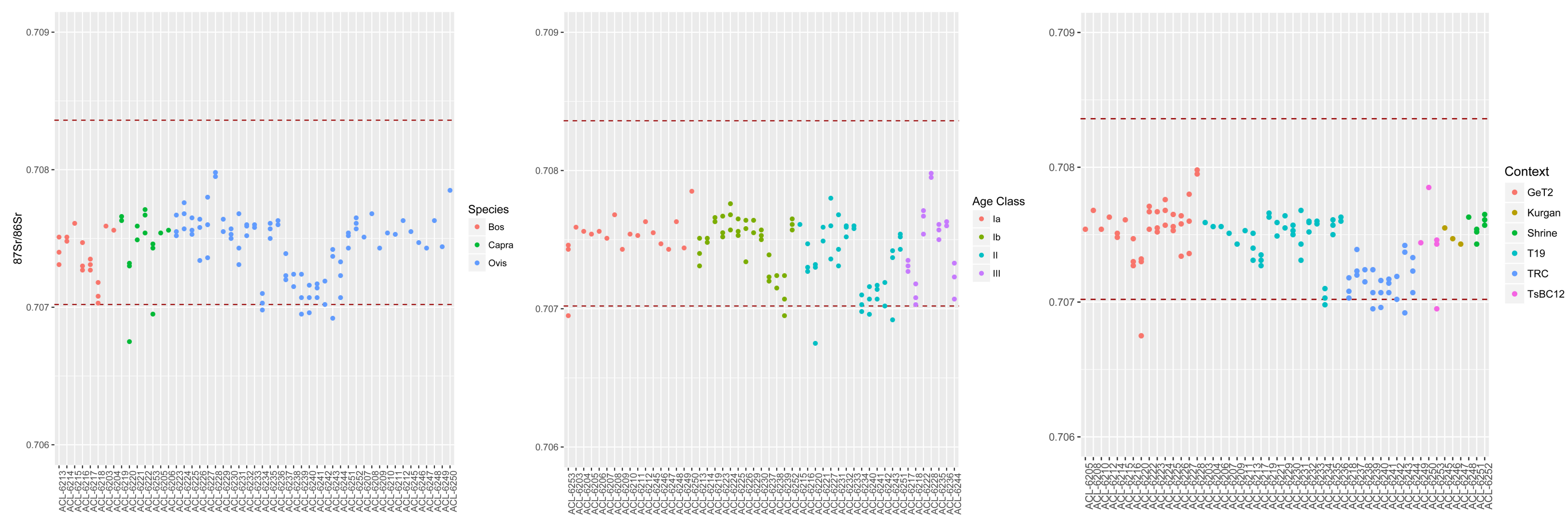

Figure 5.1. Radiogenic strontium ($^{87}Sr/^{86}Sr$) isotope analysis results.

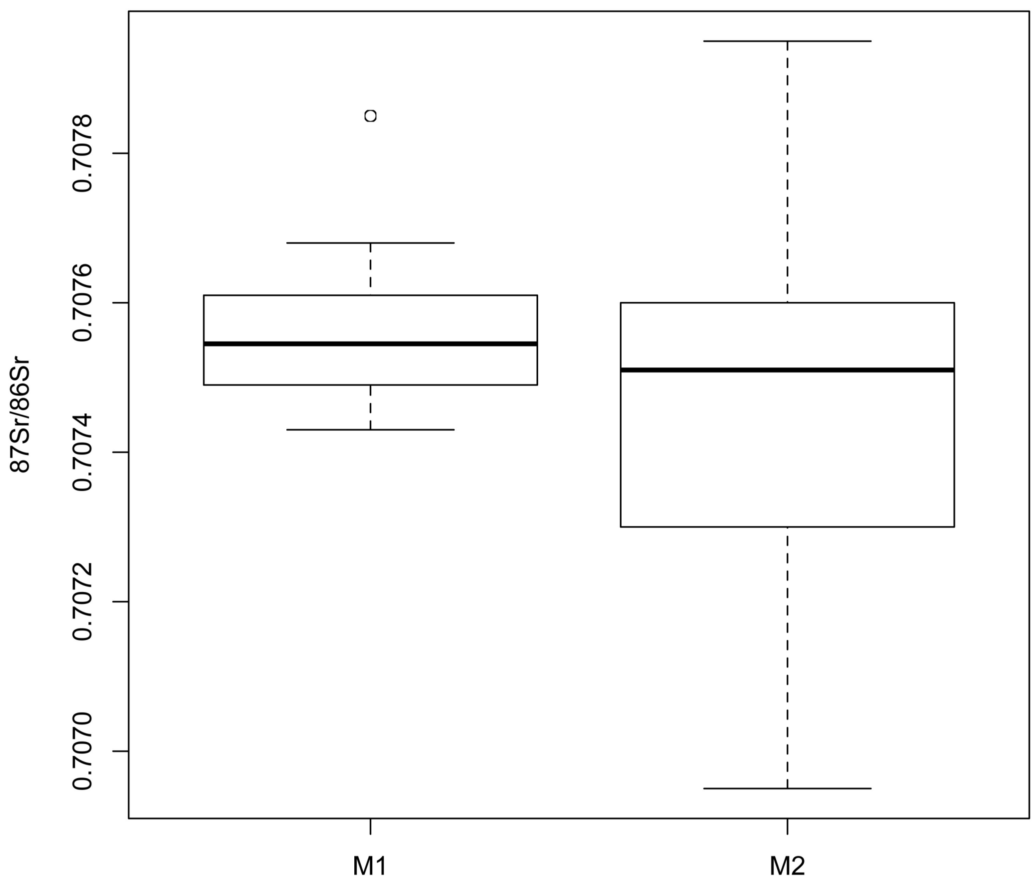

Figure 5.2. Variation in $^{87}Sr/^{86}Sr$ from samples from the first six months of life – Age Class Ia (M1s) vs. all other age classes (M2s).

In contrast, the archaeological context from which the individuals were recovered by excavation does account for some of the variation seen in the ^{87}Sr/^{86}Sr values in the sample. Individuals from the Tsaghkahovit Residential Complex had a lower mean ^{87}Sr/^{86}Sr value than individuals recovered from other contexts (this result was statistically significant – KW χ^2= 52.058, df = 5, p= 5.25e^{-10}). This result is slightly counter-intuitive, as the baseline values for the area around Tsaghkahovit are at the higher end of the Tsaghkahovit Plain baseline range, whereas the lower values of the range came from archaeological and modern rodents living on the Pambakh side of the plain. This suggests that the animals that circulate into the TRC after death are grazing separately from other animals in the plain and that this difference is maintained across species and age class boundaries.

For the 31 individuals included in the stable oxygen isotope analysis, intra-tooth sampling was also done for radiogenic strontium isotope analysis. From this, it was possible to analyze the intra-individual range in the ^{87}Sr/^{86}Sr values, which give a sense of the relative variety of dietary inputs of strontium. The individuals sampled sort into two groups. Most individuals have an intra-individual range of less than 0.2 x 10^{-4}, but a smaller sub-set of individuals have larger ranges. A very small study of cattle and horses from Bronze Age sites in Georgia reported intra-individual ^{87}Sr/^{86}Sr ranges between 0.3 x 10^{-4} and 1.7 x10^{-4}(Knipper et al. 2008). Another study that looked at sheep at the Neolithic site of Catalhoyuk (Bogaard et al. 2014) found only one individual with an intra-individual range greater than 2 x 10^{-4} (#73: 2.3 x 10^{-4}), the other sheep in the study had even narrower intra-individual ranges ($\leq$ 1.1x 10^{-4}). In contrast, a small study of cattle from prehistoric Britain showed a bimodal pattern of intra-individual ranges (Viner et al. 2010). No clear patterning in intra-individual ranges was seen when grouped by species, age class, or archaeological context (Figure 5.3).

To summarize, the analysis of radiogenic strontium in teeth suggests that most Late Bronze Age herd animals spent the first year of their lives in the Tsaghkahovit Plain or

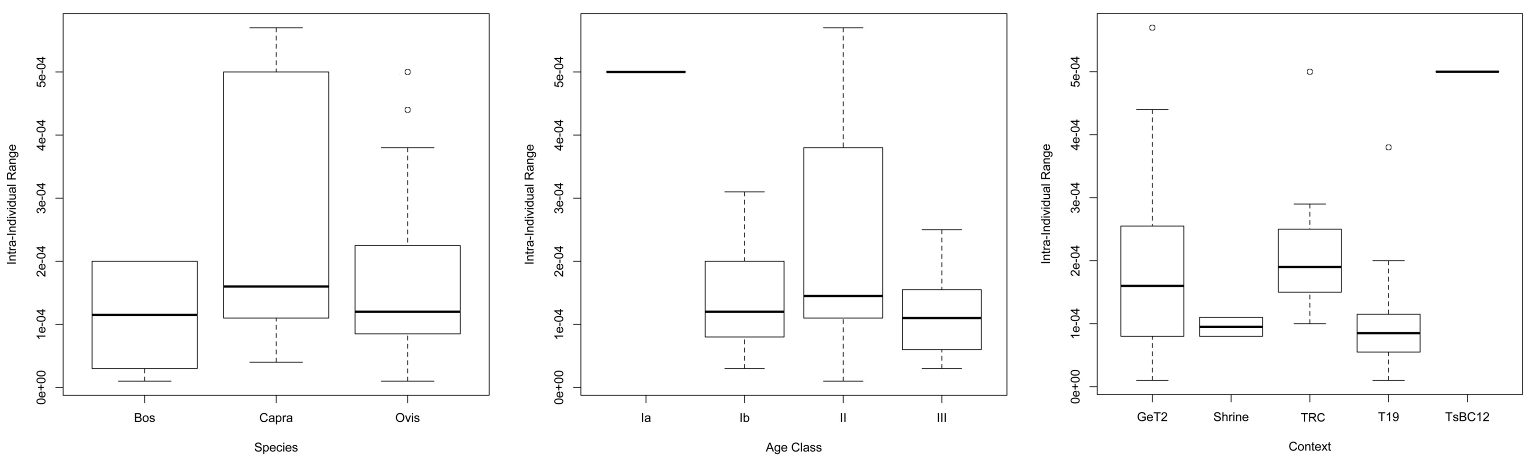

Figure 5.3. Intra-individual ranges of $^{87}Sr/^{86}Sr$ values.

another isotopically-similar region. There is very little evidence for long-distance exchange or migration from the strontium data. However, there is some evidence that animals deposited at the Tsaghkahovit Residential Complex may have grazed in different areas of the plain from the animals deposited at Gegharot. This may reflect the distribution of grazing rights between groups or individuals within the plain.

5.2.2 Seasonal mobility: Stable oxygen isotopes analysis

The enamel in second molars in sheep, goats, and cattle records the variation in temperature (reflected in the relative enrichment or depletion of δ^{18}O) over the first year of the animal's life. In a temperate climate, herd animals grazed in one location over the course of a year should reflect the seasonal variation in δ^{18}O for that location. In contrast, animals moved to different locations should show either increased or decreased seasonal variation. Most models of herd mobility suggest that mobility should result in a dampening of the seasonal variation, since movement is oriented towards avoiding seasonal temperature extremes (Britton et al. 2009; Henton et al. 2010; Henton 2010; Bocherens et al. 2001). A dampened range of intra-annual variation in δ^{18}O may also reflect the consumption of water with an averaged seasonal signal (such as from karstic springs, see Henton 2010:311). However, since the Tsaghkahovit Plain is not located in an area of karstic geology (Volodicheva 2002:352-4), dampened intra-individual signals most likely reflect mobility.

Given the estimated local annual variation in δ^{18}O, which reflects the seasonal variation in temperature in a temperate climate, it becomes possible to identify individuals whose intra-annual range suggests that they moved between places with different climatic regimes (see Appendix B for a full discussion of this method and the results). There are two major difficulties with this method. First, it is unclear whether the Late Bronze Age climate

ACL #	Species	Age Class	Context	Seasonal Pattern
6214	*Bos*	I	GeT2	Dampened
6216	*Bos*	II	GeT2	Dampened
6218	*Bos*	III	SLT	Dampened
6227	*Ovis*	II	GeT2	Dampened
6224	*Ovis*	I	GeT2	Extreme
6229	*Ovis*	I	T19	Non-sinusoidal

Table 5.1: Individuals with unusual intra-tooth δ^{18}O ranges.

in the Tsaghkahovit Plain was equivalent to the current climate.[3] Second, the process of enamelization (which occurs over a period of time) dampens the signal of seasonal variation inδ^{18}O (Balasse 2002; Balasse et al. 2012b).

Global models of δ^{18}O in precipitation suggest that the modern intra-annual range should be ~6.5-8.7‰ (see Appendix B). The majority of intra-individual δ^{18}O ranges fall reasonably close to those estimates, but a few do not (Table 5.1). Four individuals have the lowest intra-individual δ^{18}O ranges (ACL-6214, 6216, 6218, 6227), ranging from 0.92‰ to 3.94‰, and the plots of the incremental samples from these individuals are noticeably flat. An analysis of intra-individual seasonal variation in δ^{18}O in the enamel from M2s of wild mouflon from an Epigravettian hunting site (Kalavan 1) in the mountains around Lake Sevan (Tornero et al. 2016) gives another potential estimate for expected intra-annual variation. The site is at a very similar latitude to the Tsaghkahovit Plain (40N), though at a lower elevation (1640 masl vs. ~2150 masl). This study recorded intra-individual ranges from 6.9-10.2‰, and the authors argue that these ranges reflect seasonal mobility between highland and lowland pastures around Lake Sevan, based on the comparison between variation in oxygen and carbon isotope signatures across M2s and M3s.

3. For instance, Jude et al. (2016) suggest that the climate may have been cooler and drier in the Late Bronze Age.

Unfortunately, the study was unable to clarify exactly what degree of seasonal dampening is reflected in these ranges (Tornero et al. 2016:30-31). However, the ranges for the wild mouflon (reflecting a dampened signal) are greater than those predicted by the global precipitation models, which suggests that the models may underestimate the seasonal isotopic variation in the South Caucasus. Nevertheless, it is clear that the low inter-individual ranges seen in this analysis still indicate a dampening of the seasonal signal, potentially reflecting higher elevations in summer pastures and/or a greater contribution of snowmelt (resulting in lower δ^{18}O in the summer). Analysis of intra-tooth stable carbon isotopes will help clarify the significance of these results.

Thus, it seems that ACL-6214, 6216, 6218, and 6227 were either spatially mobile, spending the summer in a comparatively cool highland environment and winters in a comparatively warm lowland environment, or were drinking from a water source that was isotopically mixed. Three of these individuals are cattle, suggesting that this sort of seasonal mobility may have been more common for cattle.[4] In contrast, ACL-6224 had an unusually high intra-individual δ^{18}O range (11.25‰), much higher than the other individuals in the study and the predicted intra-annual ranges from the precipitation models. This suggests that this individual may have moved in such a way as to exacerbate the seasonal variation in temperature (and as a result seasonal variation in δ^{18}O). Finally, ACL-6229, had an intra-individual δ^{18}O range (6.08‰) within 'normal' seasonal variation for the Tsaghkahovit Plain, but the plot of δ^{18}O does not show the expected sinusoidal variation, suggesting that this individual may have moved over the course of the year, though this pattern does not match any of the standard models for seasonal mobility.

4. Knipper et al. (2008)'s small study of cattle and horse teeth from Bronze and Iron Age sites in Georgia reported that the three cattle samples had inter-annual ranges of ca. 2-3‰ and the two horses sampled had intra-annual ranges of 3-4‰. Since they do not report any climate data for the region studied, it is unclear whether these ranges reflect a more mild annual climate, or similarly reflect a dampening of a seasonal signal.

In conclusion, from the oxygen data, there is some indication of seasonal mobility for herd animals in the Tsaghkahovit Plain. Given the limited state of isotope studies in the region, and in particular, the lack of detailed mapping of bioavailable strontium outside of the Tsaghkahovit Plain, it is hard to state how the radiogenic strontium and stable oxygen isotope data relate. The simplest explanation is that the seasonal mobility (along an altitude gradient) took place either on the slopes of Mt. Aragats or up in the Pambakhs, presuming that these highland areas would be geologically similar to the plain and thus would have similar bioavailable $^{87}Sr/^{86}Sr$. Future work is required to ascertain both the bioavailable strontium signatures for nearby highland areas, as well as the relative impact of the altitudinal gradient on $\delta^{18}O$ values seasonally.

5.3 Seasonality

The data from the incremental analysis of stable oxygen isotopes shows a wide range of variation in the seasonality of birth between individuals (see Appendix B for a full discussion of the results of the stable oxygen isotope analysis). Most individuals show the expected sinusoidal variation in $\delta^{18}O$ over the length of the tooth, reflecting seasonal changes in temperature expected in the region's temperate climate (Volodicheva 2002) – high temperatures in the summer are recorded as higher $\delta^{18}O$ in the tooth enamel and low temperatures in the winter result in lower $\delta^{18}O$ values. On the basis of this seasonal variation, it is possible to estimate the seasonality of birth for individual animals. The enamel on the second molar (M2) forms over the first year of life, and as such, it records a single annual cycle. Visual inspection of the plots of incremental oxygen data for each individual indicates that there is considerable variability between individuals in the horizontal location of the maximum and minimum $\delta^{18}O$ values. This suggests that the sample contains individuals that were born at different times of the year.

By starting from a fixed point in the cycle, it is possible to more precisely estimate at what point in the year the animal was born (Balasse et al. 2003; Balasse and Tresset 2007; Meiggs 2009; Henton et al. 2010; Balasse et al. 2012a; Tornero et al. 2013). Since tooth wear in adult animals destroys the record of the starting point of the annual cycle (i.e. birth), analysis of incremental tooth enamel uses the cementum-enamel junction (CEJ), the end point of the annual cycle recorded in the M2 over the first year, as the fixed point. Earlier studies used visual matching to identify individuals whose sinusoidal curves were of matching phases (Balasse et al. 2003; Meiggs 2009; Henton 2010), however a new method uses non-linear regression to identify birth seasonality (Balasse et al. 2012a,b; Tornero et al. 2013; Balasse et al. 2013; Tornero et al. 2015; Frémondeau et al. 2015). This new method is more precise and compensates for inter-individual variation in both tooth length and tooth wear.

The non-linear regression model fits a cosine curve to the δ^{18}O data and estimates certain parameters, critically, both the period (X, i.e. the length of enamel reflecting a single annual cycle) and the delay (x_0, the distance that $\delta^{18}O_{max}$ is from the CEJ, which is dependent on the season of birth). From these estimated parameters, it is possible to compare birth seasonality between individuals using X and x_0, which are normalized to a single annual cycle. The relative position of $\delta^{18}O_{max}$ is expressed as x_0/X, which can then be plotted to show what portion of the annual cycle births are occurring in. Figures 5.4 & 5.5 show the results of the modeling for sheep, goats, and cattle. What is immediately clear is that sheep births are spaced out over nearly the entire year (86% of the annual cycle). In contrast, cattle births are more restricted, covering only 24% of the annual cycle. Goats show an intermediate pattern, potentially representing two discrete seasons of birth, but it is difficult to say whether this is merely an artifact of the small sample size.

It is difficult to determine the actual season of birth from incremental analysis of archaeological tooth enamel, due to a lack of knowledge of the relationship between tooth

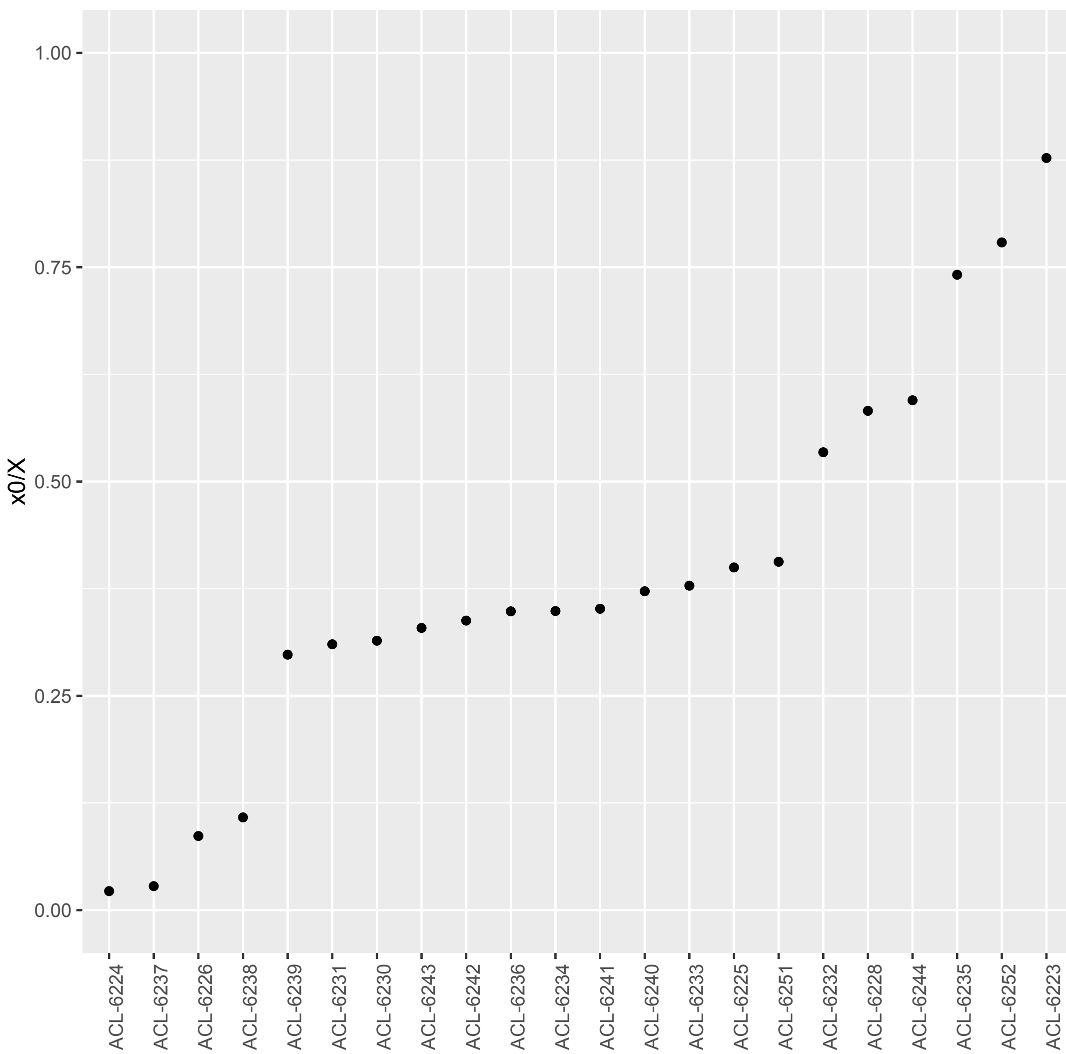

Figure 5.4. Birth seasonality (x_0/X) for sheep.

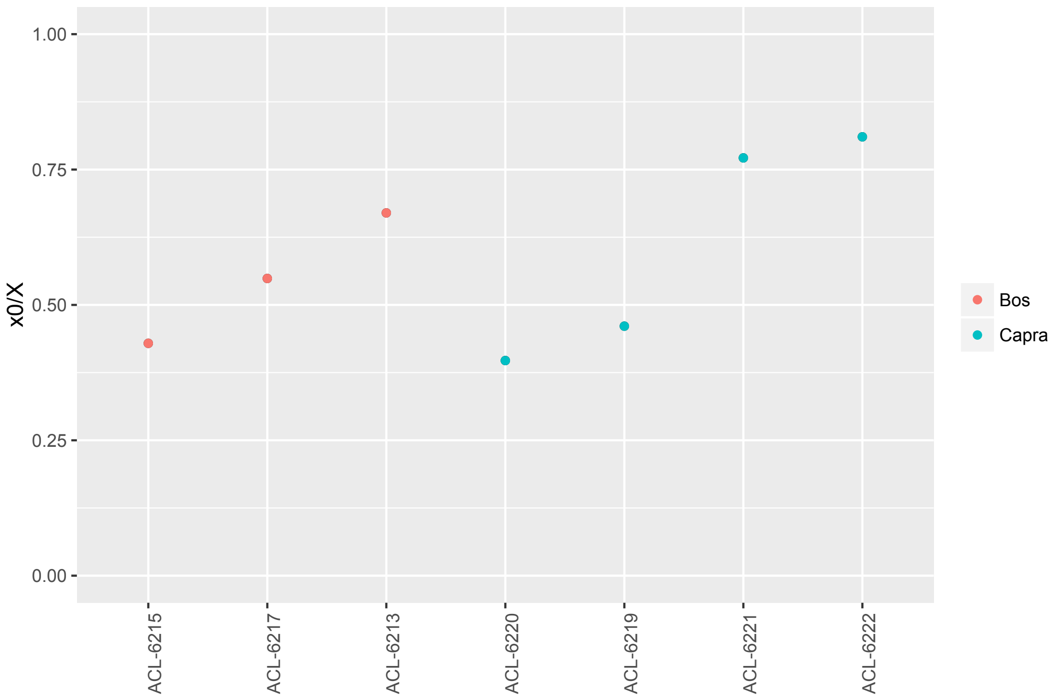

Figure 5.5. Birth seasonality (x_0/X) for goats and cattle.

growth and tooth mineralization (which is delayed by enamel maturation) (Balasse et al. 2012b:350). But a growing number of studies on modern sheep in Europe are building our knowledge about the relationship between the season of birth and its relationship to enamel formation. Unfortunately, however, the basic empirical research required to move between birth seasonality and the season of birth has not been done for the Caucasus. In any event, comparison between modern reference specimens and archaeological data depends on the (currently unverified) assumption that tooth growth has similar timing across populations (Tornero et al. 2013:4046). Nevertheless, if we assume that modern sheep (Balasse et al. 2012a,b) and the archaeological population from the Tsaghkahovit Plain show similar timing, then it appears that the initial group of births ($x_0/X \approx$ 0-0.15) is likely from the late winter and the next group ($x_0/X \approx$ 0.2-0.4) is from the spring. The modern reference populations suggest that $x_0/X \approx$ 0.6-0.8 are animals born in the early fall. Thus it would appear likely that the 2 month gap in birth seasonality (between x_0/X = 0.9-1.0) was in the mid-winter.

In any event, it is clear that sheep are born across a much larger range of the annual cycle than would be expected. Wild populations of sheep do not breed year round. Instead, the reproductive cycle in sheep is driven primarily by the annual photoperiodic cycle (i.e. timing is based on the length of daylight) (Hafez 1952; Legan et al. 1977; Karsch et al. 1984; Malpaux et al. 1997). At middle and high latitudes, this results in a restricted breeding period in wild populations and the restriction is correlated with latitude. Populations of wild mouflon (*Ovis orientalis musimon*) in France (at a slightly higher latitude than the Tsaghkahovit Plain – 44° versus 40°) have a short lambing period (1.5 - 2 months) that takes place in the early spring (mid March to late April) (Tornero et al. 2013:4047-4050). The Tsaghkahovit Plain is right on the border of the rule-of-thumb division (set at 40° latitude) between strongly-seasonal and non-seasonal births in sheep and goats (Chemineau et al. 1992; Rosa and Bryant 2003). However, the analysis of wild mouflon from the Epigravettian site of Kalavan 1 around Lake Sevan showed a marked seasonality of birth, as evidenced by the tight clustering of optimum values between individuals (though this clustering was not quantified using the non-linear regression model) (Tornero et al. 2016:33). This indicates that birthing periods in unmanaged populations in the Southern Caucasus are unlikely to be as long as the range seen in the archaeological population from the Tsaghkahovit Plain.

This indicates that herders were artificially extending the reproductive period of sheep. Generally, this is harder to do with sheep than with cattle (Balasse and Tresset 2007), as timing of reproductive availability in cattle depends on nutritional status (Hammond 1971; Dahl and Hjort 1976; Mukasa-Mugerwa 1989; Ezanno et al. 2005; Balasse and Tresset 2007) rather than on the photoperiod. This indicates that a fair amount of labor would have been required to sustain the year-round supply of sheep milk. Furthermore, care would have needed to be taken to ensure that multiple lambings per year (or over a two year cycle – see Dahl and Hjort (1976)) did not decrease the reproductive capacity of the herd (Balasse et al. 2003; Balasse and Tresset 2007).[5]

There are two main ways that prehistoric herders could have spaced sheep births across the annual cycle (Balasse et al. 2003:206): 1) by increasing the nutritional status of the ewes (Rosa and Bryant 2003) and 2) by reducing both the postpartum anoestrous period (by improving nutrition) and the lactational anoestrous period (by reducing the suckling period) (Balasse and Tresset 2007:75). It is likely, then, that herders may have supplemented the diet of some ewes, potentially through the use of fodder. Foddering is also linked to increased lactation in goats (Thomas and Rook 1983; Malau-Aduli et al. 2003; Makarewicz and Tuross 2006:868) and an increased production of milk in sheep (Arnold et al. 1979). Thus, supplemental nutrition, in the form of fodder, would also have been beneficial for milk production.

In contrast, the seasonality of birth for cattle is somewhat restricted (24% of the annual cycle), though that may be a result of the smaller sample size. In any event, a three month season of birth is similar to the reported seasons of birth for primitive breeds of cattle under conditions of extensive free-ranging and no control of reproduction in both Scotland and Northern France (Balasse et al. 2012a:37-38).

The larger sample of sheep allows for an analysis of how variables such as age and archaeological context impact birth seasonality (Figure 5.6). Comparing sheep birth seasonality between Gegharot and Tsaghkahovit, it is clear that both show the extended season of birth, though sheep from the TRC only cover 60% of the annual cycle. This may be an artifact of the smaller sample from that site. When the results are grouped

5. It is possible that this capacity for multiple lambings per year was what made sheep the more attractive choice for dairy production, despite the lower level of seasonal restriction on fertility seen in cattle (Balasse et al. 2003; Balasse and Tresset 2007). It is also possible that this preference was based in taste or nutritional considerations (Dahl and Hjort 1976).

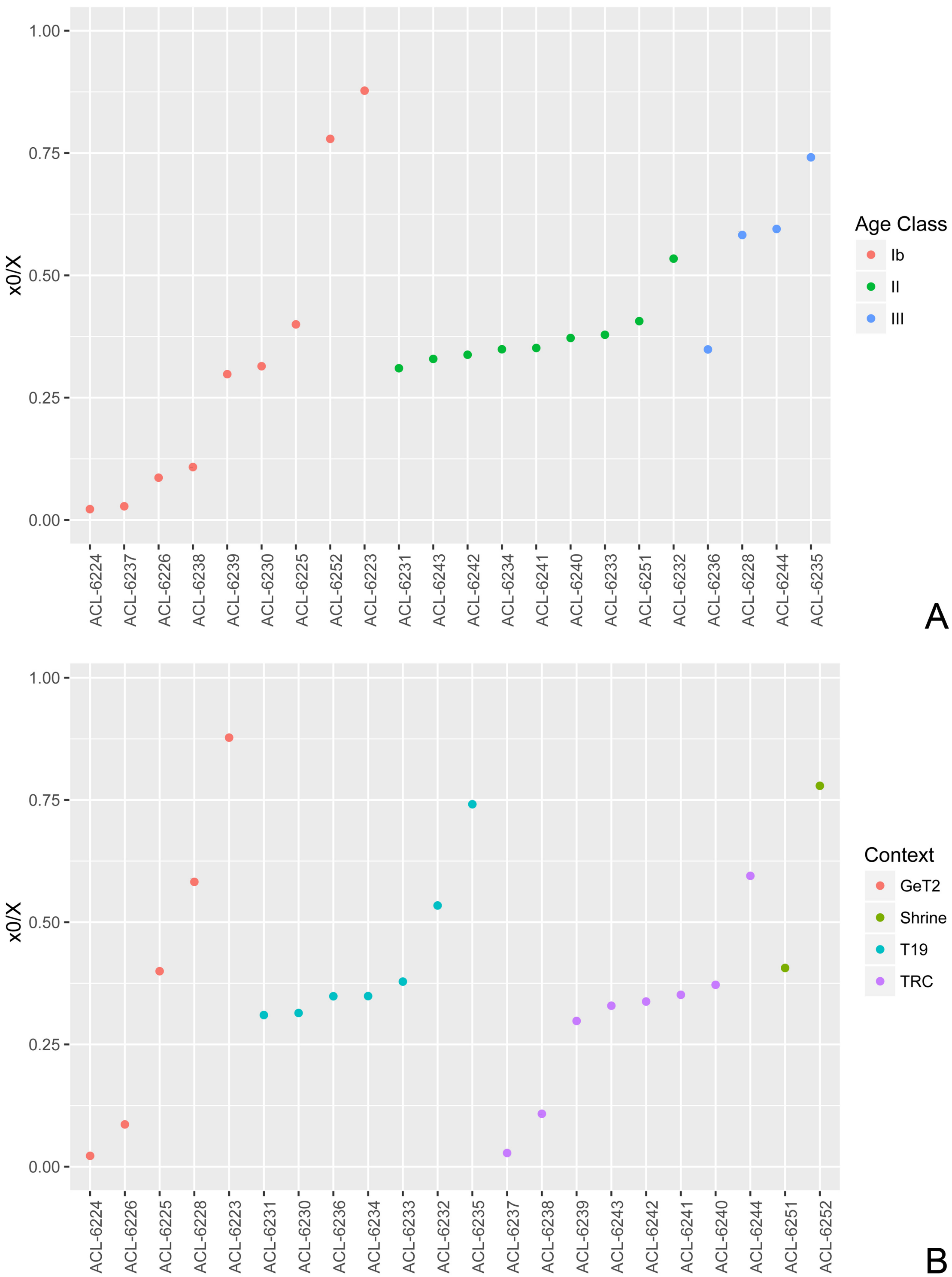

Figure 5.6. Birth seasonality (x_0/X) for sheep by a) age class and b) archaeological context.

by age class, there are noticeable differences in the birth seasonality. Animals killed as juveniles (Age Class 1b, 6-12 months) show the widest range of birth seasonality (~80% of the annual cycle). It is possible that animals in this age class group into three distinct birthing periods, separated by 2.5-3.5 months. In contrast, almost all the animals killed as sub-adults (Age Class II, 2-4 years) show a very narrow range of variation (10% of the annual cycle), probably representing spring births. Older animals (Age Class III, 4+ years) show a wider range of season of birth (~40% of the annual cycle), despite the small sample size. Thus, we have a pattern where animals slaughtered at very young ages and at older ages appear to be born across a large part of the year, whereas the animals that are slaughtered at prime meat weight are born during a limited part of the year, potentially in the spring/early summer.

5.4 Conclusion

Herding in Tsaghkahovit Plain, while generally spatially restricted within the boundaries of the plain, was complexly organized to generate milk and meat for human consumption. In order to manage the labor demands associated with these different production orientations, sheep were herded in two different fashions, resulting in two main trajectories of pre-mortem biographies. Based on the stable oxygen isotope data from the Tsaghkahovit Plain, it appears that sheep herding was organized around two different production strategies, resulting in the two different groups seen in the isotopic data. The first group consists of sheep killed either very young or as older adults and includes individuals born across most of the annual cycle. The second group is comprised of sheep that are killed after reaching prime meat weight (2-4 years old), and that are born during a narrow period of time, possibly during the spring (i.e. the default birthing season).

The distinction between these two groups highlights the complex organization of pastoralist labor and practices in the Late Bronze Age Tsaghkahovit Plain. On the whole, it seems most likely that the first group of animals represents sheep that were herded primarily for dairy production. Births were spaced out over the year, to ensure that milk was consistently available (see Balasse et al. 2012a:38; Balasse et al. 2014:133). Young animals (likely mostly males – see Chapter 6) were killed early, while some of the female lambs were retained for their reproductive potential. Ewes were bred and kept for milk production until they were no longer able to reproduce. This would explain the wide range of birth seasonality seen in Age Classes Ib and III.

However, taking care of pregnant animals and newborns is labor intensive. As a result, herders (especially those with larger flocks) may seek to constrain or shorten the birthing period, in order to reduce the labor required for that task (Balasse et al. 2003; Tornero et al. 2015). This may explain the rather restricted season of birth seen in sheep killed as sub-adults. There appears to have been a separation between groups of sheep on the basis of the seasonal scheduling of labor. The first group required intensive care year-round, potentially including the provisioning of fodder, in order to ensure multiple lambings across the annual cycle and in order to collect and process the milk produced by this group.[6]

In contrast, the other group was born during a limited period of time, perhaps in an effort to reduce the labor necessary for managing this particular group of animals. These animals were then raised to full meat-weight and killed sometime between 2 and 4 years of age. It is not clear whether this represents a cull of animals at a particular age and/or season (e.g. in the fall of the second year) or the gradual culling of these animals year-round and at a variety of points within the age-span. If the latter, it is possible that this group of animals

6. It is not clear what relationship, if any, is there between the biographies of Age Class Ia and Ib animals, since stable oxygen isotope analysis was not performed on the first molars, due to concerns about the impact of weaning on the oxygen isotope signatures. Age Class Ia animals may belong to either pattern of birth seasonality, and may represent yet another layer of complexity in labor scheduling.

supplied a range of types and quality of meat and other products (older vs. younger, etc.). Additionally, the seasonal movement of animals between highlands and lowlands would also have been a practice that put different demands on herders' labor. From the data, it appears likely that the animals moved from highland to lowlands represented another group of animals that were herded separately.

Thus there appears to have been a division of production strategies, through the division of human labor and between animal bodies. One consequence of this division was, simply, that sheep provided two types of food for humans, each with different affordances. Milk differs from meat in one key way: it does not require killing the ewe (though herders may choose to kill the lamb, to avoid it competing with human and to avoid having to feed the extra mouth), and therefore is often characterized as a strategy used by pastoralists whose wealth is based in living animals (rather than meat, sold as a commodity). However, milk is often perceived as a food that is especially suitable for certain types of people (based on age, gender, or other factors)[7] and that provides specific types of nutrition (Dahl and Hjort 1976).[8] Milk shares with meat a short-term perishability that must be managed, especially if it is to be distributed. While meat can be distributed 'on the hoof', milk must either be consumed fresh or preserved as butter or other products.

It is not clear who was consuming sheep's milk in the Late Bronze Age Tsaghkahovit Plain. There are two possible scenarios. First, milk may have been primarily produced for the domestic consumption of pastoralists, and the young lambs and older ewes represent the subsidiary meat production associated with dairying. This would make it possible for herders to maintain larger numbers of living animals, which could have been important as

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7. Marshall's (2014) argument that one individual buried in TsBC12, who has severe and likely debilitating tooth-loss (as well as healed cranial and facial fractures), may have consumed a large amount of dairy is interesting in light of this.

8. Dahl and Hjort also note that sheep's milk is higher in fat and vitamin C than cow's milk (1976:216).

a (highly tangible) form of wealth. On the other hand, the young and older sheep deposited in on-site middens may represent flocks herded to provide milk for people associated with Tsaghkahovit and Gegharot. The discovery of what was identified as a butter-making vessel on the western terrace at Tsaghkahovit (Smith et al. 2004:14) is suggestive, but not conclusive.

Nevertheless, the presence of a group of animals killed at prime meat-weight, with a narrowly controlled season of birth, may be evidence of pastoralist production aimed at providing meat for consumption beyond the domestic level. But as the discussion in Chapter 6 will show, the complexities of consumption made visible in the on-site faunal assemblages in the Tsaghkahovit Plain make it difficult to ascertain who is providing what (in terms of milk or meat) and under what terms. It is not clear whether provisioning was centrally controlled and directed, or whether herders could independently (and on a smaller scale) make transactions with people associated with sites in the plain.

CHAPTER 6

PASTORALIST PRACTICES II: DISTRIBUTION & CONSUMPTION

This chapter presents the results of zooarchaeological analyses, illuminating how herd animals and their products were distributed to, and between, Late Bronze Age sites in the Tsaghkahovit Plain. In doing so, it considers how practices that moved herd animals and their products (meat, milk, wool, blood, hides) into contexts of consumption and discard may have been organized. I consider the transition between pre- and post-mortem social lives of herd animals by analyzing the variety of culling practices that are visible in the zooarchaeological data. Age and sex data provide information on the population dynamics of herds, and how these demographic factors shaped herders' slaughter and consumption decisions. The patterning seen in the relative proportions of taxa, presence and absence of skeletal elements, the modification of bones through butchery, burning, and other processes outlines the movement of herd animals' bodies post-mortem, through processes of consumption and then discard.

The analysis of zooarchaeological data from the Tsaghkahovit Plain reveals that animal age and sex shaped herders' decisions about culling animals in complex ways. This analysis strengthens previous work that found that the animals present in the faunal assemblages from sites in the Tsaghkahovit Plain did not represent a demographically complete or isolated group and argued that the animals being provisioned to sites from other herds (Badalyan et al. 2008; Monahan 2012). It suggests that mobile pastoralists may have provisioned Late Bronze Age sites with some animals from their flocks. In addition, detailed analysis of the body part distributions within these assemblages provides evidence for new practices of consumption, linking site-based activities and mobile subjects, that have not been previously described. Towards the end of the chapter, I consider how the osteobiographies of animals who depart from the main patterns seen in spatial and seasonal mobility, as well distribution and consumption, can be interpreted in light of the overall analysis of pastoralist practices in the Late Bronze Age Tsaghkahovit Plain.

6.1 Culling: Bridging pre- and post-mortem social lives

Culling of individual animals from herds depends on decision-making that is simultaneously concerned with the reproductive viability of the population structure of the herd, the provisioning of sufficient amounts different kinds of meat, and obtaining a sufficient amount of meat overall. Culling decisions take into account the different affordances between species of herd animals. Factors that come into play here include: the timing and length of reproductive cycles, the time it takes for animals to reach peak meat weight, the amount of pasture, fodder, or water they require, cultural ideas about the relative palatability of different species, the relative amount of meat an individual animal provides and the need to store it, and the potential for orientation of production towards different pastoral products (meat, milk, wool, hides, blood, manure etc.).

Herders must take care that the breeding stock is not depleted over time, ensuring the continued reproduction or expansion of the herd. However, this factor is complicated by social structures that regulate the circulation of animals between herders and cultural ideas about the ownership of individual animals and their offspring. It is not always immediately clear at what level, and at what scale, the reproductive viability of the herd becomes important to decision-making. Cultural ideas about the relative suitability or desirability of meat from male vs. female animals or animals of different ages (e.g. lamb vs. mutton) shape culling decisions. The desirability of different types of meat may also vary seasonally, either due to reproductive/demographic concerns (competition with humans over milk or the necessity of foddering animals through the winter) or cultural concerns (such as the tradition of serving lamb at Easter [see Halstead 1996, 2007]).

6.1.1 Differences between taxa

One of the most noticeable patterns seen across the faunal assemblages from the Late Bronze Age Tsaghkahovit Plain is an extreme focus on domesticated herd animals (Figure 6.1). The vast majority of the assemblage is composed of the remains of domesticated sheep, cattle, and goats. Less than 5% of the assemblage is composed of other species, including domesticated equids, wild equids, pigs, and a range of other taxa found in very small amounts (see Appendix A). This pattern is similar to the Bronze and Iron Age faunal remains from the nearby site of Horom in the Shirak Plain (Badaljan et al. 1994) and the Early Iron Age faunal remains from the sites of Sos Höyük and Büyüktepe Höyük (Howell-Meurs 2001b).

Within this overall emphasis on domesticated herd animals, there is a macro-level pattern in the distribution of faunal remains from the major domesticated taxa. At Gegharot and at the Tsaghkahovit Citadel and West Settlement, sheep and goats numerically predominate over cattle. In contrast, at the Tsaghkahovit Residential Complex, cattle are more abundant than sheep/goats.[1] Given the size disparity between sheep/goats and cattle, this does not necessarily indicate that sheep/goats made a greater contribution to diets than cattle in some contexts, but it does suggest a spatial differential in practices of consumption of these two types of herd animals. Interestingly, there is very little differentiation in the relative balance of taxa between types of contexts of deposition within site sectors (see Appendix A).

1. The Bronze and Iron Age faunal remains from Horom also showed more cattle remains than caprines, but the total sample size was much smaller (Badaljan et al. 1994:20-21).

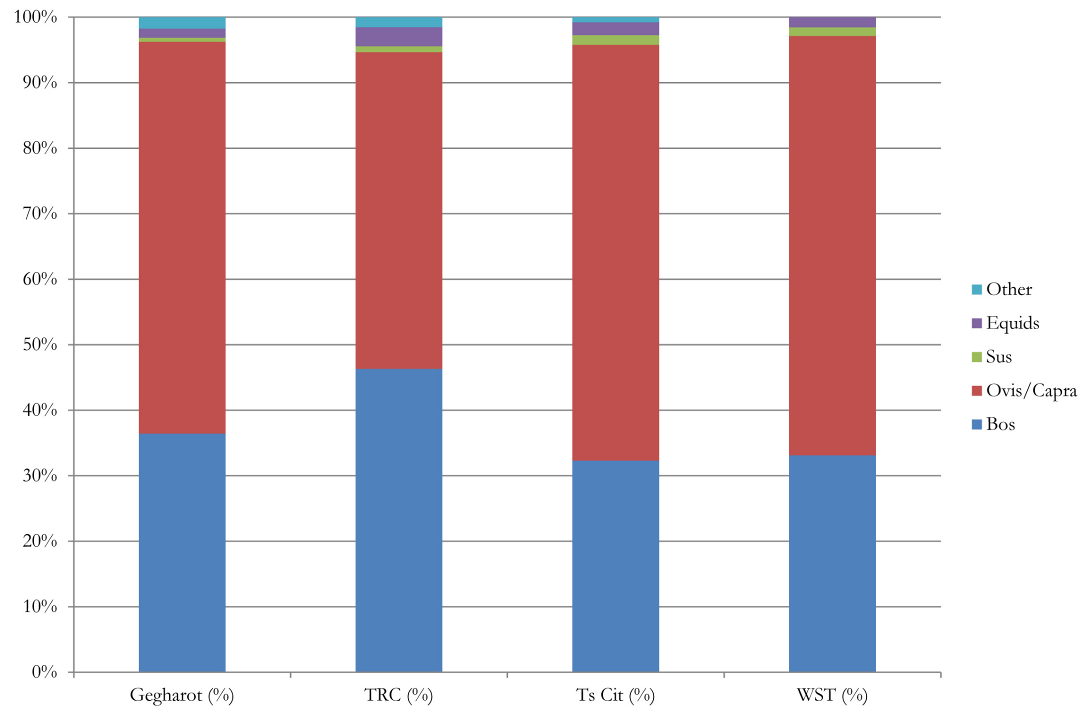

Figure 6.1. Relative proportion of major taxa (NISP).

Across all the assemblages, there is a consistent emphasis on sheep over goats. The ratio of sheep to goats ranges from 3.4 to 9.7, meaning that within the overall emphasis on caprines, sheep are the dominant species. In the zooarchaeological literature, the ratio of sheep to goats has been argued to reflect a wide range of economic and environmental factors (e.g. Bokonyi 1987:27; Zeder 1991:162, 202, 235; Piro 2009:70, 266; Sasson 2010:34-35). Traditional models of provisioning in the Near East might interpret this abundance of sheep as a result of provisioning (understanding the narrow focus on sheep as a form of specialization) or as evidence for intensive textile production.[2] More functionalist interpretations stress the relative environmental capacities of sheep versus goats, and in such models, more sheep are read as a sign of relatively abundant, non-arid pasture conditions or as an emphasis on meat production over herd security. Regardless of the

2. Currently there is no evidence for intensive levels of textile production in the Tsaghkahovit Plain.

particular model, all of these interpretations view an emphasis on sheep as a movement away from "simple" pastoralist subsistence.

These arguments are, essentially premised on different affordances of sheep versus goats, but the interpretive consequences of these 'material' differences are highly dependent on the assumptions built into the provisioning model (see Chapter 3). Working outside of these assumptions (which see pastoralism as highly environmentally determined and pre- or apolitical), it is not entirely clear how to interpret the emphasis on sheep over goats in the Late Bronze Age Tsaghkahovit Plain. Isotopic analysis does not indicate any drastic differences in mobility or birth seasonality (though this analysis is hampered by the small number of goats that were analyzed), nor does the analysis of faunal assemblages reveal major differences in the post-mortem circulation of their remains. There is tentative evidence for differences in culling patterns between sheep and goats (see below), which is indicative of different herding practices. It is worth noting that, according to Dahl and Hjort (1976:250, 269), sheep are more labor-intensive to herd than goats. So, regardless of the reasons for the imbalance, the preference might have created a greater demand on herder labor and more intensive care for herds. Nevertheless, both sheep and goats were interred whole in human burial monuments, and both are found in the special deposits of fauna associated with the shrines at Gegharot.

6.1.2 Differences based on age and sex

For herd animals in the Late Bronze Age Tsaghkahovit Plain, there are clear differences in the way that age and sex pattern the culling of the two major taxa of herd animals. Cattle and sheep/goats were culled differently on the basis of age and, to a lesser extent, sex. As Figure 6.2 shows, sheep and goats have a large cull of juvenile animals (10-30 months for caprines), with nearly half of sheep and goats being slaughtered in the first two years of

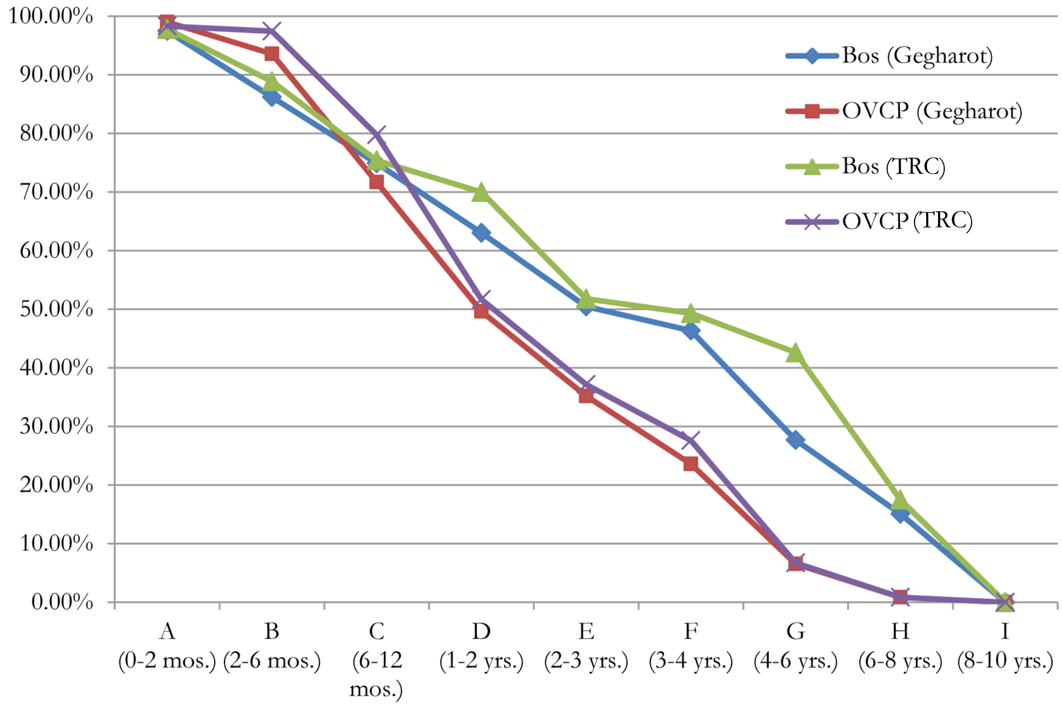

Figure 6.2. Cattle and sheep/goat survivorship based on tooth wear.

life and only 35% surviving beyond three years of age. In contrast, approximately 30% of cattle were slaughtered in the first two years and 50% of cattle survived to four years of age. The rate of culling of sub-adults and adults is similar across species. This difference is consistent between Gegharot and the Tsaghkahovit Residential Complex, despite the different relative proportions of these taxa in those two assemblages mentioned above.

This pattern of culling is consistent across the different sites and within the different types of contexts of deposition at these sites. The relative severity of the cull of young sheep suggests that individuals deposited on site do not represent the total reproductive unit, but rather the off-take of young animals, with older animals being slaughtered and deposited elsewhere. This seems especially likely given the patterning seen in skeletal elements (discussed below). In contrast, the cattle deposited on site may reflect a wider demographic range of the herd. This could be indicate that cattle herding, and the consumption of

Innominate	Male	Female	Ratio	Horn Cores	Male	Female	Ratio
Sheep/Goat - Gegharot	87	102	0.85	Sheep/Goat - Gegharot	44	7	6.29
Sheep/Goat - TRC	21	32	0.66	Sheep/Goat - TRC	15	2	7.5
Bos - Gegharot	20	6	3.33	Bos - Gegharot	-	-	-
Bos - TRC	4	6	0.67	Bos - TRC	1	0	-

Table 6.1: Ratio of osteologically male to female skeletal elements.

cattle, was organized in a way that connected them more closely either to the people living within or near the sites or to activities that took place within or near the sites. This line of explanation may also account for the greater proportion of cattle seen at the Tsaghkahovit Residential Complex. However, the isotopic analysis suggests that at least some cattle were seasonally mobile.

The data from the stable oxygen isotope analysis of teeth from middens at Gegharot and the TRC indicate that there are likely two different age-based culling strategies that shaped sheep survivorship (based on tooth wear) in these assemblages. Some of the juvenile mortality represents the off-take of young animals in the first year (the survivorship curve shows a 20% drop), born at various points during the year to ensure consistent availability of milk. The rest of the mortality in the subadult age categories represents the culling of prime-meat weight animals from 2-3 years of age, all of which born during a narrow period of the annual cycle. This may have been a strategy to reduce the amount of labor associated with that facet of pastoral production.

The ratio of male to female animals in an assemblage can be assessed in two ways. First, certain skeletal elements (such as horns and pelvises) can be identified as male or female based on sexual dimorphism in skeletal morphology. The other method, metrical sexing, indirectly assigns sex to skeletal elements based on size. This method uses skeletal elements (such as scapulas, metapodials, and astragali) that are known to show significant size differences between males and females. By plotting measurements, individual bones can be sorted in groups of likely males and likely females.

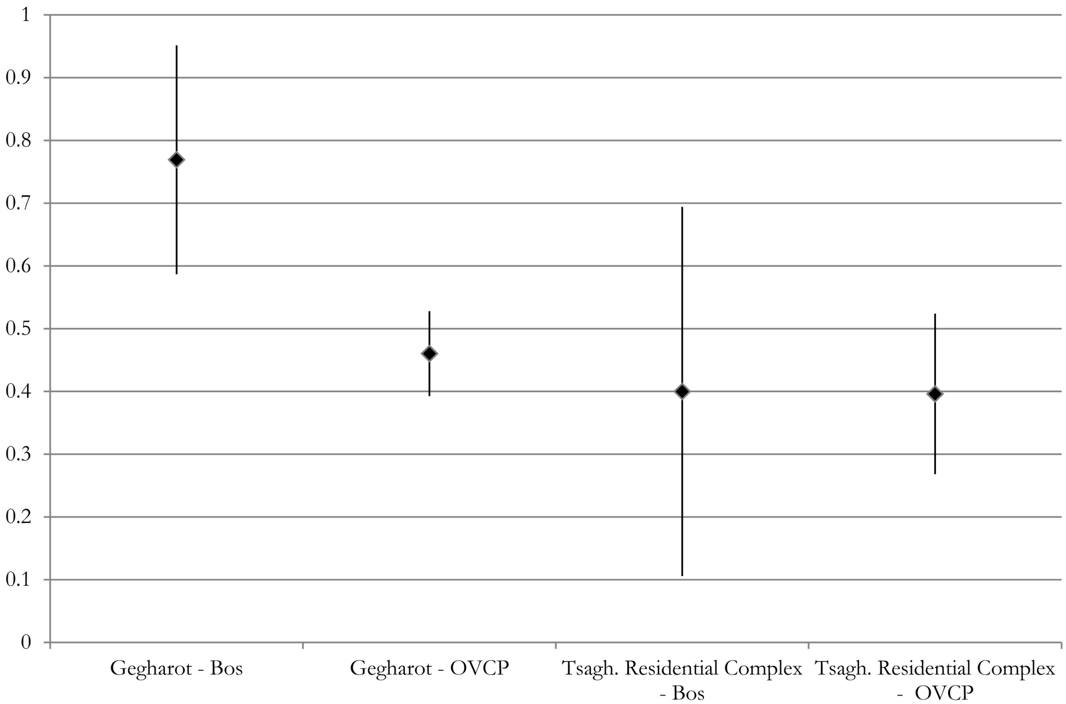

Figure 6.3. Proportion of innominates identified as male for cattle and sheep/goats, with 95% confidence intervals (calculated using multiple comparison of proportions [Buikstra et al. 1986]).

Generally, in the Tsaghkahovit Plain assemblages (see Table 6.1 & Figure 6.3), there are more female than male innominates. However, cattle at Gegharot show a much higher proportion of male pelvises. This difference is statistically significant, except for the small sample of cattle from the TRC. At Gegharot, there are no significant differences in the ratio of males to females between contexts of deposition (see Appendix A). In contrast, horn cores for both sheep and goats consistently show many more males than females.

Metrical sexing was hampered slightly by small sample sizes and a lack of clear separation between smaller and larger individuals (see Appendix A). Reasonable separation was seen in the plot of the distal breadth and depth of cattle metatarsals (Figure 6.4) and in the plots of the greatest length (GLl) of the astragalus for cattle, sheep, and goats at Gegharot (Figures 6.5 & 6.6). These analyses suggest that, for sheep and cattle at

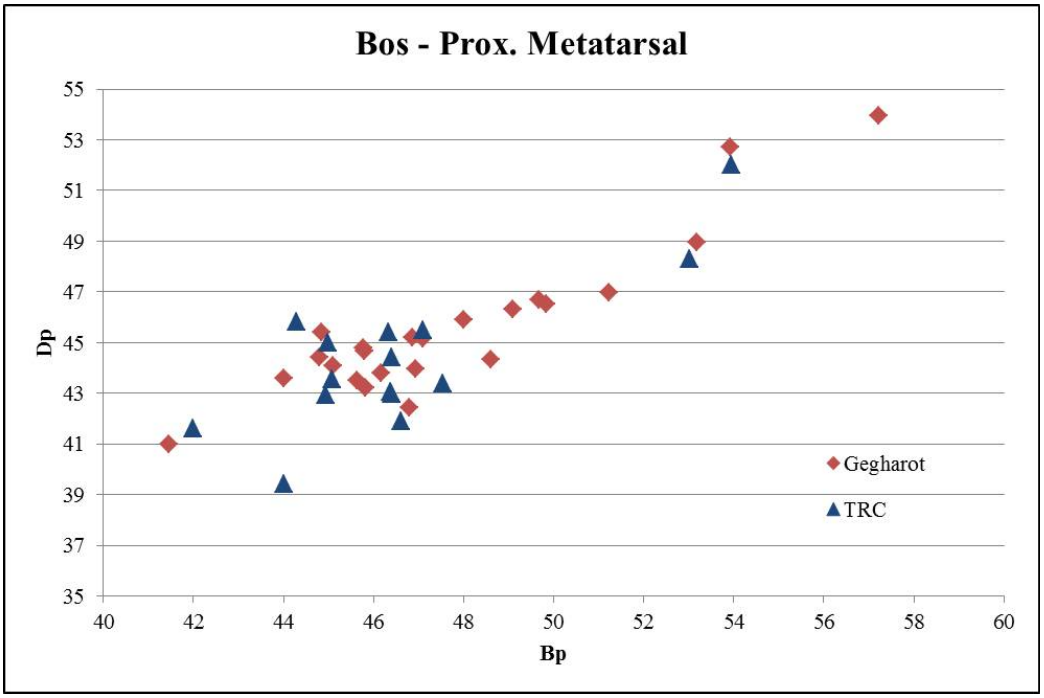

Figure 6.4. Metrical sexing for cattle metatarsals.

Gegharot, females predominated. In contrast, the plot of GLl for goats indicates a more even distribution between males and females. At both Gegharot and the TRC, the plot of cattle metatarsals also suggest that females predominated.

As the metatarsals fuse after the pelvis (0-12 months vs. 7-30 months [Silver 1969; Zeder 2006; Popkin et al. 2012]) and sexing is only done on fused elements in either method, differences in the sex ratio between pelvises and metatarsals may reflect the different sex-based culling patterns for different ages of animals. The data for cattle from Gegharot (and potentially also the TRC) tentatively suggest that more males were culled at a younger age, thus explaining the difference in the sex ratios seen in the earlier fusing pelvis and the slightly later fusing metatarsal.

The metrical data from astragali are interesting for two reasons. First, the differences between the plots of sheep and goat GLl suggests that those two species may have been culled according to different criteria at Gegharot (this is not reflected in the horn core data).

Second, astragali are over-represented in the faunal assemblage overall (see below) and they appear to reflect a different sex ratio than the pelvises (as does the horn core data), especially for cattle at Gegharot.

In any event, the high proportion of males (based on sexable skeletal elements), especially for cattle innominates at Gegharot (and potentially, also for the sheep and goat horn cores) does not fit with any likely culling pattern in standard herding models. Regardless of whether production is oriented towards the production of meat, milk, or herd stability, more females than males should be present, as they are more critical to the reproduction of the herd. Similarly, the high levels of juvenile sheep and goat mortality also seem to be beyond the limit for the reproductive viability of a herd. Thus, it is highly likely that the assemblages at sites in the Tsaghkahovit Plain present only a partial picture of the herds present in the Tsaghkahovit Plain.

The contrast between the innominate and metatarsal data for cattle may indicate that some of the animals consumed at Gegharot and the TRC were the off-take of young males from other herds (for meat and/or to avoid competition with humans for milk). It is less clear, however, why there is such a strong contrast between the innominate, metrical sexing, and horn core sex ratios. Potentially horn were curated for tool manufacture or other purposes, but it still remains an open question as to why they were only being sourced from male animals. Nevertheless, if the prevalence of young male pelvises is a result of practices of provisioning by outside pastoralist herds, it then becomes surprising that there are females present in the assemblage in any number. This may be evidence of a mixture of local herding and outside provisioning (see below).

The abundance of young male cattle at Gegharot may be an indication of practices that emphasized the use of herd animals as allocative resources. Reid (1996) draws a distinction between the use of cattle as an allocative resource, one that can be distributed, and authoritative resource, one that plays a role in social practices that create or maintain

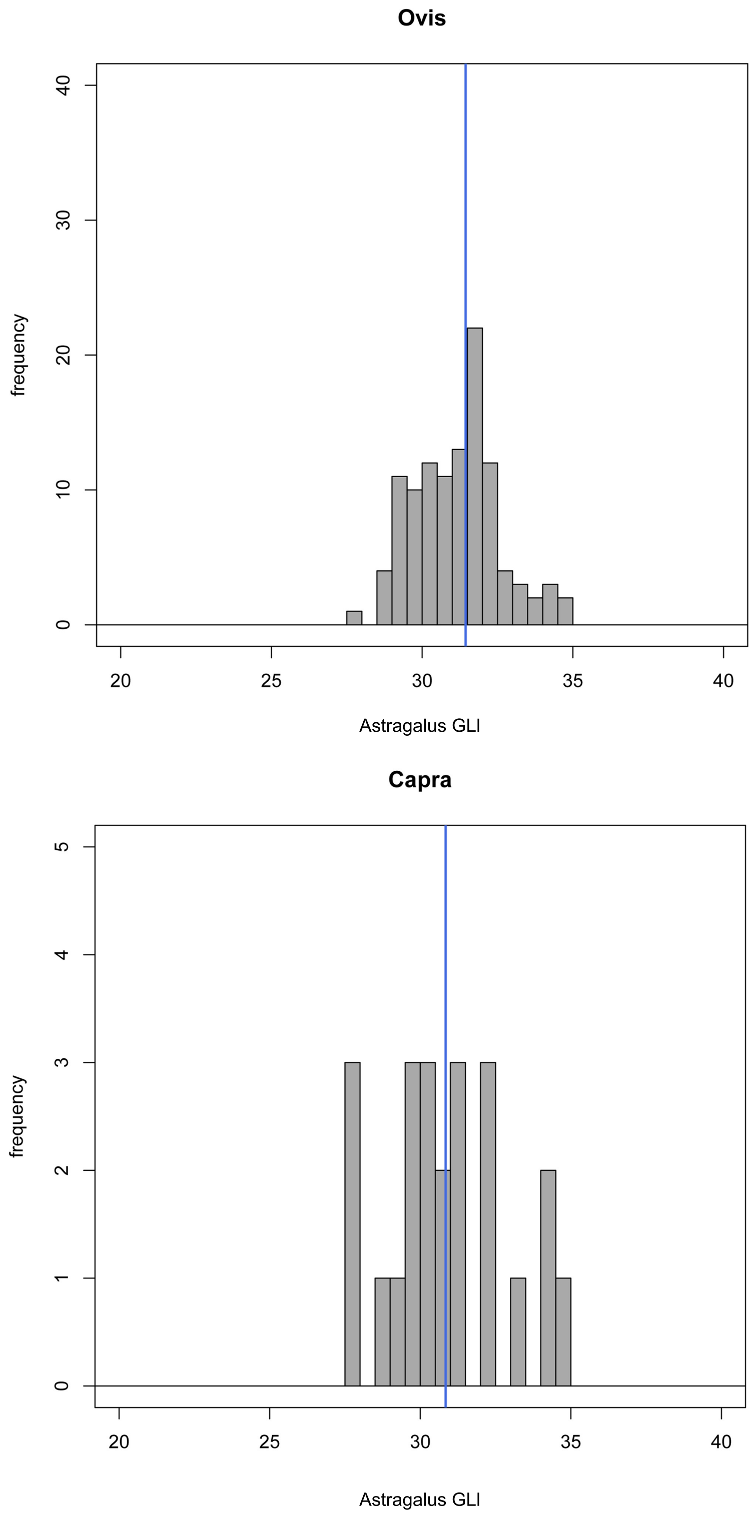

Figure 6.5. Distribution of GLl for sheep/goat astragalus at Gegharot.

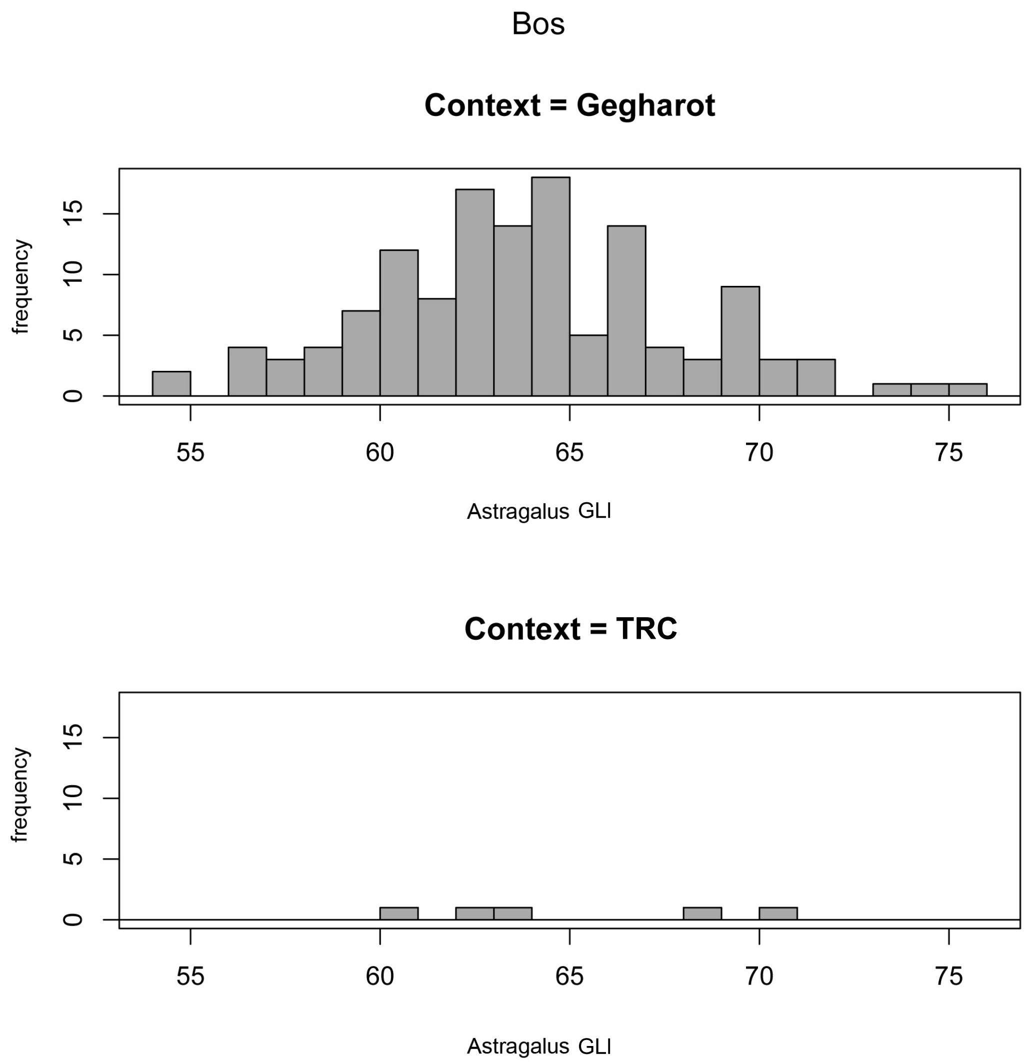

Figure 6.6. Distribution of GLl for cattle astragalus at Gegharot.

social relationships (see Chapter 3). The first typically refers to the use of male animals for their meat, either through distribution or communal consumption. In contrast, the second encompasses practices such as bridewealth and clientship arrangements, which rely on female animals (and their future reproductive potential).

Male animals are, in some ways, more suited towards use as allocative resources, due to their lower reproductive potential. Thus, the consumption of young male cattle may have been a form of distribution of meat that was meant to enhance or establish political authority, though probably not through practices of mass communal consumption (see below). It is also possible that these sorts of practices also explain the large number of male sheep and goat horn cores and the steep mortality seen in sheep and goats. However, the limited metrical sexing data does not shed much light on changes in the sex ratio of culling over different ages for sheep and goats.

On the other hand, the prevalence of female cattle (particularly in the analysis of metatarsal breadth and depth), may be a reflection of practices that resulted in a gentler rate of mortality for cattle. The emphasis on older female cattle may reflect the use of herd animals as authoritative resources, whose value is in their capacity for the reproduction of the herd, extending social relationships through time. While it might be possible to interpret the differences between cattle and sheep/goat mortality as reflecting a more local system of cattle herding, as opposed to a more extensive system of sheep and goat herding, the strontium isotope data presented in the previous chapter showed no difference in geographical origins between the different species. The differences in herding practices between cattle and sheep/goats seems to be more about differences in distribution and consumption than the spatial scale of pastoralist and herd mobility.

In light of these distinctions, it is interesting that the sheep and goats interred whole in burials are generally very young animals (less than one year).[3] Unfortunately, it was not possible to determine the sex of the whole individuals buried in Gegharot Kurgans 1 & 2, but it was possible for the three caprines buried in Burial 02 in Tsaghkahovit Burial Cluster 12. In Burial 02, two of the young animals interred were males and one was a female. Smith (2015:145) argues that the inclusion of precious and finely-made objects (sometimes in large numbers) in burials was a way of removing wealth from circulation, which served to create and maintain social differentiation in Middle Bronze Age societies in the South Caucasus. Viewed in this way, the inclusion of animals in burials works in a slightly different manner depending on the sex (as well as age) of the animal included. The interment of whole male animals represents a much less significant removal of wealth from circulation, in contrast to the inclusion of a young female animal, which represents the loss of all of that individual's future reproductive potential.

6.2 Body part distribution: Tracking consumption in and out of frame

The analysis of body part distribution reveals that there are two different groups of faunal remains present in the assemblages from sites in the Late Bronze Age Tsaghkahovit Plain. First, there are the faunal remains that represent the butchery and consumption of (more or less) whole animals, where the majority of skeletal elements are deposited on site. Second, there is another group of animals which are visible in the faunal assemblages from the sites through the presence of one or two isolated skeletal elements (found in great abundance), while the rest of skeleton is absent from the assemblage.

3. This is in contrast to the horses included in central chamber of Gegharot Kurgan 1, which were determined to be older individuals (Badalyan et al. 2008:61).

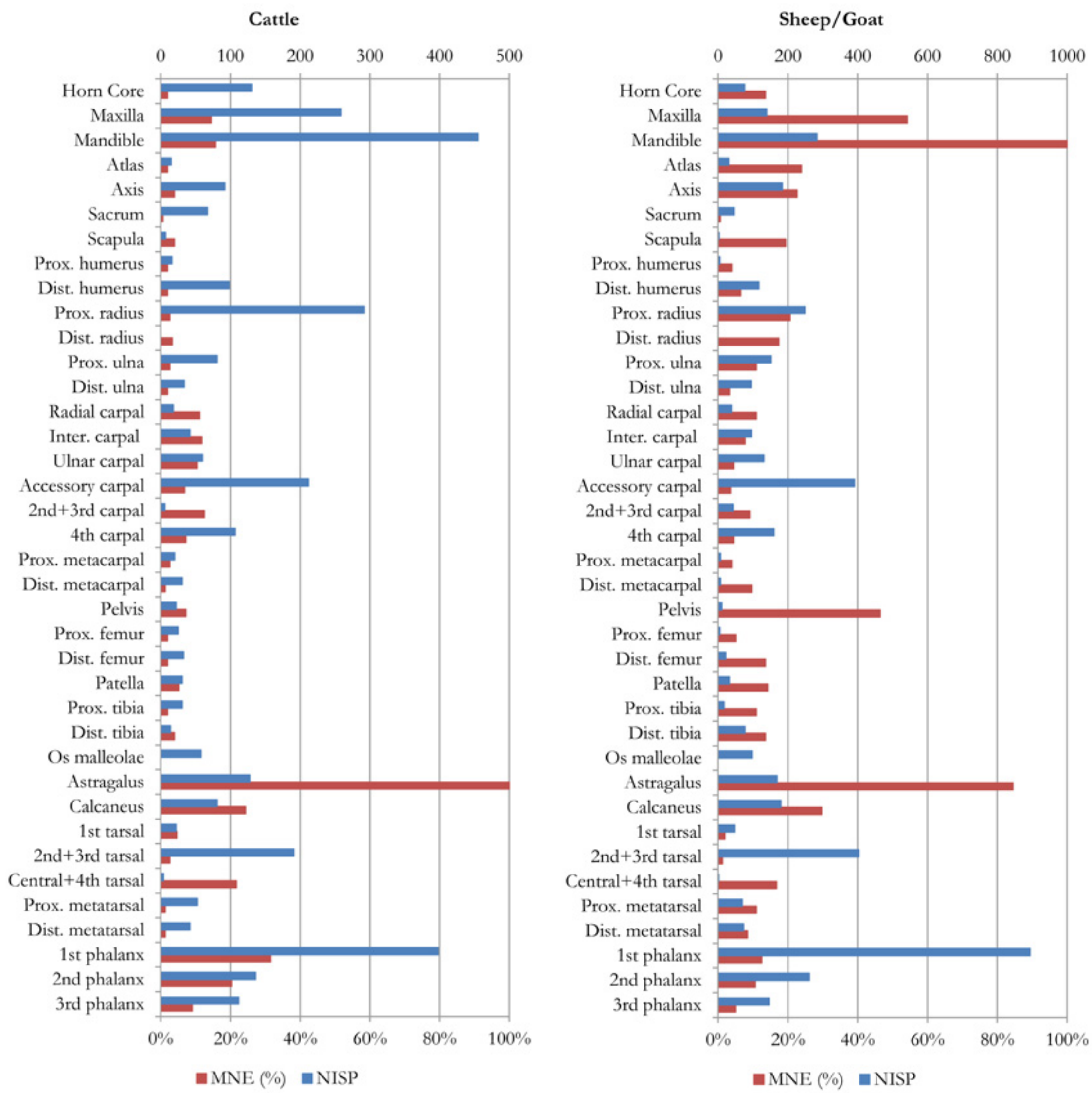

Figure 6.7. Cattle and sheep/goat body parts at Gegharot based on a) NISP and b) MNE (as percentage of the most abundant element).

Overall, analysis of the Minimum Number of Elements (MNE)[4] shows that across the faunal remains from Gegharot (Figure 6.7), cattle astragali are present in numbers well beyond any other skeletal element: 100% vs. 32% for the next most numerous element (expressed as a proportion of the most numerous element). For sheep/goats, mandibles and astragali are the most numerous (100% and 85% respectively), with the next most abundant elements (maxillae and innominates) are less than 60%. At the Tsaghkahovit Residential Complex (Figure 6.8), analysis of MNE for the entire assemblage shows a serious overabundance of calcanei, the next most abundant element is only 35% of the total for calcanei. For sheep/goats, mandibles[5] and innominates dominate the assemblage, and while there are reasonably large numbers of scapulae and astragali (>60%), the remaining elements are comparatively less abundant. Notably, this overabundance of isolated skeletal elements remains consistent across the two phases of Late Bronze Age occupation at Gegharot (Figures 6.9 & 6.10).

One problem with MNE is that it is sensitive to the level of aggregation (Lyman 2008), which means the relative abundance of skeletal elements is in part determined by how the assemblages are divided into groups. However, when the assemblages at Gegharot and Tsaghkahovit are divided into contexts of deposition, the general pattern of one or two overabundant elements alongside a relatively even representation of the rest of the skeleton (at a much lower level of abundance) is still present. What does happen is when the level of aggregation is changed, there is a slight shift in which specific elements are overabundant (see Appendix A for a full discussion).

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4. Body part representation was also assessed using NISP, but since NISP is influenced by both fragmentation and the number of each element per individual, results here are presented using MNE. For a full discussion of body part representation using both NISP and MNE, see Appendix A.

5. The dominance of mandibles across the assemblages is somewhat surprising, given that the method for calculating the MNE for that element (as detailed in Appendix A) is relatively conservative – it prioritizes avoiding double-counting individuals at the risk of undercounting relatively complete specimens.

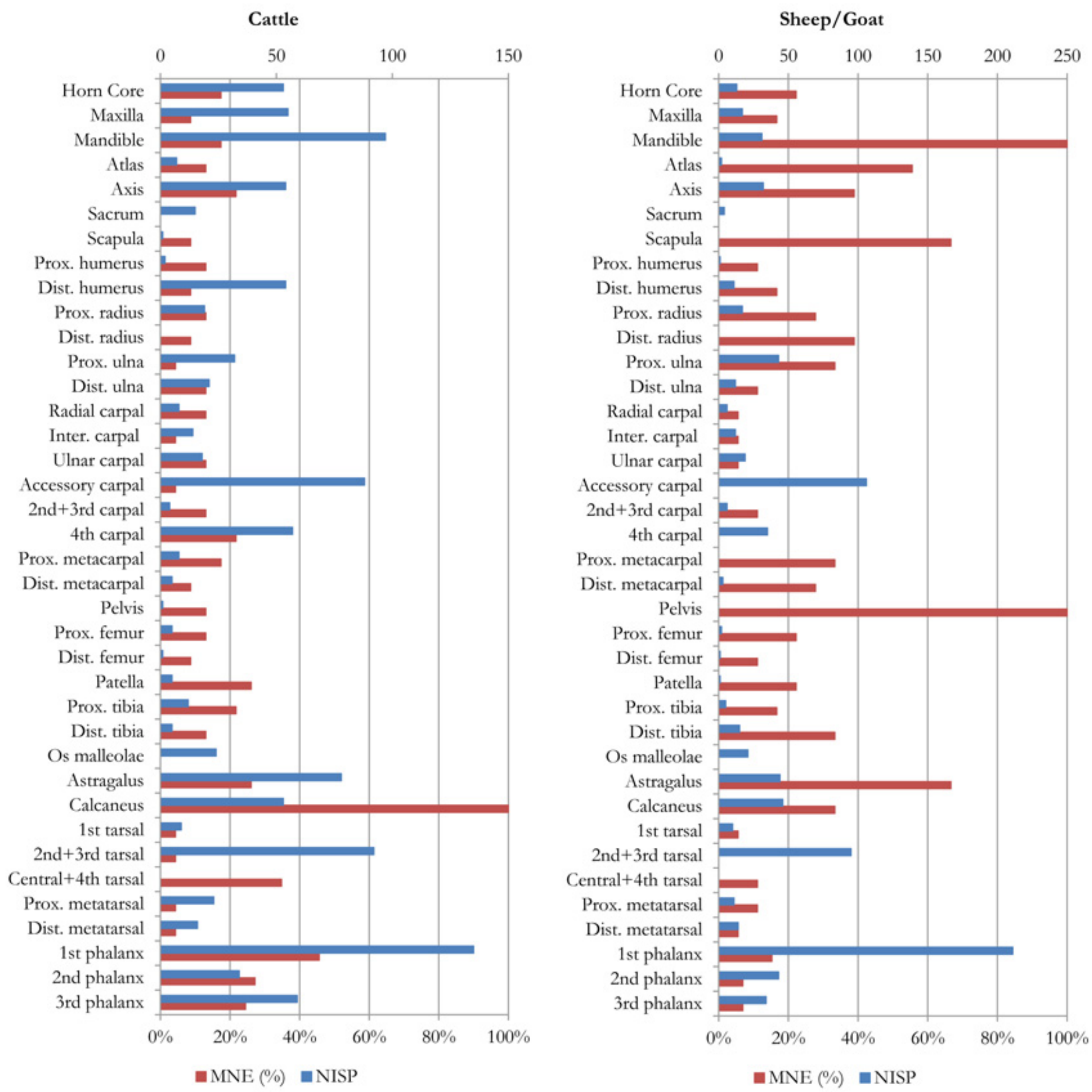

Figure 6.8. Cattle and sheep/goat body parts at the Tsaghkahovit Residential Complex, based on a) NISP and b) MNE (as percentage of the most abundant element).

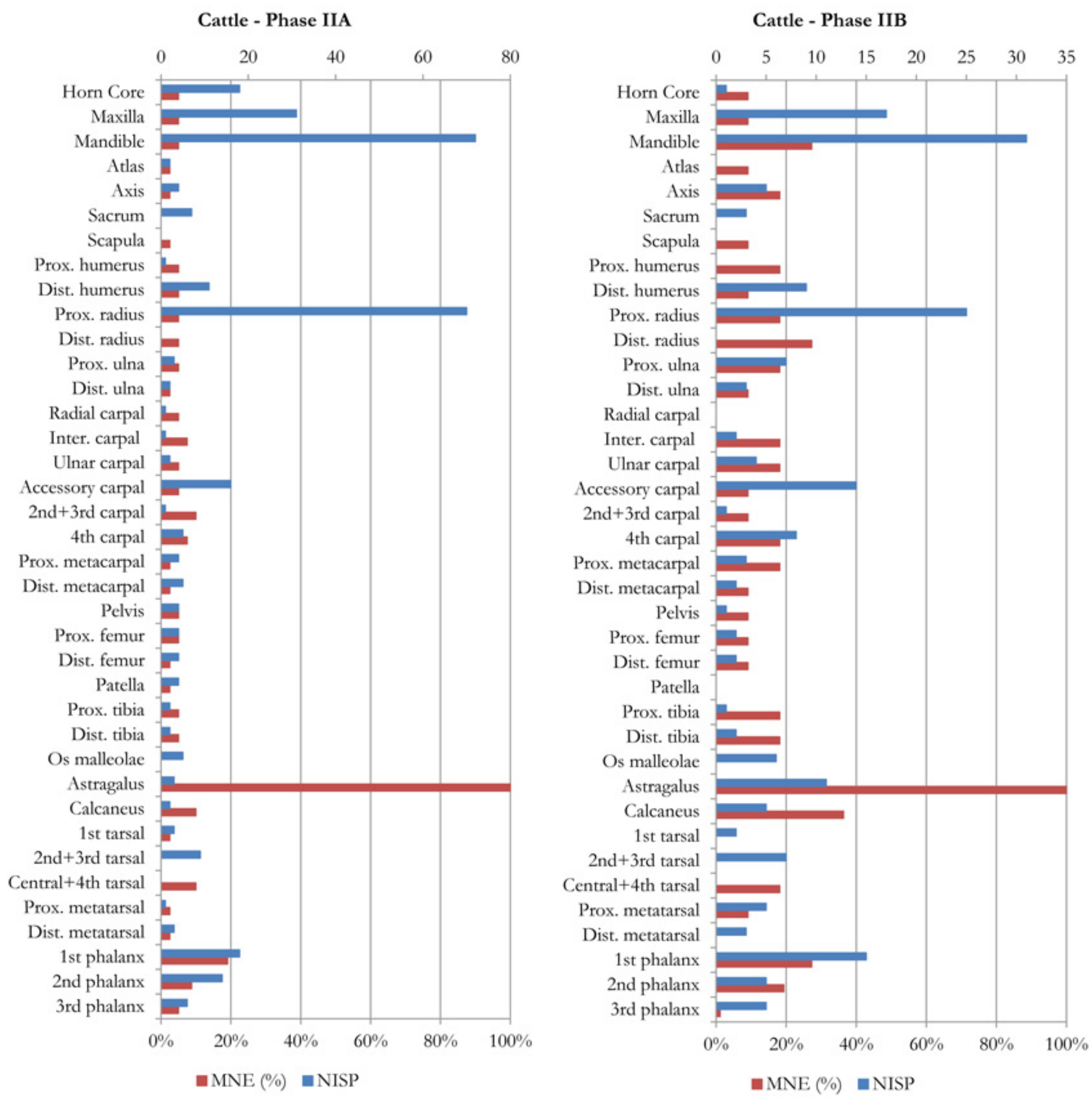

Figure 6.9. Body part representation based on NISP and MNE (as a percentage of the most abundant element) for cattle in Phase IIA and IIB.

For cattle at Gegharot, astragali appear as outliers in all types of contexts of deposition. In addition, at the lower level of aggregation, two new patterns appear. First, for intramural trash, midden, and wash contexts, astragali, calcanei, and central 4th tarsals are the overabundant elements. This is intriguing, as together these elements comprise the lower joint on the hind limb (connecting the metatarsal to the tibia). Moreover, those context types (as well as floor contexts) also show an overabundance of mandibles. For sheep/goats at Gegharot, all context types show an overabundance of astragali, and all but destruction layer and floor contexts show an overabundance of mandibles. Fill and wash contexts also have many more calcanei.

At the Tsaghkahovit Residential Complex, sheep/goats mandibles are overabundant in all context types. In contrast, innominates (which dominated the total assemblage) only appear as outliers in floor contexts at the TRC. Sheep/goat astragali and calcanei are overabundant in wash and fill contexts at the TRC. For cattle, the picture is slightly more complicated. While calcanei are overabundant in the assemblage as a whole, they appear as outliers in the MNE for only midden and wash contexts (though these contribute about 60% of the overall NISP of the TRC assemblage). Floor, midden, and wash contexts show astragali as outliers, and mandibles appear as outliers in floor and midden contexts.

Taphonomic analysis suggests that this patterning is not primarily a reflection of post-depositional destruction of faunal remains (there is very little evidence of density-mediated attrition, see Figure 6.11), but instead, results from Late Bronze Age activities. The greater variation in outliers between context types at the TRC may be a result of two different factors. First, the smaller assemblage collected at the TRC may be more sensitive to the problem of aggregation (Lyman 2008:223). Second, this result may indicate that the practices of deposition connected to different activities of distribution and consumption may have been more differentiated at the TRC than at Gegharot.

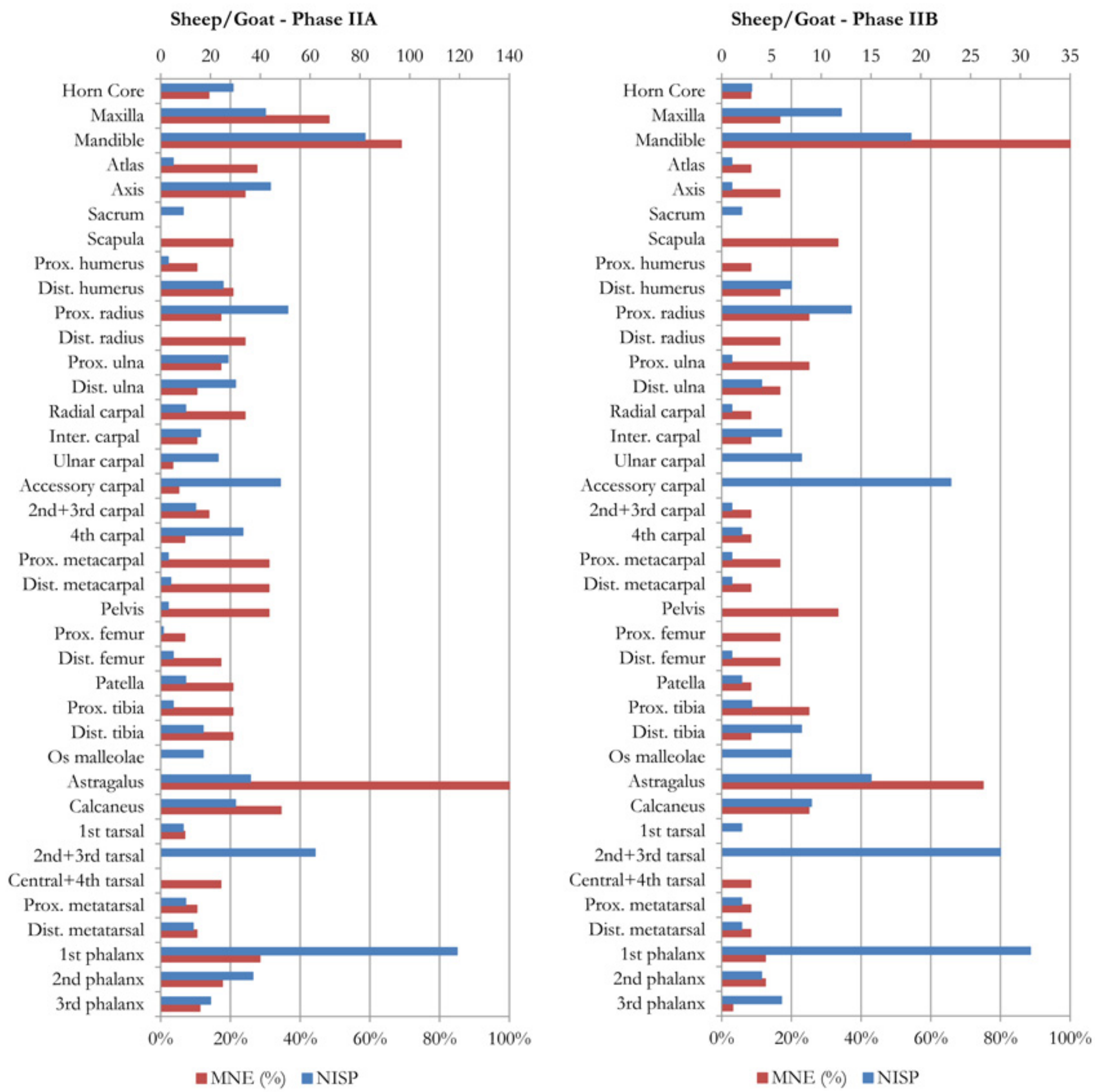

Figure 6.10. Body part representation using NISP and MNE (as a percentage of the most abundant element) for sheep/goats in Phase IIA and IIB.

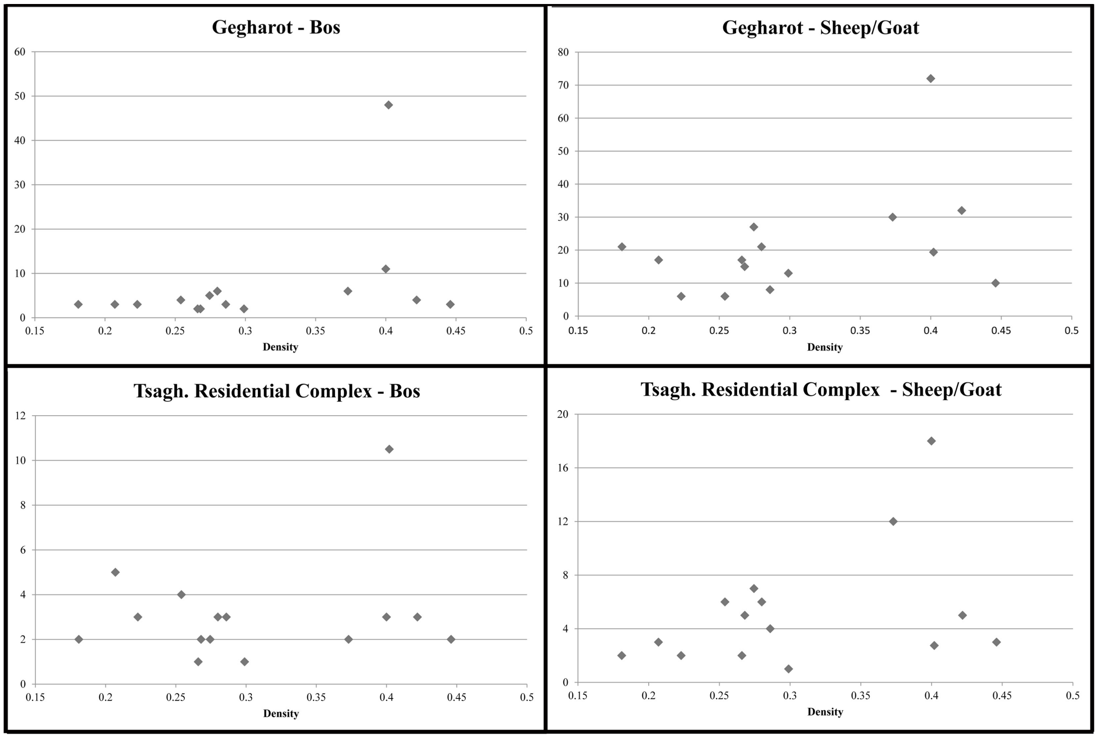

Figure 6.11. Plot of NISP versus bone-density to assess density-mediated attrition.

The patterns seen at the lower level of aggregation support the overall conclusion that there are two different groups of faunal remains within the faunal assemblages from Gegharot and the Tsaghkahovit Residential Complex. Group 1 are the (more or less) whole skeletons that are deposited in smaller numbers in the assemblage. Group 2 are the overabundant isolated skeletal elements. These groups result from the deposition of the remains of two sets of spatially-differentiated consumptive practices. Unfortunately, it is more difficult to say if these groups also represent the result of two different sets of culling practices. Mandibles (which are overabundant) provide age but not sex data and, similarly, sexable elements are not evenly distributed between the two groups.

The consumption of Group 1 appears to have taken place within or near enough to the sites that most of the butchery and consumption waste was deposited onsite. Looking at skeletal element patterning by weight sheds additional light on this question. MNE and

NISP only include skeletal elements that can be identified to the level of the genus or better. This systematically excludes skeletal elements that generally can only be assigned to body size categories, such as ribs and vertebrae. This leads NISP and MNE to underrepresent the presence of axial and head elements in the assemblage. One way to overcome this is to compare the proportions of skeletal weight of five anatomical regions (lower limb, upper limb, girdle, axial, and head as defined by Russell and Martin [2005:95]) of using the faunal remains identified to body size (sheep size and cow sized) in the assemblage to the proportions by weight of skeletal elements from two type skeletons (Soay sheep skeletons from the Institute of Archaeology, UCL and the Ullerslev aurochs skeleton [Steppan 1999]). This method maximizes the information obtained from remains only identifiable to body size. While this method lumps cervids in with cattle, and pigs and gazelle with sheep and goats, for the assemblages in the Tsaghkahovit Plain (given their low diversity), this is unlikely to have a meaningful impact on the patterning of the distribution of body parts.

This analysis (Figure 6.12) indicates that for cattle, there are less axial and skull skeletal elements than would be expected, suggesting that some butchery of these larger animals may have taken place off-site and those waste remains were left there. There is also slight evidence for an overabundance of forelimb elements for sheep/goats, which may indicate a small amount of preferential selection for that area of the body. Lastly, it is slightly surprising that the outliers identified by MNE do not seem to shift the representation by body weight. Potentially, the overabundance of specific skeletal elements is being masked by under-abundance of other elements in the same anatomical region, but further analysis is needed to confirm this.

A more in-depth investigation of food preparation is underway, but initial analysis of the assemblage from Gegharot provide evidence for both the roasting of meat, as well as the toasting of bone shafts to aid the extraction of marrow (see Appendix A for a full

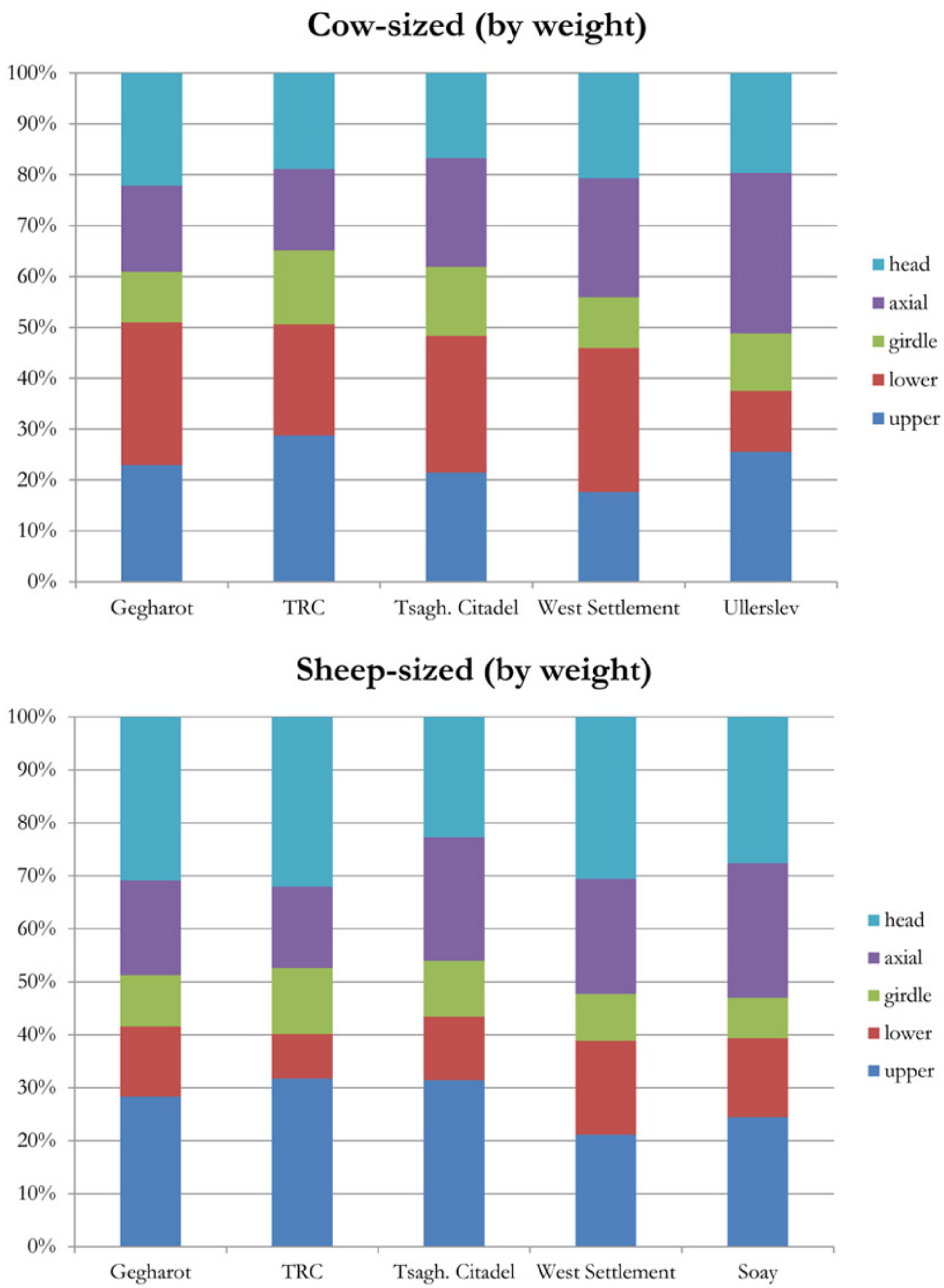

Figure 6.12. Overall distribution of skeletal elements by weight.

discussion).[6] Both cattle and sheep/goats showed similar levels of roasting (<1% of faunal remains), and only sheep/goats showed evidence of marrow toasting. It is not yet possible to link these different food preparation practices to other aspects of food preparation and consumption, such as cooking and serving vessel forms, but that will likely prove a fruitful avenue for future research.

In contrast, the consumption of animals whose remains form Group 2 is happening almost entirely "out of frame". These practices of distribution and consumption are only visible through the transport and deposition of isolated skeletal elements on site. From these isolated elements, it is difficult to address many of the key questions: Who is consuming these animals and in what contexts? How do these practices relate to those activities taking place within the sites in the Tsaghkahovit Plain? But prior to developing answers to those questions, we must first try and understand why these specific parts of herd animal bodies might have been brought on site.

One possible explanation for the overabundance of lower limb elements is that they represent evidence for the preparation of skins/hides, where the smaller limb bones are retained within the skin at the edges of the hide. However, generally the phalanges are the elements preserved in the skins, not the tarsals above them (see Zeder et al. 2013:117). Furthermore, the equivalent bones of the forelimb are not present as outliers in the assemblages. Thus, it is unlikely that the patterning seen in the Tsaghkahovit Plain is a result of this practice. There is no equivalent explanation for the presence of the large number of mandibles on site. No mandibles show signs of working, and thus were probably not collected for the manufacture of tools or other objects. It is also worth noting that mandibles may have been coming without the rest of the skull, since skull elements other than mandibles appear to be under-represented.

6. There was no evidence for either practice in the assemblage at the TRC.

	Cattle			Sheep/Goat (Total)			Sheep	Goat
	L	R	*Worked*	L	R	*Worked*	L/R	L/R
T2 Locus E640	7	3	*1*	0	4	*1*	0/3	
T18 Locus 11	2	4	*1*	-	-	-	-	-
T22 Locus 7	16	11	*8*	20	17	*7*	16/13	3/7
T28 Locus 39	5	3	-	2	2	-	2/2	-
T28 Locus 43	7	5	-	1	5	-	1/2	0/2
T32 Locus 36	3	4	*1*	-	-	-	-	-
T32 Locus 37	4	5	*3*	1	1	*1*	0/1	1/0

Table 6.2: Loci with large numbers of astragali at Gegharot.

Analysis of the spatial distribution of overabundant isolated skeletal elements (astragali, calcanei, mandibles) reveals that the overabundant isolated skeletal elements at the Tsaghkahovit Residential Complex are more or less evenly distributed across contexts yielding faunal remains. The same is true of cattle mandibles, and both cattle and sheep/goat calcanei at Gegharot. In contrast, sheep/goat mandibles and cattle, sheep, and goat astragali show uneven spatial distribution between trenches. While the distribution of sheep/goats mandibles at Gegharot is generally even, there is a large concentration of sheep/goat mandibles (MNE = 21, *Ovis* MNE = 14) in the T2 Locus 23 midden.

While astragali are found in a wide variety of contexts across the site of Gegharot, there are also specific loci with unusually large numbers of astragali (Table 6.2). Locus 11 in T18 was a Late Bronze Age pit that contained a large number of bones, including eight cattle astragali. Similarly, Locus 43 in T28 was an large early LB pit with lots of faunal remains (as well as some tools), included twelve cattle astragali. Also in T28, eight cattle astragali were found in Locus 39 – a clay platform dating to the earlier LB occupation at Gegharot.

The remaining loci where unusually high concentrations of astragali are located are spatially associated with the shrine contexts at Gegharot.[7] Locus E640 in T2 was a large

7. In this regard, there is an intriguing comparandum from the Iron Age site of Horom, located in the Shirak Plain. There, excavators uncovered a cache of 45 astragali and 56 metatarsals from both cattle and

pit located in the northwest corner of the West Terrace shrine, which contained ten cattle astragali and 4 sheep/goat astragali. There is a large concentration of astragali associated with the East Citadel shrine. Across three contiguous loci associated with the shrine, 43 cattle astragali (23 left, 21 right) and 38 sheep/goat astragali (21 left, 18 right) were found. In Trench 22, Locus 7 contained 37 sheep/goat astragali (7 of which were worked – 3 left, 4 right) and 27 cattle astragali (8 worked – 5 left, 3 right). In Trench 32, Loci 36 & 37 had unusually large numbers of astragali. Locus 37 was an ashy deposit covered by a groundstone, containing 9 cattle astragali (3 worked – 2 left, 1 right) and one left goat astragalus (worked) and one right sheep astragalus. Nearby Locus 36 (from the baulk) had 7 cattle astragali.[8] Worked astragali were also found in two of the complete vessels found in the East Citadel shrine.

The same spatial patterning – where astragali are found both in a wide variety of contexts across the sites in the plain, but are found in high concentrations in specific loci – is found for worked astragali. These worked astragali – which have burning, polishing, and/or vertical striations on the posterior surface – are found in a wide variety of contexts in the Tsaghkahovit Plain, including contexts at Gegharot, Aragatsi Berd, the Tsaghkahovit citadel,[9] and the Tsaghkahovit Residential Complex. This suggests that whatever reason astragali were preferentially brought into sites, within this, a distinction can be drawn

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red deer inside a stone installation (Badaljan et al. 1994:18). The authors suggest that this cache was also related to esoteric activities such as sacrifices and divination. However, the inclusion of metatarsals and bones from non-domesticated species are points of important difference between the two. Also, it is not possible to determine how this cache relates to more quotidian patterns seen in other faunal remains from the site (but see Badaljan et al. (1994) for basic information on the faunal remains from the excavations at Horom).

8. There are no caches of astragali associated with the West Citadel shrine.

9. A large number of worked astragali (12 *Bos* [5 left, 7 right]; 3 *Ovis* [2 left, 1 right]) were found on a floor in C2 at Tsaghkahovit, near to a pair of grinding stones, one of which was covering a pit. This is somewhat similar to the situation found in the East Citadel shrine, but later intrusive occupations at Tsaghkahovit make it impossible to determine whether there was a shrine at Tsaghkahovit.

between more and less marked forms of collection. The presence of astragali in a variety of waste contexts across the sites was not unusual, even as certain concentrations of these isolated skeletal elements may have been the site of focused attention in particular spaces, at specific times.

6.3 Osteobiographies

Within the general patterns of spatial mobility, seasonal mobility and post-mortem social lives of herd animals seen in the assemblages form the Tsaghkahovit Plain, there are a number of individuals whose biographies represent deviations from the main patterns. One way of approaching these differences analytically is to contextualize them within the individual's pre- and post-mortem biographies. Doing so allows us to ask the question of whether, or in what ways, are exceptional aspects of an animal's life experience determined by prior moments in their biographies or channel them into particular subsequent paths. In this way, seemingly exceptional cases are located within the spectrum of possible animal biographies, making more nuanced interpretations possible.

In the following sections, I present a discussion of individuals with extra-ordinary biographical experiences, grouped by pre- and post-mortem experiences. But first, it is necessary to try and establish the parameters of what constituted typical experiences and biographical trajectories for herd animals in the Late Bronze Age Tsaghkahovit Plain. In order to do this, the results of the analysis of isotopic data must be articulated with the patterns identified through the zooarchaeological analysis of faunal remains.

It is difficult to assess whether, or in what ways, the different groups identified in the oxygen isotope analysis overlap or intersect with the two groups identified through the analysis of body part representation. The two groups of sheep identified through the analysis of stable oxygen isotopes are separated by both age at death and birth seasonality.

These groups represent two different patterns in the organization of pastoralist labor, centered on managing the production of dairy and of prime-weight meat animals separately. Nevertheless, the post-mortem distribution of these animals does not seem to be spatially differentiated.

It is important to recall that the isotope analysis is based on the analysis of teeth, and in light of the unique patterning seen in skeletal elements at sites in the Tsaghkahovit Plain, is only representative of a limited part of the post-mortem distribution and consumption of herd animals. Since mandibles are one of the overabundant isolated skeletal elements (especially for sheep), potentially, the groups seen in the isotopic analysis are only representative of sheep that end up as part of Group 2 skeletal elements post-mortem. The unfortunate consequence of this fact is that it becomes difficult to analyze the culling decisions based on sex, since mandibles are not sexually dimorphic, and it is likely the sexable elements from the Tsaghkahovit Plain assemblages belong to animals in Group 1.

However, comparison between Group 1 and Group 2 on the basis of age-based culling decisions is possible through the comparison of mortality based on tooth wear and epiphyseal fusion. The first provides information on the culling decisions that shaped at least part of Group 2 (i.e. mandibles), and the latter sheds light on the culling of animals in Group 1 (as it is based on skeletal elements, such as long bones). The mortality patterns in the epiphyseal fusion data are very similar to those seen in the toothwear data (Figure 6.13). Sheep/goats show a higher mortality of younger animals than cattle. The only divergence is that sheep/goats at the TRC show a slightly less severe cull in Stage III, suggesting that there may be more older animals present than at Gegharot (see Appendix A for a full discussion). These results suggest that both Group 1 and Group 2 share similar culling practices based on age, and that they both likely represent a composite picture based on multiple herding strategies. At this point, there is no evidence that Group 1 and Group 2 were made through different age-based culling decisions.

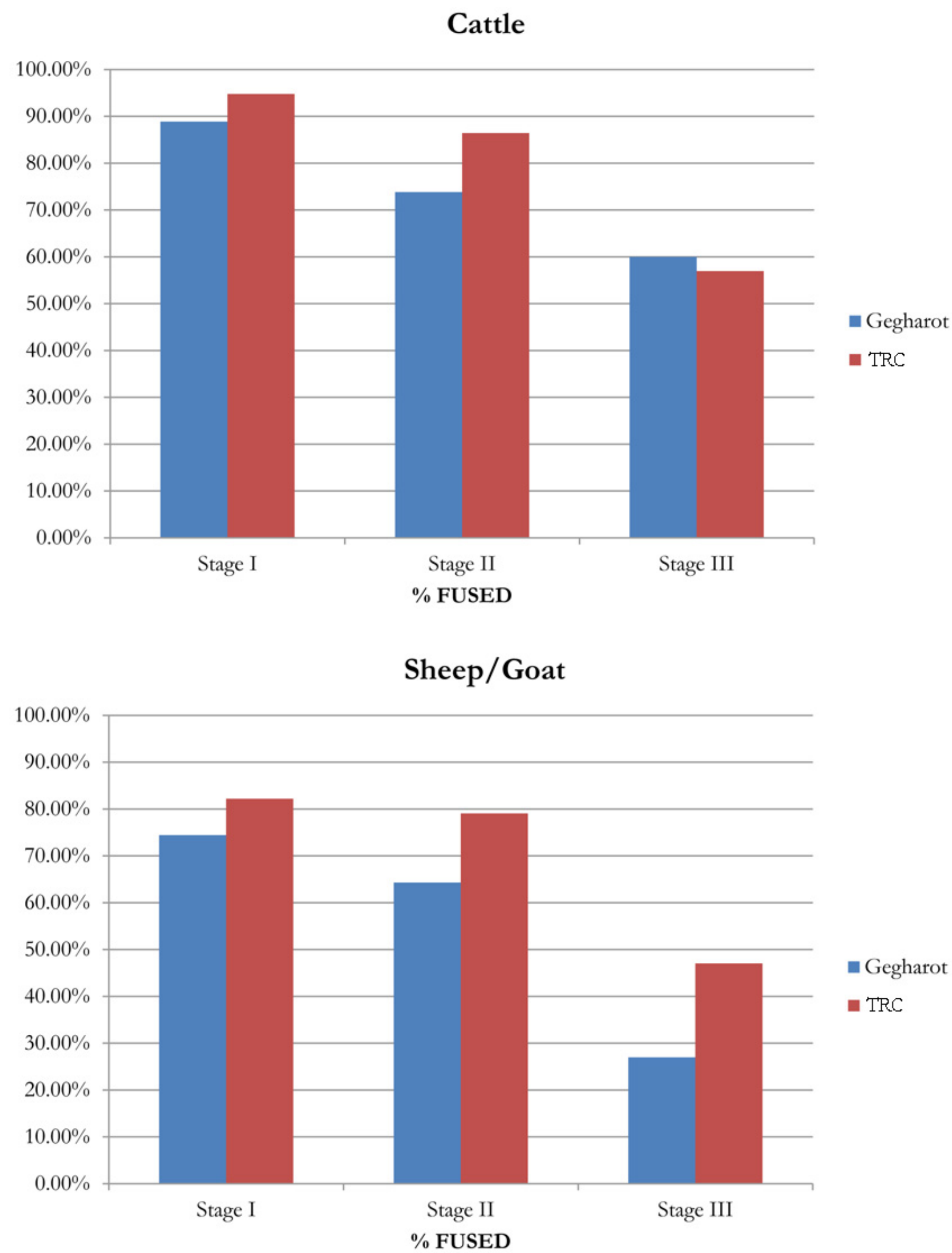

Figure 6.13. Mortality based on epiphyseal fusion.

6.3.1 Unusual pre-mortem biographies

The first individual considered here is ACL-6220. ACL-6220 is a goat that appears to have been born in the Tsaghkahovit Plain (or someplace isotopically similar), but then spent the latter part of the first year of its life outside of the Tsaghkahovit Plain. However, this movement does not seems to have strongly impacted the seasonal signal seen in the incremental δ^{18}O data from this individual. The intra-tooth range is on the lower end of expected range for the Tsaghkahovit Plain, but there is no evidence that this movement was between highlands and lowlands within the first year. It is possible that this individual remained outside of the plain or traveled between highlands and lowlands over the next couple of years. Regardless, at some point during its second or third year of life, this individual returned to Tsaghkahovit Plain and was killed at 2-3 years of age. The mandible of ACL-6220 was eventually deposited in the midden in T2 at Gegharot, and it is quite likely that the rest of ACL-6220's bones were deposited somewhere off-site (see Chapter 6).

The next group of individuals, ACL-6214, 6216, 6218, and 6227 are anomalous because the analysis of sequential δ^{18}O suggests that these animals moved over the first year of life in such a way as to minimize seasonal variation in temperature. The most likely explanation for this is a seasonal movement from highland to lowland, to avoid seasonal extremes in temperature. The radiogenic strontium data does not show any evidence of this movement, meaning it took place between regions of relative isotopic similarity.

ACL-6214 is a cow that was killed at the end of its first year of life, and ACL-6216 is a cow that was killed between 2-3 years of age. The mandibles of both of these individuals were deposited in the midden in Trench 2 at Gegharot. In contrast, ACL-6218 is a cow that was killed at a much older age (8-10 years) and its mandible was deposited in the midden (SLT10) at the TRC. ACL-6227 is a sheep that was killed at 2-3 years of age and its mandible was eventually deposited in the midden in Trench 2 at Gegharot. It is possible that cattle were more likely to be seasonally mobile than sheep, and for some reason, those animals were more likely to end up at Gegharot (and particularly, in Trench 2). There is no indication that animals that were seasonally mobile in this fashion (during at least the first year of life) were culled at a particular age of death.[10]

At the other end of the spectrum, ACL-6224 is a sheep that had an unusually high intra-individual range of δ^{18}O. This suggests that they spent the first year of their life in a place with even greater seasonal variation in temperatures than the Tsaghkahovit Plain (which would likely mean somewhere of higher elevation) or they moved seasonally over the first year in a manner that exacerbated seasonal variation (i.e. spending the winter in the highlands and summer in the lowlands). As with the individuals with dampened seasonal signals, there is no evidence of movement between geologically-distinct territories through radiogenic strontium isotope analysis. On the basis of incremental δ^{18}O analysis, it seems possible that ACL-6224 was born in the late winter/early spring and then killed towards the end of its first year of life. ACL-6224's mandible was eventually deposited in the midden in Trench 2 at Gegharot.

The last individual with anomalous incremental δ^{18}O results was ACL-6229. ACL-6229 is a sheep whose strontium isotope results are within the baseline for the Tsaghkahovit Plain and whose intra-individual range in δ^{18}O values are within the expected intra-annual variation for the Tsaghkahovit Plain. However, when the incremental δ^{18}O values are plotted, the expected sinusoidal variation is absent, and instead a linear pattern (with a fairly substantial slope) is visible. It is not at all clear what sort of seasonal mobility would produce such a pattern. In any event, ACL-6229 was slaughtered towards

10. There is also a small possibility that all of these animals come from elsewhere (where an isotopically stable source of drinking water was present) and are representative of exchange with some area outside of the plain (see Chapter 5 and Appendix B).

the end of the first year of its life and its mandible was eventually deposited in the large midden in Trench 19 at Gegharot.

Two points are made clear by these osteobiographical analyses. First, assuming that these mandibles represent consumption activities that produced the overabundance isolated skeletal elements (Group 2), there is some diversity in that group with regard to seasonal and geographic mobility, though that mobility is not visible through radiogenic strontium isotopes. Second, this analysis reveals that individuals that show unusual patterns of mobility in the first year of life are much more likely, though not exclusively, to have their mandibles deposited in the large midden in Trench 2 at Gegharot.

6.3.2 Unusual post-mortem biographies

Some herd animals' biographies are distinguished by the trajectories their remains took post-mortem. While the bodies of most herd animals ended their post-mortem social lives deposited as garbage in middens, intra-mural and other abandoned spaces, some herd animals were deposited as part of 'ritual' practices that functioned through the marked assembling of human participants and material objects (see Chapter 3), including the bodies of animals. The two major categories of these 'special' post-mortem biographies for herd animals in the Tsaghkahovit Plain are inclusion in burials and in practices that took place in the shrines at Gegharot (as discussed in Chapter 4).

6.3.2.1 Burials

ACL-4868 was a young (6-12 months) cow interred in the cist of a Late Bronze Age tomb in a burial cluster near the site of Tsaghkahovit (Marshall 2014).[11] Radiogenic strontium isotope analysis suggests that this individual was born outside of the Tsaghkahovit Plain,

11. This individual was analyzed as part of a pilot analysis in 2013 (Chazin forthcoming).

somewhere with a lower $^{87}Sr/^{86}Sr$ ratio (possibly the Ararat Plain). The incomplete enamelization of its second molar meant it was not possible to identify the seasonality of its birth. ACL-4868 was slaughtered sometime in the latter half of its first year of life and part of its remains were deposited in Burial 06 in Burial Cluster 12 at Tsaghkahovit.

Within the burial chamber, along with the human remains, were faunal remains from sheep/goats and cattle within vessels (Marshall 2014:162). The right half of ACL-4868's skull (and possibly its left lower limb) was deposited on top of the clay matrix covering the body, along with the partial remains of a horse and a sheep/goat. Its status as an intentional deposit of the right half of a skull and the left hind limb (potentially from the same individual) is distinguished further by its young age (in contrast to the overall demographic pattern for cattle) and its geographical origin outside of the Tsaghkahovit Plain.

ACL-6253 was a young male goat interred in a Late Bronze Age tomb at Tsaghkahovit. Radiogenic strontium isotope analysis suggests that this individual spent its life in the Tsaghkahovit Plain. While it was not possible to use the nonlinear regression to model ACL-6253 incremental oxygen data, perhaps as a result of its young age, visual inspection does show the expected seasonality and comparison with other individuals from the data suggests that ACL-6253 was born in the latter half of the year (possibly late summer/fall). ACL-6253 was killed at ~6 months of age and deposited in Burial 02 in Burial Cluster 12 at Tsaghkahovit.

Burial 02 was a cromlech with a pit, and ACL-6253 was deposited at the bottom of the pit (whole) alongside the crania of two other young sheep (age at death: 0-6 months).[12] On top of this deposit, an adult male was interred along with a number of whole vessels (Marshall 2014:155). Radiogenic strontium isotopic analysis of first molars (M1s) from the

12. There were other caprine post-cranial remains, but they were too eroded and fragmentary to assess if they represented the articulated post-cranial skeletons of the other two individuals.

sheep crania indicate that these animals were also born within the Tsaghkahovit Plain. It is not clear what significance this grouping of complete and partial caprine remains has, but it should be noted that it is quite similar to the interment of whole caprine skeletons in the Gegharot kurgans, both in the inclusion of multiple individuals, their young age, and local origin.[13] This grouping of interred individuals is also interesting for the way it mixed both sheep and goats, as well as male and female animals. As discussed earlier, the inclusion of female animals represents a greater removal of potential wealth from circulation than the male individuals, due to the loss of future reproductive potential. It is also possible that the pairing of male and female animals was significant, though our inability to determine the sex of the individual caprines interred in Gegharot Kurgans 1 & 2 makes it difficult to ascertain whether this was a widespread pattern.

6.3.2.2 Shrines

Very few mandibles were recovered from shrine contexts, as most of the faunal remains from these contexts were post-cranial. However, the mandibles of two individuals (both from the East Citadel shrine) were analyzed. ACL-6251 was a sheep, and radiogenic strontium analysis indicates that it likely was born and spent the first year of its life in the Tsaghkahovit Plain. Incremental stable oxygen isotope analysis suggests that ACL-6251 was born during the main birthing season, likely in the spring. That, in addition to its age of death, suggests that it was likely being raised towards the production of prime meat-weight animals (see Chapter 5). There is no indication of seasonal mobility between highlands and lowlands in its first year of life. ACL-6251 was killed sometime in its 2nd or 3rd year of life, and its mandible was eventually deposited in an area located to the south of the main shrine

13. The M1s from the individuals interred in Kurgans 1 & 2 also had $^{87}Sr/^{86}Sr$ that fell within the baseline values for the Tsaghkahovit Plain.

area on the eastern citadel. This locus consisted of a clay basin containing seven whole vessels, an assortment of tools, and the sherds of a large pithoi, in addition to a fairly large number of faunal remains. The presence of a large number of astragali (including some worked ones), suggests that ACL-6251 may also have participated in activities associated with the shrine in some way.

ACL-6252 was a young male sheep, and radiogenic strontium isotope analysis suggests that it spent the first year of its life in the Tsaghkahovit Plain. Incremental stable oxygen isotope analysis indicates that ACL-6252 was likely born in the latter part of the year (perhaps in the late fall/early winter), and there is no indication of seasonal mobility between highlands and lowlands. ACL-6252 was slaughtered at some point in the latter half of its first year of life. ACL-6252's mandible was eventually deposited within a clay platform along the western wall of the eastern citadel shrine. The deposit included ACL-6252's crania, as well a sheep metacarpal 3-4 (right) with associated first phalanxes and a sheep metatarsal 3-4 (left), and the distal epiphysis of a sheep/goat metapodial with associated first phalanxes (which may have belonged to ACL-6252 as well).

The limited osteobiographical information available for herd animals recovered from shrine-related deposits are noteworthy only inasmuch as these individuals are not particularly marked (through exceptional pre-mortem biographies) in relation to general patterns seen for herd animals in the Late Bronze Age Tsaghkahovit Plain. Instead, the markedness of animals that participated in rituals associated with the shrines was generated within and through those activities.

6.4 Conclusions

The analysis of faunal remains from excavations at Late Bronze Age sites reveals a series of lively, if opaque, post-mortem social lives for herd animals. Culling, the moment of transition between pre- and post-mortem social lives, was shaped by the age and species of the individual, and likely as well by their sex. There is tentative evidence that cattle were used as both allocative and authoritative resources, distinguishing between young (likely male) cattle and older (possibly female) cattle. The most notable result of the faunal analysis is the identification of two different groups within the faunal assemblages. First, there is a group of faunal remains that represent that on-site consumption of (more or less) whole animals. In contrast, the second group is represented only by isolated skeletal elements (mandibles and tarsals) found in overabundance across contexts and across sites.

While the first group is hardly surprising, the second group is difficult to accommodate within existing models and analytics in zooarchaeology. These elements are particularly unruly in the way that they defy explanation, both in terms of the commonplace imagined affordances of animal bodies, as well as in their suggestion that critical pieces of the puzzle are just out of view. We are left struggling with basic questions: Who is consuming these animals? In what contexts, in what ways, and to what ends? Why do these isolated elements end up being deposited on-site? How do these elements link activities and practices that take place off-site with those on-site? What is the relationship between the marked and unmarked deposition of these elements within sites?

One way of framing the question is to ask: what affordances might these specific elements (tarsals, mandibles) have had? Unlike the innominate, which is a relatively meat-bearing part of the body, tarsals and mandibles have very little meat. There is some evidence that for astragali, the distinctive shape of the bone and its compact hardness were the features of interest. A number of astragali at Gegharot (as well as smaller numbers at the TRC, Tsaghkahovit citadel, and Aragatsi Berd) show signs of polishing, intentional striation, and burning (potentially to color them). Smith and Leon (2014:556) link these forms of working to divination activities performed in the shrines. As noted earlier, however, no mandibles showed any signs of being worked.

Another possible affordance of these isolated skeletal elements may have been metonymy, where a skeletal part stood in the for the whole of the animal in some way. The display of skulls as physical souvenirs of feasting is one example of such skeletal metonymy that is found cross-culturally (for examples, see works cited in Russell 2012:388). The tradition of 'head and hoof' burials in the Eurasian steppes (Piggott 1962; Anthony 1995) relies on a similar sort of metonymy. This use of isolated skeletal elements need not have been part of 'ritual' activity. Animal skulls and hides have also served as tokens for various forms of accounting, for instance, in the collection of the pelts of animals killed in the effort to reduce predator populations in the western United States.

Speculating further, it is possible that the circulation of these isolated skeletal elements functioned as a way of bringing a tangible piece or memento of off-site events back to the sites. Potentially, this gave the people or groups associated with sites control over aspects of the memory of these events, or they might have drawn continued prestige through the connection (made material through bone) to past off-site activities. This possibility raises the question of what other metonymic materials may have circulated that might have complemented or contested the material narratives constructed within sites. However, beyond the concentrations of astragali, there is no evidence that most of these isolated skeletal elements were displayed or curated. At the very least, many ended their object lives discarded along with everyday refuse.

Perhaps, instead, it was the act of partition itself that mattered. The partitioning of animal bodies may have served as a way of materially marking a simultaneous cohesion (through shared events or practices) and separation (figured through the physical partitioning of animal bodies). Alternately, the somewhat 'unmarked' collection of isolated skeletal elements may be evidence of the imposition of a centralized (or at least, emplaced) authority over decentralized transactions and circulations. Future work will need to consider these potential transactions in light of the circulation of other materials.

Studies of the production and distribution of ceramics in the Tsaghkahovit Plain have identified that production drew on multiple local clay sources, and appears to have taken place mainly offsite (as no evidence of ceramic production has been recovered from excavations). Moreover, there are some noticeable imbalances in the circulation of ceramics in the Tsaghkahovit Plain. Multiple neutron activation analysis and microscopy studies (Lindsay et al. 2008; Smith et al. 2009; Greene 2013; Lindsay and Greene 2013) have shown that the majority of ceramics at Gegharot were produced using clays from elsewhere in the Tsaghkahovit Plain, rather than nearby sources.

Greene's (2013) in-depth analysis (using multiple archaeometric techniques) of production chains and ceramic flows suggests that the production of ceramics was complexly organized, with some ceramic forms made from multiple sources and others with more local and restricted production. Distribution was also complexly structured, with different fortresses receiving ceramics that differed in both clay source and fabric type, even as the overall range of forms in the ceramic assemblages are similar between sites. However, these datasets and their current interpretations differ from what we see in the faunal remains. The ceramic data emphasizes the sharp distinction between Gegharot and other sites in the plain. In contrast, the distinction between the two groups of faunal remains (and the two sets of practices of consumption) is drawn between eventual deposition on- and off-site, and this pattern is shared between Gegharot and the Tsaghkahovit Residential Complex.

If nothing else, what remains clear is the 'non-representativeness' of the "death assemblages" present in the faunal assemblages from the sites in Tsaghkahovit Plain. These assemblages do not represent a self-contained and self-reproducing 'natural' unit of herd animals (and the herders who attend to them). As discussed in an earlier chapter, there is mounting evidence that much of the LBA population were mobile pastoralists, who may have had limited interactions with the activities taking place within the walls of sites.

The partial nature of the faunal assemblages parallels the absence of clear evidence for everyday living in the excavated contexts at sites in the Tsaghkahovit Plain. Both of these material absences highlight the absence of much of the Late Bronze Age population from the spaces of sites. Moving forward, we must begin to think about how (methodologically and analytically) we might begin to see the practices, people, and herds that are just out of view.

CHAPTER 7

CONCLUSIONS

This dissertation approached the "problem" of pastoralism (Porter 2012) by starting from the premise that what makes pastoralism unique as form of human practice are the sustained relations between humans and herd animals. Using companion species as an analytical frame enables a new understanding of the potential political stakes of pastoralist practices – their potential to shape political organization and subjectivity. Rather than assuming that pastoralist practices are shaped by ecological or rational economic imperatives, this dissertation uses the concept of 'affordances' as a means to specify the ways in which herd animals' ethological capacities and proclivities necessarily shape, but do not sharply determine, the form that pastoralist human-animal relationships take. This emphasis on human-animal relationships enables us to analyze how pastoralist practices other than mobility might shape the forms that political organization takes in pastoralist societies.

In Chapter 3, I discuss three approaches that can be used to analyze to the political stakes of human-herd animal relationships. The first considers the status of herd animals within relations of authority or power with humans. This question is at the heart of recent scholarly debates ('trust versus domination') about the nature of herd animal domestication. It asks what is the nature of power relations between humans and herd animals and what forms of 'subjectivity' herd animals had within the human-animal social collectives in the past. The second approach asks how the material and ethological affordances of herd animals shape the long-term entanglement of the social and physical reproduction of both humans and animals, an entanglement that renders animals as necessary objects of human labor and care. The third analytic explores how the material qualities of animal bodies and their products generate value. In this view, building from the work of Nancy Munn, the value generated through pastoralist practices enables social action, including the generation of inequality and hierarchy.

While the first approach transposes some of the questions of classical political theory to human-herd animal relationships, the second and third approaches allow consideration of how pastoralist practices might in turn shape the practices that generate political authority and subjectivity – linking them to the practical work of building and maintaining political organization. The theoretical framework presented in this dissertation highlights the the political stakes and implications of everyday, quotidian pastoralist practices, as well as the role of animals in marked activities, such as rituals. By analyzing both the marked and unmarked practices that build and maintain political authority and organization, the analytic developed in the dissertation bridges between traditional political-economic approaches and more semiotically-oriented approaches to political authority. Moreover, focusing on human-herd animal relationships in these ways also allows us to consider how the pre- and post-mortem social lives of herd animals shape pastoralist political organization.

In order to address these theoretical questions materially, this project used a three-part framework to build from the zooarchaeological and isotopic analysis of faunal remains to a consideration of how pastoralist practices might have structured Late Bronze Age political organization in the Tsaghkahovit Plain, Armenia. Pastoralist practices were broken down into three aspects: 1) space, 2) seasonality, 3) distribution and consumption. Space and seasonality consider the pre-mortem biographies of herd animals and the organization of labor required to manage both the production of pastoralist products and the reproduction of animal bodies and the herd as a human-animal collective. These two categories encompass the spatial and temporal dimensions of pastoralist production and how these are shaped by the different proclivities of herd animals of different species, ages, and sexes. In this study, radiogenic strontium and oxygen isotope analysis of the teeth from herd animals from Late

Bronze Age sites in the Tsaghkahovit Plain provided information about the spatial and seasonal organization of pastoralist mobility and labor.

Distribution and consumption refers to practices that move herd animals and their products (meat, milk, wool, blood, hides) into contexts of consumption and discard. The act of culling bridges between human engagement with living animals and use of animal bodies after death (as the material for further acts of consumption and circulation). Culling practices are highly attentive to the different material characteristics of animal bodies and their implied temporalities. These practices comprise the post-mortem social lives of animal bodies – critical points in the processes that shape the value of herd animals and spaces in which political work can be done. Zooarchaeological analysis of the faunal remains from assemblages excavated from sites in the Tsaghkahovit Plain, attentive to the variety of archaeological contexts within and between sites, provided information about the culling of animals and the circulation and consumption of their remains post-mortem. This analysis considered both everyday and extraordinary contexts of consumption.

From the analysis of faunal remains from Late Bronze Age sites in the Tsaghkahovit Plain, a picture emerges of a complexly organized system of pastoralist production. Nearly all of the animals analyzed in the study of radiogenic strontium isotopes had values that fell within the local baseline range of $^{87}Sr/^{86}Sr$. This suggests that these animals were not exchanged or herded over long geographic distances (at least in the first year of life). However, given the preliminary state of isotopic mapping in the region, it is possible that isotopic similarities through the region are masking herd animals' mobility. The results of incremental stable oxygen isotope analysis suggest that some animals were moved seasonally, as their $\delta^{18}O$ values differ from the expected seasonal pattern for the Tsaghkahovit Plain. Some of these animals show a dampened seasonal signal that is consistent with movement of herd animals between highlands in the summer and lowlands in the winter, in order to ensure good pasture and mild climatic conditions (cf. Britton et al.

2009; Henton et al. 2010; Henton 2010; Bocherens et al. 2001). However, a small number of other individuals appear to have moved in other, as yet opaque, patterns. Analysis of intra-individual stable carbon isotopes (which is currently ongoing) will help to clarify these results, as would additional mapping of strontium and oxygen isoscapes in Armenia.

Incremental analysis of stable oxygen isotopes in tooth enamel from sheep revealed two different biographical trajectories for sheep in the Late Bronze Age Tsaghkahovit Plain.[1] These two groups are evidence of two different modes in the organization of Late Bronze Age pastoralist labor. The first group are sheep that were born during a narrow window of time (~1.5 months), most likely at some point during the spring (cf. Tornero et al. 2016), who were then slaughtered at some point between two and four years of age. These animals were most likely raised primarily for the production of meat, as they were kept alive until they reached full meat-weight. It is not clear if these animals were culled at a specific point seasonally or as needed, once they had reached full meat-weight. The narrow window of birth seasonality suggests that herders worked to limit the period of high labor associated with caring for pregnant ewes and newborn lambs by keeping births clustered tightly together.

In contrast, a different group of sheep were born over the entire annual cycle – except, perhaps, for a short period of time, likely in mid-winter – and then slaughtered either in the latter half of their first year of life or as a mature adult (4+ years). These sheep were most likely raised to provide a year-round supply of milk and other dairy products for human consumption. The maintenance of sheep reproductive potential throughout the year, and the constant care for pregnant ewes and newborns, represented a considerable investment of labor on the part of herders. It is likely that part of this labor include foddering of pregnant

1. Analysis of birth seasonality on smaller samples of goats and cattle suggest that goats were also likely born across a fairly wide part of the year, whereas cattle births may have been more limited. These samples were too small to make any definitive conclusions.

ewes (and possibly newborn sheep as well). Ongoing analysis of the stable carbon isotope data from these teeth will shed light on this question in the future. From the analysis of zooarchaeological data, there is no indication that, once these animals were killed, they circulated differently post-mortem (despite the different ages at death). However, it is difficult to associate the teeth from faunal assemblages with other post-cranial skeletal materials. As a result, it is not always possible to directly connect pre-mortem biographies with data about the age, sex, and spatial patterns seen in culling practices.

Culling practices are a key component of pastoralist organization, and a moment that directly links herd animals' pre- and post-mortem biographies. Culling is heavily influenced by the material affordances of herd animals – specifically the sex and age of animals, which shape both the future reproductive potential of individual animals and the material characteristics of their products (meat, milk, wool). With regards to age as a factor shaping culling practices, the data reveal different patterns of culling between cattle and sheep/goats. Sheep and goats show a steeper drop in survivorship over the first three years of life – driven by a large cull of juvenile (10-30 months) caprines. This pattern results from the combination of culling of animals in the first year (related to dairy production) and the culling of prime meat-weight animals. In contrast, cattle show comparatively gentler rates of mortality. This may indicate that the cattle herding was more closely connected to on-site activities or participants, resulting in a wider demographic range of animals being deposited on site. It is possible to speculate that the intermittent occupations at the Tsaghkahovit Residential Complex, which has a greater proportion of cattle than other sites in the plain, may be connected to the potential seasonal mobility of cattle identified through stable oxygen isotope analysis (see below). Nevertheless, without further isotopic analysis of a larger number of cattle, this is a preliminary hypothesis.

Due to the different affordances of male and female animals vis a vis reproduction, culling practices often break sharply between male and female animals. The specific contours of culling practices as they relate to sex in the Late Bronze Age are difficult to identify in the Tsaghkahovit Plain assemblages. In general, most assemblages from the Tsaghkahovit Plain show more females than males, which is to be expected, given that fewer males are required for the demographic reproduction of the herd. However, innominates for cattle at Gegharot show an unusually high number of males. This may reflect a cull of young male cattle, one that may not be visible in the overall mortality patterns based on tooth wear. This may indicate practices of provisioning sites from the herds of mobile pastoralists.

Evidence of Late Bronze Age culling practices is muddied, in part, by the palimpsest of different groups of animals and different practices of distribution and consumption that characterizes the Late Bronze Age faunal assemblages in the Tsaghkahovit Plain. It is difficult to assume, in light of the unusual patterning seen in body part representation, that the ageing data (based on teeth) and the sex data (based on horn cores and other limited post-cranial elements) present information about the same groups of animals. However, the data suggest that cattle may have been used as both allocative and authoritative resources. The off-take of young, male cattle for the distribution of meat may have created a particular set of relations, between giver and receiver, with a specific temporality –one based in the materiality of meat (which is both partible and perishable). In contrast, the presence of older cattle (likely mostly female) in the assemblages as a whole suggests a different set of relations, one that was based in the affordances of female bodies and the future-oriented temporality of reproduction. It appears that both strategies were at play in the Late Bronze Age, but it is not clear to what ends; nor is it immediately apparent how these two strategies interacted.

Within the Late Bronze Age Tsaghkahovit Plain, there are two main patterns in the distribution and consumption of domesticated herd animals. First, the consumption of some sheep, goats, and cattle appears to have taken place within or near enough to the sites that most of the butchery and consumption waste was deposited on-site. Overall, these consumption practices are marked by the relative completeness of the skeletal representation. There is a very little evidence for the preferential selection of cuts of meat. There is also evidence for both the roasting of meat and the toasting of bones for marrow extraction.

The second group of remains seen in the faunal assemblages from Late Bronze Age sites in the Tsaghkahovit Plain are markedly overabundant isolated skeletal elements. This pattern is seen for both cattle and sheep/goats, at Gegharot and the Tsaghkahovit Residential Complex, and in both phases of the Late Bronze Age occupation of Gegharot. The overabundant elements include both mandibles and the tarsals (astragali, calcanei, and central 4th tarsals). These elements represent a material connection between activities and practices taking place off-site with those taking place within sites. It is important, however, to note that these connections, and the activities they were linked to, appear to have consisted of relatively more and less marked ones. The presence of unusually large numbers of astragali (many of them intentionally worked) in "shrine" spaces at Gegharot contrasts both with the unremarkable inclusion of these isolated skeletal elements in many different types of archaeological contexts and with their fairly even distribution throughout the Late Bronze Age faunal assemblages.

In order to bridge between the analysis of pre- and post-mortem lives – and between the analytical methods of isotopic chemistry and zooarchaeology – this study used the concept of osteobiography to tack between the general patterns seen across the assemblages and the individual trajectories of specific animals. This approach connects the information provided by isotopic analysis about the experiences of the living animal with the post-mortem social life of its material remains. As the analysis of herd animals from the Tsaghkahovit Plain reveals, this is a challenging task, given the realities of the difficulty of connecting post-cranial remains to mandibles (aside from the exceptional burials of whole, articulated individuals). Furthermore, the specific complexities of the post-mortem circulation of herd animal remains in the Late Bronze Age Tsaghkahovit Plain make it unusually difficult to link the results of the isotopic analysis with the analysis of culling practices and the consumption and circulation of animal remains.

Nevertheless, osteobiographical analysis reveals that herd animals with unusual pre-mortem biographies are much more likely to be deposited in the midden in Trench 2 at Gegharot than in the other midden contexts sampled in the isotope study. Herd animals with unusual post-mortem biographies – that is to say, animals that were deposited as a result of activities connected with ritual or mortuary practices – are remarkable only in the unremarkableness of their pre-mortem biographies. The individual animals buried in graves and connected to activities in the shrines were not marked out as special by the facets of their biographies visible in the isotopic study or in the analysis of their skeletal remains. Rather, it seems that these individuals were made unique through their participation in practices connected to mortuary and other ritual activities.

Building from these results, it is possible to develop a preliminary answer to the initial questions raised by this dissertation about the connection between the organization of pastoralist practices and the organization of political life in the Late Bronze Age in the Tsaghkahovit Plain. Herd animals, as objects of labor and care, help to structure practices of pastoralist labor marked by differential mobility of people and animals and competing production orientations. In particular, differential production of sheep meat and milk required the negotiation of competing demands on pastoralist labor, demands that seem to be at least partially linked to practices connected with fortress sites. Herd animals, through the circulation of their bodies post-mortem, also created value through their consumption as food and their participation in extraordinary activities connected to mortuary and other ritual practices. These values appeared to have shaped both social cohesion (perhaps linking mobile subject together) as well as differentiation: processes that may have served to create and maintain Late Bronze Age political authority.

The data analyzed here revealed a number of lines of evidence that suggest that sites in the Late Bronze Age Tsaghkahovit Plain were at least partially provisioned from herds that were not directly associated with the sites. This raises the question of whether the provisioning of pastoralist products was a centrally-administrated practice or one that was characterized by more loosely-arranged, individual connections between the people who produced and those that consumed. The production and circulation of ceramics (and the goods they contained) from Late Bronze Age sites in the Tsaghkahovit Plain has recently been interpreted as evidence of a tributary system centered at Gegharot - one in which the inward flow of fine ceramics and other goods[2] is balanced by an outward flow of coarse ware vessels linked to food processing and other forms of equipment (produced from clay sources near Gegharot) (Lindsay and Greene 2013:708). The authors argue that this system served to reproduce Late Bronze Age political authority through a logic of reciprocal ritual obligations between authorities and subjects.

The analysis of faunal remains and pastoralist production suggests a slightly different set of relationships. At least part of the circulation of animals and their products appears to have taken the form of provisioning of meat to sites by other pastoralists who generally remained off-site. It is not entirely clear under what sort of system (taxation, tribute, sacrifice, individual transaction) this provisioning was undertaken. Nevertheless, the complexity seen in the organization of pastoralist practices of production, circulation, and consumption in the Late Bronze Age Tsaghkahovit Plain reflects the orientation towards multiple pastoralist products (meat, milk, and potentially wool), and these practices

2. Roman Hovesepyan has suggested that the millet and grape found in macrobotanical samples from Late Bronze Age sites in the Tsaghkahovit Plain may have been traded in from the Ararat Plain (Badalyan et al. forthcoming).

appear to have been organized at multiple scales. This arrangement was a result of negotiations over, and decisions regarding, competing demands for human labor and animal reproductive and labor power. As the prior zooarchaeological models discussed in Chapter 3 suggest, one of the main points of conflict is over the age that animals (of different sexes) are slaughtered and who, subsequently, gets to consume them. The prevalence of older cattle in the assemblages may suggest that cattle (in contrast to sheep) were too valuable to be slaughtered young. This may have been because of they were used for traction in field agriculture, but it may also represent their value as breeding stock and living wealth. Nevertheless, the data suggests that sites in the Tsaghkahovit Plain were probably provisioned with young male cattle, reflecting their relative superfluousness relative to the reproductive potential of female cattle. However, both groups (young males and older cattle) ended up being deposited on site at the end of their post-mortem social lives.

In contrast, the sheep and goats provisioned to Late Bronze Age sites appear to have been primarily young animals. At least some of these young animals were culled as part of production strategies oriented towards the year-round provisioning of milk. However, others were culled at later ages (once they had reached prime meat weight), suggesting that there may have been a demand for the provisioning of meat from young animals. The inclusion of young animals as whole sacrifices in graves suggests that demand might have taken the form of ritual requirements. However, it is possible that the prevalence of younger animals on-site may reflect pastoralist wool production. Younger animals, off-take from the herd, could have been provisioned while the adult animals used for their wool were kept by the pastoralists off-site. Such a scenario would mean that both cattle and sheep were being used for secondary products – resulting in some animals being kept alive for longer – but only adult cattle are consumed in the activities that lead to deposition on site. It is difficult to say whether the provisioning of meat from young animals was driven by demands from those consuming the meat at the sites or requirements of the practices that shaped that consumption.

In order to interpret these decisions as actions taken within a field of possibility determined by power and political authority (rather than mere biological or rational economic imperatives), it is necessary to attempt to assess where the push or pull for these decisions was located. In the Near Eastern provisioning models (e.g. Zeder 1991; Allentuck and Greenfield 2010; Arbuckle 2012), this is generally framed as a question of whether the central administrative authority or the mobile pastoralists dictated what kinds of meat were supplied to urban centers. Provisioning of older animals is read as pastoralists being able to dictate terms, where it is assumed that those consuming the provisioned meat would prefer young animals. However, rather than a simplistic division between producer and consumer, or pastoralist and urban administration, the key question for the Late Bronze Age Tsaghkahovit Plain is: what is driving the dual production strategy of meat and milk? These two modes of pastoralist production require very different arrangements of labor – including, potentially, different forms of spatial and seasonal mobility. They also produce pastoral products with very different material affordances, not merely in taste, but also in terms of perishability/preservability and the sort of human-animal intimacies they engender (Tapper 1988; Orton 2010a; Mlekuž 2015; Hamilakis 2008).

The considerable amount of human effort required to artificially prolong the reproductive availability of sheep means that is a step that was probably not taken lightly. Who would want fresh dairy products to be available year-round and why? Or was the extension of birth seasonality primarily oriented towards the year round availability of tender lambs? Or were these two seen as inextricably meshed together? Again, the use of young caprines in mortuary sacrifices suggests that they may have had special value, which made them uniquely suited for participation in specific practices of meat consumption (associated with onsite activities in some way). However, the consistency of culling patterns between different sites and site sectors suggests that the consumption of young lambs was not necessarily restricted to certain groups or activities within the sites. The results from these analyses resist any easy interpretation of these decisions as an outcome of a conflict between centralized administration and outside mobile pastoralists.

The last factor structuring this matrix of demands and decisions is pastoralist mobility. The extension of birth seasonality across the year represents a real increase in particular forms of pastoralist labor. As a result, it seems likely that the the shortened birth season seen in sheep slaughtered at prime meat weight reflects a decision to restrict the labor demands related to that aspect of pastoralist production. It may also have enabled seasonal mobility. Pregnant ewes and newborn lambs are not well-suited to long-distance movement (Balasse et al. 2003), so restricting the birth season of those flocks that were moved in the landscape would have meant a greater flexibility in the scheduling of movement. In contrast, the extension of the birthing season for other flocks would likely have reduced those animals (and their herders) ability to move seasonally. Thus, the dairy/tender meat production was potentially more localized than prime meat weight production. It is not clear whether "local" in this instance would have been pastoralist encampments or Late Bronze Age sites. However, if there was differential mobility between these groups of animals, this does not resolve clearly in either the radiogenic strontium or stable oxygen data from this analysis.

Another aspect of the extended birth season would be the need to shelter pregnant ewes and young lambs during the winter months. Access to food would have been limited during this season by snow, and the cold temperatures would add physiological stress. Access to shelter would have been an important factor in extending the birth season. It is possible that the seasonal occupation of the Tsaghkahovit Residential Complex (Lindsay and Greene 2013) may have been during the winter. The structures built at the TRC may have served to shelter dairy herds and their herders. If the settlement was seasonally occupied during the winter by pastoralists, this may also suggest an explanation for the higher representation of cattle in the faunal assemblages. The large size of cattle means that either a large number of people are needed to consume the entire carcass before it spoils (through feasting or other forms of sharing and redistribution) or the meat must be preserved (Dahl and Hjort 1976:163; McCormick 2002; Halstead 2007). Low temperatures during the winter months would mean that smaller groups (such as kinship or labor groups) could slaughter and preserve cattle meat for their own use. Other lines of evidence – such as paleobotanical samples or cementum annuli on faunal remains – would need to be collected and examined to test this hypothesis. This hypothesis may also explain why animals from the TRC have strontium isotope ratios which cluster in one part of the local baseline range for the Tsaghkahovit Plain, in contrast to animals deposited at other sites.

In light of this, it may be possible to consider the Tsaghkahovit Residential Complex as a form of infrastructure, one that helped enable the distinctive organization of pastoralist labor revealed in these analyses. The labor and care taken to clear and level the ground at the TRC may reflect a centralized and organized action to direct or enable, or the very least emplace, the labor regime necessary to prolong the birth season. Its location next to the fortress would have associated these herders and their flocks, and the products they produced, with other activities that took place within and around the fortress (even if only seasonally) (cf. Kolata 1997).

The variable reproductive and generative potential of herd animals' bodies structured pastoralist labor in the Late Bronze Age, as well as the differential value of living animals. The circulation of animal bodies post-mortem also generated values – values that structured and enabled specific forms of social action. What emerges from the data considered here is how the post-mortem circulation of animal bodies worked to generate both social cohesion and well as differentiation, through the differential values of animals based on age, species, and biography. These values were enacted through both a more quotidian circulation of animals and their products for consumption on-site as well as extraordinary practices of sacrifice and other ritual activities (both on-site and connected to mortuary practices).

These practices linked mobile pastoralists and people who were engaged in other forms of activity through shared consumption, some of which may have taken place off-site. It also, presumably, linked pastoralist labor and its products with other regimes of production and consumption. The circulation of isolated body parts onto sites also created linkages in time and space between off-site and on-site activities and participants. The partitioning of animal bodies peri- or post-consumption was a specific choice within a semiotic context that conferred a particular value to the isolated body parts that circulated, as well as to how and where they circulated. Similarly, the concentration of animals who appear to have participated in seasonal movements in the GeT2 midden at Gegharot suggests differential access to animals with unique biographies. This unequal distribution may have conferred distinction (thereby enabling future social action) and/or reflected a heightened capacity for forms of social action on the part of certain individuals or groups.

These dynamics of cohesion and differentiation also shaped mortuary rituals. Marshall (2014) has argued that changed mortuary practices in the Late Bronze Age worked to both create linkages between people (through interment in cemeteries together) and create distinctions (through burial architecture and the items included in the graves). Animals were included in mortuary rituals in three ways: inside vessels, as ‘meat units’, or as whole individuals interred in graves and mortuary monuments. The first two forms of inclusion seem to be more directly linked to the consumption of meat than the third. Their purpose may have served as somewhat straightforward allocative relationships of commensality or provisioning, whether that was framed as a obligation based in kinship or other kinds of affiliative relationships between the living and the dead. In contrast, the inclusion of whole animals may have been linked to other forms of human-animal relationships. As a form of social practice, it may have drawn on the capacity of herd animals to act as authoritative resources. As such, it may have been intended to generate particular temporalities of connection between the living and the dead or within the mortuary realm itself. Interestingly, the data from the Gegharot kurgans suggests that sets (pairs?) of young animals were preferentially used for this form of social action. While the young age precludes an analysis of the choices made on the basis of sex, it does suggest that particular emphasis was placed on sacrificing or including animals who have not yet achieved their reproductive potential.

Returning to the concept of affordances, it is now possible to trace out some of the characteristics of herd animals that shaped their value in Late Bronze Age societies in the Tsaghkahovit Plain. The age of herd animals at their death seems to have been important. It is possible that the meat of young animals was seen (as it is in our own society) as particularly desirable (on the grounds of taste). Or, the prevalence of young sheep (and some young cattle) may have been a result of their differential participation in the labor of producing specific pastoral products such as meat or dairy. The off-take of young animals as part of dairy consumption may have led to them being provisioned to sites as a matter of expedience rather than (or in addition to) desire. On the other hand, if the young animals present in the assemblages at these sites resulted from acts of sacrifice, the unrealized reproductive potential may have made for a more meaningful or efficacious sacrifice.

Different species of animals also seemed to have different affordances in the Late Bronze Age. The prevalence of older cattle in assemblages, and the absence of older sheep, may reflect a greater value placed on cattle. The contrast between the value of cattle and smaller stock – resulting in different culling patterns where cattle are not slaughtered young – has been described for Near Eastern pastoralists (Russell 2012:336) and African pastoralists (Dahl and Hjort 1976:111). In these examples, sheep and goats are evocatively described as "small change", referring to the fact that they are comparatively easier to part with due to their lower relative value. Alternatively, it is possible that the presence of older cattle and absence of older sheep results from the different secondary products derived from these species – with the use of cattle for traction tying them more closely to sites and the role of sheep in the production of wool linking them to non-sites spaces. There are also intriguing hints about the relative values of sheep and goats in the Late Bronze Age Tsaghkahovit Plain. While sheep predominate numerically, goats may have been valued for their ability to reduce pastoralists' labor through their ability to help herd sheep (Dahl and Hjort 1976:250) or for their hair. The paired sets of young sheep and goats in Gegharot Kurgan 1 may suggest that despite the numerical imbalance, there was a conceptual complementarity between the species.

Lastly, the results of this analysis suggest that there were also specific values assigned to different herd animal body parts. The circulation of sheep, goat, and cattle mandibles and hind feet indicates that these body parts had specific meanings and were able to function metonymically in some way. Curating mandibles or the other overabundant elements may have metonymically referenced parts of the body that were especially valued, as is the case for sheep heads in Druze feasts (where it is valued because it shows the characteristics of the animal consumed, see Grantham 1995). It is possible that this metonymy was linked in some way to the widespread Eurasian metonymic use of the 'head and hoof' of horses in mortuary assemblages (Piggott 1962). Or, it may have been a form of expedience, in which the material specificities of these elements – their durability, unique morphology, and ready identification to species and also perhaps age and size – lent them a particular suitability to be used as tokens for forms of accounting.

Drawing together some of these lines of interpretation suggested above, a possible picture emerges. The two patterns seen in the analysis of body part representation in the faunal assemblages from Late Bronze Age sites in the Tsaghkahovit Plain show the coexistence of practices of sacrifice and ritualized consumption alongside more quotidian practices that circulated animal products into sites. The logics of sacrifice structured the consumption of young animals, primarily sheep, both through extraordinary ritual practices (potentially connected to divinatory activities associated with the shrines) and the alimentary consumption or distribution of meat secondary to or in association with these extraordinary activities. This consumption may have taken place off-site. In both forms, this consumption likely served to legitimize forms of political authority. This legitimacy was, at least in part, manufactured and sustained through practices (involving animals) that produce cohesion and distinction together and made ordered, material arguments about the moral order of the world (Fowles 2012).

At the same time, the smaller-scale consumption of whole animals on-site suggests that people or groups had access to animal products through other channels. One potential is that kinship networks may have connected people living in or near sites in the Tsaghkahovit Plain to other, more mobile members of society. These relationships may have provided pastoral products to those engaged in emplaced activities, while also cementing smaller-scale connections between mobile and sedentary members of society – in addition to those generated through larger-scale ritual and administrative activities. Both sets of practices may have been ways in which the conflict between demands on pastoralist labor and demands for provisioning sites in the Late Bronze Age were managed. It is likely that the larger-scale and potentially more centralized systems of provisioning identified in this analysis were structured through relationships of political subjectivity and/or ritual obligation, as Adam T. Smith has suggested for the Late Bronze Age more generally (Smith and Leon 2014; Smith 2015). Nevertheless, the data discussed here also highlight the role that smaller-scale relationships and practices may have played in managing the new labor demands and enabling the functioning of a complex system of pastoralist practices. It seems quite possible that these relationships and practices were channeled through kinship networks in some way.

What emerges from the analyses presented in this dissertation and their interpretation in this chapter are two main points. First, pastoralist practices (directly grounded in human-animal relationships) worked to produce both social cohesion and differentiation across a number of registers. Second, the complex organization of pastoralist production, circulation, and consumption entailed a number of competing and conflicting objectives, practices, and orientations. These disjunctures required negotiation and intervention, around which power and authority were almost certainly both in play and at stake. While the specific content of and engagement around these points of friction remains opaque, the archaeological evidence presented here suggests that Late Bronze Age political authorities were able to command and re-distribute certain resources, through practices and activities of consumption linked in part to fortress sites. However, these results also suggest that this organization was countered by other networks and activities that circulated both people and animals in other, potentially less regulated and centralized, ways.

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APPENDIX A

ANALYSIS OF LATE BRONZE AGE FAUNAL REMAINS

A.1 Methods

The zooarchaeological analysis of Late Bronze Age faunal remains presented here is based on the large assemblage of faunal remains collected from the ongoing Project ArAGATS excavations at multiple sites in the Tsaghkahovit Plain, Armenia. Over 100,000 elements have been identified and catalogued from Late Bronze Age (primarily by Dr. Belinda Monahan, though some of the assemblages from the Tsaghkahovit Residential Complex (TRC) and Aragatsiberd and all of the faunal remains form Kurgan 2 were identified by the author).

Specimens were identified as far as is possible in terms of: species, sex, skeletal element, and side. Modifications such as gnawing, burning, and butchery or other marks were be recorded in detail and drawn. Standard measurements were be taken following von den Driesch (1976) and all specimens weighed. In addition to these basic quantitative and qualitative data, information about the age of animals was recorded using stages of epiphyseal fusion and tooth wear developed for caprines, cattle, and pigs. In general, all faunal remains were from intact and securely-dated contexts (usually dated by stylistic analysis of pottery, and sometimes on the basis of radiocarbon dates) were recorded. All remains were coded following the coding system established for Project ArAGATS, based on BONESORT II (Redding et al. 1978) and entered into the online ArAGATS database.

A.1.1 Units of Analysis

Post-hoc, on the basis of excavation notes and diagrams (as well as personal communication with the excavators when necessary), I assigned Late Bronze Age loci to one of the following categories of depositional context: midden, pit, intra-mural trash, cultural fill, destruction debris, wash, vessel, special feature, and indeterminate. This system attempts to address the temporal and spatial patterning of the materials deposited in any context, and to engage with the variety of depositional practices in evidence at Gegharot and Tsaghkahovit (especially given the episodes of destruction and reconstruction). The distinctions between these categories more or less map onto the common distinction between primary (in-situ), secondary (redeposited but temporally distinct), and tertiary (redeposited and temporally mixed) deposits used by many zooarchaeologists working in the Near East (Meadow 1978; Zeder 1991; Russell and Martin 2005), while also reflecting different engagements with the built environment of these sites.

Similarly, where possible at Gegharot, Late Bronze Age loci with faunal remains were assigned to the site-specific phases IIA and IIB on the basis of radiocarbon dates and excavation information. Phase IIA corresponds to the first period of occupation of Gegharot in the Late Bronze Age which was ended by the first destruction of the site. Phase IIB is the later period of occupation of the site during the Late Bronze Age, which was also ended by a destruction episode. While many loci could not be confidently assigned to either phase, Table A.39 lists the loci that were assigned to each phase. Section A.7 presents a discussion of diachronic patterning in the LBA faunal assemblage at Gegharot.

A.1.2 Quantification

The two major approaches to quantifying faunal remains from archaeological sites are Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNE). While both approaches have unique advantages and limitations (Lyman 1994), for this study I have forgone calculating MNI and use either NISP and or the weight of bones to quantify the assemblages. Since MNI is highly dependent on units within which it is calculated – the problem of aggregation – it was not used to analyze the relative abundance of taxa primarily. There was no clear unit below the level of the site at which it was possible to reasonably assume that the entire animal would have been present, as this assumption is hard to sustain even at the level of the site itself. Furthermore, there was no need to compare between mammals, birds, and fish (Lyman 2008; Reitz and Wing 2008:202-213) due to the overwhelming dominance of major mammalian taxa (Section A.3).

When recording, number of pieces and number of elements were not recorded separately (cf. Russell and Martin 2005:37-38). Rather, associated unfused epiphyses and diaphyses were recorded and weighed separately (and associated in the database), but with only the diaphyses being given a count of one (so that it would only count once towards the NISP). Pieces of bones with modern breaks that were clearly associated were recorded together and given a count of one. In order to analyze the distribution of body parts for the three major taxa (Bos, Capra, and Ovis), the minimum number of elements (MNE) was calculated at two levels of aggregation: the site sector and the depositional context type within site sectors for Gegharot and the Tsaghkahovit Residential Complex.

MNE suffers from the same problems of aggregation that MNI does (Lyman 2008), but it allows for a more standardized comparison across body parts and can help assess the impact that fragmentation has on the relative prevalence of body parts through comparison with NISP. Due to the way the faunal remains from the Project ArAGATS excavations were recorded, MNE was calculated using a slightly modified from of White's (1953) method.[1] Elements were separated out by side and fusion state, but all fusion states were counted toward the MNE. Only remains coded as complete, 3/4-complete, or 1/2-3/4 complete were

1. Since age, size, and/or sex data was not generally recorded for individual elements, it could not be used to generate the MNE count using Bokonyi's (1970) method.

counted towards the MNE.[2] For the innominate, the acetabulum was used. For mandible, the higher count of the cheek row or 4th premolars (in association with a tooth row) was used for the MNE. For most contexts, the 4th premolars produced a higher MNE, likely related to the relative fragmentation of the mandibles. In general, this method produces an undercount because the completeness refers to the entire skeletal element rather than the skeletal feature used for the count. This problem particularly impacted the MNE counts for mandibles, scapulas, and innominates.

A.2 Taphonomy

A.2.1 Recovery

One way of testing sample recovery is to compare the ratio of first to second phalanges for both cattle and sheep/goat. These elements occur in the body in equal number and have similar densities, but second phalanges are smaller than first phalanges, so differential recovery of these two elements should indicate whether smaller materials are being lost when remains are hand-collected. Similarly, any differences in the ratios between cattle and sheep/goats also indicates the loss of smaller materials, as sheep/goat phalanges are smaller than cattle phalanges. Tables A.1and A.2 show the impact that size and screening have on the recovery of first and second phalanges.

Looking at the differences in the ratios produced when using NISP or MNE reveals the impact that fragmentation has on these elements. At Gegharot, fragmentation has little effect on the ratio for cattle, though unsurprisingly, this effect is more noticeable in the screened remains. For sheep and goats, the first phalanges are considerably more fragmented than the second phalanges. At the TRC, the method of counting has little

2. This method of calculating MNE excludes shafts from long bones elements that are > 50% complete, since they can't be assigned to proximal or distal.

<u>Cattle</u>	NISP			MNE		
Gegharot	1PHL	2PHL	ratio	1PHL	2PHL	ratio
Screened	177	116	65.54%	142	109	76.76%
Unscreened	278	143	51.44%	249	138	55.42%
Tsagh. Residential Complex						
Screened	39	23	58.97%	33	20	60.61%
Unscreened	58	32	55.17%	51	30	58.82%
<u>Sheep/Goat</u>	NISP			MNE		
Gegharot	1PHL	2PHL	ratio	1PHL	2PHL	ratio
Screened	91	59	64.84%	68	55	80.88%
Unscreened	192	77	40.10%	153	73	47.71%
Tsagh. Residential Complex						
Screened	11	8	72.73%	6	8	133.33%
Unscreened	20	9	45.00%	16	8	50.00%

Table A.1: Ratio of second to first phalanges calculated using NISP and MNE.

impact on the ratio for cattle and for sheep/goats, using MNE increases the ratio, suggesting that 1st phalanxes are more fragmented than second, though the sample size is very small for this assemblage.

At Gegharot, screening does increase the ratio of first to second phalanges for both cattle and sheep/goats, though this effect is stronger for sheep/goats (presumably due to their smaller size). This effect is not statistically significant for cattle ($\chi^2 = 2.3636$, df = 1, p = 0.1242) and was barely below the cut-off for sheep and goats ($\chi^2 = 5.0375$, df = 1, p = 0.0248). At TRC, screening has a larger impact on the recovery of sheep/goat second phalanges, but again this was not statistically significant ($\chi^2 = 0.61509$, df = 1, p = 0.4329) due to the smaller screened sample sizes. Overall, this metric suggests that there may be remains that are not being recovered through excavation, but body size of the taxa and screening only marginally impact this measure of recovery. Potentially, this is result of differential patterns of deposition and/or fragmentation of first and second phalanges, but it is not entirely clear what activities would cause that.

Gegharot	1st Phalanx	2nd Phalanx	Ratio
Screened			
Cattle	177	116	65.54%
Sheep/goat	91	59	64.84%
Unscreened			
Cattle	278	143	51.44%
Sheep/goat	192	77	40.10%
TOTAL			
Cattle	455	259	56.92%
Sheep/goat	283	136	48.06%
Tsagh. Residential Complex	**1st Phalanx**	**2nd Phalanx**	**Ratio**
Screened			
Cattle	39	23	58.97%
Sheep/goat	11	8	72.73%
Unscreened			
Cattle	58	32	55.17%
Sheep/goat	20	9	45.00%
TOTAL			
Cattle	97	55	56.70%
Sheep/goat	31	17	54.84%

Table A.2: Ratio of second to first phalanges comparing cattle and sheep/goat.

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel
Cultural Fill	16.80%	18.86%	12.25%
Destruction Layer	35.42%	-	0.00%
Floor	16.09%	22.49%	0.00%
Hearth	0.00%	0.00%	-
Intramural Trash	0.00%	0.00%	-
Midden	82.62%	88.34%	-
Pit	46.06%	49.09%	0.00%
Special Feature	6.21%	-	0.00%
Indeterminate	2.11%	0.00%	63.06%
Vessel	1.85%	-	-
Wash	11.80%	0.00%	0.00%

Table A.3: Percentage of remains that come from screened loci for each context of deposition.

A.2.1.1 Screening

One important aspect of sample recovery is screening, as demonstrated in the now classic paper by Payne (1972). Across the Project ArAGATS excavations, the decision to screen any particular loci is left up to the excavator, though as a general rule, only non-mixed cultural deposits are selected for screening. As a result, the assemblage of remains from screened deposits is not evenly distributed across site sectors (Table A.3). At both Gegharot and the Tsaghkahovit Residential Complex, ~40% of faunal remains are from screened loci. In contrast, at the citadel at Tsaghkahovit, only ~10% of remains are from screened loci. Moreover, the distribution of remains from screened contexts does not match the overall distribution of faunal remains between deposition context types (Table A.4).

At Gegharot, nearly 2/3 of the screened materials comes from midden contexts, followed by pit and destruction layer contexts. In contrast, wash, fill, and floor contexts are comparatively under-screened. At the Tsaghkahovit Residential Complex, over 3/4 of the screened materials are from midden contexts, whereas fill, floor, and pit contexts are

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel
Cultural Fill	4.64%	10.08%	14.87%
Destruction Layer	9.14%	-	0.00%
Floor	1.14%	6.67%	0.00%
Hearth	0.00%	0.00%	-
Intramural Trash	0.00%	0.00%	-
Midden	66.14%	76.27%	-
Pit	14.79%	6.97%	0.00%
Special Feature	0.38%	-	0.00%
Indeterminate	0.82%	0.00%	85.13%
Vessel	0.06%	-	-
Wash	2.89%	0.00%	0.00%

Table A.4: Relative proportion of screened remains by deposition context.

comparatively under-screened. At the Tsaghkahovit citadel, most (~85%) of the screened remains come from indeterminate contexts, even though floor contexts make up most of the assemblage.

This patterning, in part, helps to explain the counter-intuitive pattern where screening has differential effects between site sectors and contexts of deposition. Overall, screening appears to have a negligible effects on the percentage of remains identified to the level of genus or better, especially at Gegharot and the TRC, which have the highest levels of screening (Table A.5). However, screening does appear to have an effect on the relative proportion of indeterminate remains (not assignable to any taphonomic specificity beyond "mammal") and body size classes (large, medium, and small mammal) (Table A.6).[3] However, this effect is not consistent across the site sectors or between types of depositional contexts.

3. It is worth noting that this method covers a much broader range of faunal remains than the ratio of 1st to 2nd phalanges.

	Screened		Unscreened	
	N	%	N	%
Gegharot	6116	35.45%	9045	32.98%
Tsagh. Residential Complex	1657	30.71%	2202	24.31%
Tsagh. Citadel	141	12.78%	2995	32.25%

Table A.5: Effect of screening on the percentage of remains identified to genus or better.

	Screened	Unscreened	Screened	Unscreened
Gegharot				
Large Mammal	5556	7639	32.20%	27.86%
Medium Mammal	8198	11572	47.52%	42.20%
Small Mammal	189	330	1.10%	1.20%
Indeterminate	3303	7736	19.15%	28.21%
Tsagh. Residential Complex				
Large Mammal	2152	2830	39.89%	31.25%
Medium Mammal	2072	2391	38.41%	26.40%
Small Mammal	96	83	1.78%	0.92%
Indeterminate	1065	3689	19.74%	40.73%
Tsagh. Citadel				
Large Mammal	152	3111	13.78%	33.50%
Medium Mammal	460	4638	41.70%	49.95%
Small Mammal	15	99	1.36%	1.07%
Indeterminate	476	1431	43.16%	15.41%

Table A.6: Impact of screening on recovery of faunal remains (by body size).

At Gegharot, counter-intuitively, screened contexts have a lower percentage of remains identified as 'indeterminate' than unscreened ones and screening has no effect on the relative proportion of body sizes in recovered remains ($\chi^2 = 487.93$, df = 3, $p < 2.2e^{-16}$). At the Tsaghkahovit Residential Complex, screening also decreases the proportion of indeterminate remains but also slightly increases the proportion of medium-sized mammals ($\chi^2 = 816.81$, df = 3, $p < 2.2e^{-16}$). For the citadel at Tsaghkahovit, screening significantly decreases the proportion of large mammal sized remains and increases the percentage of indeterminate remains ($\chi^2 = 549.62$, df = 3, $p < 2.2e^{-16}$). These differences are likely a result of both different taphonomic histories as well as different practices of screening during excavation.

The effects of screening on body size at Gegharot and the TRC are mostly replicated across the different contexts of deposition, the only exceptions being that in destruction layer contexts at Gegharot, screening increases the proportion of medium-mammal sized remains, while still reducing the percentage of indeterminate remains ($\chi^2 = 510.31$, df = 3, $p < 2.2e^{-16}$). In the other context types, the impact of screening is more distributed across body size categories. For instance, midden contexts that were screened had (statistically significantly) lower proportions of medium-sized remains ($\chi^2 = 69.686$, df = 3, p = $4.984e^{-15}$). All of the rest of the context types showed much less strong effects, as indicated by much higher p-values for the chi-squared tests. At the Tsaghkahovit Residential Complex, the overall pattern is mostly driven by midden contexts (where screening increases the proportion of medium-sized mammals and decreases indeterminate remains – $\chi^2 = 95.879$, df = 3, $p < 2.2e^{-16}$). Cultural fill and floor contexts only partially show this effect (decreased indeterminate remains [$\chi^2 = 33.798$, df = 3, p = $2.186e^{-7}$] and increased medium mammal [$\chi^2 = 26.195$, df = 3, p = $8.681e^{-6}$], respectively).

	Screened		***Unscreened***		***Screened***		***Unscreened***	
	Cultural Fill				**Destruction Layer**			
Large Mammal	211	26.34%	1197	30.17%	222	14.09%	666	23.17%
Medium Mammal	445	55.56%	1900	47.90%	904	57.36%	771	26.83%
Small Mammal	10	1.25%	68	1.71%	60	3.81%	16	0.56%
Indeterminate	135	16.85%	801	20.19%	389	24.68%	1420	49.41%
	Midden				**Pit**			
Large Mammal	4145	36.33%	849	35.38%	722	28.29%	834	27.91%
Medium Mammal	5051	44.27%	1241	51.71%	1340	52.51%	1302	43.57%
Small Mammal	56	0.49%	3	0.13%	41	1.61%	55	1.84%
Indeterminate	2132	18.69%	307	12.79%	447	17.52%	658	22.02%
	Wash				**Floor**			
Large Mammal	147	29.52%	931	25.01%	47	23.98%	336	33.10%
Medium Mammal	246	49.40%	1650	44.33%	106	54.08%	459	45.22%
Small Mammal	16	3.21%	60	1.61%	0	0.00%	25	2.46%
Indeterminate	89	17.87%	1078	28.96%	43	21.94%	195	19.21%

Table A.7: Impact of screening on recovery of faunal remains (by body size) by context at Gegharot.

	Screened		***Unscreened***		***Screened***		***Unscreened***	
	Cultural Fill				**Floor**			
Large Mammal	150	27.57%	823	35.17%	91	25.28%	380	30.62%
Medium Mammal	137	25.18%	750	32.05%	160	44.44%	383	30.86%
Small Mammal	11	2.02%	39	1.67%	6	1.67%	11	0.89%
Indeterminate	234	43.01%	727	31.07%	102	28.33%	466	37.55%
	Midden				**Pit**			
Large Mammal	1840	44.71%	223	41.07%	71	18.88%	78	20.00%
Medium Mammal	1590	38.64%	141	25.97%	185	49.20%	165	42.31%
Small Mammal	47	1.14%	6	1.10%	29	7.71%	9	2.31%
Indeterminate	638	15.50%	173	31.86%	91	24.20%	138	35.38%

Table A.8: Impact of screening on recovery of faunal remains (by body size) by context at the TRC.

Gegharot	Proximal	Distal	Index
Cow size	40	99	28.78%
Sheep size	68	187	26.67%
Tsagh. Residential Complex	Proximal	Distal	Index
Cow size	14	59	19.18%
Sheep size	9	46	16.36%

Table A.9: Humerus Index.

A.2.2 Attrition

The differential density of skeletal elements can shape their relative likelihood of surviving peri-and post-depositional taphonomic processes. It is important to assess to what extent density-mediated attrition can explain the patterning seen in skeletal elements. One measure of attrition in an assemblage in the humerus index, which is that ratio of fragments of the proximal humerus (which is a low density element) to fragments of the distal humerus (which has a much higher density). The ratio was calculated using NISP and included all the fragments identified as either proximal or distal humerus (no shaft fragments) for all sheep-sized and cow-size taphonomic categories (Ben Arbuckle, pers. comm.) in order to account for difference in relative identifiability of these elements. Table A.9 shows the humerus indices for the Tsaghkahovit Plain assemblages.

Across the contexts, the humerus index indicates that relative to distal humerus fragments, there are relatively fewer proximal humerus fragments. There is no difference, however, between sheep-size and cow-size remains within site-sector assemblages and for both size categories, Gegharot has a higher index than the TRC. While this index indicates that density-mediated attrition may be a factor for this element, it is worth noting that the values for the humerus index at sites in the Tsaghkahovit Plain (particularly Gegharot) are higher than those recorded in a number of Anatolian assemblages (see Arbuckle et al. 2009:146).

While the humerus index suggests that density-mediated attrition was potentially a significant factor in shaping these assemblages, another broader measure suggests that density is not the primary factor shaping relative abundance of skeletal elements. Graphing the relationship between element density and its relative abundance (using MNE) allows for the identification of assemblages that are primarily a result of density-mediated attrition. Different sets of measurements of bone density exist, but for this study I used the values produced by Symmons (2002), as they are recent and based on a large sample (see Orton (2010b) for an assessment of the existing data sets). For this study, I used his entire sample (of different ages and fusion states) because the MNE was calculated using all fusion stages and calculated the median values for each scan site (per Symmons' (2002) recommendation).

Visual inspection of the graphs (Figure A.1) shows that across the assemblage there is no clear correlation between element density and abundance. These visual results are confirmed by linear regression analysis, which showed no significant correlation between the two variables. This analysis does highlight a number of elements that appear as outliers. At both Gegharot and the TRC, cattle first phalanges appear as an outlier. For sheep/goats, innominates are an outlier at both Gegharot and the TRC (where scapulas are also highly abundant).

A.2.3 Peri-depositional damage

A.2.3.1 Gnawing

Gnaw marks on bones were recorded in one of three categories: carnivore gnawing, rodent gnawing, and gnawing (when the agent could not be positively identified, so this category also includes some carnivore-gnawed elements). Positively-identified carnivore gnawing was extremely low across the assemblage, and total gnawing was also similarly slight

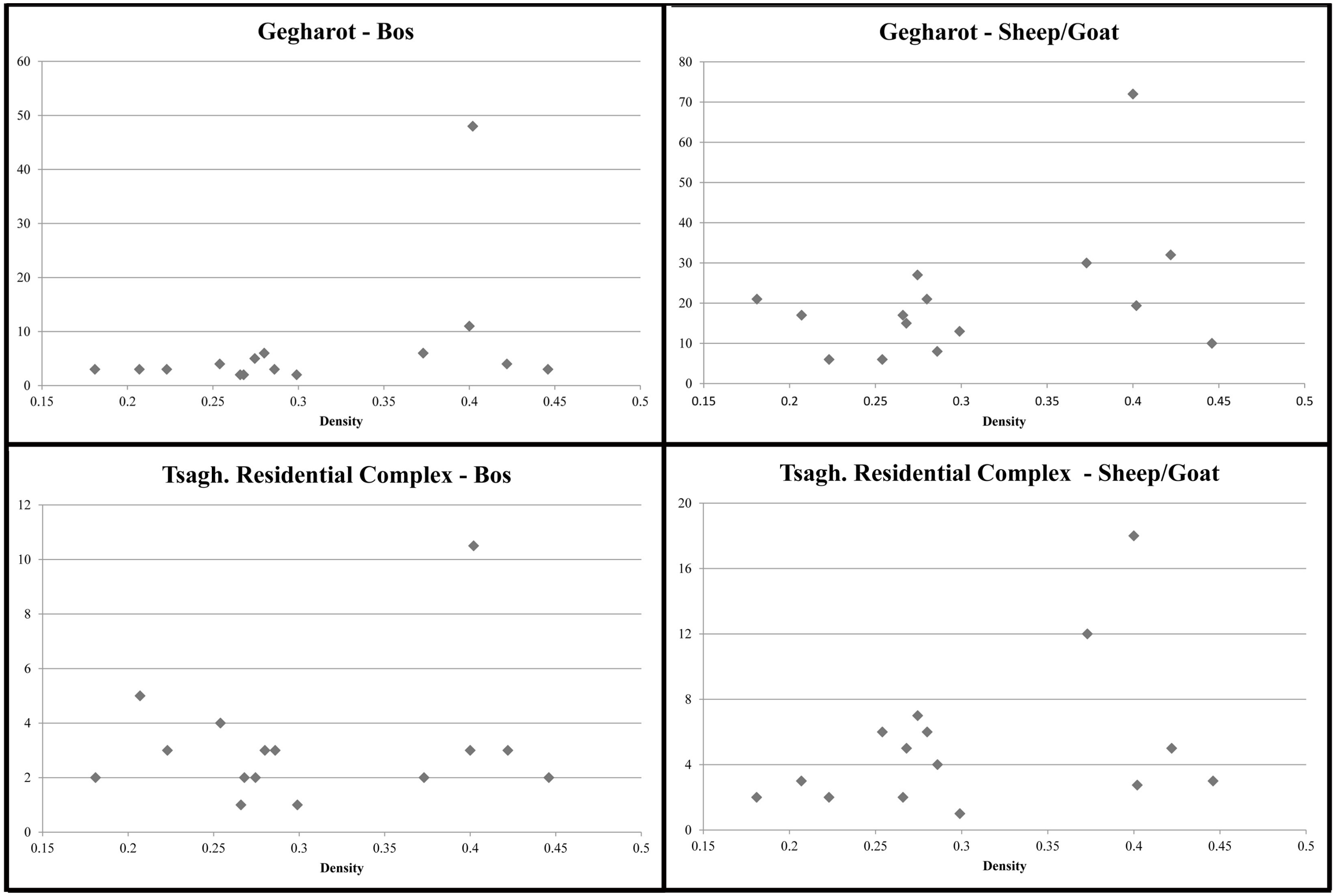

Figure A.1. Density mediated attrition. Graphs of element density vs. element abundance.

(Table A.10). This suggests that gnawing by dogs was not a major factor in shaping the Tsaghkahovit Plain assemblages. To confirm this, I looked at gnawing rates on long bone fragments, as Morey & Klippel (1991) suggest that assemblages with high levels of carnivore gnawing will have gnaw marks on a high percentage of long bone fragments. Very few long bone fragments (<10%) showed gnaw marks (Table A.11), which further confirms that remains were likely buried quickly or dogs had limited access to areas where garbage was deposited. Potentially, dogs had slightly greater access to garbage at the Tsaghkahovit Residential Complex, particularly to remains deposited in hearths and middens.

A.2.3.2 Burning

Generally, rates of burning were low across the Tsaghkahovit Plain assemblages (Table A.12). Gegharot showed the highest levels of burning (~6%) and the TRC showed the least (<1%). Unsurprisingly, the destruction layer contexts at Gegharot showed the highest level of burning, but almost all context types at Gegharot show higher levels of burning compared to contexts from the TRC (Table A.13). At the Tsaghkahovit citadel, indeterminate contexts also showed slightly elevated rates of burning, as do pits from the West Settlement. Calcined bones were rare across the assemblage, which indicates that the destruction episodes did not result in intense fires. While rare, nearly all of the calcined faunal remains are from pits at Gegharot and the West Settlement. The ones from Gegharot are from a pit in trench T2E and potentially are cleared destruction debris. The pit at the West Settlement with calcined bones was a Late Bronze Age pits with multiple layers of deposition visible in the profile. Radiocarbon dates from the pit could only be assigned a general Stratum 2 (Late Bronze) date.

Total Gnawing	Gegharot		Tsagh. Residential Complex		Tsagh. Citadel		West Settlement	
Cultural Fill	199	4.17%	150	5.20%	83	6.20%	1	8.33%
Destruction Layer	171	3.84%	-	-	25	7.69%	14	6.48%
Floor	44	3.59%	67	4.18%	319	6.45%	20	8.70%
Midden	883	6.39%	189	4.06%	-	-	-	-
Intramural Trash	165	7.62%	16	5.78%	-	-	-	-
Wash	198	4.69%	188	4.47%	160	7.46%	-	-
Pit	235	4.24%	24	3.13%	13	9.35%	21	2.06%
Hearth	0	0.00%	7	12.07%	-	-	-	-
Special Feature	41	3.92%	-	-	0	0.00%	-	-
Vessel	16	2.69%	-	-	-	-	-	-
Indeterminate	341	5.07%	0	0.00%	67	4.50%	23	6.93%
TOTAL	2293	5.13%	641	4.44%	667	6.42%	79	4.37%
Carnivore Gnawing								
Cultural Fill	19	0.40%	12	0.42%	0	0.00%	0	0.00%
Destruction Layer	21	0.47%	-	-	0	0.00%	1	0.46%
Floor	4	0.33%	13	0.81%	1	0.02%	3	1.30%
Midden	101	0.73%	50	1.07%	-	-	-	-
Intramural Trash	18	0.83%	0	0.00%	-	-	-	-
Wash	25	0.59%	0	0.00%	1	0.05%	-	-
Pit	28	0.51%	0	0.00%	0	0.00%	3	0.29%
Hearth	0	0.00%	0	0.00%	-	-	-	-
Special Feature	2	0.19%	-	-	0	0.00%	-	-
Vessel	2	0.34%	-	-	-	-	-	-
Indeterminate	53	0.79%	0	0.00%	0	0.00%	1	0.30%
TOTAL	273	0.61%	75	0.52%	2	0.02%	8	0.44%

Table A.10: Gnawing.

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel	West Settlement
% LBFR w/ CRNG	0.04%	0.04%	0.00%	0.00%
% LBFR w/ GNWD	10.14%	8.52%	13.52%	9.84%
% GNWD on SHFT* **	8.91%	8.52%	9.97%	8.21%

Table A.11: Carnivore Gnawing. LBFR = long bone fragment, CRNG = carnivore gnawed, GNWD = gnawed. * Remains coded as "shaft". **Included remains coded as both "gnawed" and "carnivore gnawed".

A.2.4 Fragmentation and breakage

Two measures were used to assess the relative level of fragmentation and the physical deterioration (due to weathering, processing, or other processes) of bones. The first measure is the percentage of bones that can be identified to the taphonomic level of genus or higher (Table A.14).[4] The other measure of the relative level of fragmentation of faunal remains is the proportion of remains that are identified as being <1/4 complete, 1/4-1/2 complete, 1/2-3/4 complete, 3/4-complete, or complete.

Across assemblages from the Tsaghkahovit Plain, between 25-35% of remains collected could be identified to the level of genus or higher. Gegharot has a slightly higher percentage of remains identified to the level of genus or higher ($\chi^2 = 317.72$, $df = 3$, $p < 2.2e^{-16}$). At Gegharot, middens and intramural trash deposits have higher percentages of remains identified to the level of genus or better, in contrast to remains from destruction layer contexts and recovered from inside of vessels. Potentially, this is difference is related to the particular processes and practices that define these contexts (fire and structural collapse and butchery and cooking, respectively). At the Tsaghkahovit

4. More fragmented or deteriorated bones are harder to identify, though skeletal element, species, and the skill of the analyst also impact the relative identifiability of a particular specimen.

	Gegharot		Tsagh. Residential Complex		Tsagh. Citadel		West Settlement	
Burnt	2262	5.06%	111	0.77%	300	2.89%	50	2.77%
Partially Altered	29	0.06%	0	0.00%	1	0.01%	2	0.11%
Slightly Altered	226	0.51%	3	0.02%	2	0.02%	6	0.33%
Calcined	5	0.01%	0	0.00%	0	0.00%	5	0.28%
Total Burnt	2522	5.65%	114	0.79%	303	2.92%	63	3.48%

Table A.12: Burning.

	Gegharot		Tsagh. Residential Complex		Tsagh. Citadel		West Settlement	
Cultural Fill	351	7.36%	34	1.18%	33	2.46%	1	8.33%
Destruction Layer	589	13.24%	-	-	22	6.77%	16	7.41%
Floor	82	6.70%	17	1.06%	19	0.38%	5	2.17%
Midden	340	2.46%	34	0.73%	-		-	-
Intramural Trash	13	0.60%	2	0.72%	-		-	-
Wash	201	4.76%	16	0.38%	17	0.79%	-	-
Pit	427	7.71%	11	1.44%	6	4.32%	31	3.05%
Hearth	4	3.23%	0	0.00%	-		-	-
Special Feature	70	6.69%	-	-	0	0.00%	-	-
Vessel	42	7.06%	-	-	-		-	-
Indeterminate	403	5.99%	-	-	206	13.83%	10	3.01%

Table A.13: Burning by context.

	Gegharot	Tsagh. Residential Complex	Tsagh. Citadel	West Settlement
Cultural Fill	32.30%	29.58%	24.05%	50.00%
Destruction Layer	24.47%	-	39.08%	21.76%
Floor	33.50%	22.74%	33.36%	37.39%
Hearth	40.32%	32.76%	-	-
Intramural Trash	41.92%	13.00%	-	-
Midden	41.27%	31.92%	-	-
Pit	33.25%	26.50%	30.94%	23.08%
Special Feature	32.19%	-	20.00%	
Indeterminate	28.86%	0.00%	18.00%	23.80%
Vessel	17.65%	-	-	-
Wash	29.34%	21.32%	33.82%	
Total	**33.94%**	**26.70%**	**30.19%**	**25.06%**

Table A.14: Percentage of remains identified to the level of genus or better.

Residential Complex, the pattern is different, with floor and wash contexts showing lower percentages of remains identified to the level of genus or better. At the West Settlement, the pits show a lower percentage of remains identified to the level of genus or better than the assemblages from other site sectors.

Looking at relative completeness of identified specimens, at Gegharot, ~80% of remains are less than 50% complete (Figure A.2). The destruction layer, vessel, and wash contexts have higher proportion of remains that were less than 1/4 complete. All the contexts from the TRC show a higher percentage of remains that are less than 50% complete than contexts at Gegharot. Similar to wash contexts at Gegharot, wash contexts at the TRC have an even greater percentage of remains that are less than 50% complete.

While the fracture freshness was not recorded, fragmentation was recorded as either pre-depositional, post-depositional, or recent. Pre-depositional fragmentation refers only to bones that showed cut marks or gnawing and burning across fractures – so this category necessarily undercounts the number of bones in the assemblage that were broken fresh. The

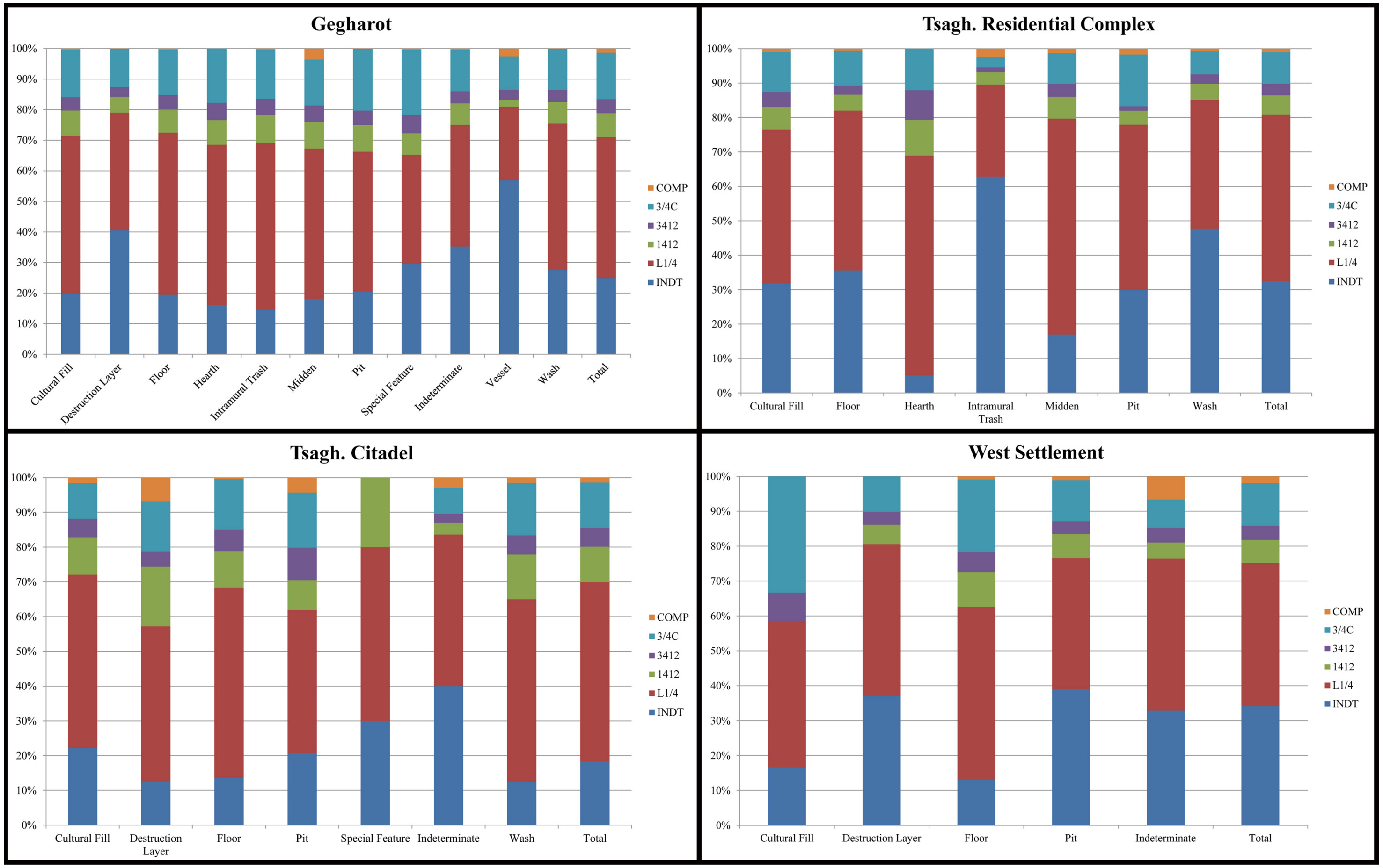

Figure A.2. Fragmentation.

	Gegharot		Tsagh. Residential Complex	
Pre-depositional	3290	7.36%	245	1.70%
Post-depositional	35256	78.91%	10664	73.79%
Recent	5519	12.35%	3362	23.26%
	Tsagh. Citadel		West Settlement	
Pre-depositional	477	4.59%	100	5.53%
Post-depositional	9173	88.30%	1299	71.85%
Recent	593	5.71%	373	20.63%

Table A.15: Origin of fragmentation.

category of recent fragmentation does allow the assessment of the impact of fragmentation during excavation and analysis. Gegharot shows more bones categorized as fragmented before deposition, and the TRC has fewer (Table A.15). Both the TRC and the West Settlement have more recent breaks ($\chi^2 = 2371.3$, $df = 6$, $p < 2.2e^{-16}$). The higher levels of elements coded as "pre-depositional" at Gegharot is likely a result of the higher levels of butchery and burning.

In order to assess whether the fragmentation seen in the assemblages was a result of human activity or post-depositional taphonomic processes, I calculated a slightly modified version of Marean's (1991) completeness index (following Russell and Martin 2005:90-91). This index assesses the level of fragmentation in the carpals and tarsals, on the assumption that because they are of low-utility (in terms of meat and marrow),[5] any fragmentation results from something other than human processing.

At Gegharot, both cow-size and sheep-size remains have a similar index values (Table A.17). In contrast, at the TRC, sheep-sized remains have a higher index value, indicating that larger animal remains may have undergone more post-depositional fragmentation (Table A.18). This comprehensive picture contrasts slightly with the fragmentation seen

5. For this reason, the calcaneus (which contains a small amount of marrow) has been excluded (Russell and Martin 2005:90-91).

	Gegharot		Tsagh. Residential Complex		Tsagh. Citadel		West Settlement	
Cultural Fill	409	8.58%	62	2.15%	55	4.11%	1	8.33%
Destruction Layer	680	15.28%	-		29	8.92%	21	9.72%
Floor	97	7.92%	44	2.75%	127	2.57%	15	6.52%
Midden	550	3.98%	79	1.70%	-	-	-	-
Intramural Trash	53	2.45%	4	1.44%	-	-	-	-
Wash	259	6.14%	36	0.86%	60	2.80%	-	-
Pit	547	9.87%	19	2.48%	9	6.47%	47	4.62%
Hearth	6	4.84%	1	1.72%	-	-	-	-
Special Feature	91	8.69%	-	-	2	20.00%	-	-
Vessel	77	12.94%	-	-	-	-	-	-
Indeterminate	521	7.74%	0	0.00%	195	13.10%	16	4.82%

Table A.16: Recent breakage by context.

	Cow-sized		Sheep-sized	
	N	Index	N	Index
Cultural Fill	71	77.11	62	82.26
Destruction Layer	86	77.91	72	81.94
Floor	16	78.13	9	81.94
Midden	195	78.40	103	79.00
Intramural Trash	36	74.65	12	83.33
Wash	42	80.95	58	80.82
Pit	95	82.50	79	83.70
Hearth	1	87.50	3	87.50
Special Feature	27	81.94	24	83.33
Vessel	13	81.73	8	92.19
Indeterminate	67	78.92	75	83.00
TOTAL	**649**	**83.09**	**505**	**81.91**

Table A.17: Completeness Index for Gegharot contexts.

	Cow-sized		Sheep-sized	
	N	Index	N	Index
Cultural Fill	16	75.78	5	90.00
Floor	8	70.31	6	79.17
Midden	31	76.61	10	88.75
Wash	11	82.95	4	87.50
Pit	3	87.50	4	87.50
TOTAL	**69**	**77.17**	**29**	**86.64**

Table A.18: Completeness Index for Tsaghkahovit Residential Complex contexts.

in second phalanges. The completeness indices are roughly similar across the different contexts of deposition. The completeness indices across all of the assemblages are rather high, higher than those reported by Arbuckle et al. (2009) and similar to those from Catalhoyuk (Russell and Martin 2005:90). This suggests that most of the fragmentation seen in the assemblage is pre- or per-depositional and is human-caused.

A.3 Relative Proportions of Taxa

Overall, the assemblages from the Tsaghkahovit Plain are overwhelmingly focused on domesticated animals, in particular sheep, goats, and cattle. Much smaller amount of equids and pigs are present in the assemblages, and very few wild animals overall. Across the assemblages, however, there are differences in the proportions of the major domesticated taxa. In this regard, the differences are much greater between site sectors than between different context types within sectors (Table A.20and Figure A.3).

Replicating the results of previous analyses (Badalyan et al. 2008; Monahan 2012; Badalyan et al. forthcoming), the data in Table A.20 show that sheep/goats predominate over cattle at Gegharot and the citadel and West Settlement at Tsaghkahovit. In contrast, at the Tsaghkahovit Residential Complex, sheep/goats are found in roughly similar proportions to cattle. This difference is statistically significant ($\chi^2 = 290.49$, $df = 12$, $p < 2.2e^{-16}$) and is due primarily to the difference in cattle and sheep/goat at the TRC. Notably, the TRC also has noticeably higher levels of equid remains than the other assemblages (which was reflected in the residuals for the χ^2test).

These overall trends are more or less consistently reflected across context types (Figure A.3). Midden and intramural contexts at Gegharot had slightly higher levels of cattle, whereas special features had even higher levels of sheep/goats. Floors and pits had slightly higher levels of taxonomic diversity (as reflected by higher percentages in the Other category). At the Tsaghkahovit Residential Complex, the proportions of taxa are relatively consistent across context type and most of the fluctuation is driven by small sample size. The one possible exception to this are floor contexts, which have higher proportions of sheep and goats compared to the rest of the assemblage. Equids are fairly evenly distributed across the four largest context categories. The proportions of major taxa are similar across

	Cultural Fill	Wash	Midden	Destruction Layer	Intramural Trash	Floor	Pit	Hearth	Special Feature	Vessel	Indet.	Total
Bos taurus	500	380	2430	350	403	144	593	17	60	30	615	5522
Ovis aries	212	157	501	116	54	34	179	8	94	10	95	1460
Capra hircus	52	36	98	19	13	3	59	7	7	0	29	323
Ovis/Capra	704	598	2563	552	415	202	869	17	168	63	1137	7288
Sus scrofa	12	21	21	8	4	0	8	1	2	0	17	94
Equids	19	32	74	14	17	7	15	0	0	1	30	209
Canids	7	5	5	4	3	16	5	0	0	0	5	50
Rodents	18	12	0	22	2	2	11	0	1	0	0	68
Other carnivores	4	1	1	1	0	1	0	0	0	0	1	9
Birds	2	2	2	1	0	1	38	0	1	0	2	49
Fish	0	0	1	1	0	0	2	0	0	1	0	5
Amphibians	1	1	0	0	0	0	97	0	0	0	0	99
Large Mammal	889	666	2496	524	517	232	948	18	134	42	998	7464
Medium Mammal	1354	1078	3120	979	413	336	1522	35	254	101	1384	10576
Small Mammal	58	64	59	50	11	8	89	1	18	10	53	421
Indet.	936	1167	2439	1809	314	238	1105	20	308	337	2366	11039
Total	**4768**	**4220**	**13810**	**4450**	**2166**	**1224**	**5540**	**124**	**1047**	**595**	**6732**	**44676**

Table A.19: Taxa by Context at Gegharot.

	Gegharot	%	Tsagh. Residential Complex	%	Tsagh. Citadel	%	West Settlement	%
Bos	5522	36.42%	1788	46.33%	1013	32.30%	150	33.11%
Ovis/Capra	9071	59.83%	1865	48.33%	1991	63.49%	290	64.02%
Sus	94	0.62%	35	0.91%	46	1.47%	6	1.32%
Equids	209	1.38%	112	2.90%	62	1.98%	7	1.55%
Other	265	1.75%	59	1.53%	24	0.77%	0	0.00%

Table A.20: Proportions of major taxa.

context type at the citadel at Tsaghkahovit. At the West Settlement, most of the assemblage comes from pit contexts, which are dominated by sheep/goat remains.

A.3.1 Sheep to Goat Ratio

The ratio of sheep to goats within the assemblages ranges from 3.4 to 9.7 (Table A.21). However, the high value from the West Settlement is most likely an artifact of the extremely small sample of remains positively identified as either *Ovis aries* or *Capra hircus.* A multiple comparison of proportions test (following Buikstra et al. 1986) shows that the ratios from the site sectors potentially represent samples from the same population (Figure A.4), thus these differences in sheep to goat ratios are not statistically significant.

Depositional contexts within site sectors showed an even greater range (0.75 to 13.4). At Gegharot, none of these different ratios are likely to be samples of different populations. At the TRC, however, the very low ratio of sheep to goats (0.75) in floor contexts is significantly different from other contexts at the TRC (Figure A.5). Similarly, the very low sheep to goat ratio in pits at the citadel at Tsaghkahovit is statistically significant. Since many of the contexts in these assemblages were dominated by astragali and/or mandibles, which can be identified to species for caprines, these elements were removed in order to assess if they were unduly influencing the overall sheep:goat ratio. As Table A.22 shows, the outliers do not meaningfully shift the overall ratios for the site sectors.

A.4 Skeletal Element Patterning

A.4.1 Minimum Number of Elements

Figure A.6 presents the distribution of cattle and sheep/goat body parts at Gegharot, based on NISP and on MNE. In the first graph, mandibles and first phalanges predominate. In

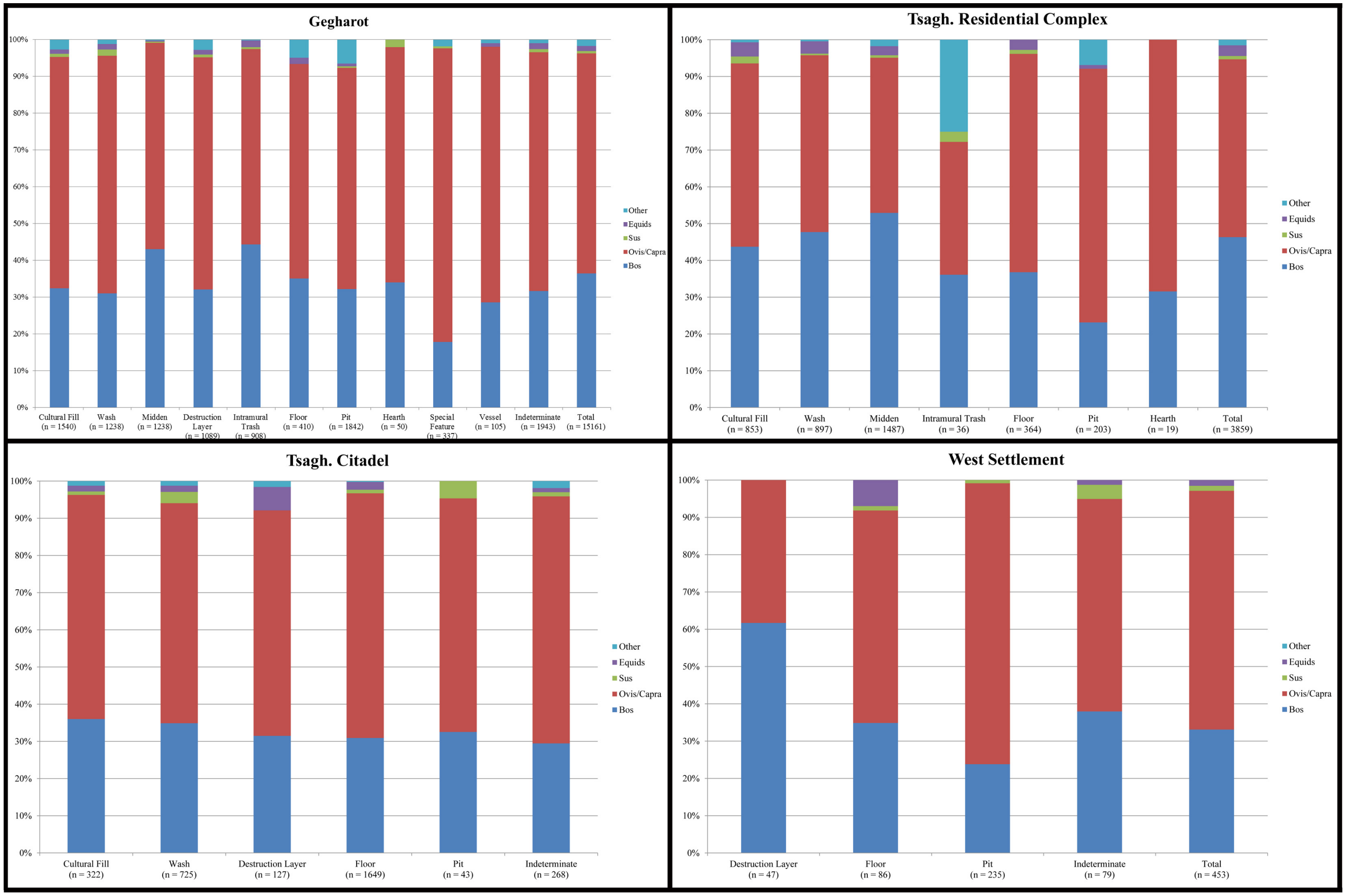

Figure A.3. Proportions of major taxa by depositional context.

	Cultural Fill	Wash	Midden	Destruction Layer	Intramural Trash	Floor	Pit	Hearth	Special Feature	Indet.	Total
Gegharot	4.1	4.4	5.1	6.1	4.2	11.3	3.0	1.1	13.4	3.3	4.5
Tsagh. Residential Complex	4.2	4.8	3.1	-	4.0	0.75	10.0	-	-	-	3.4
Tsagh. Citadel	8.3	5.3	-	7.7	-	4.6	0.1	-	-	7.5	3.8
West Settlement	-	-	-	*	-	*	3.3	-	-	*	9.7

Table A.21: Sheep to goat ratios. *Other contexts had *Ovis aries* and no *Capra hircus*.

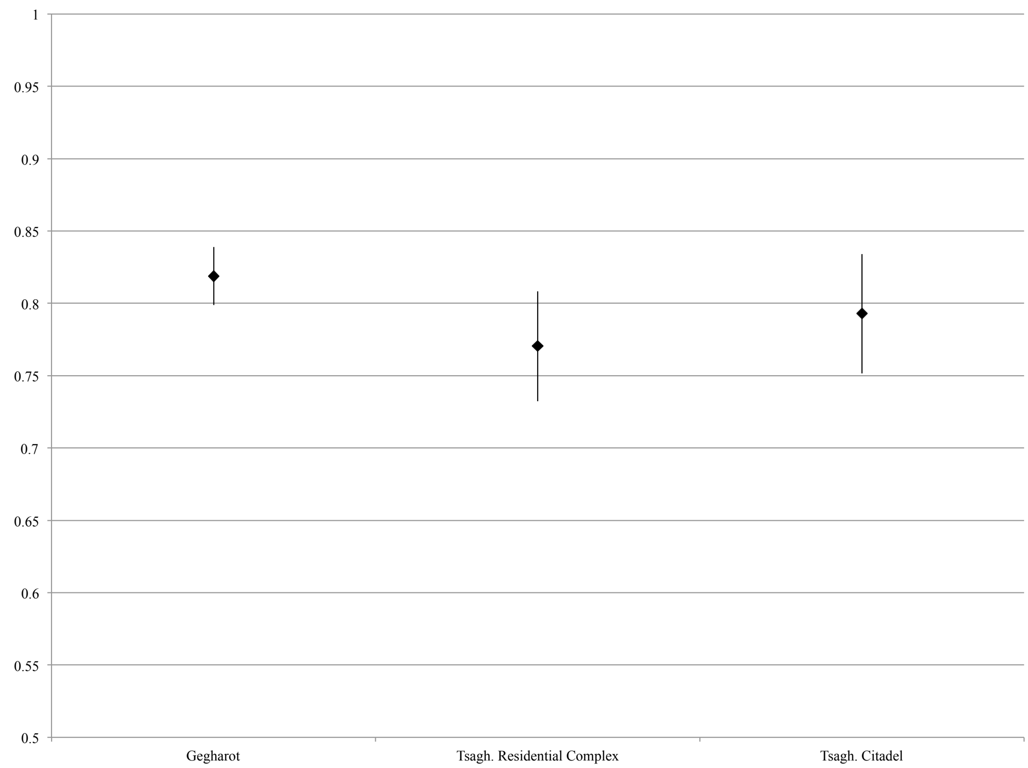

Figure A.4. Proportion of sheep plotted with 95% confidence intervals.

	W/O Astragalus	W/O Mandible	Total	Astragalus	Mandible
Gegharot					
Sheep	1300	1302	1460	160	158
Goat	291	291	323	32	32
Ratio	4.5	4.5	4.5	5	4.9
Tsagh. Residential Complex					
Sheep	370	331	379	9	48
Goat	110	105	113	3	8
Ratio	3.4	3.2	3.4	3.0	6.0

Table A.22: Sheep to goat ratios without outliers.

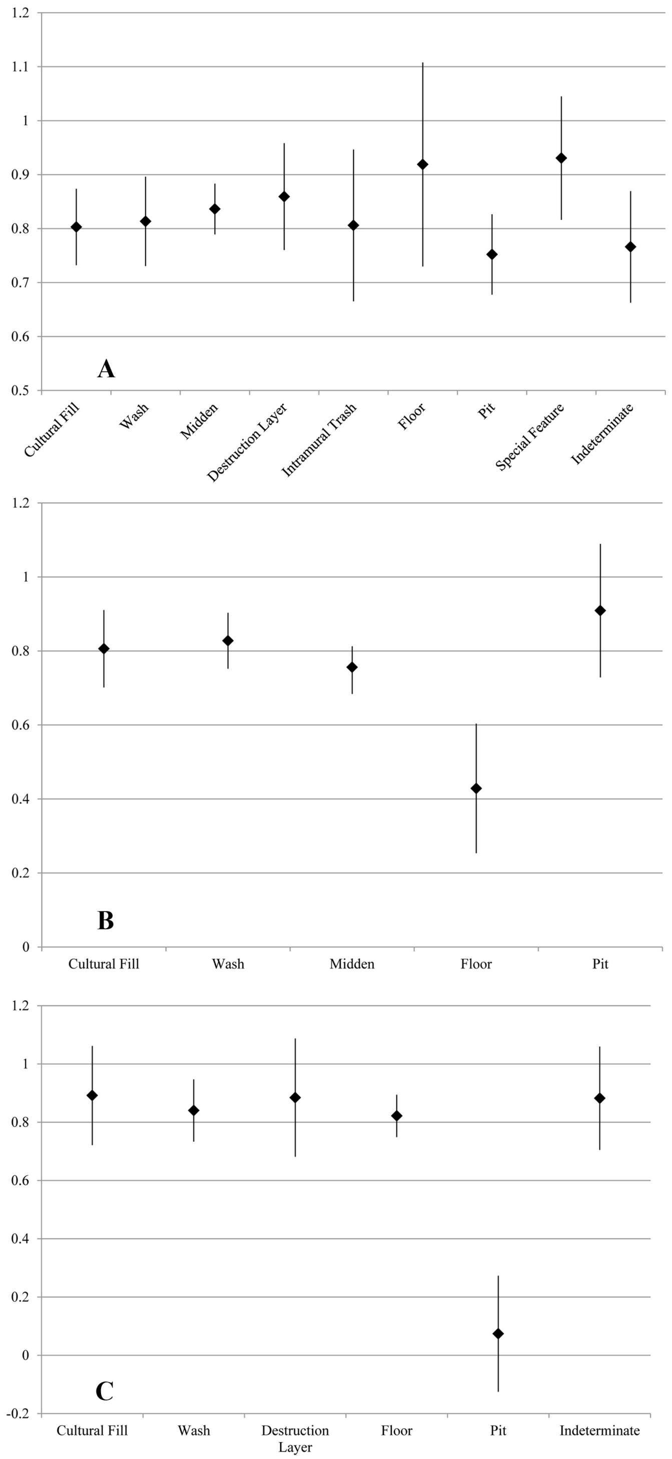

Figure A.5. Proportion of sheep by context plotted with 95% confidence intervals) at: a) Gegharot, b) Tsaghkahovit Residential Complex, and c) Tsaghkahovit Citadel.

the second graph, astragali are the clear outliers. Because first phalanges are numerically more abundant in the skeleton (eight per individual), they are inflated relative to other elements in NISP, hence the shift between NISP and MNE for this element. Beyond this, the assemblage of cattle remains at Gegharot is generally dominated by lower limb elements (carpals, tarsals, and phalanges) and mandibles and maxillae. For sheep/goats, whether calculated using NISP or MNE, mandibles are the clear outlier. Astragali are also relatively more abundant when looking at MNE. Compared to cattle, sheep/goats show a generally more even distribution across body areas, though there are slightly more lower hind-limbs than forelimbs. There is no clear evidence of density-mediated attrition of the softer proximal ends of limbs bones for either taxa.

Figure A.7 presents the distribution of cattle and sheep/goat body parts at the Tsaghkahovit Residential Complex. For cattle, NISP shows mandibles as an outlier (with large numbers of innominates and scapulae), but MNE shows calcanei as the major outlier. Outside of these outliers, there is a reasonably even distribution of body parts, though lower hind-limbs predominate over forelimbs. For cattle, there is no evidence of density-mediated attrition of the softer proximal ends of limbs bones. For sheep/goats, both NISP and MNE show mandibles and innominates to be the predominate outliers. There are also large numbers of astragali, scapulas, and atlases. Generally, upper limbs predominate, with slightly more elements from the girdle and axial skeleton. Here, there is a slight indication that density mediated attrition may have reduced the number of proximal limb fragments.

Overall, all of the site sector assemblages and all of the context types with site sectors are dominated by one or two individual elements that far exceed the relative abundance of all other parts of the skeleton. When the assemblages from site sectors are broken down by context type, different elements appear as outliers (see Table A.23). Across context types, there is little evidence that density mediated attrition may have reduced the number

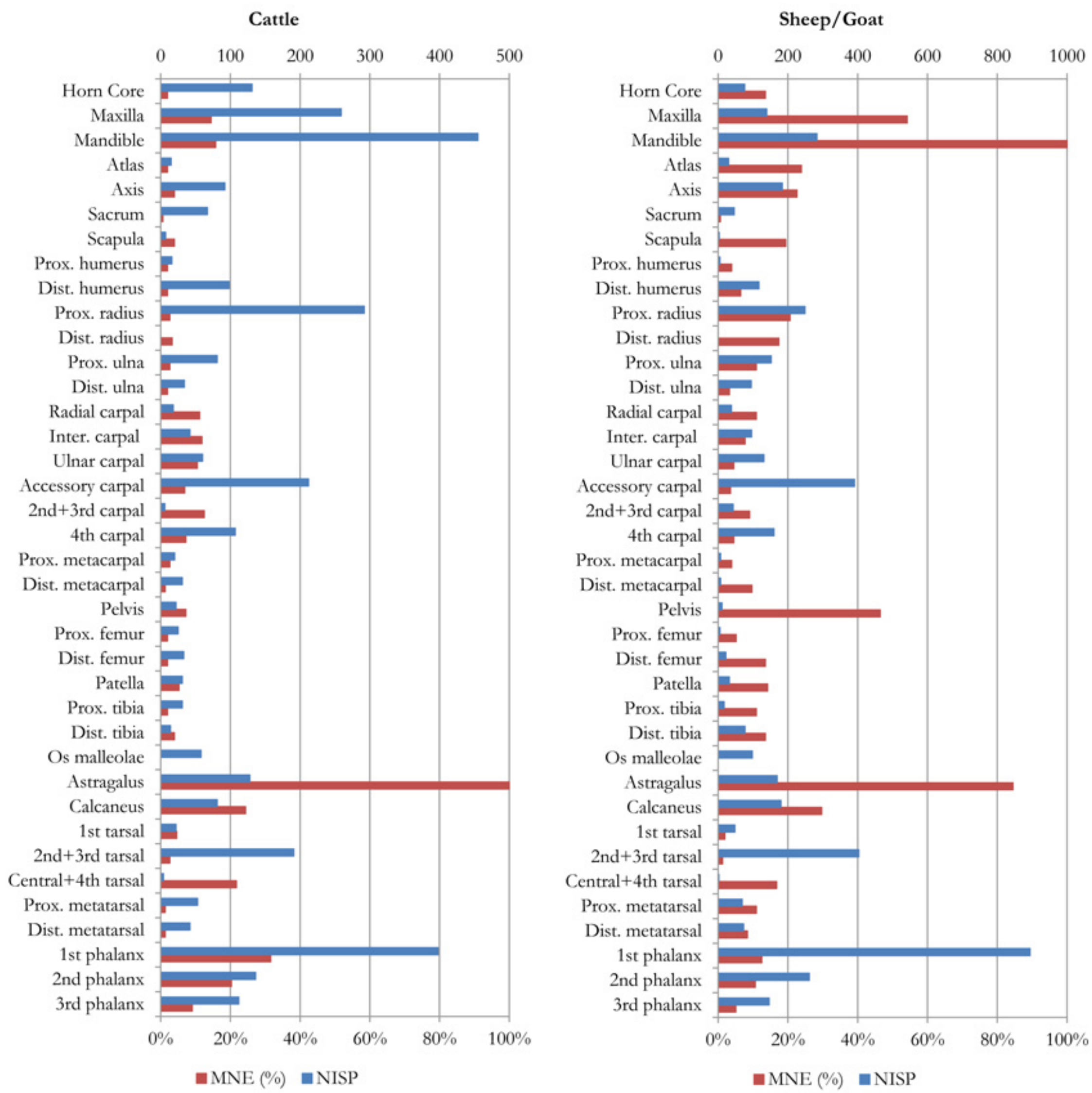

Figure A.6. Cattle and sheep/goat body parts at Gegharot based on a) NISP and b) MNE (as percentage of the most abundant element).

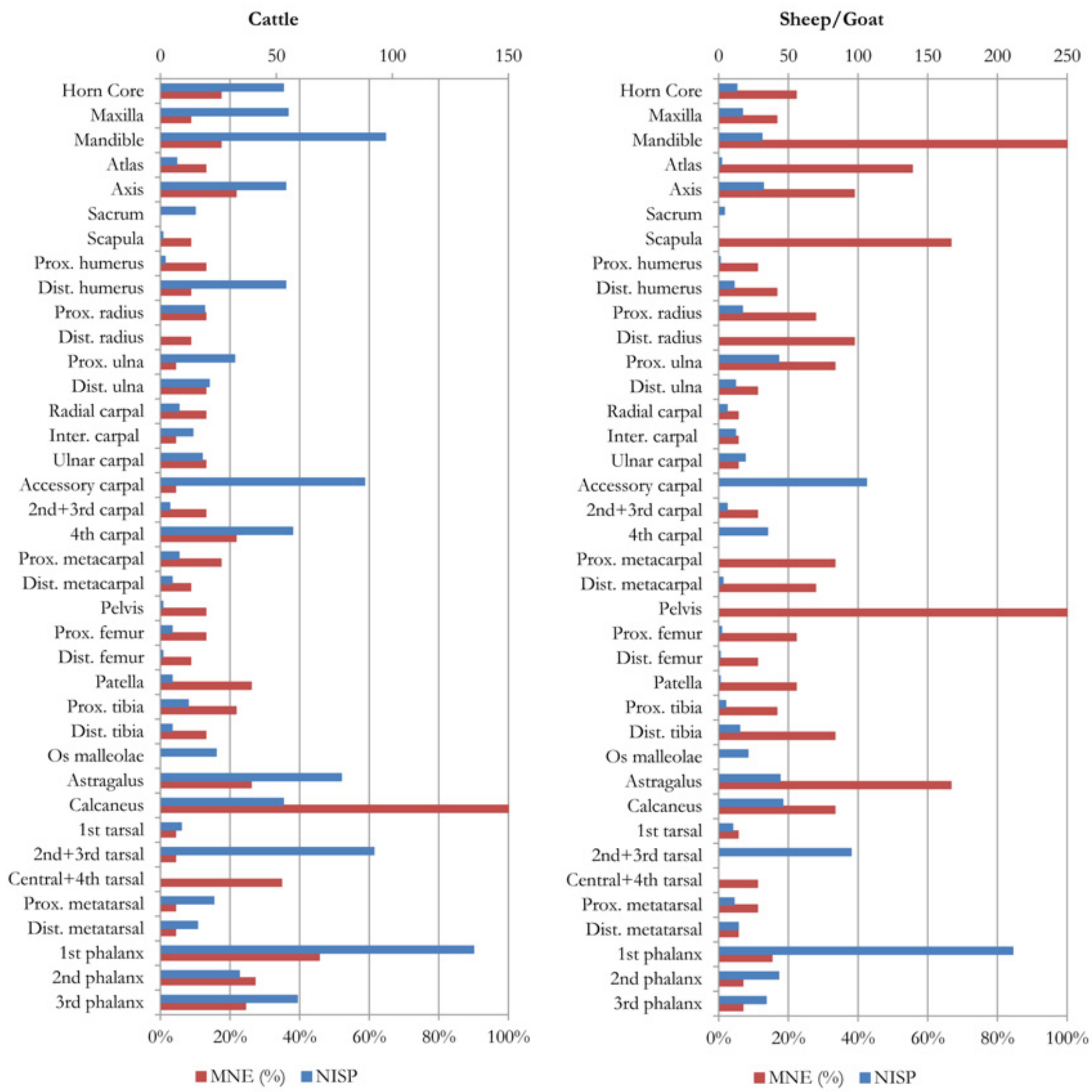

Figure A.7. Cattle and sheep/goat body parts at the Tsaghkahovit Residential Complex, based on a) NISP and b) MNE (as percentage of the most abundant element).

of proximal limb fragments. The only exceptions to this are for cattle in wash contexts at Gegharot, and sheep/goats in wash contexts at the TRC.

Beyond the clear outliers in the different context types, the balance between different areas of skeleton varies between context types.

For cattle at Gegharot:

- Cultural Fill – Fairly even, slightly more lower hindlimb
- Destruction Layer – Fairly even, slightly more lower limbs
- Floor – Slightly more head and forelimb
- Intramural trash – Dominated by hindlimb, especially the lower parts
- Midden – Dominated by head and lower limbs (especially lower hindlimb)
- Pit – Fairly even
- Wash – Dominated by lower hindlimb, but beyond that even
- Indeterminate – Fairly even

For sheep/goats at Gegharot:

- Cultural Fill – Slightly more upper than lower limbs
- Destruction Layer – More axial and upper limb, especially for the forelimb
- Floor – Mostly even
- Intramural trash – Dominated by head, innominate, and upper forelimb
- Midden – More upper forelimb and lower hindlimb
- Pit – Fairly even

- Special Feature – More upper forelimb and lower hind limb
- Wash – Fairly even
- Indeterminate – Dominated by head and hindlimb

For cattle at the Tsaghkahovit Residential Complex:

- Cultural Fill – Fairly even, thought few carpals
- Midden – Fairly even
- Wash – More upper forelimbs

For sheep/goats at the Tsaghkahovit Residential Complex:

- Cultural Fill – Dominated by girdle elements (scapula, innominate)
- Floor – Dominated by upper forelimb
- Midden – Fairly even, though limited carpals and tarsal (with the exception of astragali)
- Pit – Slightly more upper limbs
- Wash – More girdle, and more upper than lower limbs

For more detailed information on the NISP and MNE by context types, see A.8.

Within these difference across context types, it is worthwhile to note that beyond the strong individual outlier elements, there is no strong or consistent patterning in the body parts found in these assemblages. All parts of the carcass are present across the sites, including elements of low economic utility, if not in even amounts. There are some slight trends in the data. For instance, the samples of cattle elements from different contexts at Gegharot generally have slightly more elements from hind-limbs and lower limbs (with

	Gegharot - Cattle	**Gegharot - Sheep/Goat**	**TRC - Cattle**	**TRC - Sheep/Goat**
Cultural Fill	NISP: Astragalus, 1st phalanx	NISP: Mandible	NISP: Mandible, scapula, 1st phalanx	NISP: Mandible
	MNE: Astragalus, 1st phalanx	MNE: Mandible, astragalus, calcaneus	MNE: Astragalus	MNE: Mandible
Destruction Layer	NISP: Astragalus, 1st phalanx, horn	NISP: Mandible, astragalus		
	MNE: Astragalus	MNE: Astragalus		
Floor	NISP: Mandible, also innominate, astragalus, and 1st phalanx	NISP: Innominate, scapula	NISP: Mandible, 1st phalanx	NISP: Mandible, innominate
Midden	NISP: Mandible	NISP: Mandible	NISP: Mandible	NISP: Mandible
	MNE: Astragalus, calcaneus, central 4th tarsal	MNE: Mandible, maxilla	MNE: Calcaneus	MNE: Mandible
Intramural Trash	NISP: Mandible, 1st phalanx	NISP: Mandible		
	MNE: Astragalus, calcaneus, central 4th tarsal	MNE: Mandible		
Wash	NISP: Mandible, innominate, 1st phalanx	NISP: Mandible, scapula	NISP: Mandible	NISP: Mandible
	MNE: Astragalus, calcaneus, central 4th tarsal	MNE: Mandible, astragalus	MNE: Calcaneus	MNE: Mandible
Pit	NISP: Astragalus 1st Phalanx	NISP: Mandible, 1st phalanx		NISP: Mandible
	MNE: Astragalus	MNE: Astragalus, mandible		
Special Feature		NISP: Mandible, astragalus		
Indeterminate	NISP: Mandible, 1st phalanx	NISP: Mandible		
	MNE: Astragalus	MNE: Mandible, maxilla, astragalus		

Table A.23: Outliers by context. Context types with small sample sizes only have NISP calculated.

some exceptions). For sheep/goats at both Gegharot and the TRC, a number of context types have slightly more upper forelimbs.

A.4.2 Body Parts by Skeletal Weight

The analysis in the previous section has the disadvantage of only including skeletal elements that can be identified to the level of the genus or better. This systematically excludes skeletal elements that generally can only be assigned to body size categories, such as ribs and vertebrae. In particular, that means that NISP and MNE underrepresent the presence of axial and head elements in the assemblage. One way to overcome this issue is to compare the proportions of skeletal weight of five anatomical regions (lower limb, upper limb, girdle, axial, and head as defined by Russell and Martin [2005:95]) of the archaeological remains identified to body size (sheep size and cow sized) to the proportions by weight of skeletal elements from two type skeletons (Soay sheep skeletons from the Institute of Archaeology, UCL and the Ullerslev aurochs skeleton [Steppan 1999]).

This method maximizes the information obtained from remains only identifiable to body size. One downside of this method is that horses and cervids are lumped in with cattle, and pigs and gazelle are lumped in with sheep and goats. However, given that these taxa comprise a very small proportion of the assemblage from sites in the Tsaghkahovit Plain, this is unlikely to have a meaningful impact on the patterning of the distribution of body parts.[6]

Looking at the body part representation by weight between site sectors for cattle-sized animals (Figure A.8), the assemblages at Gegharot and the Tsaghkahovit Residential Complex have a greater proportion of lower limb elements (carpals, tarsals, and phalanges)

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6. Another disadvantage of this method is the difficulty of assessing the statistical significance of patterning, since a χ^2 test is not be appropriate.

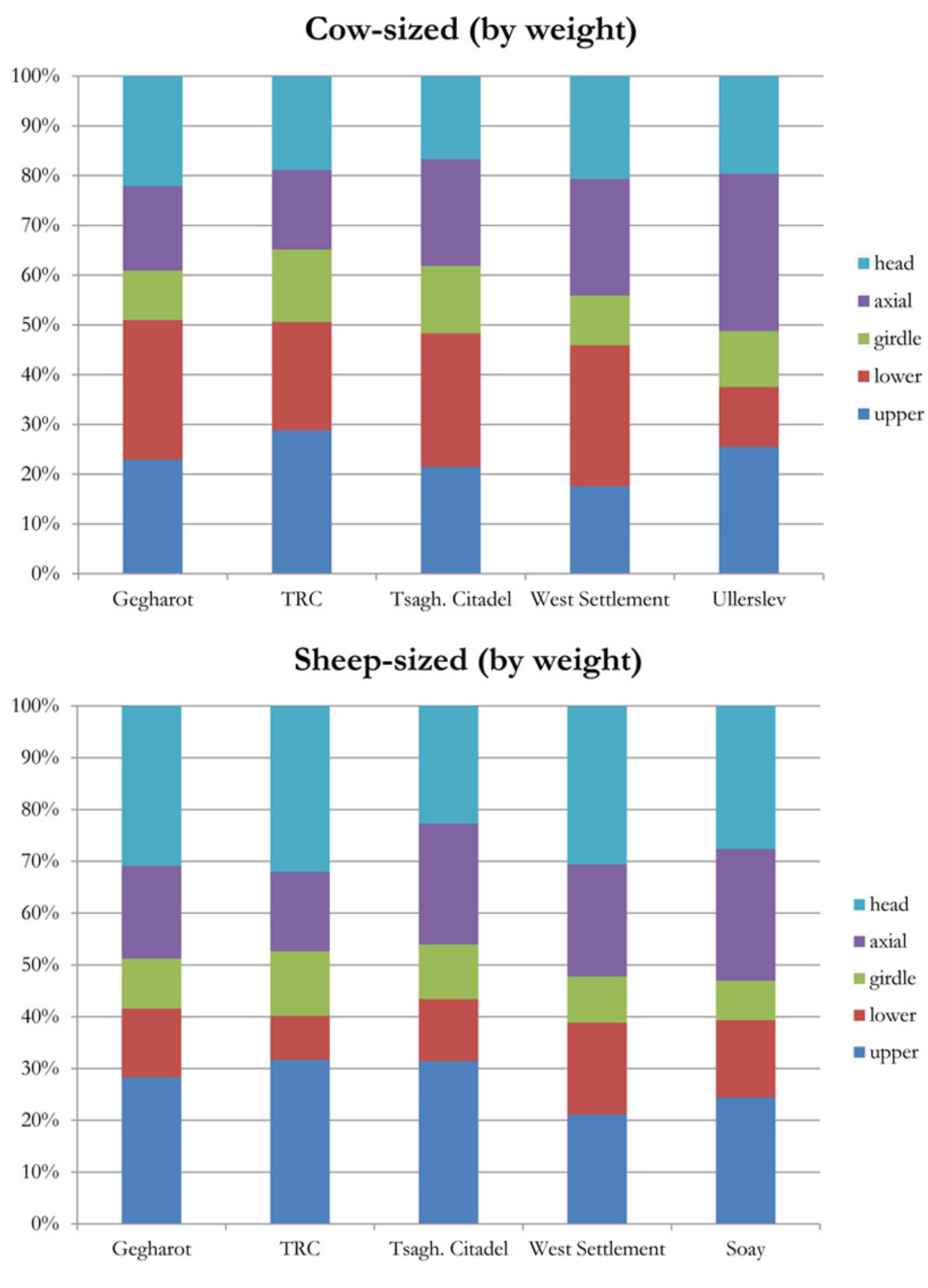


Figure A.8. Overall distribution of skeletal elements by weight.

and a smaller proportion of axial elements when compared to the type skeletons. The citadel at Tsaghkahovit also shows an excess of lower limb elements, but with slightly more axial elements than Gegharot or the TRC. The much smaller assemblage from the West Settlement is also dominated by lower limbs. For sheep-sized remains, the proportions are closer to the proportions seen in the type skeletons. At the TRC, there are fewer axial elements than in the type skeletons. The assemblages from Gegharot, the TRC, and the citadel at Tsaghkahovit show slightly more upper limb elements.

Turning to the distribution of body parts by context of deposition (Figure A.9), for cow-sized remains at Gegharot, all context types show the same overabundance of lower limbs and comparative lack of axial elements. Within this, destruction layer, pit, vessel, and special feature contexts all showed fewer than expected upper limb elements. Special feature and vessel contexts also had relatively few girdle elements. For sheep-sized remains at Gegharot, most contexts showed reduced amount of axial elements. Beyond this, the assemblages do not markedly depart from the distribution of skeletal elements seen in the type skeleton. Pit contexts had higher level of upper limbs, and midden contexts had more head elements by weight than would be expected.

At the Tsaghkahovit Residential Complex (Figure A.10, cow-sized remains across context types, showed increased proportions of lower limb elements and decreased proportions of axial elements. For sheep-sized remains, the clearest pattern is the reduced amount of axial elements in most contexts. Wash contexts had more upper limb elements than the type skeletons.

A.4.3 Synthesis

These two methods of assessing body part representation highlight some key trends in the data, while painting slightly different pictures. The overabundance of lower limbs for cattle

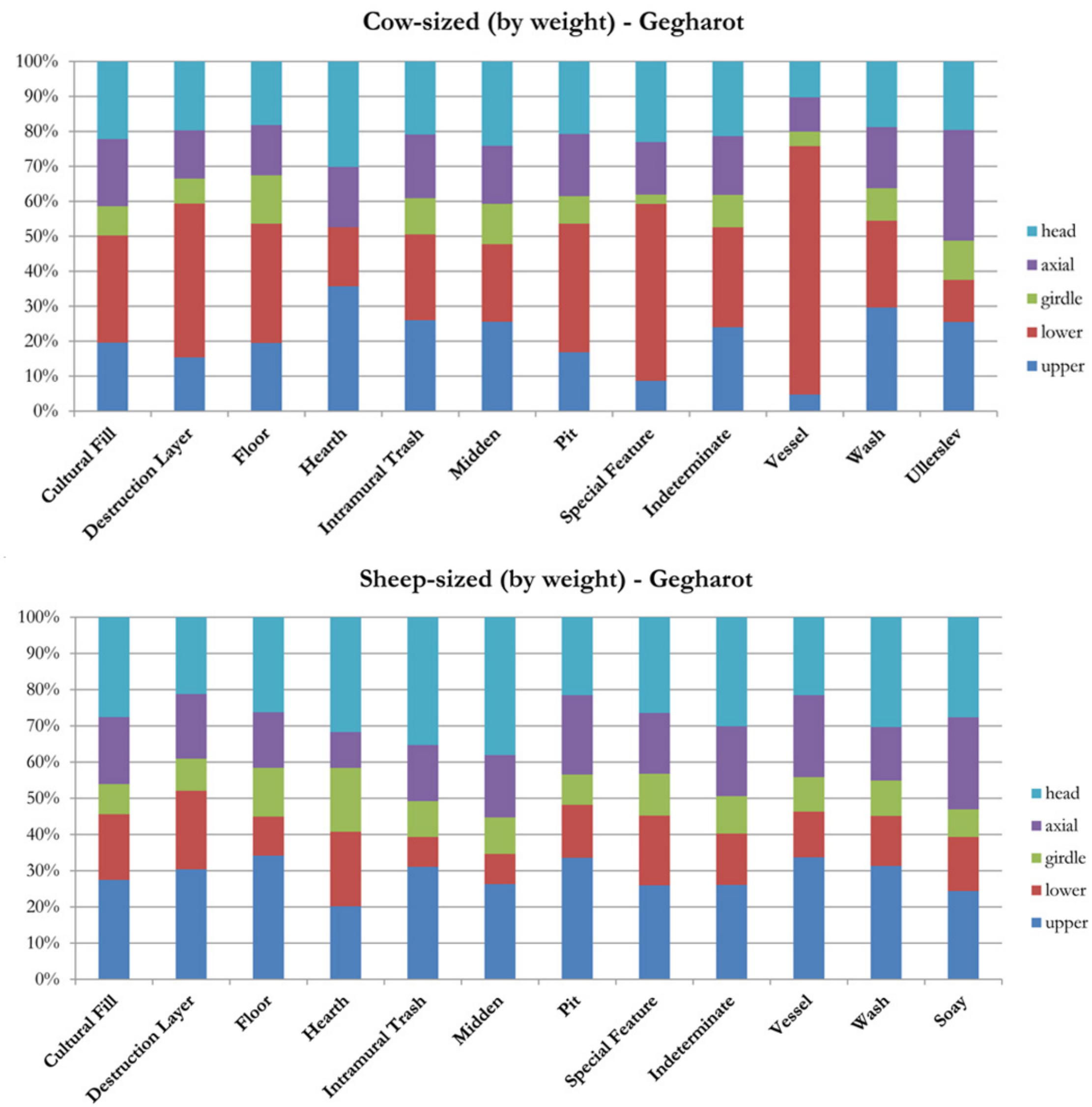


Figure A.9. Distribution of skeletal elements by weight by context of deposition at Gegharot.

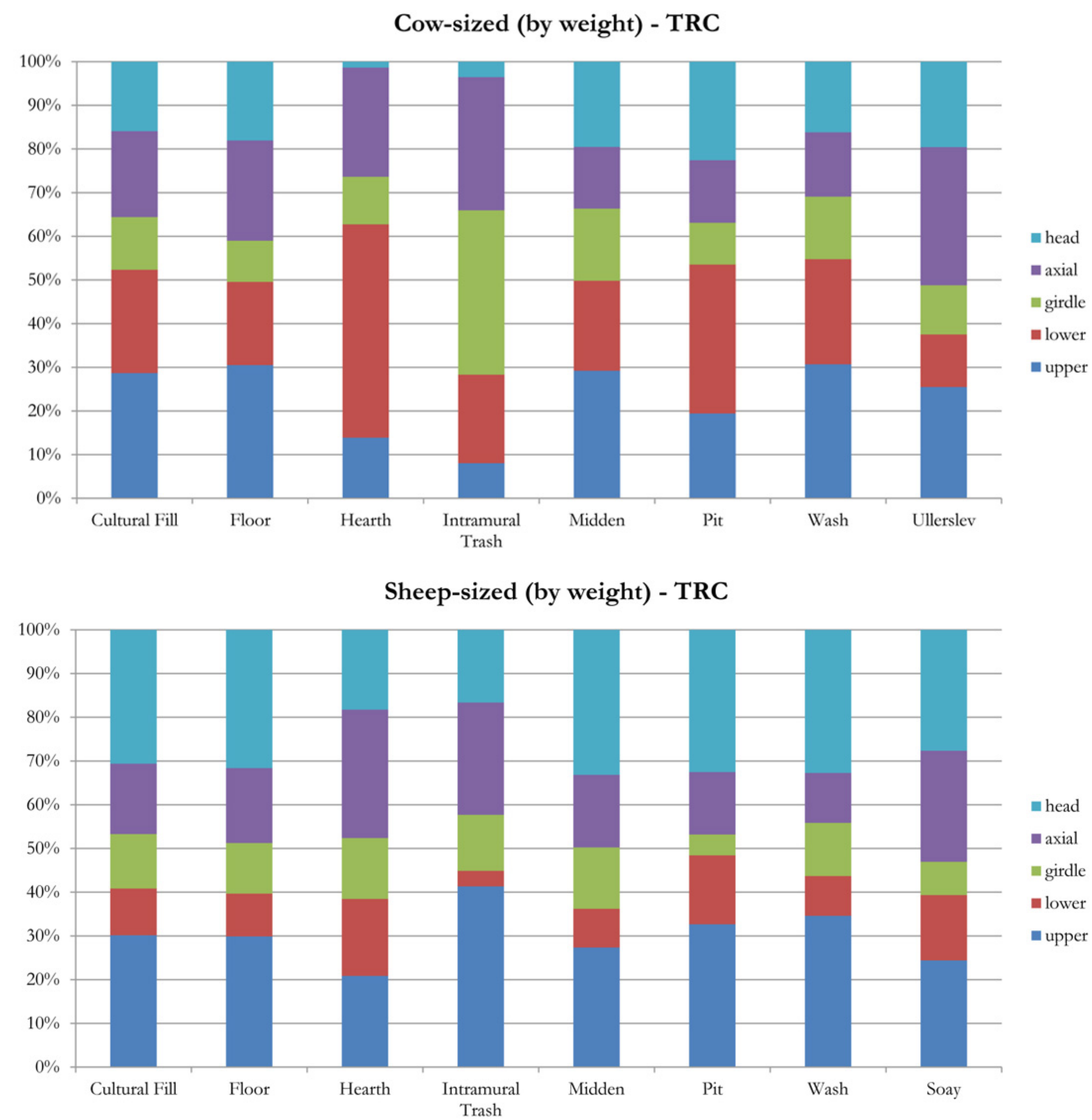


Figure A.10. Distribution of skeletal elements by weight by context of deposition at the Tsaghkahovit Residential Complex.

at Gegharot reflects the outsized numbers of astragali, as well as other lower limb elements such as tarsals and phalanges. At the TRC, the lower limb outliers had a less noticeable impact on the proportions by weight, but the results from both analyses are in agreement. The outliers identified by NISP and MNE have less of an impact by weight for sheep/goats at Gegharot, and almost none at the TRC. This suggests that for much of the assemblage the overabundance of these outliers is masked in the analysis by weight by a corresponding under-abundance of other elements within that category, since outside of the individual outliers and the lack of axial elements, both the MNE and the by weight analysis agree that the assemblage is not overwhelmingly skewed towards one anatomical category.

Looking at body part representation by context, the unusually high number number of sheep/goat mandibles registers as increased head elements by weight in midden contexts at Gegharot. But for other context types, the MNE outliers do not register in the analysis by weight. Pit contexts are dominated by astragali and mandibles in the analysis of MNE, but by weight, there is an overabundance of upper limbs. For cattle, both MNE/NISP and weights show an overabundance of lower limb elements. Midden contexts have mandibles as outliers as well as a higher proportion of head elements by weight.

At the Tsaghkahovit Residential Complex, the two analyses generally agree for cattle. In particular, cultural fill and wash contexts show a concordance between the outliers identified by MNE and the increased proportion of lower limb elements by weight. For sheep/goats, the overabundance of mandibles is not visible in the analysis by weight. Wash contexts show an overabundance of upper limbs in both analyses.

Unsurprisingly, the underrepresentation of axial elements seen in the weights is not visible in the analysis of NISP and MNE. Interestingly, despite the overabundance of mandibles in many contexts, this had no impact on the proportion of head elements by weight. This could be a result of the fragmentation of mandibles into lighter but identifiable pieces, but is more likely to be a result of a sizable under-abundance of non-mandible head

Innominate	Male	Female	Ratio	Horn Cores	Male	Female	Ratio
Sheep/Goat - Gegharot	87	102	0.85	Sheep/Goat - Gegharot	44	7	6.29
Sheep/Goat - TRC	21	32	0.66	Sheep/Goat - TRC	15	2	7.5
Bos - Gegharot	20	6	3.33	Bos - Gegharot	-	-	-
Bos - TRC	4	6	0.67	Bos - TRC	1	0	-

Table A.24: Ratio of osteologically male to female skeletal elements.

elements. Both of these patterns indicate that much of the axial skeleton and potentially skulls as well were deposited off-site. Potentially, this suggests that the initial butchery took place off-site, with only some portions of the carcass being transported to the sites – but that these portions of the carcass were not limited to elements of high economic utility.

A.5 Sex & Age

A.5.1 Sex

The ratio of male to female cattle and sheep/goats in the assemblages was assessed in two ways. First, elements that could be directly identified as osteologically male or female (the innominate and horn cores) were tabulated (Table A.24). At Gegharot, substantially more innominates were identified as male than female for cattle. Moderately more innominates were identified as female than male for sheep/goats at Gegharot and for both cattle and sheep/goats at the TRC, though it should be noted that the sample size of sexable cattle skeletal elements at the TRC was very small. A multiple comparison of proportions test (Buikstra et al. 1986) reveals that the difference in male to female ratios between cattle at Gegharot and sheep/goats at both sites is statistically significant (Figure A.11). In contrast, for both cattle and sheep and goats at Gegharot and the TRC, the horn cores found in the assemblages were predominately male.

Only Gegharot had a large enough sample to look at the sex ratio between context types for sheep/goats (Table A.25). There is some variation in the ratios, but a multiple

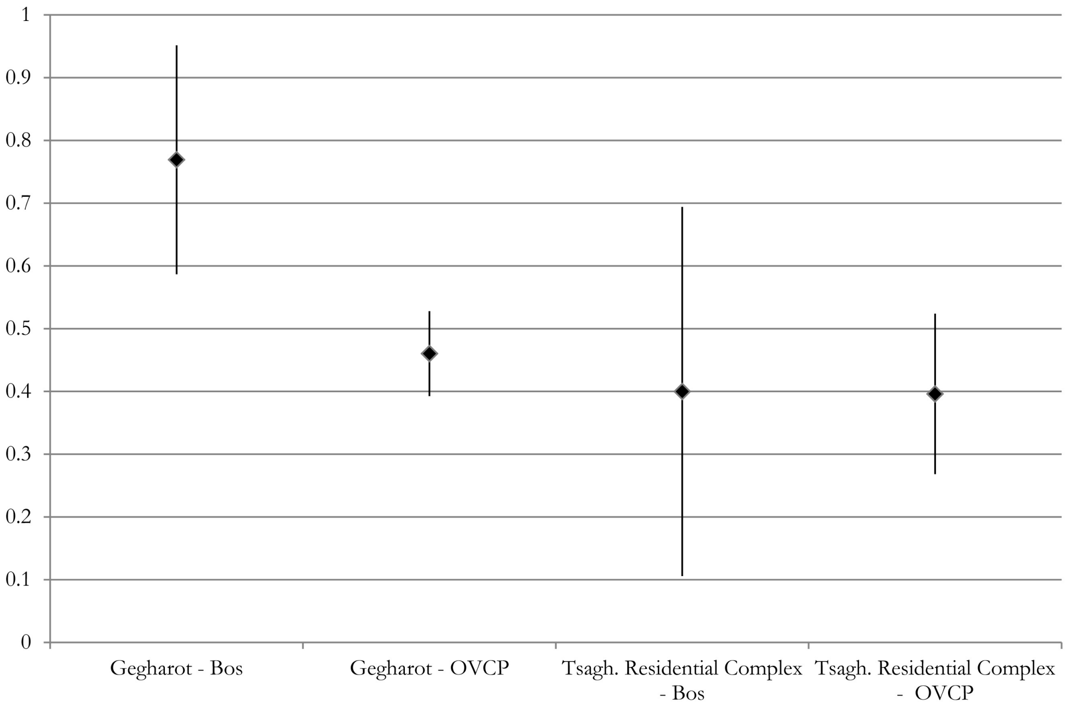


Figure A.11. Proportion of males. Ratios are graphed with a 95% confidence interval.

comparison of proportions test (Buikstra et al. 1986) reveals that there is no statistically significant different in the sex ratios seen in different contexts of deposition (Figure A.12).

The other way the ratio of males to females in the assemblage was assessed is by graphing measurements of skeletal elements known to show sexual dimorphism (Russell and Martin 2005:51-52; Arbuckle et al. 2009). This method has the advantage of sometimes allowing for a greater sample size, though for the assemblages from the Tsaghkahovit Plain, there were not always large numbers of measured elements that show sexual dimorphism. For the assemblage from Gegharot, there were enough measured scapulas to plot the length by breadth of the glenoid fossa for both *Ovis aries* and *Capra hircus* as well as to plot the greatest length of the astragalus (GLl) (Figures A.13 & A.14). For the scapulas, there isn't a clear separation into clusters, making interpretation difficult. The distribution of sheep GLl is shifted below the mean, suggesting that females outnumber males in the assemblage.

	Male	Female	Ratio
Cultural Fill	6	12	0.5
Destruction Layer	6	7	0.86
Floor	3	1	3
Hearth	1	0	-
Intramural Trash	6	4	1.5
Midden	27	44	0.61
Pit	13	12	1.08
Special Feature	4	3	1.33
Unknown	15	11	1.36
Vessel	1	0	-
Wash	6	7	0.86

Table A.25: Ratio of osteologically male to female sheep/goat skeletal elements by context types at Gegharot.

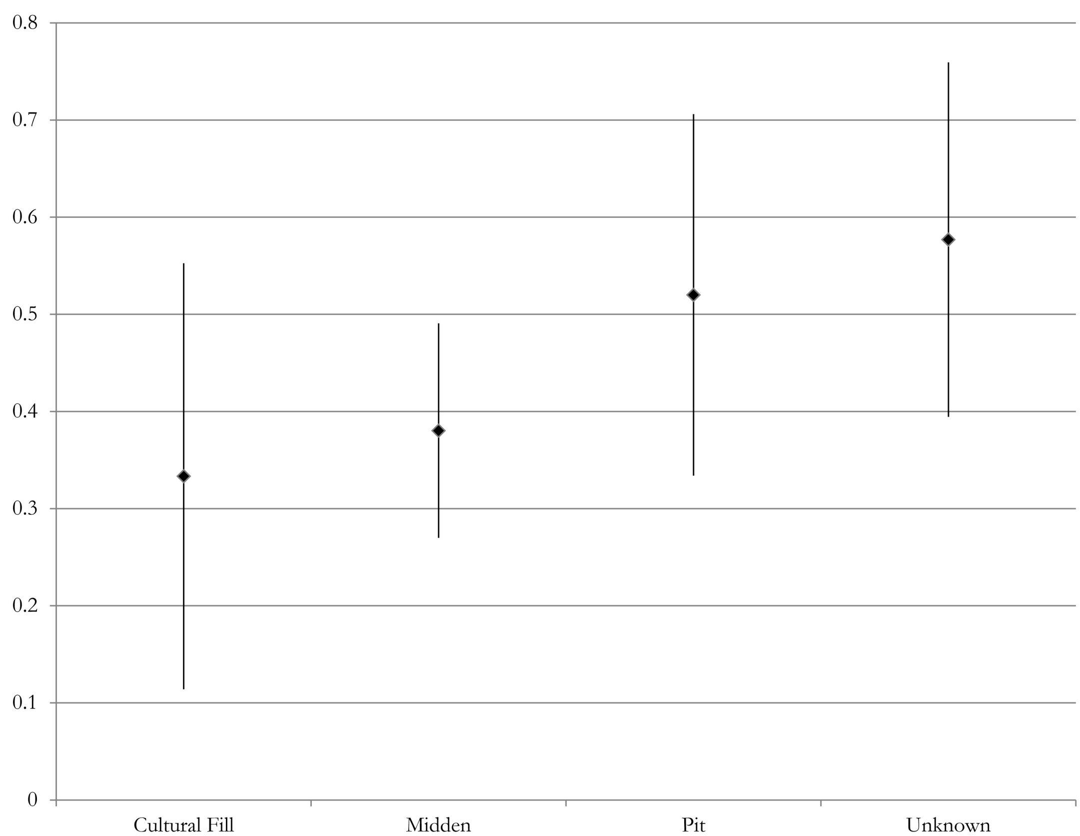


Figure A.12. Proportion of sheep/goat males from context types at Gegharot. Ratios are graphed with a 95% confidence interval and only samples with n > 15 were included.

In contrast, the plot of goat GLl is more evenly centered around the mean, suggesting that females and males are present in more equal numbers.

For cattle at Gegharot, the proximal breadth vs. depth was plotted for both metacarpals (Figure A.16) and metatarsals (Figure A.17). The plot of metacarpal depths and breadths does not resolve neatly into two groups, in contrast, the metatarsal data does, and there appear to be more smaller (presumably female) animals.[7] The plot of GLl for cattle at Gegharot is unimodal and is not noticeably skewed (Figure A.15). For the Tsaghkahovit Residential Complex, there were not enough measured sheep/goat elements to do an analysis of metrical sex. However, for cattle, it was possible to plot the proximal metatarsal depth vs. breadth, as well as the length and breadth of the glenoid. The plot of metatarsal measurements resolves neatly into two groups (Figure A.17), with smaller animals predominating. There is much less clear separation in the plot of glenoid measurements.

A.5.2 Teeth

One way of estimating the age at death of hypsodont animals is to compare the wear patterns in mandibular teeth to wear patterns from modern comparative samples. Methods for wear-staging age of death have been developed for cattle and for sheep/goats (Payne 1973, 1987; Grant 1975). From these methods, it is possible to calculate survivorship over the lifespan of an animal. In order to estimate survivorship, generally a sample of at least 25 is necessary (Lyman 1987). Luckily, the samples from Gegharot and the TRC were large enough to generate a survivorship curve for both cattle and sheep/goats (Figure A.18). While ideally, sheep and goats could be separated out, as they are potentially herded using

7. Gyondjyan and Manaseryan (2014) found that sexual dimorphism was clearly present for the cattle in their sample.

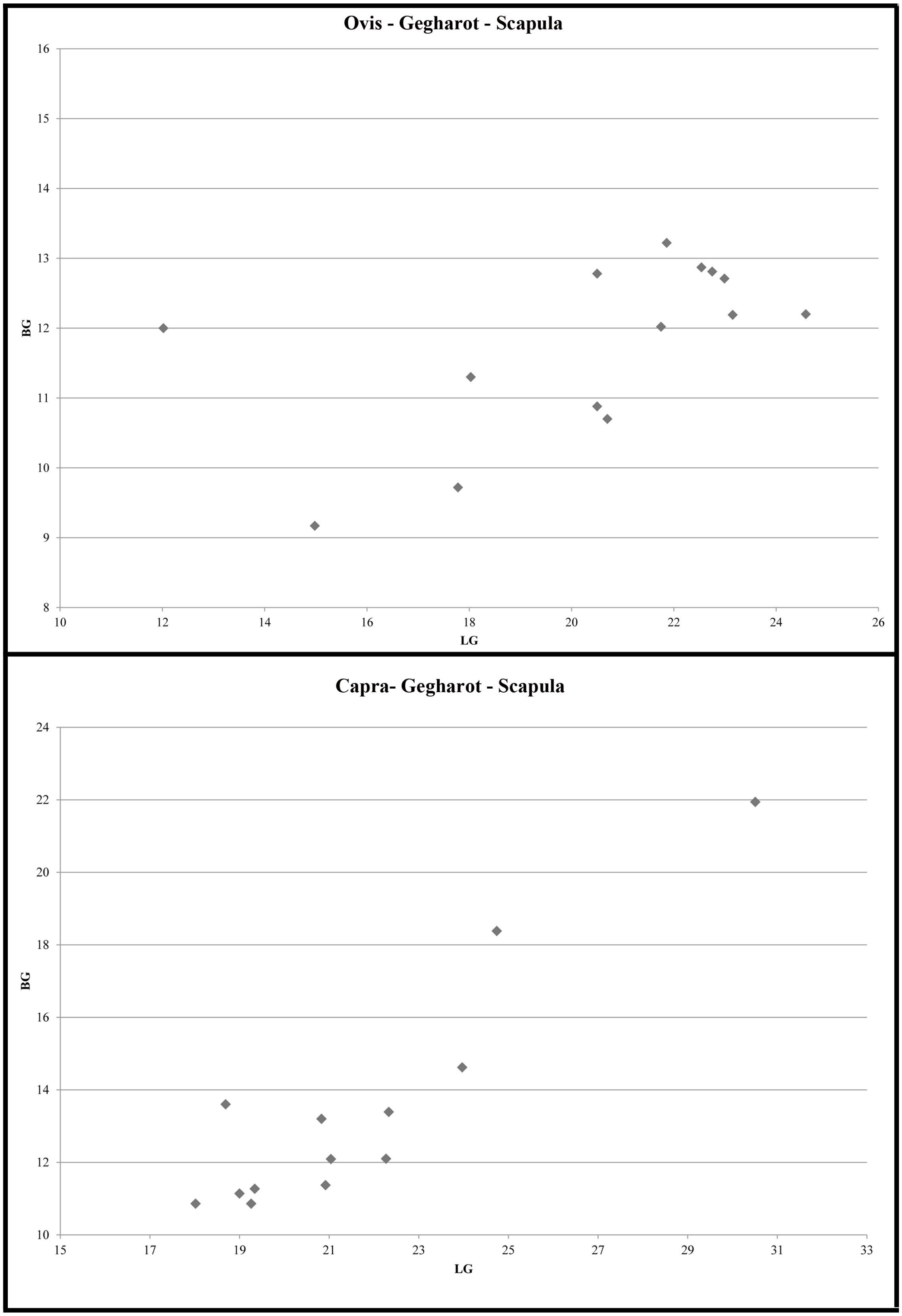


Figure A.13. Metrical sexing for sheep/goats at Gegharot.

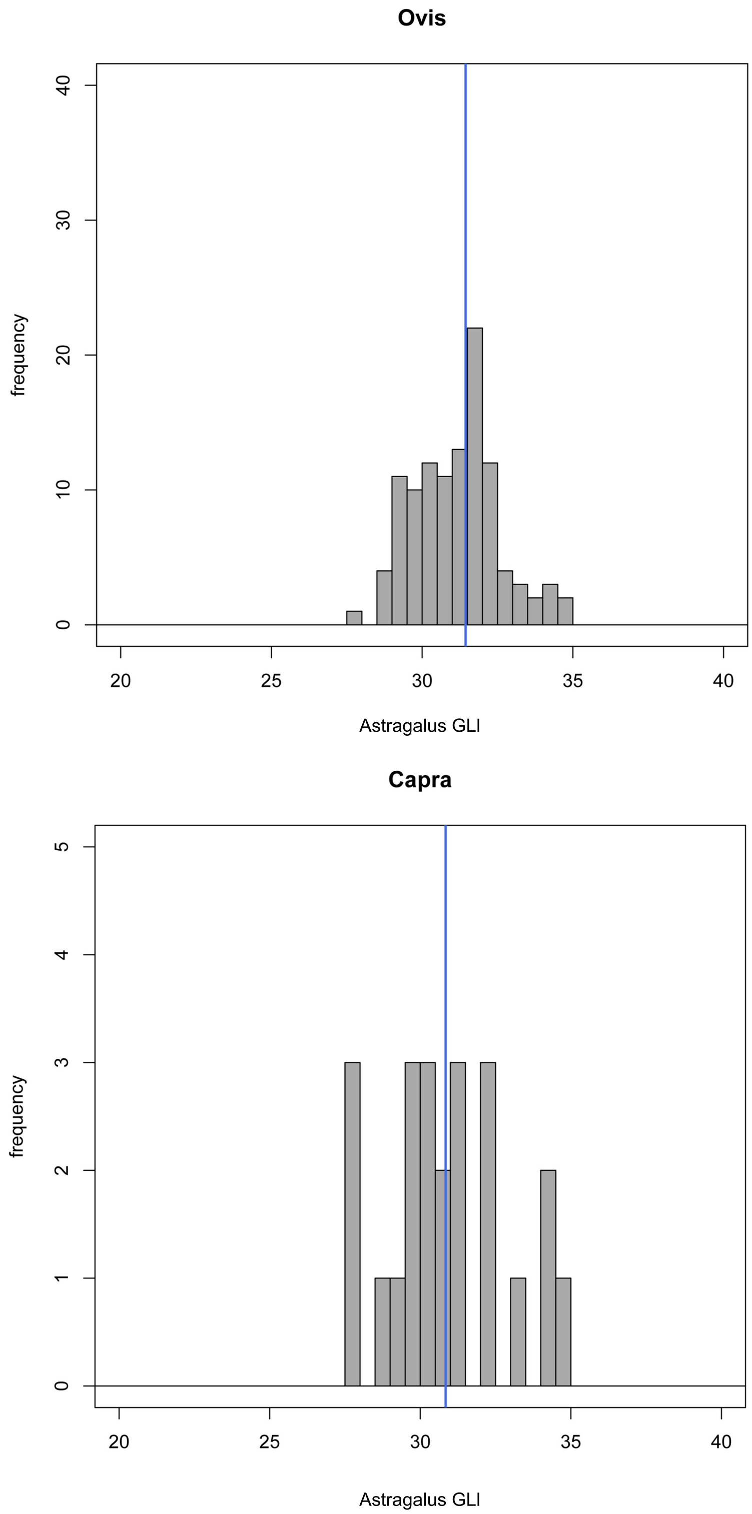


Figure A.14. Distribution of GLl for sheep/goat astragalus at Gegharot.

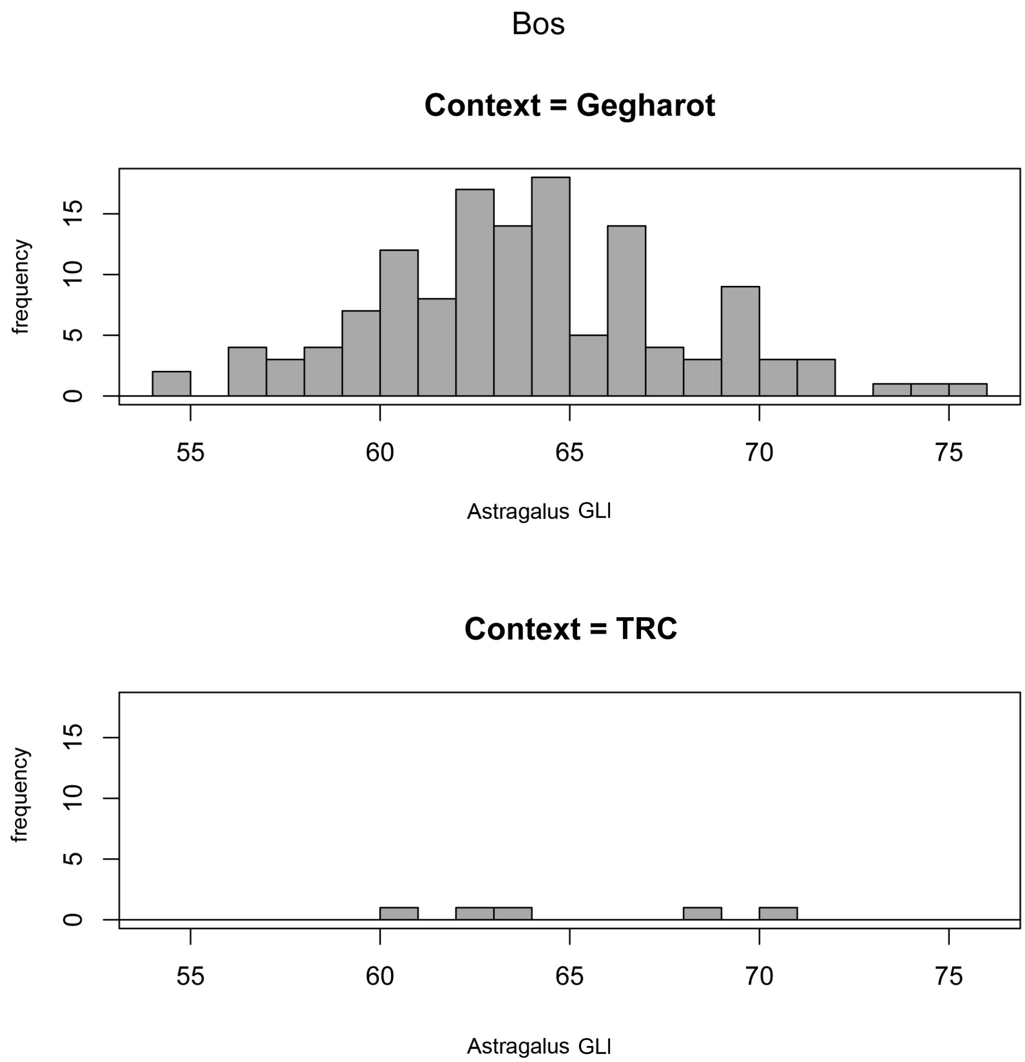


Figure A.15. Distribution of GLl for cattle astragalus at Gegharot.

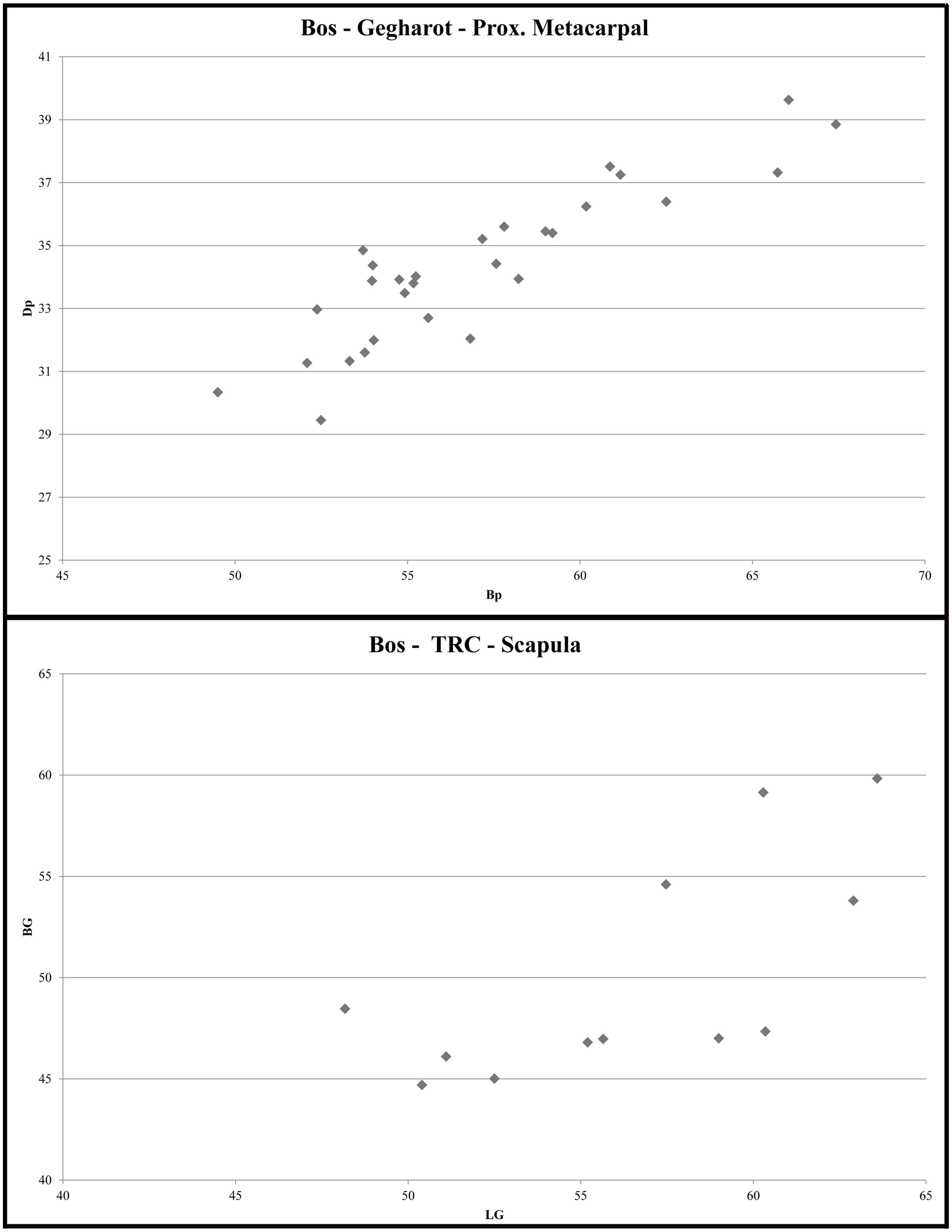


Figure A.16. Metrical sexing for cattle Gegharot.

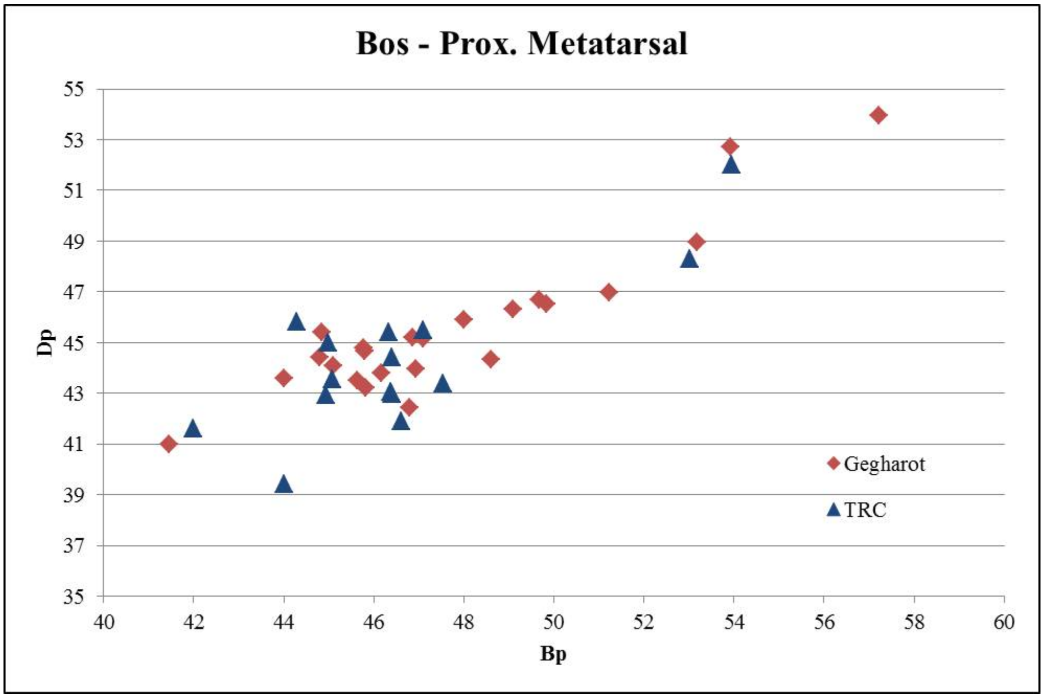


Figure A.17. Metrical sexing for cattle metatarsals.

different strategies, not all mandibles are assignable to genus, and at the TRC, the samples for goats were too small to generate a survivorship curve.

For sheep/goats, the survivorship curves for both Gegharot and the TRC are extremely similar (Figure A.19). Both show 50% mortality by two years of age, and when only *Ovis* mandibles are graphed, the curve becomes even steeper, nearing 60% mortality by two years of age. The smaller sample of *Capra* mandibles (n=34) showed a basically the same pattern of survivorship. In contrast, for both site sectors, the survivorship curves for cattle show a lower rate of mortality for young animals, with 50% mortality only occurring by three to four years of age. The survivorship curves for cattle are generally less steep than those for sheep/goats and lack the point of inflection seen at two years of age in sheep/goats. The survivorship curves for sheep/goats show a low level of neonate mortality. It is unlikely that this pattern is solely a result of the relatively fragility of neonate bones, as fetal bones were recovered from both Gegharot and the TRC (Table A.26).

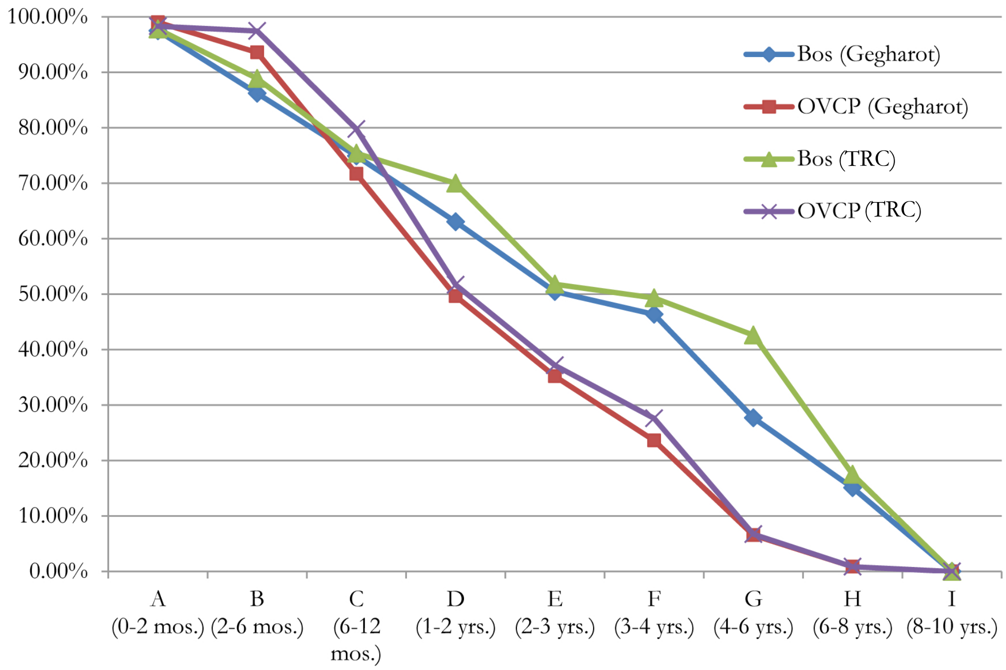


Figure A.18. Survivorship curves.

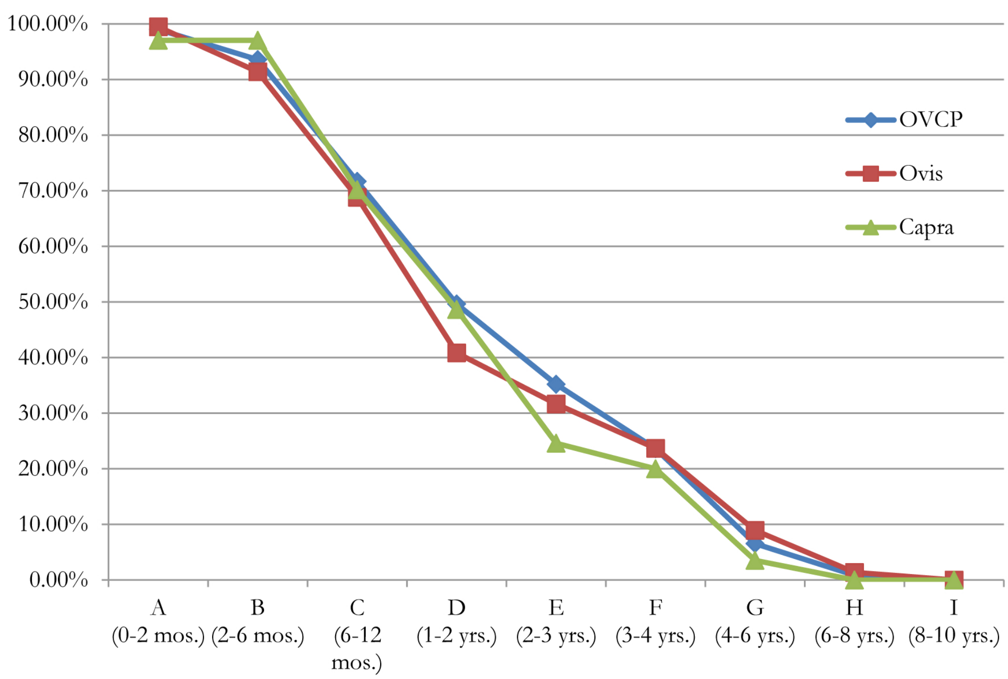


Figure A.19. Survivorship curves for sheep versus goats at Gegharot.

	Gegharot Sheep/Goat	%	Gegharot Cattle	%	TRC Sheep/Goat	%	TRC Cattle	%
Cultural Fill	8	0.83%	9	1.80%	1	0.24%	5	1.34%
Destruction Layer	4	0.58%	2	0.57%	-	-	-	-
Floor	3	1.26%	4	2.78%	-	-	2	1.49%
Intramural Trash	7	1.45%	1	0.25%	1	7.69%	-	-
Midden	28	0.89%	21	0.86%	3	0.48%	3	0.38%
Pit	24	2.17%	8	1.35%	1	0.71%	-	-
Special Feature	3	1.12%	0	0.00%	-	-	-	-
Vessel	1	1.37%	2	6.67%	-	-	-	-
Wash	4	0.51%	3	0.79%	3	0.70%	1	0.23%
Indeterminate	10	0.79%	4	0.65%	-	-	-	-
Total	**92**	**1.01%**	**54**	**0.98%**	**9**	**0.48%**	**11**	**0.62%**

Table A.26: Fetal/Neonate Count.

	Sheep/Goats	Cattle
Infant	0-1 years	0-1 years
Juvenile	1-2 years	1-3 years
Sub-adult	2-4 years	3-4 years
Adult	4+ years	4+ years

Table A.27: Age categories.

In order to statistically assess the strengths of these difference (cf. Marom and Bar-Oz 2009), Payne and Grant's wear stages were collapsed into four age categories: infant, juvenile, sub-adult, and adult (Table A.27).[8] There is no statistical difference in the distribution of mandibles in age categories between Gegharot and the TRC for both sheep/goats ($\chi^2 = 4.117$, df = 3, p = 0.2491) and for cattle ($\chi^2 = 0.35928$, df = 3, p = 0.9485). There is also no statistically significant difference between age categories for sheep and goats at Gegharot ($\chi^2 = 4.5839$, df = 3, p = 0.2049). However, there is a statistically significant difference in the distribution between age categories for sheep/goats and cattle for the Tsaghkahovit Plain assemblage as a whole ($\chi^2 = 54.415$, df = 3, p = $9.312e^{-12}$). Cattle have significantly more adults than sheep/goats, and significantly fewer sub-adults.[9]

By lumping Payne's age at death categories, it is possible to analyze whether any of the context types at Gegharot show a different pattern in mortality. In general, all of the context types show a similar pattern (Table A.29). A χ^2 test of the contexts where n > 25 shows no statistically significant difference ($\chi^2 = 7.9942$, df = 12, p = 0.7856). For the cattle at Gegharot (Table A.30), midden contexts showed a different pattern than mandibles from all other contexts. This difference is (comparatively weakly) statistically significant

8. Not all mandibles used to calculate survivorship could be assigned to one of these groups, as some of Payne's broader wear stages overlap these category boundaries.

9. Potentially, the difference in the sub-adult category is driven by the different age range between the two taxa. However, a similar difference is not seen for the juvenile category, which also has different age ranges.

	Sheep/Goat - Gegharot	**Bos - Gegharot**	**Sheep/Goat- SLT**	**Bos - SLT**	**Sheep/Goat Total**	**Bos Total**
Infant	135	26	14	10	149	36
Juvenile	79	33	16	11	95	44
Sub-adult	82	4	9	1	91	5
Adult	89	54	9	22	98	76
N	385	117	48	44	433	161
Infant	27.84%	22.22%	29.17%	22.73%	34.41%	22.36%
Juvenile	16.29%	28.21%	33.33%	25.00%	21.94%	27.33%
Sub-adult	16.91%	3.42%	18.75%	2.27%	21.02%	3.11%
Adult	18.35%	46.15%	18.75%	50.00%	22.63%	47.20%

Table A.28: Mortality by general age class.

($\chi^2 = 12.65$, $df = 3$, $p = 0.00545$), and most of the χ^2 statistic is driven by the difference in the Infant and Adult categories. For the Tsaghkahovit Residential Complex (Table A.31), there is no noticeable difference between context types for either sheep/goats ($\chi^2 = 6.7053$, $df = 6$, $p = 0.349$) or cattle ($\chi^2 = 7.2746$, $df = 6$, $p = 0.2962$).

A.5.3 Epiphyseal Fusion

Another way of estimating the age at death of animals from archaeological faunal remains is to use epiphyseal fusion. Different skeletal elements fuse at different ages, and if the general progression and timing of the fusion of these elements is known, then a general age at death can be inferred. Actualistic studies have produced information about the timing and sequence of epiphyseal fusion for both cattle (Silver 1969) and sheep and goats (Silver 1969; Noddle 1974; Moran and O'Connor 1994; Zeder 2006; Popkin et al. 2012). While these studies agree in broad strokes, they report differences in both the timing and the sequence of fusion for sheep and goats, based on sex, breed, nutritional status, and castration. It remains an open question whether modern "unimproved" breeds or wild animals represent the most appropriate model for the timing of epiphyseal fusion of domesticated animals after the initial process of domestication but before the development of breeds, such as the animals from Late Bronze Age societies in the Tsaghkahovit Plain.

For this study, I modified the fusion schedule presented by Zeder (2006) for sheep and goats (Table A.32), by combining Zeder's stages A and B, and stages E, F, and G into larger stages. I avoided using Zeder's Stage D, as the elements included in it are ones that shift in both order and timing between different studies. The order and timing of the elements used here roughly agree with the data presented in a recent study by Popkin et al. (2012) for male and female sheep. If the population under study includes castrated animals, then the ranges for the timing are considerably expanded and begin to overlap. For this study,

Sheep/Goat	Cultural Fill	Destruction Layer	Floor	Intramural Trash	Midden	Pit	Wash	Indeterminate
Infant	10	5	3	4	63	15	8	25
Juvenile	9	5	2	3	34	4	8	10
Sub-adult	9	7	1	6	33	8	7	10
Adult	11	4	5	9	30	6	7	12
N	39	21	11	22	160	33	30	57
	Cultural Fill	Destruction Layer	Floor	Intramural Trash	Midden	Pit	Wash	Indeterminate
Infant	25.64%	23.81%	27.27%	18.18%	39.38%	45.45%	26.67%	43.86%
Juvenile	23.08%	23.81%	18.18%	13.64%	21.25%	12.12%	26.67%	17.54%
Sub-adult	23.08%	33.33%	9.09%	27.27%	20.63%	24.24%	23.33%	17.54%
Adult	28.21%	19.05%	45.45%	40.91%	18.75%	18.18%	23.33%	21.05%

Table A.29: Sheep/Goat mortality by age category for context types at Gegharot.

Cattle	Midden	Non-Midden
Infant	21	5
Juvenile	19	14
Sub-adult	2	2
Adult	21	33
N	63	54
	Midden	Non-Midden
Infant	33.33%	9.26%
Juvenile	30.16%	25.93%
Sub-adult	3.17%	3.70%
Adult	33.33%	61.11%

Table A.30: Cattle mortality by age category for context types at Gegharot.

Sheep/Goat	**Cultural Fill**	**Floor**	**Midden**	**Wash**
Infant	4	2	4	8
Juvenile	5	2	9	10
Sub-adult	5	4	7	5
Adult	8	3	10	3
N	22	11	30	26
	Cultural Fill	Floor	Midden	Wash
Infant	18.18%	18.18%	13.33%	30.77%
Juvenile	22.73%	18.18%	30.00%	38.46%
Sub-adult	22.73%	36.36%	23.33%	19.23%
Adult	36.36%	27.27%	33.33%	11.54%
Cattle	**Midden**	**Wash**	**Other**	**Total Bos**
Infant	2	3	5	10
Juvenile	6	4	1	11
Sub-adult	0	1	0	1
Adult	10	6	6	22
N	18	14	12	44
	Midden	Wash	Other	Total Bos
Infant	11.11%	21.43%	41.67%	22.73%
Juvenile	33.33%	28.57%	8.33%	25.00%
Sub-adult	0.00%	7.14%	0.00%	2.27%
Adult	55.56%	42.86%	50.00%	50.00%

Table A.31: Mortality by age category for context types at the Tsaghkahovit Residential Complex.

Sheep/Goat	Approx. Calendar Age	Zeder 2006
Stage I	0-12 months	A, B
Stage II	12-18 months	C
Stage III	30-48 months	E, F, G
Cattle	**Approx. Calendar Age**	-
Stage I	6-18 months	-
Stage II	24-30 months	-
Stage III	32-48 months	-

Table A.32: Epiphyseal fusion stage categories used in this study.

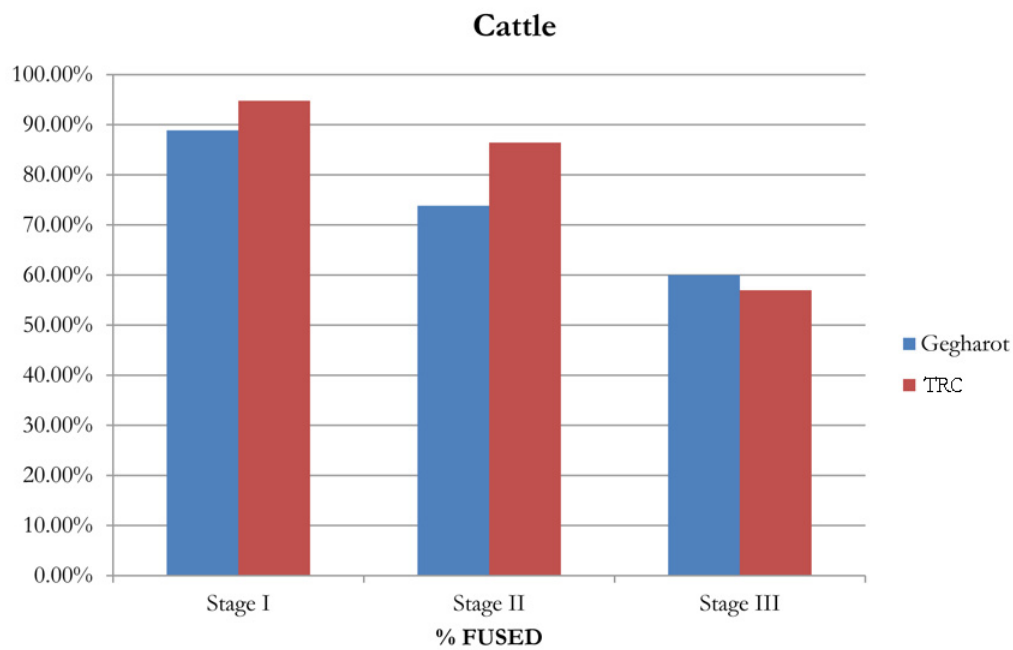
the presumption is that castrates are not present, and the timing figures for only male and females are used. For cattle, I used the timing and sequence from Silver (1969), broken into three categories (Table A.32).

The percentage fused for each category indicates the number of animals from the assemblage that were older than the category cut-off at time of death. For cattle, at both Gegharot and the TRC, there is very low mortality for the first two stages, suggesting that many animals were living past two years of age (Figure A.20). This roughly matches the pattern seen in the mortality based on tooth wear. By Stage III, the percentage fused has dropped to 50-60%, which again, roughly accords to the pattern seen in the tooth wear data.

Sheep and goats show a lower percentage fused in Stages I and II than cattle, which is a similar pattern to the tooth wear data. By Stage III, the epiphyseal fusion data for Gegharot has diverged from the TRC. The data from Gegharot shows < 30% fused elements for Stage III, in contrast to ~50% fused at the TRC. The low percentage of fused elements in Stage III at Gegharot matches the data from tooth wear, the lower mortality seen at the TRC suggest a more moderate kill-off, with more animals living beyond 3-4 years of age. Looking at the data (Table A.33), no single element is driving this patterning in Stage III at the TRC.

Gegharot				
Cattle	**Fused**	**Fusing**	**Unfused**	**Total**
Stage I	983	13	110	1106
Stage II	192	3	65	260
Stage III	132	5	83	220
	%	**%**	**%**	**% Fusing + % Unfused**
Stage I	88.88%	1.18%	9.95%	11.12%
Stage II	73.85%	1.15%	25.00%	26.15%
Stage III	60.00%	2.27%	37.73%	40.00%
Sheep/Goat	**Fused**	**Fusing**	**Unfused**	**Total**
Stage I	469	32	129	630
Stage II	256	24	118	398
Stage III	135	33	332	500
	%	**%**	**%**	**% Fusing + % Unfused**
Stage I	74.44%	5.08%	20.48%	25.56%
Stage II	64.32%	6.03%	29.65%	35.68%
Stage III	27.00%	6.60%	66.40%	73.00%
Tsagh. Residential Complex				
Cattle	**Fused**	**Fusing**	**Unfused**	**Total**
Stage I	363	0	20	383
Stage II	102	0	16	118
Stage III	49	8	29	86
	%	**%**	**%**	**% Fusing + % Unfused**
Stage I	94.78%	0.00%	5.22%	5.22%
Stage II	86.44%	0.00%	13.56%	13.56%
Stage III	56.98%	9.30%	33.72%	43.02%
Sheep/Goat	**Fused**	**Fusing**	**Unfused**	**Total**
Stage I	134	3	26	163
Stage II	34	3	6	43
Stage III	40	4	41	85
	%	**%**	**%**	**% Fusing + % Unfused**
Stage I	82.21%	1.84%	15.95%	17.79%
Stage II	79.07%	6.98%	13.95%	20.93%
Stage III	47.06%	4.71%	48.24%	52.94%

Table A.33: Epiphyseal fusion counts.



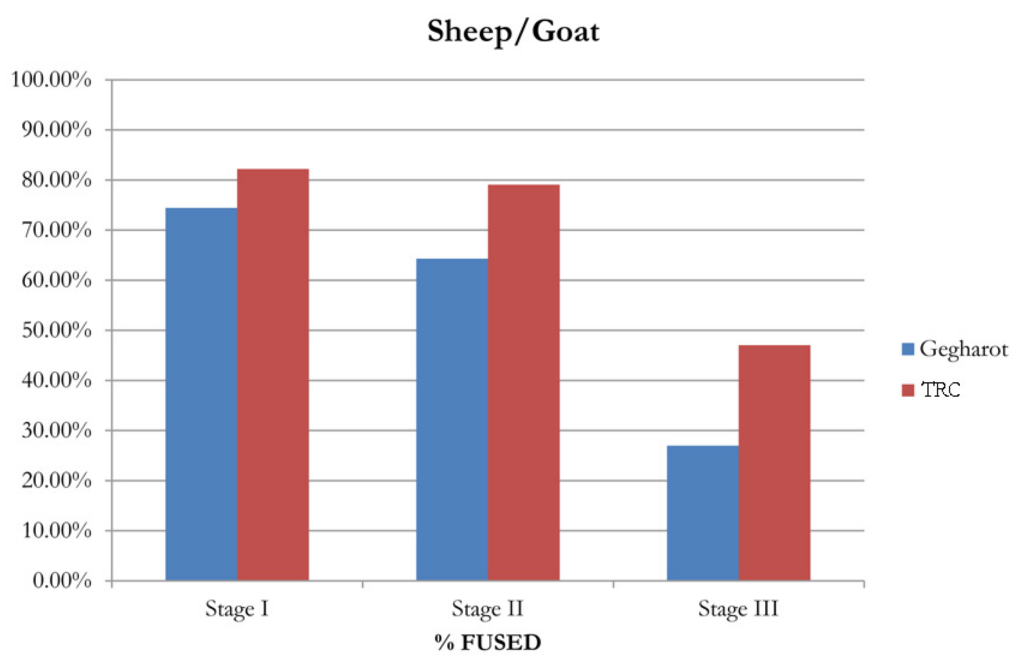


Figure A.20. Mortality based on epiphyseal fusion.

A.5.4 Synthesis

Dental and post-cranial methods of ageing skeletons are hard to directly compare, due to the different underlying biological processes. Estimating age at death using tooth eruption and wear covers the entire lifespan from birth to death and is based on teeth, which are robust elements that are likely to survive post-depositional taphonomic processes. In contrast, age at death estimates based on epiphyseal fusion cannot separate out different ages at death for animals who die after a particular element is fused and different elements are more or less robust (and therefore more or less likely to survive post-depositional taphonomic processes). Both methods require on reasonable sample sizes and the timing of both biological processes is subject to variation on the basis of differences in nutrition, health, and breed characteristics.

In order to overcome the differences in these methods, and to compare the structure of culling dynamics indicated by each line of evidence, it is useful to use more approximate age stages (as seen above, in Figure A.27). The toothwear and eruption data show that while caprines have a larger cull of juvenile animals (10-30 months), both caprines and cattle show a similar level of culling of sub-adult and adult animals. Mortality estimates based on epiphyseal fusion also show that more sheep and goats are slaughtered at a younger age than cattle, which show a slower and steadier rate of slaughter. This difference between taxa is consistent across site sectors. The epiphyseal fusion data for sheep/goats at Gegharot shows a higher mortality across the board than sheep/goats from the TRC. This difference is not seen in the tooth wear data. The limited toothwear data available for depositional contexts within the site sectors shows few differences. The only potential distinction in age data is that cattle from the middens at Gegharot show much higher levels of infant morality and much lower levels of adult mortality. This suggests that young animals may have been preferentially deposited in middens. This same pattern was not seen at the TRC.

A.6 Butchery & Food Preparation

A.6.1 Butchery

Across the assemblages, < 2% of the faunal remains show butchery marks (Table A.34). The assemblage from the TRC shows the lowest percentage of butchery marks, and the assemblage from the West Settlement has the highest (though this may be an artifact of the small sample size there). There are no substantial differences in the occurrence of butchery marks across context types. A more noticeable difference is seen in the rates of occurrence of butchery marks between taxa (Table A.35). In generally, cattle have higher rates of butchery marks across all site sector assemblages. At the TRC, equids also show a higher incidence of butchery marks. Cervids also show higher rates of butchery marks, though this reflects the fact that much of the cervids remains in these assemblages are antlers, which often show removal marks. This pattern suggests that butchery of larger animals such as cattle and horses may have been more difficult or done by less skilled butchers, as the presence of butchery marks represents a mistake when the butcher is using stone tools, where contact with the bones may dull the edge of the tool (Guilday et al. 1962:64; Russell and Martin 2005:85).

A.6.2 Roasting & Marrow Extraction

While some methods of cooking (such a boiling or baking) may not visibly alter the surface of bones, evidence for roasting consists of light to moderate burning on the articular ends of meat-bearing bones. Similarly, slight burning on long bone shafts may be evidence of toasting to liquefy bone marrow (Binford 1978:152-3). Most of the burning potentially related to roasting and marrow toasting comes from the assemblage from Gegharot. No

	Gegharot		Tsagh. Residential Complex		Tsagh. Citadel		West Settlement	
Cultural Fill	33	0.69%	32	1.11%	23	1.72%	0	0.00%
Destruction Layer	41	0.92%	-	-	6	1.85%	2	0.93%
Floor	9	0.74%	23	1.44%	95	1.92%	10	4.35%
Midden	271	1.96%	53	1.14%	-	-	-	-
Intramural Trash	34	1.57%	2	0.72%	-	-	-	-
Wash	43	1.02%	20	0.48%	31	1.45%	-	-
Pit	91	1.64%	5	0.65%	3	2.16%	15	1.47%
Hearth	1	0.81%	1	1.72%	-	-	-	-
Special Feature	11	1.05%	-	-	1	10.00%	-	-
Vessel	11	1.85%	-	-	-	-	-	-
Indeterminate	90	1.34%	-	-	18	1.21%	9	2.71%
TOTAL	**635**	**1.42%**	**136**	**0.95%**	**177**	**1.70%**	**36**	**1.99%**

Table A.34: Butchery marks by context type.

	Gegharot	%	Tsagh. Residential Complex	%	Tsagh. Citadel	%	West Settlement	%
Cattle	280	5.07%	60	3.36%	63	6.22%	11	7.33%
Sheep/Goats	227	2.50%	31	1.66%	79	3.97%	17	5.86%
Equids	4	1.91%	7	6.25%	1	1.61%	0	0.00%
Pigs	0	0.00%	0	0.00%	1	2.17%	0	0.00%
Cervids	7	4.05%	1	8.33%	6	23.08%	1	50.00%

Table A.35: Butchery by taxa.

	Ends	%	Shafts	%
Bos	9	0.16%	0	0.00%
Sheep/Goat	14	0.15%	4	0.04%
Cow size*	10	0.08%	13	0.10%
Sheep size**	15	0.08%	41	0.36%

Table A.36: Burning on articular ends versus shafts at Gegharot. *Includes cattle. **Includes sheep/goats.

evidence of either practice was seen in the assemblage at the Tsaghkahovit Residential Complex.

Within the assemblage from Gegharot, there is some variation in the contexts in which possible roasting and marrow toasting burn marks are located (table A.37). Pit and vessel contexts have comparatively high levels of possible roasting burns. Pit contexts also have a higher percentage of possible marrow toasting burns. Cattle and sheep/goats show extremely similar levels of evidence for roasting (TableA.36). Sheep/goats bones seem more likely to show evidence of marrow toasting. Table A.38 shows the skeletal elements that had possible roasting marks.

A.7 Diachronic Analysis

The Late Bronze Age occupation at the site of Gegharot can be divided into two phases: IIA and IIB. Phase IIA consists of the first period of LB occupation, one that was closed by a destruction event. The most recent Bayesian modeling of radiocarbon dates from Gegharot indicates that Phase IIA dates approximately to the 15th -13th centuries BCE. Phase IIB is a later occupation that also ended with a large destruction event, and has been dated approximately to the mid-13th to mid-12th centuries BCE.

While chronologies for this period are generally not finely distinguished enough to allow loci to be assigned to a phase on the basis of ceramics, the dramatic nature of the period-ending destruction events allows for some loci to be assigned to a specific phase

	Roasting	%
Cultural Fill	1	0.02%
Destruction Layer	4	0.09%
Floor	1	0.08%
Midden	0	0.00%
Intramural Trash	0	0.00%
Wash	2	0.05%
Pit	10	0.18%
Hearth	0	0.00%
Special Feature	1	0.10%
Vessel	2	0.34%
Indeterminate	4	0.06%
	Marrow Toasting	%
Cultural Fill	8	0.17%
Destruction Layer	15	0.34%
Floor	4	0.33%
Midden	0	0.00%
Intramural Trash	0	0.00%
Wash	7	0.17%
Pit	19	0.34%
Hearth	0	0.00%
Special Feature	1	0.10%
Vessel	1	0.17%
Indeterminate	0	0.00%

Table A.37: Possible roasting and marrow toasting burns by context type at Gegharot.

	Bos	Sheep/Goat	Cow-size	Sheep-size
1st Phalanx	1			
Femur (prox)			1	
Femur (dist)	2			
Humerus (prox)		1		
Humerus (dist)	2	2		
Acetabulum	2	1		
Tibia (prox)		1		
Tibia (dist)	1	2		
Atlas		2		
Cervical Vert				1
Patella		3		
Radius (prox)		2		

Table A.38: Possible roasting burn marks.

Phase IIA		Phase IIB	
T15.a3	T26.22	T15.12	T02.E514
T15.a4	T26.23	T02.E7	T02.E537
T15.a5	T26.29	T02.E8	T21.2
T15.21	T28.8	T02.E9	T26.3
T15.25	T28.9	T02.E10	T26.4
T02.E211	T28.13	T02.E100	T26.16
T02.E624	T28.14	T02.E101	T26.17
T02.E634	T28.24	T02.E102	T26.18
T02.E640	T28.40	T02.E103	T26.19
T02.E645	T28.43	T02.E104	T28.3
T21.3	T30.24	T02.E105	T28.7
T21.4	T30.30	T02.E106	T30.3
T21.6	T30.31	T02.E107	T30.5
T21.22	T27*	T02.E108	T30.7
T21.37	T32*	T02.E109	T30.8
T21.54		T02.E202	T30.10
T21.13		T02.E203	T30.11
T26.20		T02.E208	

Table A.39: Loci at Gegharot assigned to either Phase IIA or IIB. *All Late Bronze Age loci in T27/32 were assigned to Phase IIA, except for Locus 2, which was a mixed wash deposit above a destruction layer.

on the basis of archaeological context (and radiocarbon dating). The loci at Gegharot that could be assigned to a specific phase are listed in Table A.39.

One consequence of this method of phasing of the Late Bronze Age loci at Gegharot is that not all types of contexts of deposition are proportionally represented in the IIA and IIB assemblages (Table A.40). Nearly half of the IIA assemblage is from pits and, unsurprisingly, nearly a quarter of the assemblage is from destruction layer contexts. Over half the IIB assemblage is from destruction layer contexts. This may in part explain why the IIB assemblage shows a much lower percentage of faunal remains identified to the level of genus or better, and a much higher percentage of indeterminate remains (Table A.41).

Interestingly, there does seem to be a change in time in the proportions of major domesticated taxa (Table A.42). The Phase IIA assemblage resembles the overall

	IIA		IIB	
Cultural Fill	503	7.60%	365	9.85%
Destruction Layer	1582	23.90%	2051	55.37%
Floor	-	-	416	11.23%
Hearth	22	0.33%	95	2.56%
Intramural Trash	200	3.02%	21	0.57%
Midden	140	2.12%	-	-
Pit	2677	40.45%	-	-
Special Feature	165	2.49%	238	6.43%
Vessel	172	2.60%	272	7.34%
Wash	724	10.94%	246	6.64%
Indeterminate	434	6.56%	-	-

Table A.40: Phase IIA and IIB context types.

	IIA		IIB	
% ID to genus	2227	33.65%	739	19.95%
% Indeterminate	1210	18.28%	1949	52.62%

Table A.41: Relative identifiability of the IIA and IIB assemblages.

assemblage from Gegharot, with sheep and goats making up over 2/3 of the remains identified to genus. In contrast, the Phase IIB assemblage shows a much higher proportion of cattle (as well as a lower proportion of "Other"). This is a statistically significant difference ($\chi^2 = 104.37$, $df = 4$, $p < 2.2e^{-16}$). This difference is most likely a reflection of change between the two phases of occupation, since both pits or destruction layer contexts showed a greater proportion of sheep and goats than cattle in the analysis of the total Gegharot assemblage. In contrast, the sheep to goat ratio stays fairly constant across the two phases of occupation (Table A.43).

Analysis of the distribution of body parts using NISP and MNE reveals no significant differences between Phase IIA and IIB for both cattle (Figure A.21) and sheep/goats (Figure A.22). In both, mandible and astragali appear as overwhelming outliers for sheep and goats, and astragali for cattle, against a relatively even spread of other body parts. This places the IIA and IIB assemblages in line with the analysis of the total assemblage from Gegharot,

	IIA	%	IIB	%
Bos	528	23.71%	303	41.00%
Ovis/Capra	1553	69.74%	417	56.43%
Sus	12	0.54%	2	0.27%
Equids	17	0.76%	11	1.49%
Other	117	5.25%	6	0.81%

Table A.42: Major taxa in Phase IIA and IIB.

	IIA	IIB
Ovis	317	84
Capra	49	16
Sheep:Goat	6.47	5.25

Table A.43: Sheep to goat ratio in Phase IIA and IIB.

especially in light of the dominance of pit and destruction contexts. This analysis indicates that the social practices producing the extremely large numbers of astragali and mandibles are shared across both periods of Late Bronze Age occupation.

Looking at body part distribution by weight, for cattle, there are no noticeable differences between Phase IIA and IIB (Figure A.23). Both show the underrepresentation of axial elements and overrepresentation of lower limb elements that is seen across the Gegharot assemblage. For sheep/goats, Phase IIB has relatively more girdle elements and fewer axial elements. Beyond that, the Phase IIA patterns reflect the skeletal standard and are in line with the patterning seen in the total assemblage at Gegharot.

Unfortunately, it was only possible to look at survivorship based on tooth wear age estimates for sheep/goats (Figure A.24). In general, the survivorship curves from both Phase IIA and IIB resemble the curve for the total Gegharot assemblage. The curve for Phase IIA shows a relatively high rate of morality in the 2nd year (60% versus 40% for Phase IIB). But when assigned to the four categories of infant, juvenile, sub-adult, and adult, this difference is not statistically significant ($\chi^2 = 5.0961$, $df = 3$, p=0.1649).

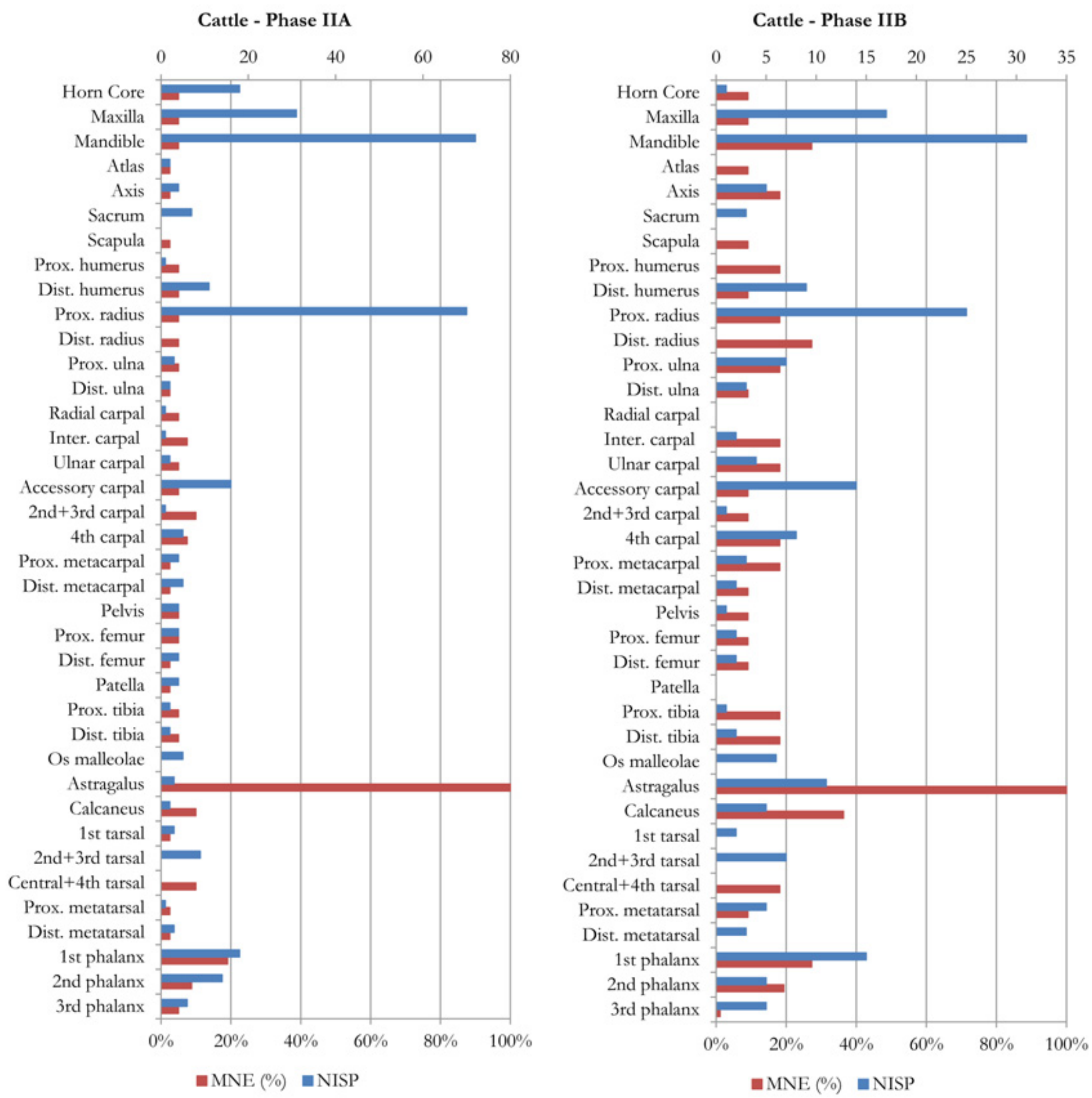


Figure A.21. Body part representation based on NISP and MNE (as a percentage of the most abundant element) for cattle in Phase IIA and IIB.

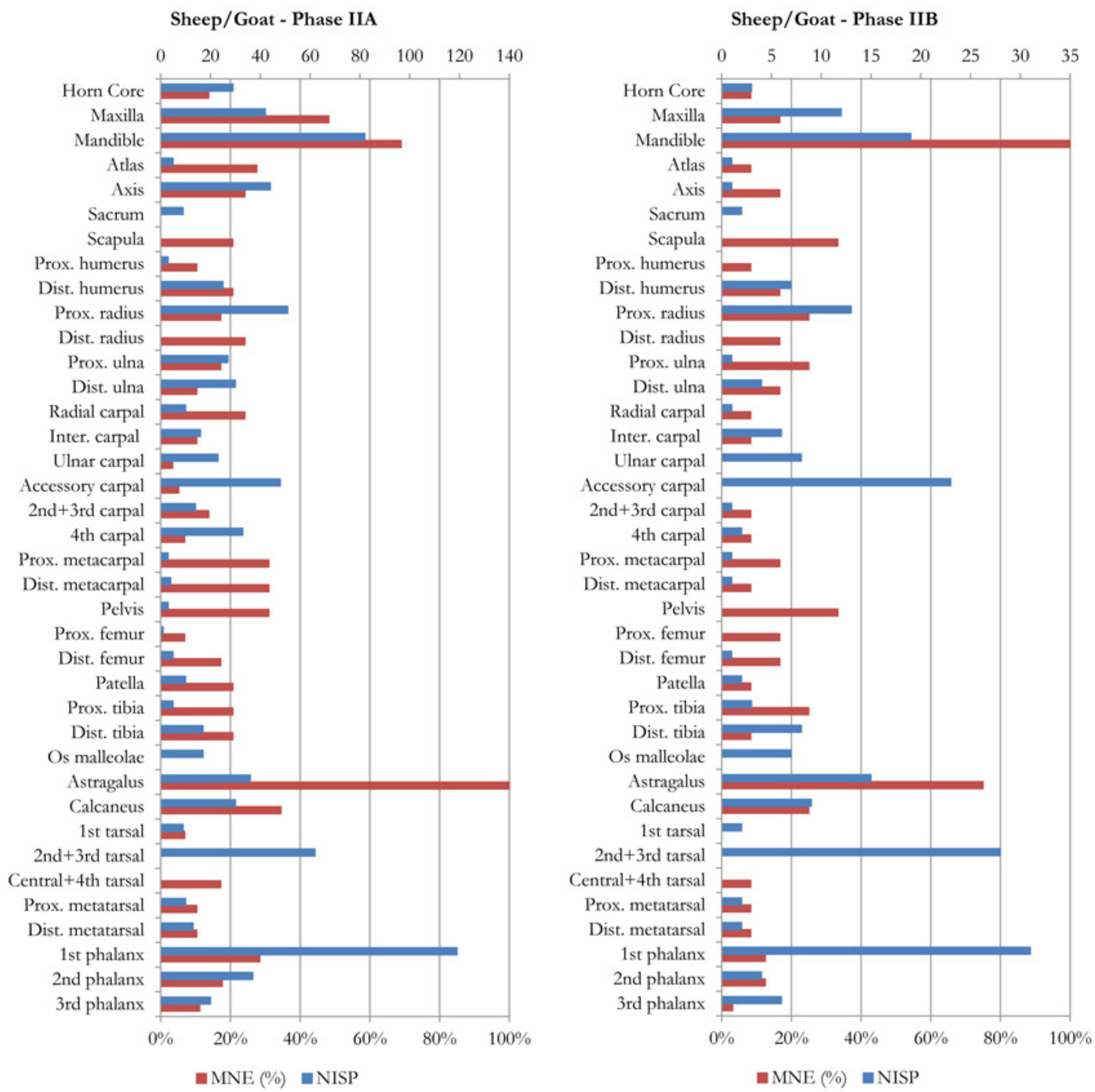


Figure A.22. Body part representation using NISP and MNE (as a percentage of the most abundant element) for sheep/goats in Phase IIA and IIB.

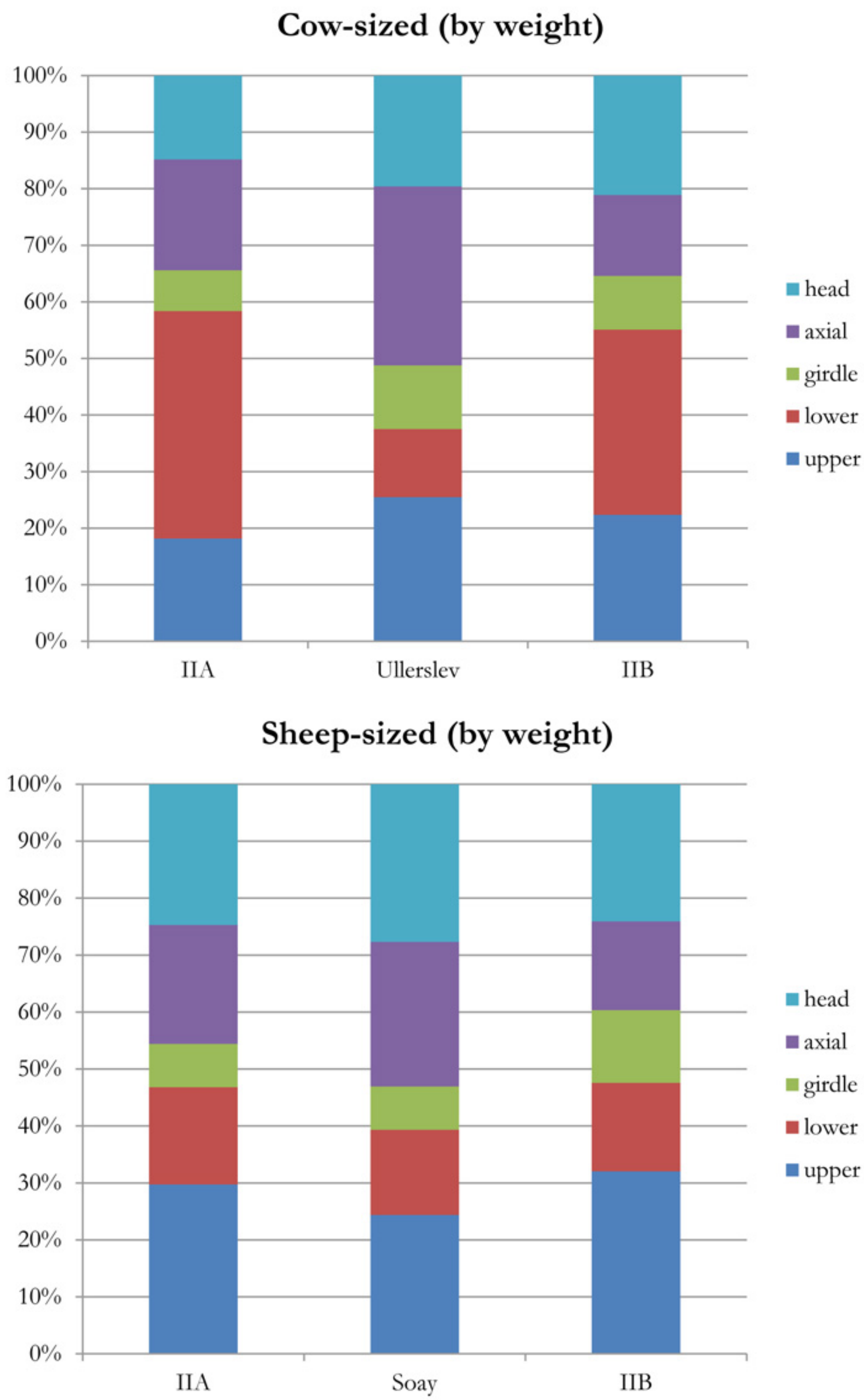


Figure A.23. Body part representation by skeletal weight for cattle and sheep/goats in Phase IIA and IIB.

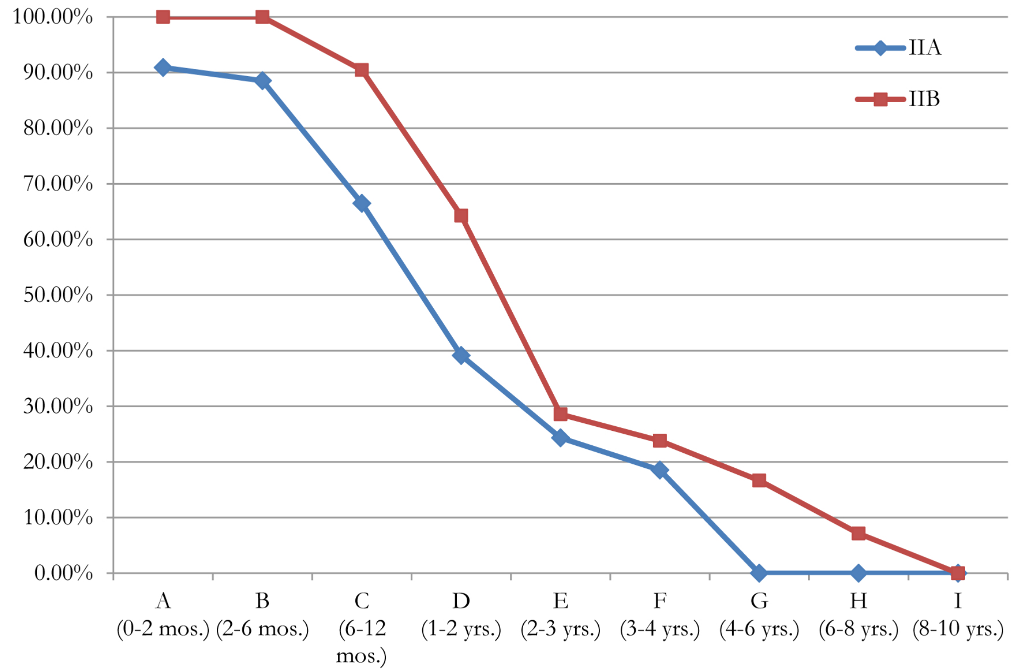
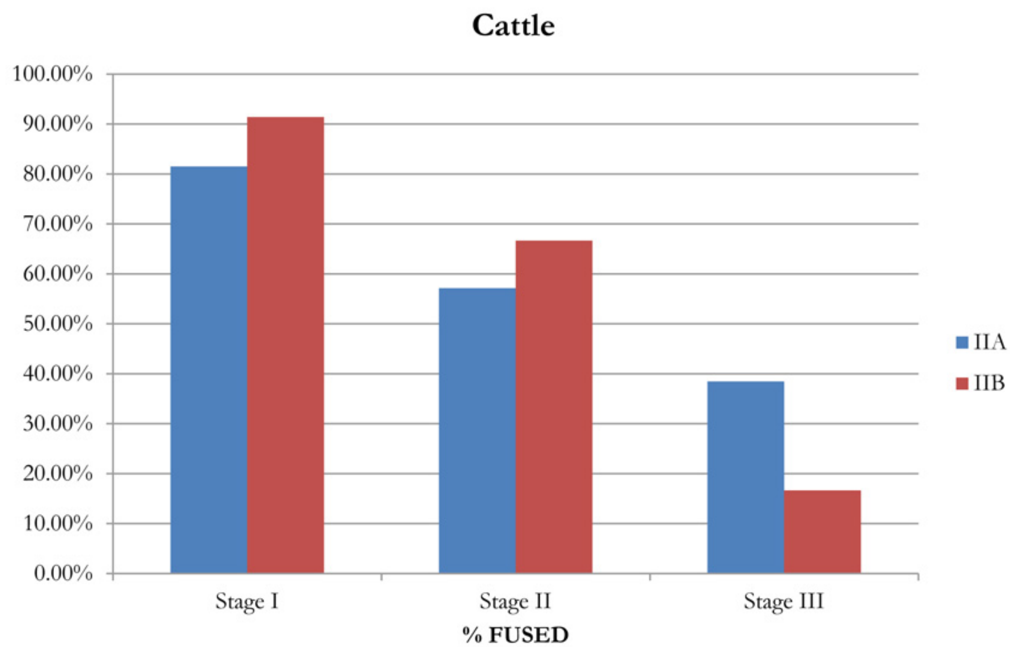


Figure A.24. Survivorship for sheep/goats in Phase IIA and IIB.

Calculating the percentage of fused elements for Stages I-III presents a slightly different picture (Figure A.25). For cattle, both the samples from Phase IIA and IIB show lower percentages of fused elements in Stages II and III. The mortality for Phase IIA shows a more gradual decline, whereas for Phase IIB, there is a sharp decline in the percentage fused in Stage III. For sheep and goats, the graph for Phase IIA matches the pattern seen for the total assemblage in Stages I and II, but has a lower percentage fused for Stage III. For Phase IIB, there are higher percentages of fused elements across all three stages, suggesting a lower level of mortality.

Lastly, there were no differences in the ratio of male to female cattle and sheep/goats (Table A.44), based on elements that could be directly sexed. Strangely, the samples for Phase IIA and IIB showed a two to one ratio of male to female sheep/goats, which is higher than the ratios seen for sheep/goats in the total Gegharot assemblage. This difference does



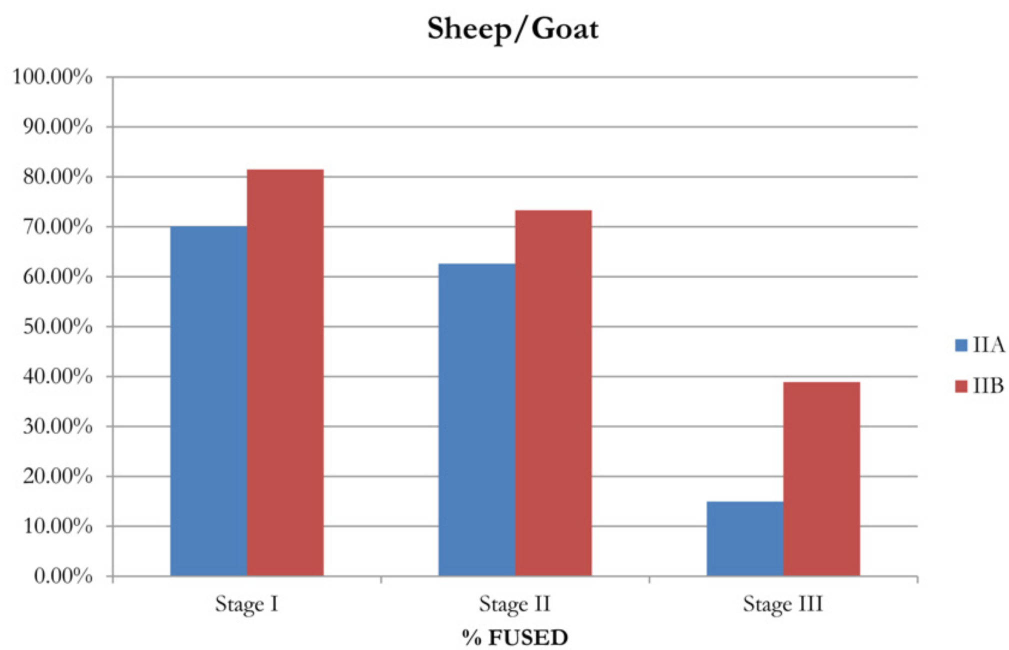


Figure A.25. Epiphyseal fusion for cattle and sheep/goats in Phase IIA and IIB.

	Male	Female	Ratio
IIA - Sheep/Goat	55	26	2.115384615
IIA - Cattle	0	2	-
IIB - Sheep/Goat	17	8	2.125
IIB - Cattle	0	3	-

Table A.44: Ratio of male to female cattle and sheep/goats in Phase IIA and IIB.

not reflect a difference in the male-female ratios for Pit and Destruction Layer context types and therefore must reflect some other variable.

A.8 Body part representation by NISP/MNE by context type

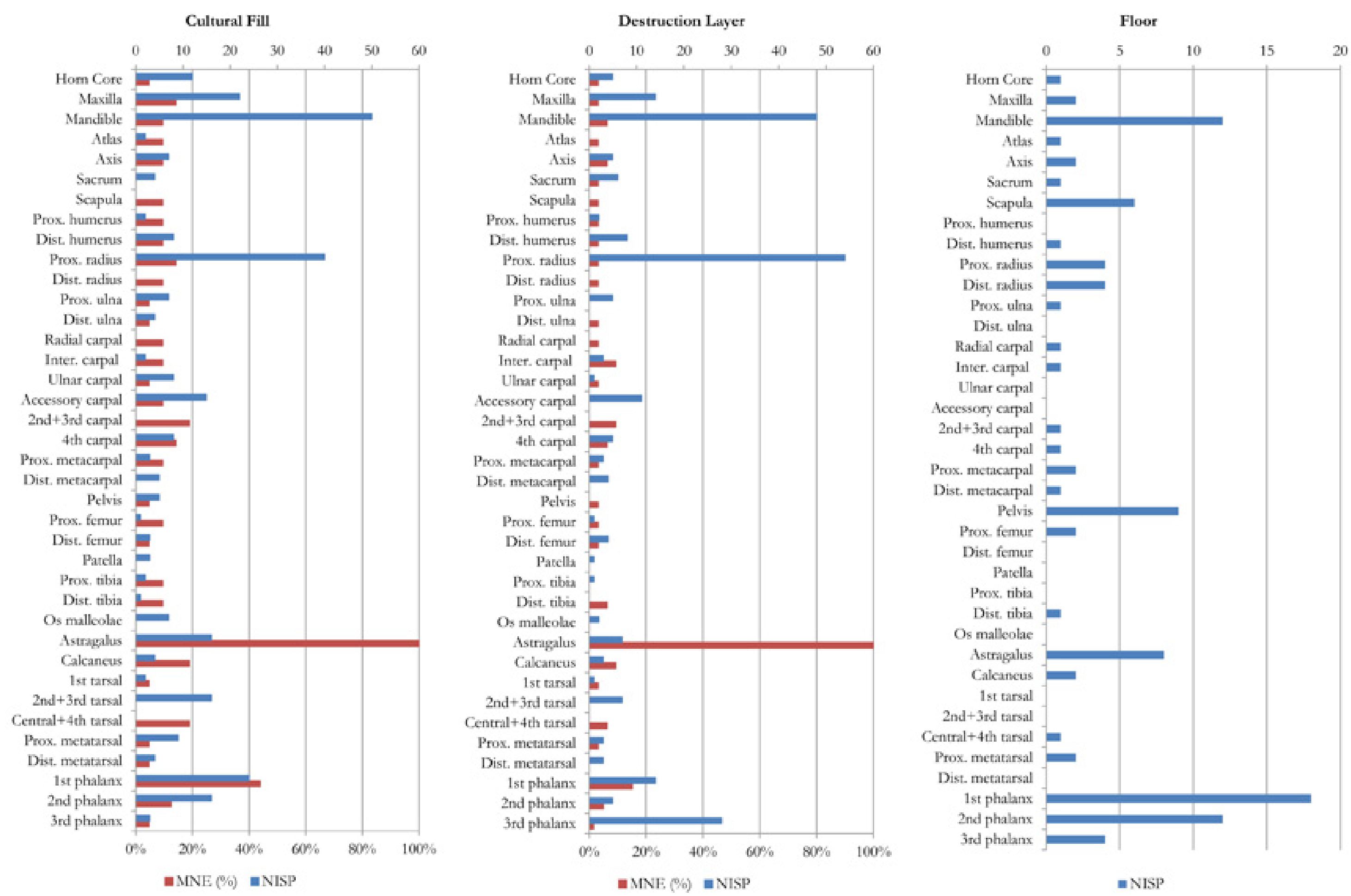


Figure A.26. Body part representation by NISP/MNE for cattle by context type at Gegharot.

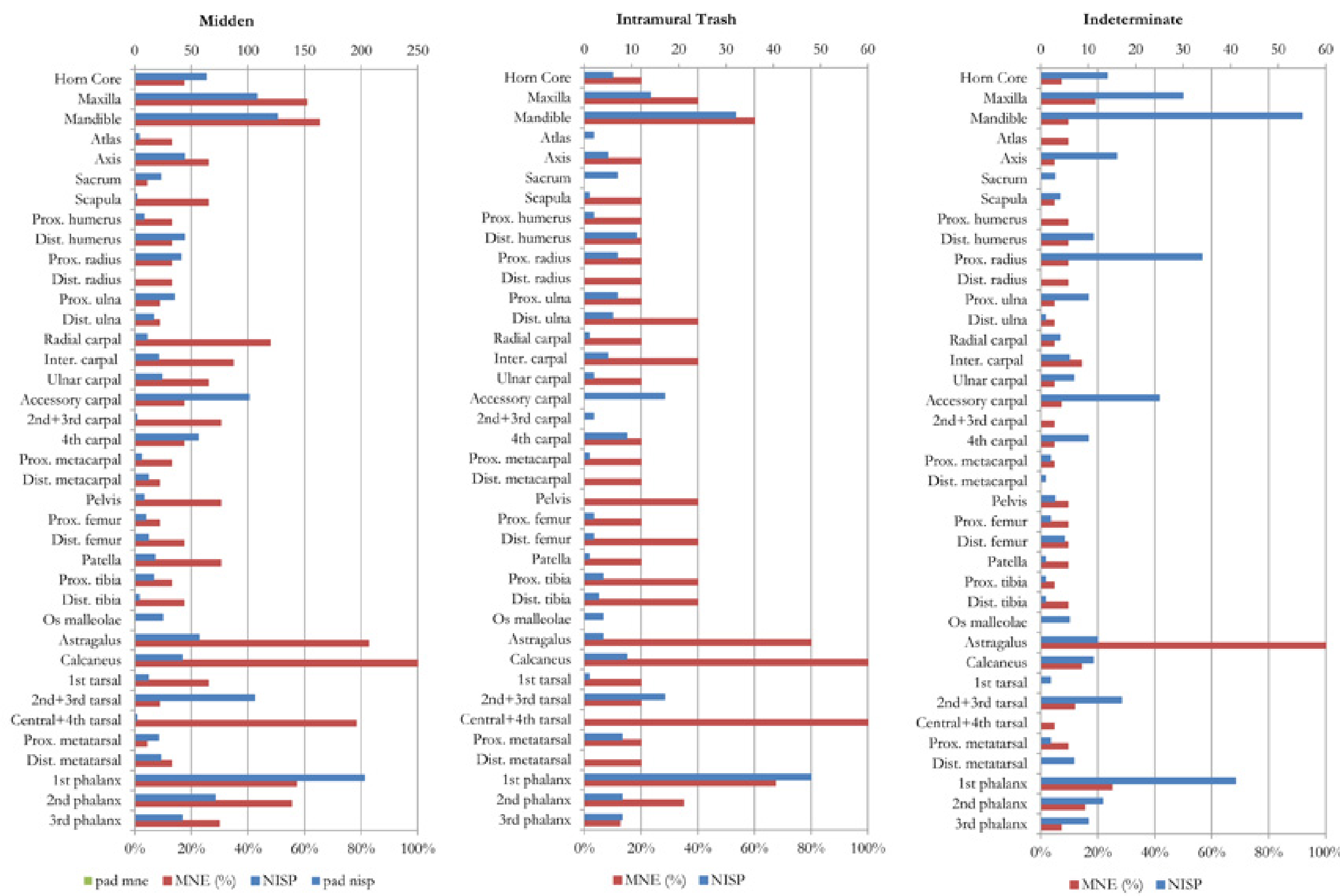


Figure A.27. Body part representation by NISP/MNE for cattle by context type at Gegharot (cont'd).

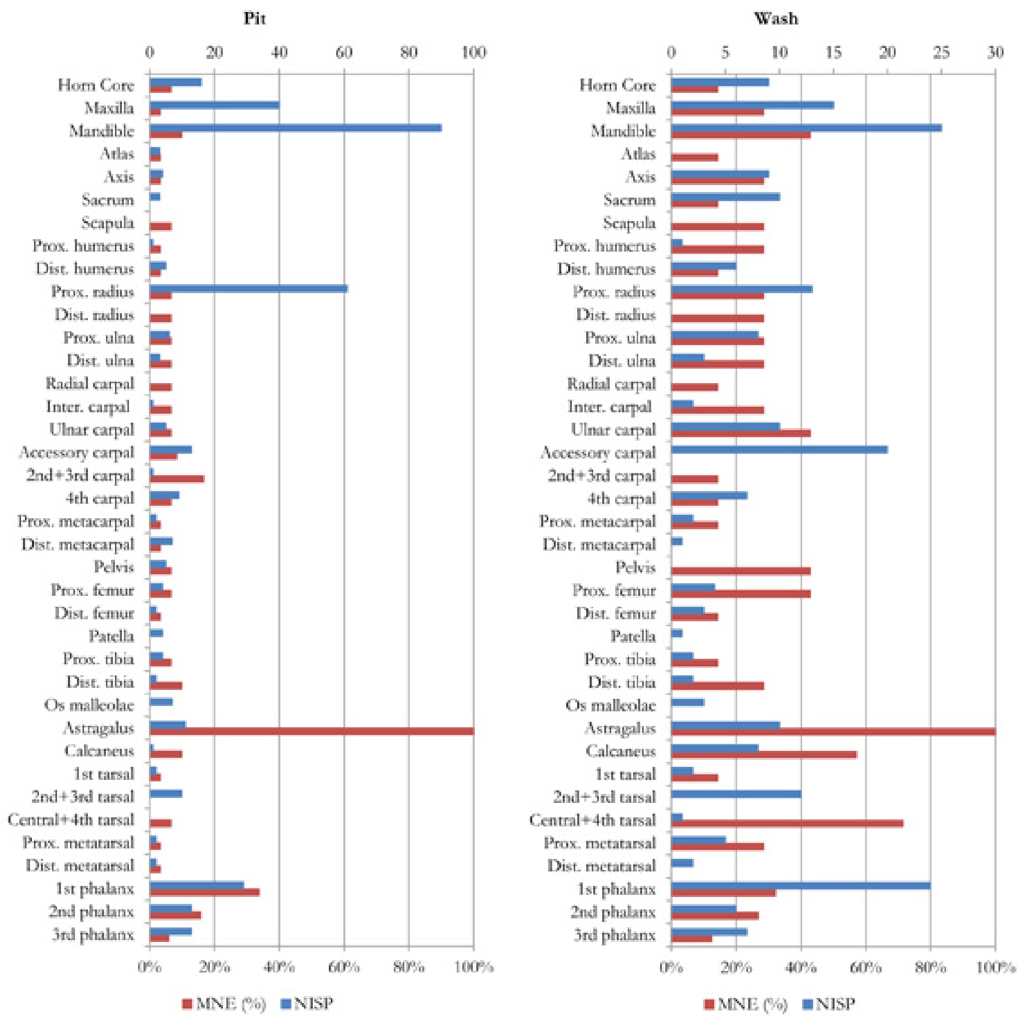


Figure A.28. Body part representation by NISP/MNE for cattle by context type at Gegharot (cont'd).

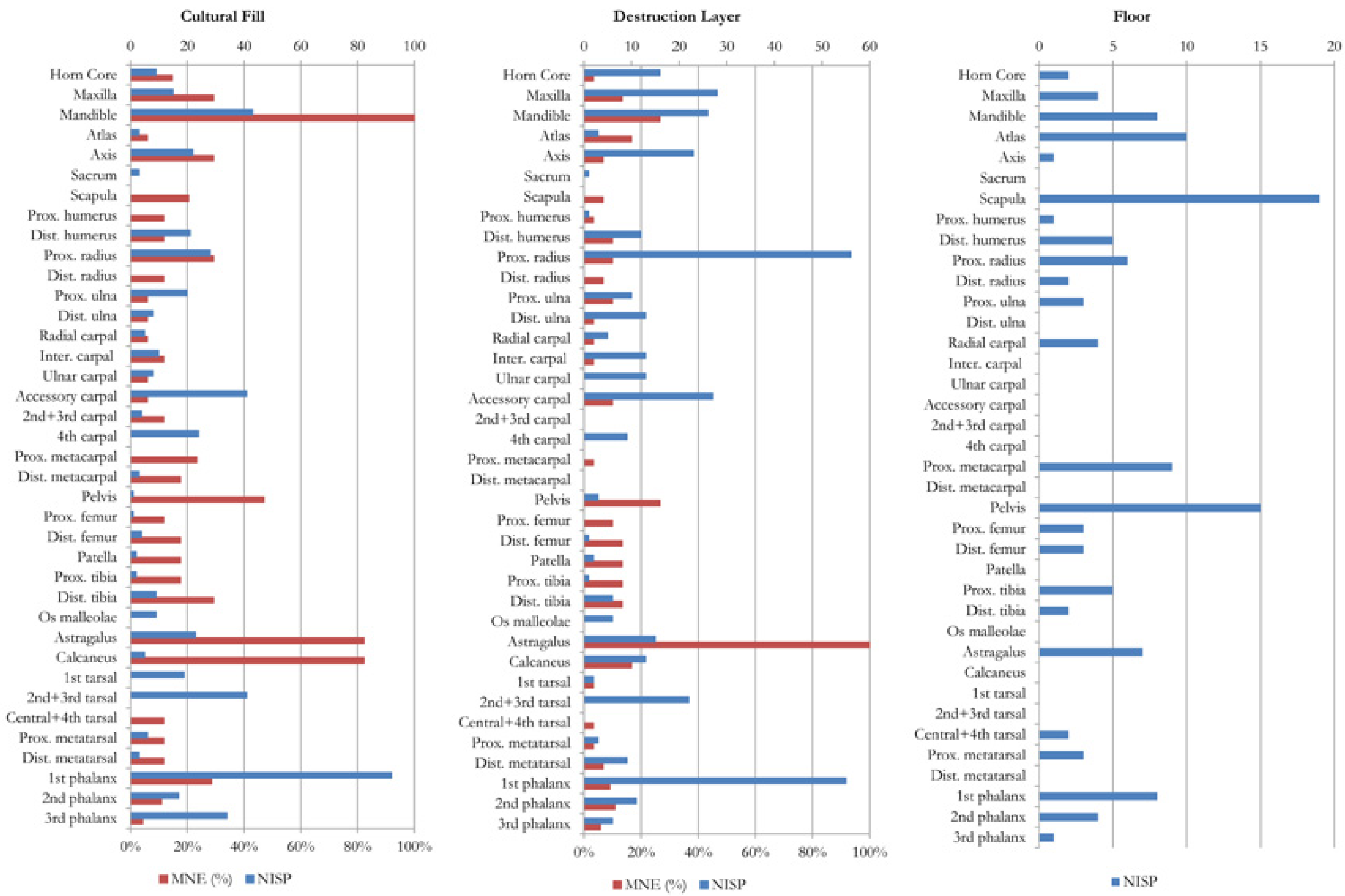


Figure A.29. Body part representation by NISP/MNE for sheep/goat by context type at Gegharot.

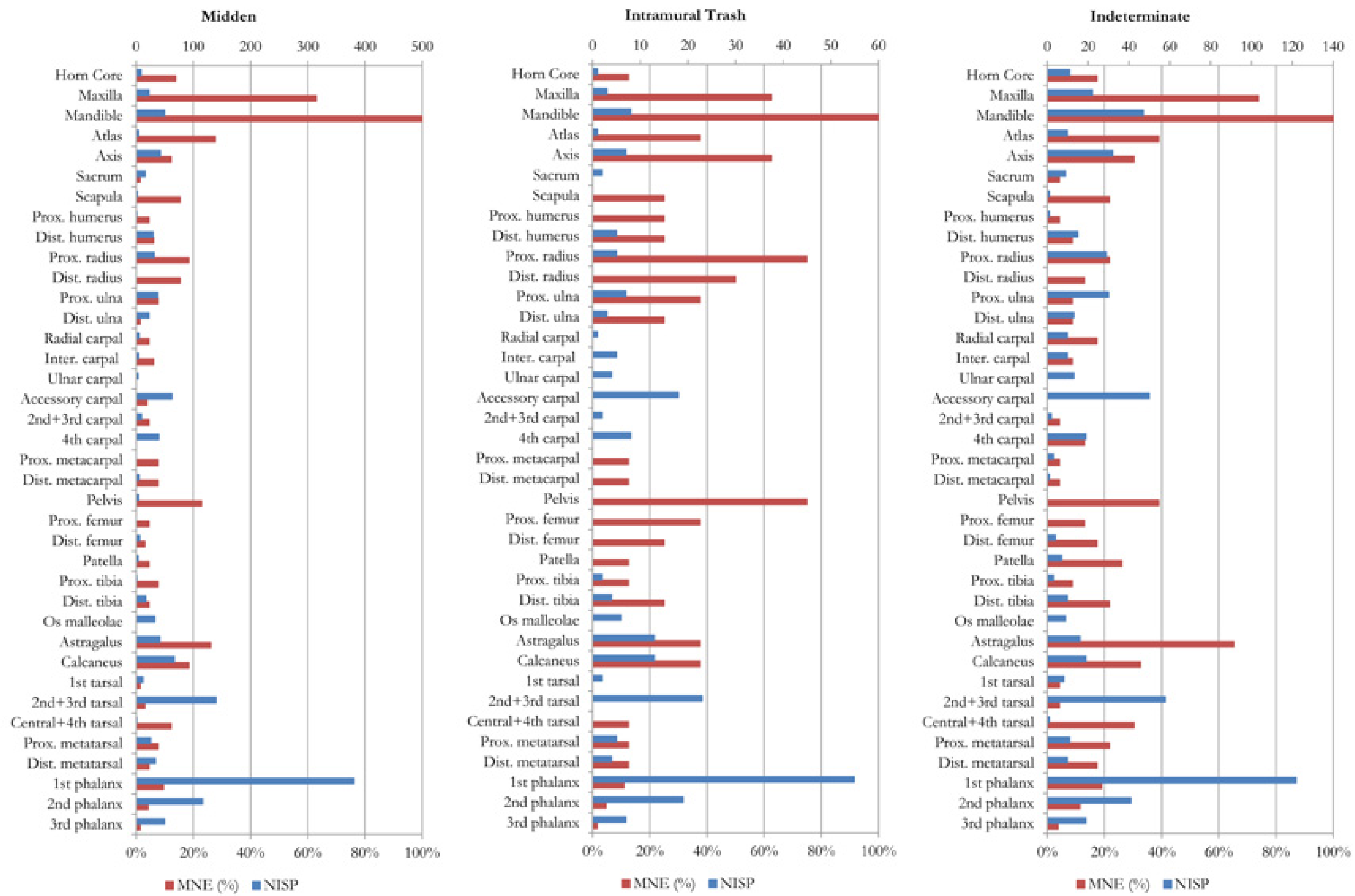


Figure A.30. Body part representation by NISP/MNE for sheep/goat by context type at Gegharot (cont'd).

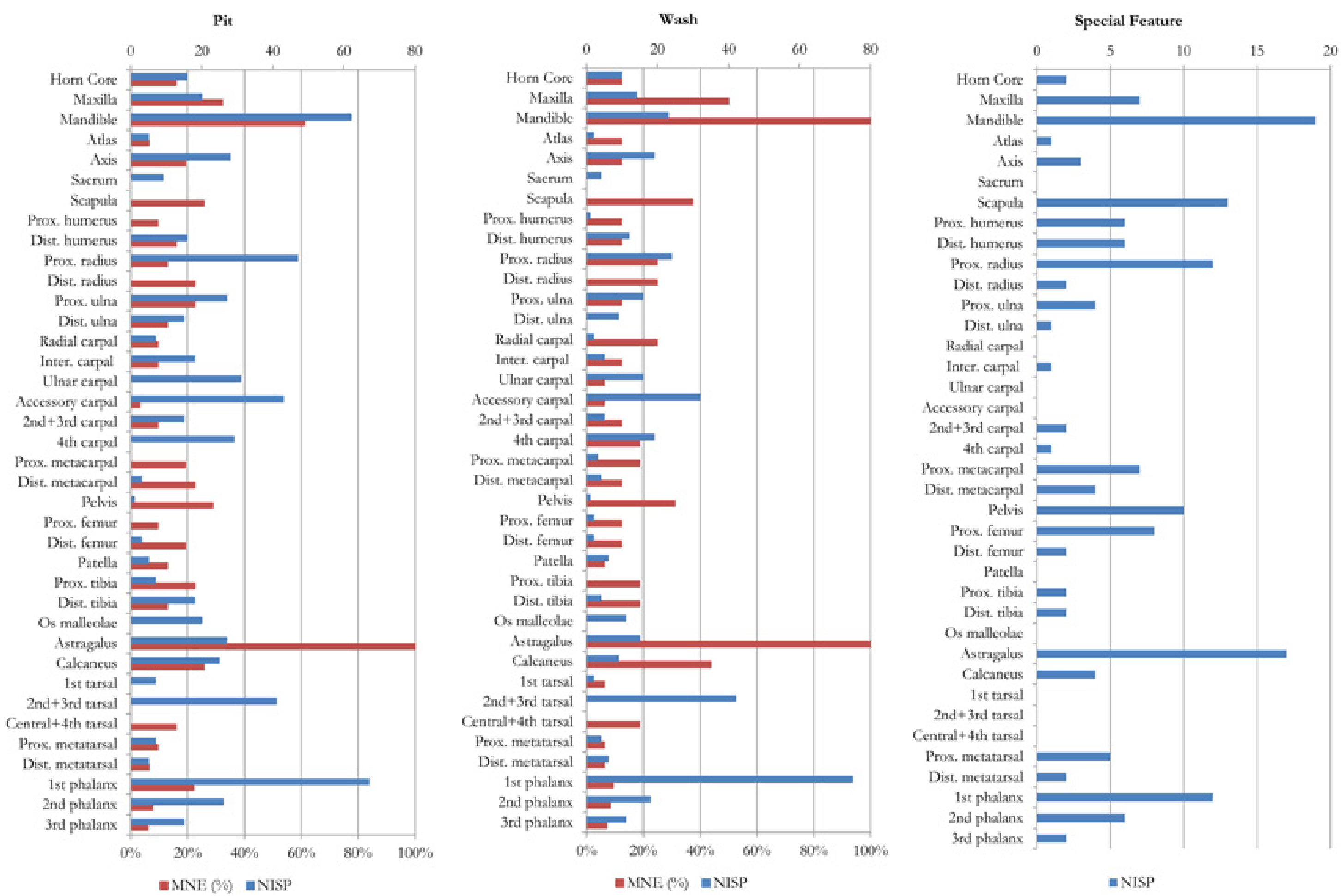


Figure A.31. Body part representation by NISP/MNE for sheep/goat by context type at Gegharot (cont'd).

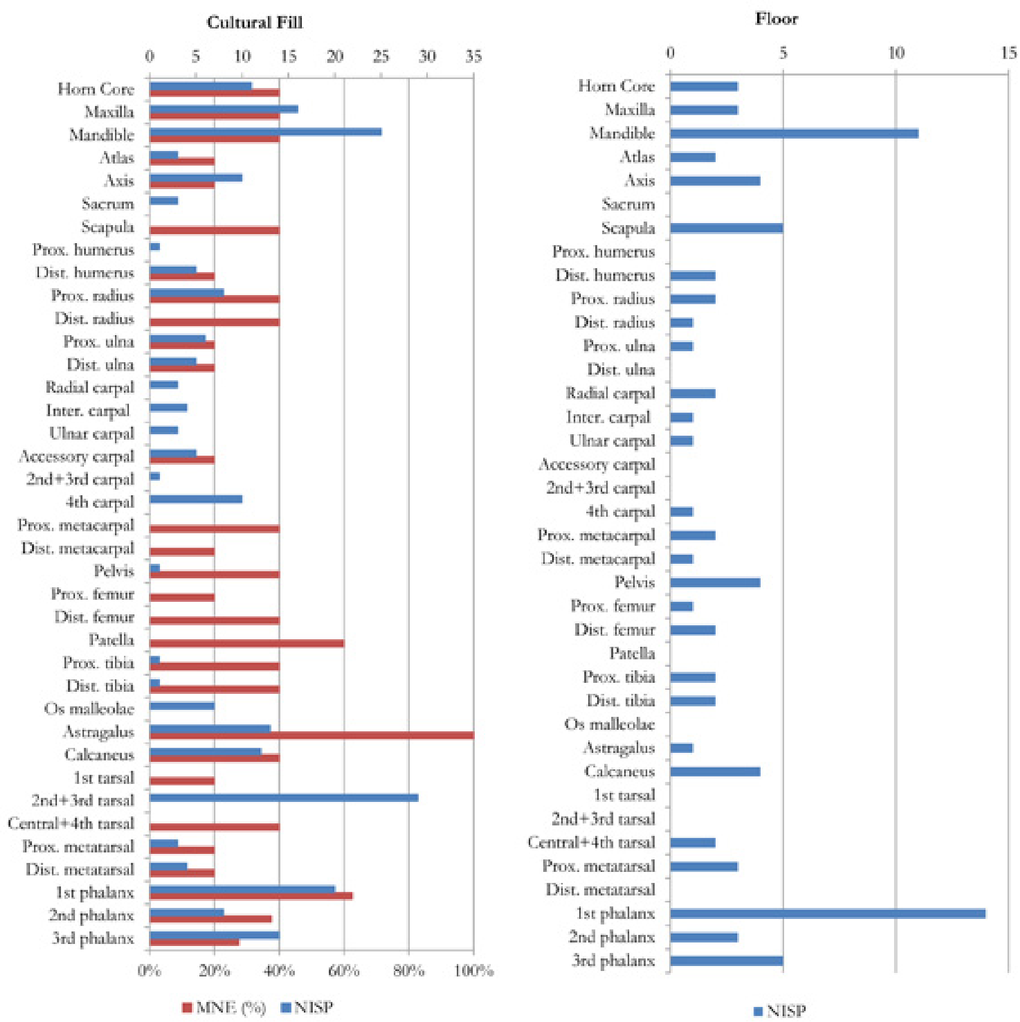


Figure A.32. Body part representation by NISP/MNE for cattle by context type at Tsaghkahovit Residential Complex.

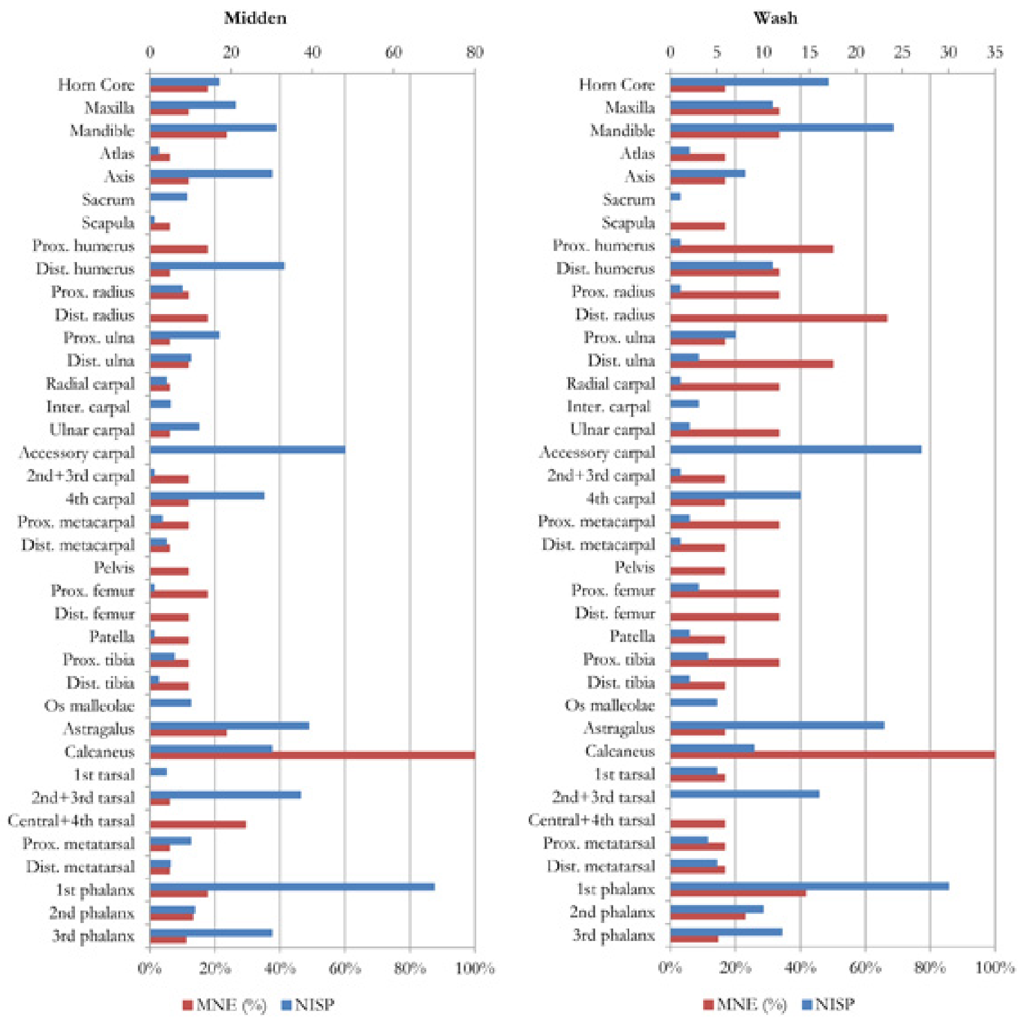


Figure A.33. Body part representation by NISP/MNE for cattle by context type at Tsaghkahovit Residential Complex (cont'd).

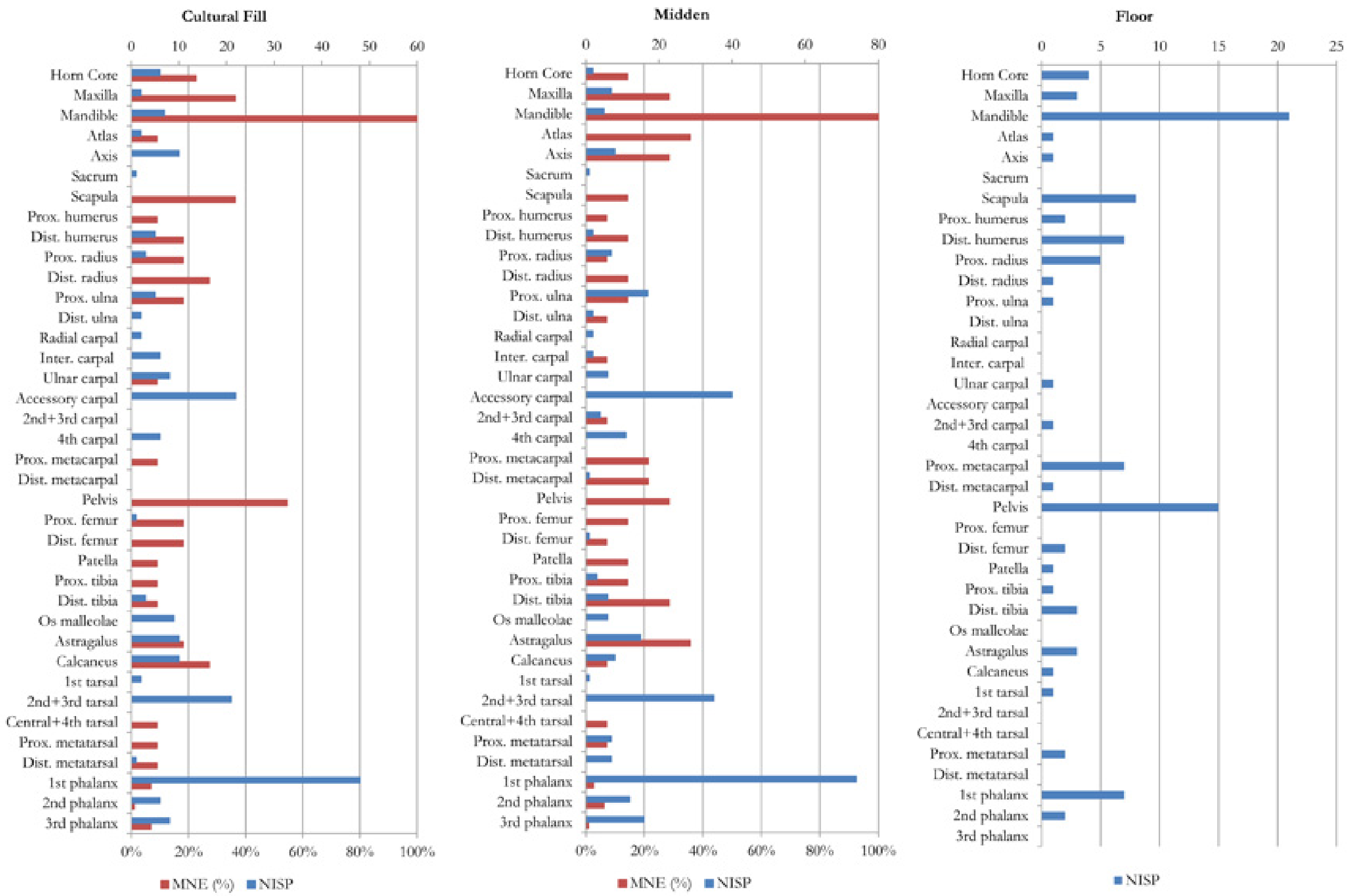


Figure A.34. Body part representation by NISP/MNE for sheep/goats by context type at Tsaghkahovit Residential Complex.

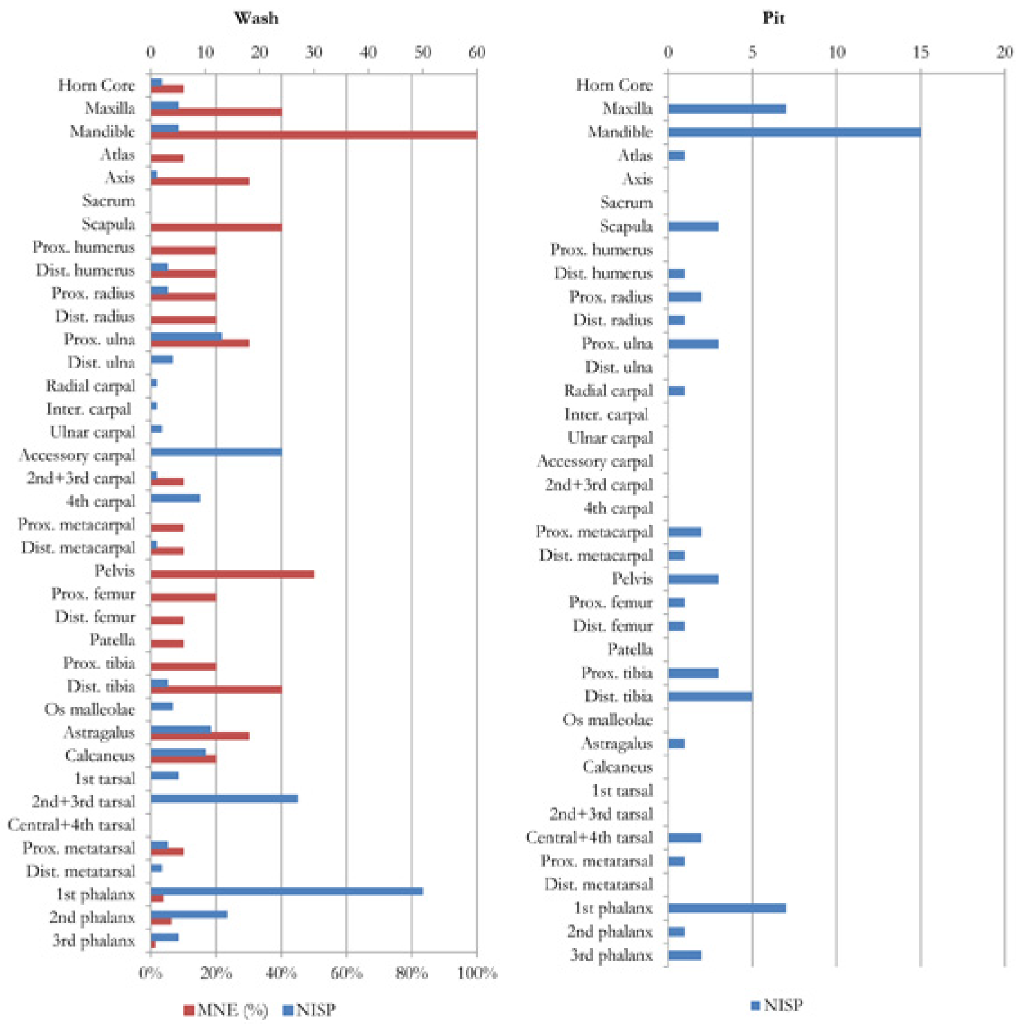


Figure A.35. Body part representation by NISP/MNE for sheep/goats by context type at Tsaghkahovit Residential Complex (cont'd).

APPENDIX B

ISOTOPE ANALYSIS

This dissertation uses data from the analysis of stable oxygen and radiogenic strontium isotopes in order to investigate questions about organization of pastoralist practices in the Late Bronze Age in the South Caucasus. The analysis of stable oxygen isotopes provides information about the seasonality of birth and proxy data for the movement of animals across the landscape. Radiogenic strontium isotope analysis provides information about the mobility of herd animals in space. This appendix presents information about the structure and composition of enamel and its formation as skeletal tissue and the basic principles and environmental dynamics underlying the analysis of stable oxygen and radiogenic strontium isotopes in archaeological faunal remains. This is followed by the presentation of the results of the analysis of isotopes in tooth enamel from archaeological fauna from sites in the Tsaghkahovit Plain, Armenia and a discussion of what information they provide on pastoralism in the Late Bronze Age. A full interpretation of these results, within the context of other forms of data, is presented in Chapters 5 & 6.

B.1 Composition and Formation of Enamel in Teeth

Mammalian teeth are composed of three different types of tissue: enamel, dentine, and cement. Enamel is the hard, shiny layer that covers the crown of the tooth, which along with with the root of the tooth, is often coated with a layer of cement (a bone-like tissue). Dentine is the tissue that forms the main structure of the root beneath the surface layers of enamel and cement. These tissues have both organic and inorganic components. The organic component of dentine and cement is compromised of collagen, a fibrous protein found in skeletal tissues such as dentine, cement, and bone. In contrast, when enamel forms, the matrix laid down is about 30% protein (Hillson 2005:149). As the enamel matures, protein and water are removed from the matrix, leaving less than 1% protein in fully mature tooth enamel. The vast majority of the inorganic component of mammalian teeth is apatite, composed of calcium phosphate minerals, usually in the form hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) , which is only found in animal tissues (Hillson 2005:146).

Enamel is formed by a set of specialized cells called ameloblasts. Amelogenesis (the production of enamel) takes place in two stages. The first of these is matrix production, where the initial organic matrix is formed and seeded with crystallites. The second phase, maturation, involves the progressive removal of water and protein, increasing the size of the crystallites and producing the strong, inorganic mature enamel (Weinmann et al. 1942; Suga 1982). The limited organic content and reduced porosity of enamel (in contrast to bone) makes it more resistant to diagenetic alteration from the burial matrix (Lee-Thorp et al. 1989; Lee-Thorp and van der Merwe 1991), though different chemical components of the apatite crystalline structure (i.e. phosphate vs. carbonates) have different interactions with burial environmental.

In mammals, the enamel of different teeth forms at different times during the development of the young animal. Some teeth form *in utero* and others form in the early years of an animal's life. Unlike other biological tissues such as bone or hair, enamel, once it is formed, is not remodeled. This means that isotopic analysis of tooth enamel can provide information about the early years of an animal's life. In hypsodont animals, such as bovids (cattle, sheep, and goats), the enamel is formed progressively over a number of months and the structure of the tooth makes it possible to sample the enamel sequentially within a tooth, thereby producing a time series over the course of enamel formation (Koch et al. 1989, 1994; Fricke and O'Neil 1996; Stuart-Williams and Schwarcz 1997; Kohn et al. 1998; Sharp and Cerling 1998; Sharma et al. 2004; Nelson 2005; Bernard et al. 2009; van Dam and Reichart 2009).

The complexity of amelogenesis in hypsodont teeth causes several potential sources of bias in intra-tooth sampling. As outlined in by Balasse (2003:4-6), these factors include: 1) geometry of enamelization fronts, 2) direction of sampling, 3) duration of amelogenesis. The complex geometry of enamelization fronts ensures that when samples are mechanically drilled, they sample multiple episodes of deposition, rather than presenting a singular isotopic "snapshot". Experimental work has shown, however, that there is no difference in the amount of time averaging due to sampling between sampling along the line of hypoplasia and sampling straight across the column of the tooth (Balasse 2003).

In sheep, the 2nd molar enamelizes over the first 12 months of the animal's life (Weinreb and Sharav 1964, Awassi breed; Milhaud and Nezit 1991, south Pre-Alps breed; Zazzo et al. 2010, Suffolk cross). Similarly, in cattle, the 2nd molar forms over approximately the first year (Brown et al. 1960, multiple breeds). While there are no studies that have determined the timing of enamel formation in goats, given the similarities in tooth eruption schedules between sheep and goats and the similar timing in second molar enamel formation between sheep and cattle (both bovids), it is reasonable to presume (as Meiggs [2009] and Blaise and Balasse [2011] do) that the second molar forms over the first year in goats as well. The first molar enamelizes beginning *in utero* (Witter and Misek 1999) and over the first 6-7 months after birth in sheep (Weinreb and Sharav 1964, Awassi breed; Milhaud and Nezit 1991, south Pre-Alps breed) and in the first three months in cattle (Brown et al. 1960).

However, the processes of primary and secondary mineralization results in a general attenuation of the isotopic signal of seasonal temperature changes (Passey and Cerling 2002:3225). Shifts of ~6 months in oxygen isotopic signal have been demonstrated experimentally for sheep and cattle (Balasse et al. 2012b:359; Blaise and Balasse 2011:3089; Zazzo et al. 2010). In addition, the method of sampling introduces further time-averaging of the signal (see below). Nevertheless, changes in temperature and in diet have been successfully tracked using intra-tooth sequential sampling (Balasse et al. 2003; Balasse and Tresset 2007; Makarewicz and Tuross 2006; Kirsanow et al. 2008).

B.2 Principles & Dynamics of Isotopic Analysis

B.2.1 Stable Oxygen Isotopes

There are two main stable isotopes of oxygen, ^{16}O and ^{18}O, whose overall abundance on the earth is fixed at 99.8% and 0.2% respectively (Schoeninger 1995). When the ratio of these two stable isotopes are measured, the results are reported against one of two international standards for the ratio of $^{18}O/^{16}O$. The first is Vienna Standard Mean Oceanic Water (VSMOW), which is based on the ratio of the two isotopes in a specific sample of seawater, and is most commonly used in studies of precipitation. The other standard is Vienna PeeDee Belemnite (VPDB), based on a particular sample of PeeDee Belemnite and is generally used in studies analyzing carbonates and minerals. It is possible, however, to convert values between scales (Coplen et al. 1983) and the choice of standard to report against is mostly a matter of convention and convenience. The ratio of oxygen isotopes in samples other than the standards are reported as the relative difference ($\delta^{18}O$) between the sample and the standard (δ= $(\text{Ratio}_{\text{sample}}/\text{Ratio}_{\text{standard}}) - 1.10^3$), and is measured in units per mil (‰). The ratio of isotopes in a sample may be greater or less than that of the standard, and such samples are referred to as enriched or depleted respectively.

The slight difference in atomic mass of the two isotopes means that the transition from liquid to gaseous phases results in the depletion of the heavier isotope, a process known as fractionation. The source of oxygen isotopes in environmental systems is predominately water, most of which is oceanic. Oceanic water is in isotopic equilibrium, but water exchange at the surface preferentially takes up the lighter isotope during cloud formation (Gat 1996). Temperature and solar radiation dynamics at different latitudes impact this process (Gat 1996). Over land, the condensation from gas to liquid phase in precipitation preferentially rains out the heavier isotope. The rate of depletion in the δ^{18}O values varies with the rate of precipitation, as a function of temperature in high and mid latitudes, but it controlled by other dynamics in the lower latitudes near the equator (Dansgaard 1964).

The δ^{18}O of precipitation varies seasonally with ambient temperatures at high and middle latitudes (Gat 1980; Rozanski et al. 1993), making it a useful indicator of seasonality in temperate climatic regimes. Altitude has a similar effect on the isotopic composition of rainwater (Siegenthaler and Oeschger 1980). It should be noted, however, that there are other factors that impact the isotopic composition of rainwater (Fricke and O'Neil 1999:188). Processes of evaporation and transpiration can effect the isotopic composition of groundwater (Darling et al. 1996), though for processes of infiltration, these have a relatively minor effect. In contrast, evaporation can have a large effects on the isotopic composition of large lakes (Darling et al. 1996, 2006).

Oxygen isotopes in plants reflect the isotopic composition of meteoric water and temperature (Sternberg 1988; Flanagan and Ehleringer 1991), though these dynamics are also affected by other factors such as aridity. Because mammals maintain constant body temperatures, and derive the bulk of their oxygen from food and water sources rather than air, the oxygen isotope ratios in body water should indicate source water composition (Schoeninger et al. 2000). Levin et al. (2006) have shown that in mammalian species that obtain the majority of their body water by drinking surface water, the δ^{18}O of body water correlate with the δ^{18}O of local precipitation.

In mammals, the phosphate and carbonate fractions of tooth enamel has been shown to reflect the δ^{18}O of their body water (Bryant et al. 1996; Iacumin et al. 1996; Iacumin and Longinelli 2002), though these dynamics vary with species physiology (Luz et al. 1984; Delgado Huertas et al. 1995; Kohn and Cerling 2002). Nevertheless, Kohn et al. (1998) have shown that isotopic variation in large mammals mostly reflects environmental conditions, rather than physiological variability. The variation in δ^{18}O of precipitation and plants is tracked in formation of hydroxyapatite during tooth growth and amelogenesis, leading to variability in δ^{18}O both within and between teeth (Koch et al. 1989; Fricke and O'Neil 1996; Stuart-Williams and Schwarcz 1997; Kohn et al. 1998; Sharp and Cerling 1998; Sharma et al. 2004; Nelson 2005; Bernard et al. 2009; van Dam and Reichart 2009).

B.2.2 Strontium Isotopes

Strontium has four naturally occurring isotopes: ^{84}Sr, ^{86}Sr, ^{87}Sr, and ^{88}Sr. Three of these isotopes are stable (non-radiogenic) and the fourth, radiogenic ^{87}Sr forms from the natural β decay of rubidium-87. The abundances for ^{87}Sr are normalized to the stable ^{86}Sr isotope and are generally reported as the ratio of ^{87}Sr/^{86}Sr. Both rubidium-87 and the various strontium isotopes (stable and radiogenic) are found in varying quantities in a number of rocks and minerals (Capo et al. 1998; Bentley 2006). The ratio of ^{87}Sr/^{86}Sr in bedrock depends on both the age and geochemical origin of the geological substrate (Faure 1986). Both the initial amount of rubidium and the amount of radioactive decay that has occurred influence the ratio of ^{87}Sr/^{86}Sr in any bedrock source. However, for archaeological timescales, the ratio of ^{87}Sr to^{86}Sr is essentially stable, since the half life of rubidium-87 is 49 billion years (Bentley 2006).

Strontium cycles through the biosphere in the following fashion: first, strontium is released into the environment by the weathering of bedrock. Once released, strontium from the weathered rock travels through hydrological cycles and is taken up by vegetation and other organisms. Eventually, strontium isotopes enter the ocean, primarily through rivers, where it is then deposited in marine carbonates (the largest marine sink of Sr) (Capo et al. 1998). Small amounts of Sr are exchanges directly between the ocean and the atmosphere. Soil values of ^{87}Sr/^{86}Sr (and therefore bioavailable Sr) depend on the age and type of bedrock, as well as soil formation processes that shape the relative level of atmospheric input of Sr to soils (Hartman and Richards 2014:251-7). Nevertheless, in most cases, weathering dominates the source contributions to soil Sr composition (Bentley 2006:148). However, minerals within rocks and different bedrock sources of the same rock type (i.e. granites) can vary in their Sr composition (Bentley 2006:141), meaning that any bedrock source may produce a range of values for $^{87}Sr/^{86}Sr$.

Due to the high atomic mass of strontium, and in contrast to light elements such as oxygen and carbon, fractionation from geological and biological processes is very slight (Capo et al. 1998; Bentley 2006). Thus, the $^{87}Sr/^{86}Sr$ measured in archaeological remains should directly reflect the $^{87}Sr/^{86}Sr$ of ingested food and water. However, the $^{87}Sr/^{86}Sr$ of ingested food and water reflects the local "biologically available" $^{87}Sr/^{86}Sr$ rather than simply reflecting a unitary geological source. As Bentley (2006:136) notes, the biologically available Sr in any system is the result of a process of mixing of different inputs (primarily geological, but also atmospheric and hydrological).

The strontium available to plants comes from either the soil or the atmosphere (Capo et al. 1998:215), but weathered rock in the local area is the dominate contributor generally (Bentley 2006:151). As noted before, biological processes have minimal impact on the $^{87}Sr/^{86}Sr$, so plant $^{87}Sr/^{86}Sr$ values reflect soil values (Capo et al. 1998:208). However, plant $^{87}Sr/^{86}Sr$ values are much more consistent than soil values, reflecting the mixing process that produces the local bioavailable Sr (Bentley 2006). A similar averaging is seen among herbivores, which graze on plants of varying $^{87}Sr/^{86}Sr$ (Burton et al. 1999). Moreover, the relative amount of Sr in food sources impacts the final $^{87}Sr/^{86}Sr$ in archaeological bones and teeth (Ericson 1985). However, the $^{87}Sr/^{86}Sr$ of biologically available Sr does vary over space, and with proper mapping, that variation can be used to track mobility in the past.

B.3 Sampling Strategy & Methods

B.3.1 Sampling Strategy

The sampling strategy employed in this study was developed in light of two unique features of the faunal assemblages from Late Bronze Age sites in the Tsaghkahovit Plain. First, the large number of faunal remains from securely dated Late Bronze Age contexts meant that there were far more mandibles than could be analyzed. Sampling then had to attempt to characterize the Late Bronze Age faunal remains through sampling that would be representative, at least in regard to the specific research questions for the isotopic analysis. Second, since this is a largely synchronic study (in contrast to other, previous isotopic analyses of large collections of faunal remains [e.g. Meiggs 2009; Henton 2010]), sampling was stratified along other variables of interest to the study.

Second molars were selected for analysis for two reasons. First, second molars have been shown to have a lower level of inter-individual variability than third molars (Blaise and Balasse 2011:3088; Zazzo et al. 2010:3584). Second, second molars are unlikely to be affected by weaning, as 80-90% of the enamelization occurs in the last 6 months of development (Balasse 2003), so the fractionation of oxygen isotopes is not likely to be impacted. A smaller sample of first molars (n=16) was selected for strontium analysis in order to analyze any trends related to mobility that affected the youngest group of animals.

The teeth used in the isotopic analysis described here were selected from the three large middens described in Chapter 4. Sampling was stratified by species and then by age class. First, mandibles with complete first molars (M1) or second molars (M2) and could be securely placed in one of the three age classes (Age Class I (0-2 years), Age Class II (2-4 years), and Age Class III (4+ years) were identified. In this instance, the same age classes were used for all three species, in contrast to the dental and post-cranial ageing system used in the zooarchaeological analysis (see Appendix A), which reflect the different lifespans of cattle and caprines.[1] This approach was used in light of the absence of sub-adult cattle mandibles in the middens, in an attempt to cover the range of ages present in the samples from the midden.

For mandibles with M2s, teeth were further selected to have a crown height greater than 20 mm for sheep and 25 mm for cattle, as the pilot study I conducted suggested teeth with at least half of the original length of the tooth were necessary to ensure a sufficient number of samples (~ 10 samples/individual) to interpret the shape of the annual curve (this accords with the results of Tornero et al. (2013:4054), whose modeling suggests that individual with crown heights < 18 mm will not record enough of the annual cycle to determine brith seasonality).

The initial list of mandibles with complete M1s or M2s from the three middens (T2, T19, and SLT10/14) gave a set of M2s which differed from the overall demographic patterns seen across the LBA assemblage. In particular, there were fewer cattle teeth than would be expected given their representation in the total faunal assemblage, and within that group there were more young animals than expected, given the kill off patterns seen in the zooarchaeological analyses. Due to this, the sampling for oxygen analysis is focused on sheep, with limited sampling from cattle and goats to provide context.

Samples from sheep were stratified first by archaeological context (T2, T19, and SLT10/14), and then by age class, weighted on the basis on demographic data from faunal analysis (hence twice as many individuals were sampled from age class II (2-4 years) as from age classes I and III for sheep and goats, but were sampled evenly across age classes for cattle). The exception to this is GeT2 (which had an unusually large number of very young animals) where four individuals were sampled from age class I, and one each from

1. Thus for sheep and goats, Age Class I = infant+juvenile (0-2 years), Age Class II = sub-adult (2-4 years), and Age Class III = adult (4+ years). In contrast, for cattle, Age Class I = infant+ younger juvenile (0-2 years), Age Class II = older juvenile + sub-adult (2-4 years), and Age Class III = adult (4+ years).

age classes II and III. Similarly, only one individual from age class III was sampled for SLT10/14, because no other suitable mandible was recovered from that context. Samples for cattle and goats were stratified only by age class, given the small number of individuals. Additional individuals from mortuary and shrines contexts were also included in the analyses (see Chapter 4). Lastly, a sample of very young individuals (sheep, goats, and cattle) were selected for bulk radiogenic strontium analysis on the M1 (n = 16, 10 from middens and 6 from special contexts).

B.3.2 Methods: Trace Elements Analysis

In addition to analyzing tooth enamel for radiogenic strontium and stable oxygen isotopes, a small portion of the sampled enamel was analyzed for trace elements to assess diagenesis (Kohn et al. 1999; Budd et al. 2000). A stock solution of the enamel samples was prepared by dissolving enamel in nitric acid. Major, minor, and trace elemental concentrations, including calcium (Ca), phosphorus (P), and uranium (U), in the samples were measured on a quadrupole inductively-coupled plasma mass spectrometer (Q-ICP-MS) at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University.

B.3.3 Methods: Stable Oxygen Isotopes

Enamel samples for the analysis of stable oxygen and carbon isotopes were prepared according to established methods (Knudson and Price 2007; Koch et al. 1997; Lee-Thorp et al. 1989). The surface of the tooth was cleaned mechanically, and then a sample of enamel was collected using a Dremel Mini-Mite equipped with a diamond-tipped drill bit. The intra-tooth samples were drilled in sequence, starting from the cervix to the apex of the crown. Between 8 and 15 samples were drilled per tooth, depending on the crown height.

The complex process of amelogenesis causes several sources of potential bias in intra-tooth sampling of enamel. The geometry of enamelization fronts, the direction of sampling, and the duration of amelogenesis affects the amount of time-averaging within a sample taken for isotopic analysis (Balasse 2003). Experimental results indicate, however, that sampling straight across the lobe of the molar does not result in any more signal attenuation than sampling along the line of hypoplasia (Balasse 2003).

Each sample consisted of a band of enamel 1-2 mm thick, drilled across the entire width of the lobe, producing a 5-10 mg sample of enamel powder. This powder was then treated with a 2% bleach (NaOCl) solution for 24 hours to remove any organics from the sample, and then with 0.1M acetic acid (CH_3COOH) for 24 hours in order to remove any diagenetic carbonates. Ratios of stable oxygen and carbon isotopes in archaeological hydroxyapatite carbonate ($\delta^{18}O_{carbonate(VPDB)}$, $\delta^{13}C_{carbonate(VPDB)}$) were measured using a Thermo-Finnigan Delta V Advantage isotope ratio mass spectrometer (IRMS) equipped with a Thermo-Finnigan Gas Bench II at the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University. Oxygen isotope ratios ($\delta^{18}O_{\text{Carbonate (VPDB)}}$) are reported relative to the VPDB (Vienna PeeDee belemnite) carbonate standard and are expressed in per mil (‰) using the following standard formula: $\delta^{18}O = \left[\left(\frac{^{18}O}{^{16}O}\right)_{sample} / \left(\frac{^{18}O}{^{16}O}\right)_{standard} - 1 \right] X\, 1000$ (Craig 1961; Coplen 1995).

B.3.4 Methods: Radiogenic Strontium Isotopes

All enamel samples were prepared by the author, using established procedures (Knudson and Price 2007; Torres-Rouff and Knudson 2007:Appendix I) in the Archaeological Chemistry Laboratory at Arizona State University. For radiogenic strontium analysis, the surface of the tooth was cleaned mechanically, and then a sample of enamel was collected using a Dremel Mini-Mite equipped with a diamond-tipped drill point. Samples for radiogenic strontium analysis were analyzed at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. For M2s, three samples were taken per tooth: one near the cementum-enamel junction (CEJ), one in the middle of the crown, and one at the top of the crown. For the M1s, a single sample of enamel was drilled near the CEJ.

After preparation of the stock solution and assessment of potential diagenetic contamination (via trace elements analysis), strontium was separated from the sample matrix using the automated prepFAST system developed at Arizona State University. This system is a fully automated, offline chromatography method that has been demonstrated to be as accurate and precise as conventional manual column elution (Romaniello et al. 2015:1910).[2] Strontium isotope samples from the pilot study conducted in 2013 were manually separated using EiChrom SrSpec resin (50-100 μm in diameter). Radiogenic and stable strontium isotopes were measured on a Neptune multi-collector inductively-coupled plasma mass spectrometer (MC-ICP-MS).

B.4 Results & Analysis

B.4.1 Diagenesis

Before analyzing the results of the stable oxygen and radiogenic strontium isotope analysis, it is important to assess whether the burial environment and post-depositional taphonomic processes might have altered the isotopic composition of the tooth enamel and to what extent we can expect the measured ratios of isotopes from the carbonate component of the enamel to reflect the original environmental signatures present at the time of amelogenesis. The process of decomposition of the body and other organic materials, water movement

2. Refer to Romaniello et al. (2015) for a fuller description of the column elution protocol.

through the soil column, bacterial and fungal activity, freeze/thaw cycles, and other processes influence the chemical environment around the deposited teeth and may result in the exchange of ions between the enamel components and the surrounding matrix, potentially altering the ratio of isotopes present in the enamel.

Organic and carbonic acids produced by tissue decomposition create an acidic microenvironment, which may cause the dissolution of inorganic calcium phosphates in bone and tooth mineral components. Secondary mineralization/recrystallization could potentially incorporate ions from the surrounding soil matrix, as well as the dissolved bone or tooth mineral (Pate 1994:183). Recrystallization is clearly evident in dentine or bone but not in enamel (Ayliffe et al. 1994).

In general, enamel is considered to be a better choice for isotope analysis of archaeological materials due to its resistance to diagenetic alteration over time. Enamel is considered more reliable than bone or tooth dentine (Lee-Thorp et al. 1989; Lee-Thorp and van der Merwe 1991:349; Price et al. 2002). While structural carbonate is often considered less resistant to diagenesis than the phosphate component, enamel carbonates in particular have been shown to less susceptible to alteration than bone and dentine (Wang et al. 1994; Iacumin et al. 1996; Cerling et al. 1997; Kohn et al. 1999; Budd et al. 2000).

Kohn et al. (1999)'s study suggests that while strontium isotopes in enamel carbonates are not completely immune to diagenetic alteration, low levels of uranium and other rare earth elements (REEs) should indicate enamel that has not been diagenetically altered and the original ratio of radiogenic strontium isotopes is preserved. For stable oxygen isotopes, while the oxygen isotopes in carbonates are more susceptible to diagenetic alteration than those in enamel phosphates, Kohn et al. (1999)'s results indicate that this has a relatively slight effects on the ratio of stable oxygen isotopes (~1‰), one that should not greatly impact the patterning in birth seasonality under study here.

All of the enamel samples in this study had uranium levels considerably below Kohn et al.'s (1999) 1 ppb cut-off for uncontaminated fossil enamel (Table B.5). This suggests that there has been relatively little diagenetic alteration of the enamel and that both the original strontium and oxygen signatures should be retained. This suggests that, despite the relative vulnerability of enamel carbonates to diagenetic alteration, the impact on oxygen isotope ratios should be well below the ~1‰ estimate.

Another method used to assess the relative impact of diagenesis on archaeological bone and enamel is the ratio of calcium to phosphorus. Based on the chemical formula of hydroxyapatite, one would expect at 1.67 molar ratio of Ca to P, but experimental measurements on modern enamel range from 1.5-1.68 (Elliott 1994). This is due to the poor crystallinity of hydroxyapatite, which results in greater levels of substitution for Ca at the crystal surface (Sillen 1989). Calcium deficient apatites such as hydroxyapatite have been shown to be highly reactive to solutions containing calcium ions, such as calcium carbonate, which would elevate the Ca:P of affected enamel. As a result, calcium carbonate in the burial environment potentially could alter the $^{87}Sr/^{86}Sr$ of the enamel, since Ca can substitute for Sr in chemical bonding.

Unfortunately, there is no established standard for what is acceptable level of deviation in Ca:P for the purposes of archaeological studies of strontium isotopes. Approximately a third of the samples had Ca:P that were in the normal range for modern enamel (Table B.5). The remaining two thirds of the samples were only slightly elevated, all but one sample had a Ca:P of less than 2.0. However, the pre-chemistry analysis of this samples as part of the prepFAST protocol suggests that those ratios may be artificially elevated, since the pre-chemistry analysis measurements were all in the normal range and consistently lower. One sample, ACL-6225-K showed an abnormally high ratio of calcium to phosphate (2.2). It is not clear what would cause such an anomalous value, as the measurements for U and other REEs for this sample do not indicate any diagenetic contamination.[3] Intra-tooth, samples showed minimal variation in the Ca:P within a single tooth, fluctuating in the third decimal. These results suggest a minimal impact of diagenetic substitution on the $^{87}Sr/^{86}Sr$ measured in the archaeological samples.

B.4.2 Radiogenic Strontium

B.4.2.1 Baseline Strontium Values in the Tsaghkahovit Plain

Currently, well-established baselines or isoscapes for the region are lacking, which limits the potential for fine-grained analysis of isotopic results. However, there is still much information to be gleaned about cultural practices of production and consumption from broad-scale comparisons and patterns in isotopic results, even if they cannot be definitively linked to the precise dynamics of fractionation and biopurification within ecosystems. For strontium isotope analysis, rather than using the expected or observed radiogenic strontium isotope values for the geologic formations in the study area, interpretation of the strontium data presented below is based on the bioavailable strontium available in each region, as determined by the strontium values found in the bones and shells of modern and archaeological rodents and land snails. Using bioavailable strontium (as measured in animals with small home ranges) to define ‘local’ baselines allows the model to account for biopurification and the environmental mixing of strontium sources (Price et al. 2002; Bentley et al. 2004; Bentley 2006).

Maureen Marshall has produced preliminary baseline values for bioavailable radiogenic strontium for the Tsaghkahovit Plain, as well as values for the Shirak Plain to the west and

3. This sample was measured a second time (as part of quality control analysis in the prepFAST protocol) and this also returned an anomalously high Ca:P but normal U and other REE levels.

the Ararat Plain to the south (Marshall 2014). These baselines were produced using an established method, which defines the “local” $^{87}Sr/^{86}Sr$ of a region or site as a range of two standard deviations around the mean (i.e. mean ± 2σ) of the $^{87}Sr/^{86}Sr$ of modern and/or archaeological fauna with limited home ranges. Modern and archaeological rodent samples from the Tsaghkahovit Plain had a mean $^{87}Sr/^{86}Sr$ = 0.70769 ± 0.00067, archaeological land snails from the site of Horom in the Shirak Plain had a mean $^{87}Sr/^{86}Sr$ = 0.70836 ± 0.00007, and a single modern rodent from Aknashen in the Ararat Plain had the $^{87}Sr/^{86}Sr$ = 0.706669.

The larger range of bioavailable strontium in the Tsaghkahovit Plain reflects the varying underlying geology (see Marshall [2014] for a full discussion), however Marshall’s results suggest that the different geological formations do not produce discriminable values of bioavailable radiogenic strontium. Nevertheless, it is possible to identify individuals whose signatures indicate an origin outside of the Tsaghkahovit Plain, and tentatively assign them to the regions adjacent to the Plain. As the preliminary baseline values for the Tsaghkahovit Plain suggest, one problem with the local baseline approach is that it obfuscates the complicated nature of the mixing inherent in bioavailable Sr values, and in the case of studies of human remains, elides the complicated nature of human-environment interactions (see Makarewicz and Sealy 2015 for one version of this critique). Nevertheless, it is important to keep in mind the relative scale and coarse-ness of the mapping of the Sr isoscape in the Tsaghkahovit Plain and in the surrounding region.

B.4.2.2 Sr Isotope Analysis Results & Analysis

The results of the radiogenic strontium analysis of enamel samples from the Tsaghkahovit Plain are presented in Table B.6 and graphically in Figure B.1. Using the preliminary baseline values generated by Marshall (2014), the vast majority of samples fall within the "local" range for the Tsaghkahovit Plain. There is one clear outlier: ACL-6220. ACL-6220 is a sub-adult goat (*Capra hircus*) recovered from the midden in GeT2, and the sample taken nearest to the CEJ had a ^{87}Sr/^{86}Sr was considerably lower (0.70675) than the baseline values for the Tsaghkahovit Plain. While it is impossible to say precisely where this individual may have spent time outside of the Tsaghkahovit Plain, the Shirak Plain to the south (which is geologically distinct) has shown lower ^{87}Sr/^{86}Sr values. There are number of observations that fall just outside of the lower boundary of baseline established for the plain, however, given the preliminary and limited nature of the current Tsaghkahovit Plain isoscape, these values are treated conservatively as likely also being local (unless the oxygen data suggests otherwise – see below).

The measured ^{87}Sr/^{86}Sr are broken down by species, age category, and archaeological context in Figure B.1, and statistical summaries of the data are presented in Figure B.2. Individuals recovered from the Tsaghkahovit Residential Complex (across species and age categories) had a lower mean ^{87}Sr/^{86}Sr (0.70715). The plot of means and 95% confidence intervals, as well as the results of a Kruskal-Wallis test (KW χ^2= 52.058, df = 5, p= $5.25e^{-10}$), shows that this difference in means is statistically significant. Post-hoc testing through pair-wise comparisons using the Dunn-Bonferroni method (SPSS ver. 22) reveals that this rejection of the null-hypothesis is driven by the lower values of ^{87}Sr/^{86}Sr at the Tsaghkahovit Residential Complex – the pairwise comparisons between the TRC and other contexts are statistically significant at the α= 0.05 level for all pairs except TsBC12, likely due to very small number of samples from TsBC12.

This result is unlikely to reflect diagenetic contamination by the burial environment, as the baseline values for archaeological and modern rodent samples from the site of Tsaghkahovit cluster on the higher end (0.70792 $\pm$ 0.00047) of the overall range for the Tsaghkahovit Plain. This result suggests that the animals recovered from the middens at the

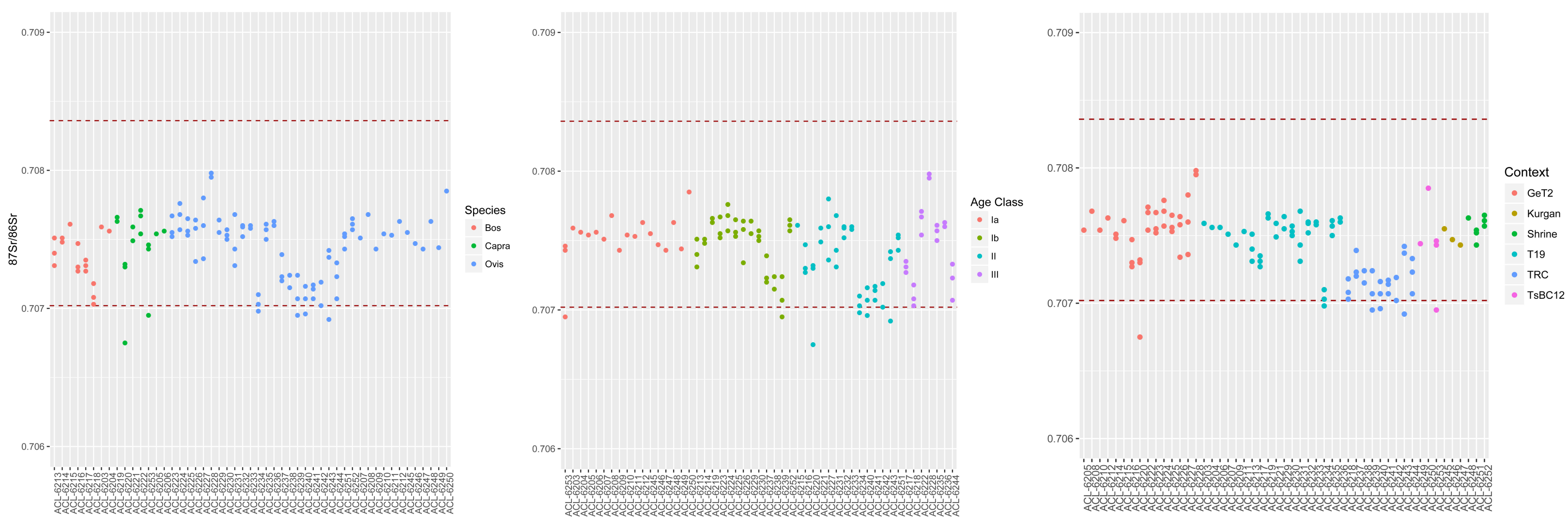


Figure B.1. Variation in $^{87}Sr/^{86}Sr$ by a) species, b) age category, and c) archaeological context.

TRC were eating a different diet (with different range of $^{87}Sr/^{86}Sr$ inputs) than the animals recovered from other archaeological contexts in the Tsaghkahovit Plain.

The box plot of the distribution of $^{87}Sr/^{86}Sr$ by archaeological context also identifies ACL-6234, a 2-3 year old sheep, as an outlier. Its $^{87}Sr/^{86}Sr$ values are unusually low compared to the other individuals from T19. There is no meaningful difference in the mean$^{87}Sr/^{86}Sr$ value between cattle, sheep, and goats (KW χ^2= 2.1313, df =2, p= 0.3445). The $^{87}Sr/^{86}Sr$ values of samples from goats show a narrower range of variation (as measured by the IQR). The mean $^{87}Sr/^{86}Sr$ value doesn't vary much between age groups, though the mean for juveniles (Stage II) is slightly lower, with the Kruskal-Wallis test statistic barely reaching significance at the $\alpha = 0.05$ level (KW χ^2= 8.2364, df = 3, p= 0.04137). Post-hoc testing through pair-wise comparisons using the Dunn-Bonferroni method (SPSS ver. 22) reveals that none of the pairwise comparisons reach the α= 0.05 level of significance. What the post-hoc tests do suggest is that Age Class II is slightly different from the other classes – but it is not clear if this is due to sampling or to actual differences in the populations being sampled.

The very youngest animals (Infant - Group Ia) where the $^{87}Sr/^{86}Sr$ was measured on the M1, show a much narrower range of variation (as measured by the IQR). In order to assess whether the narrow range in variation among the infant animals (Group Ia - M1s) reflects a general feature of the early life stage of animals in the Tsaghkahovit Plain or reflects a specific feature of the biographies of animals slaughtered at a very young age, I compared the $^{87}Sr/^{86}Sr$ values from the CEJ on the M1s (from Group Ia) to the mid-point values on the M2s (from all other groups).[4] The CEJ of the M1 enamelizes approximately

4. It is difficult to adequately assess whether the variation introduced by the mid-point value not being in the precisely the same point on each individual M2 introduced any further noise beyond what might be expected in the formation and maturation of tooth enamel. It is unlikely that the samples in either the M1 and M2 group represent precisely the same period of time. Nevertheless, it does seem that the different levels of variation is capturing a real dietary signal.

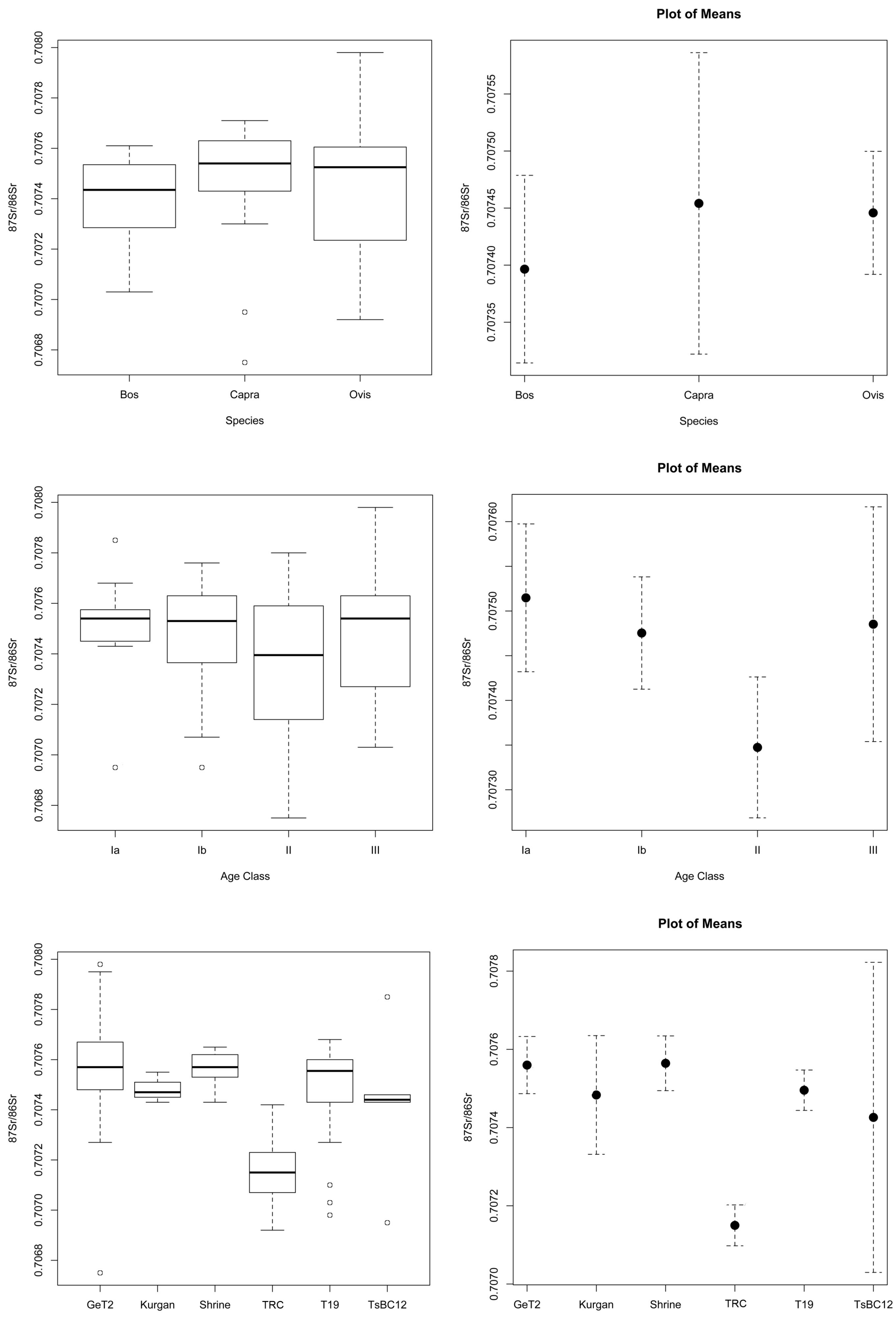


Figure B.2. Statistical summaries of $^{87}Sr/^{86}Sr$ by species, age category and archaeological context. On the left are box plots of $^{87}Sr/^{86}Sr$ and on the right are the mean values of $^{87}Sr/^{86}Sr$ plotted with a 95% confidence interval.

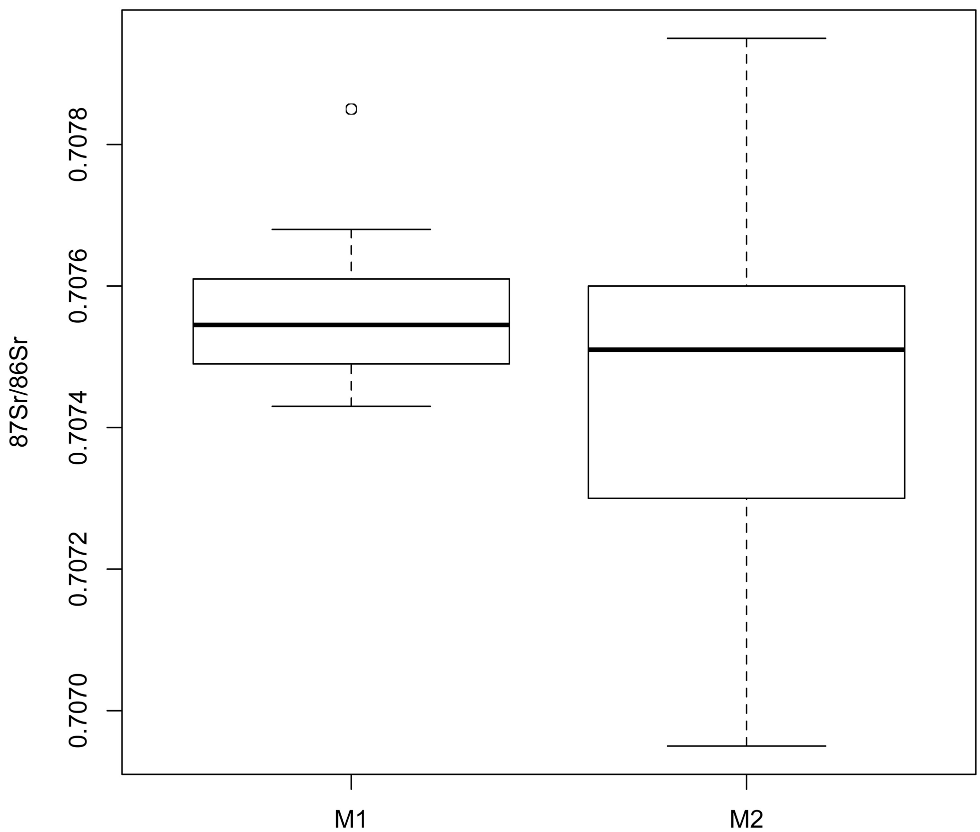


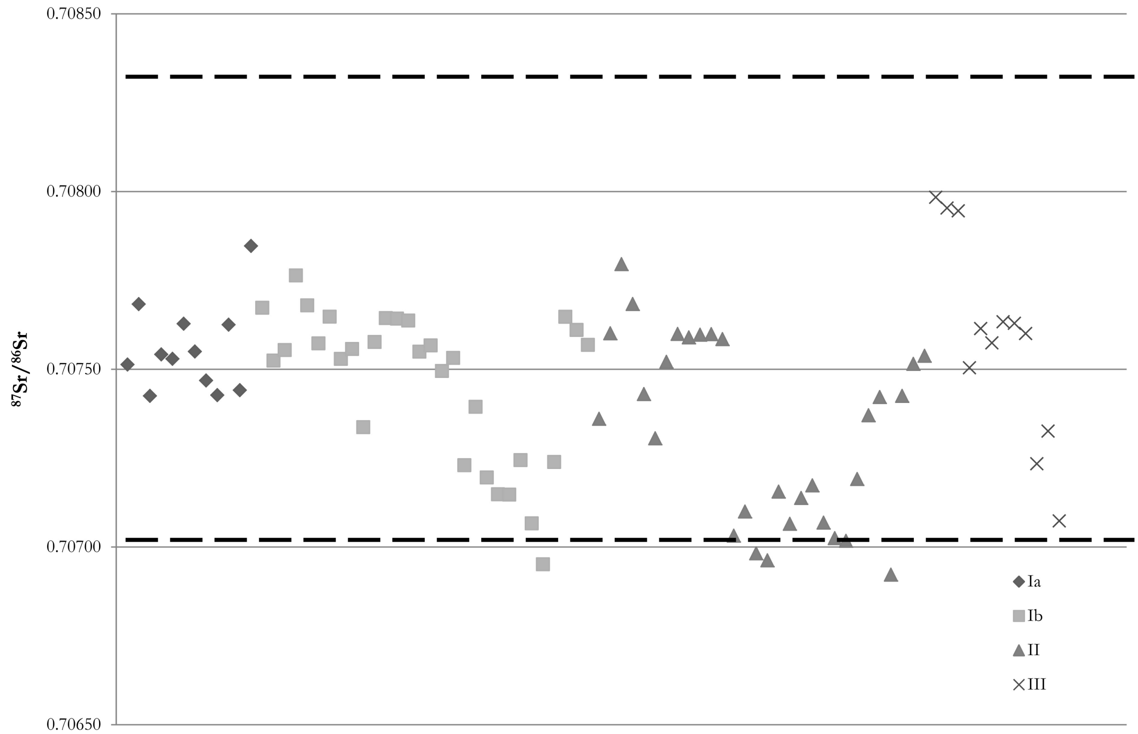
Figure B.3. Comparison of $^{87}Sr/^{86}Sr$ values from animals killed in the first year (Group Ia - M1s) and all other individuals (M2s).

at the same time as the middle of the M2 (Balasse et al. 2001; Zazzo et al. 2010), allowing for a rough comparison. While the mean and median of the $^{87}Sr/^{86}Sr$ values of the two groups are approximately the same (Two-sample Wilcoxonn test: W = 365, p = 0.08607), the values from the M2s (i.e.. animals slaughtered after 1 year) show a much wider range of variation. Both the IQR (M1: 0.0001 vs. M2: 0.0003, see Figure B.3) and the standard deviation (M1s: 0.0001 vs. M2s: 0.0003) for the M2 samples are much larger, indicating that animals slaughtered in the first year of life had a much more isotopically-consistent diet.

Enough sheep mandibles were included in the analysis to analyze separately (Figure B.4, B.5), whereas there are too few cattle and goats in the sample to draw any sort of separate conclusions. For sheep, the patterning is roughly the same as for complete set of samples. Infants (Group Ia) have a much narrower range of variation. Looking at variation by archaeological context, again the $^{87}Sr/^{86}Sr$ values from the TRC are significantly lower than those from GeT2, T19, and the shrines (KW χ^2= 47.359, df = 3, p= 4.8x10^{-9}; Post-hoc testing through pair-wise comparisons using the Dunn-Bonferroni method [SPSS ver. 22]). Due to the limited nature of sampling of mandibles from goats and cattle, it is not possible to say much beyond that the analysis does not suggest that cattle and goats had wildly different dietary inputs of Sr.

B.4.2.3 Analysis of intra-individual $^{87}Sr/^{86}Sr$ results

In order to analyze the patterning in intra-individual $^{87}Sr/^{86}Sr$ values (Figures B.7 & B.8), the range was calculated for each M2 sampled. The distribution of the intra-individual ranges was unimodal and skewed heavily towards the lower end of the distribution. The majority of the M2s sampled had a range below < 0.0002. When the ranges are grouped by context (Figure B.6), the median intra-individual ranges are roughly similar (though the



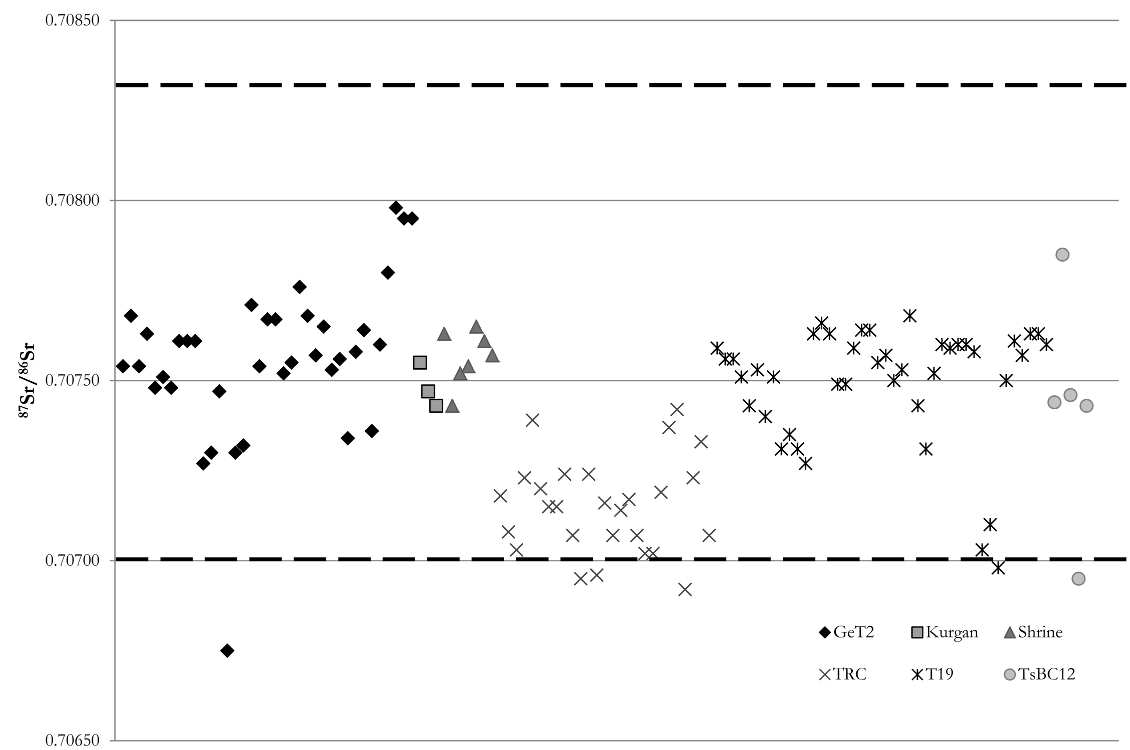


Figure B.4. Variation in $^{87}Sr/^{86}Sr$ by age category and archaeological context in sheep teeth.

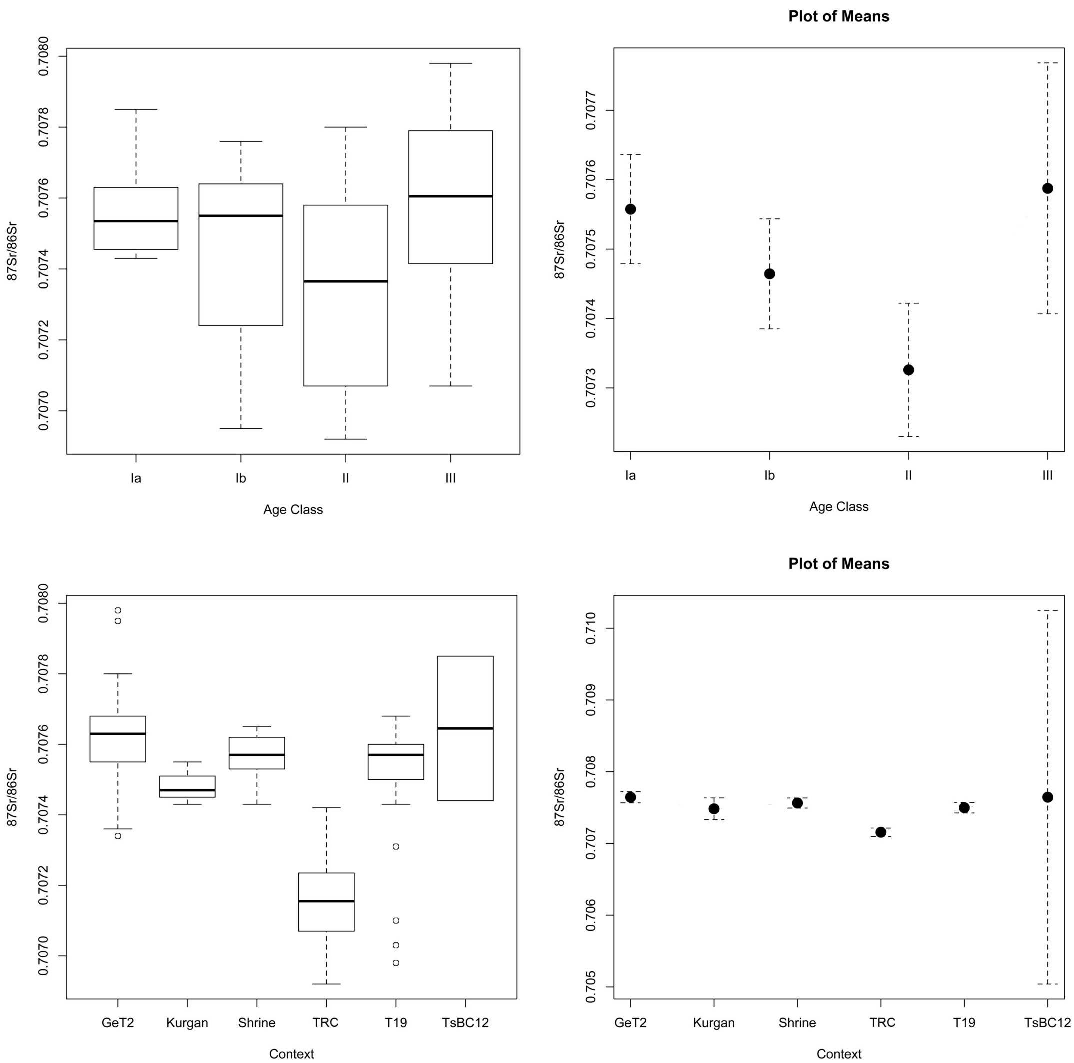


Figure B.5. Statistical summaries of $^{87}Sr/^{86}Sr$ for sheep by age category and archaeological context. On the left are box plots of $^{87}Sr/^{86}Sr$ and on the right are the mean values of $^{87}Sr/^{86}Sr$ plotted with a 95% confidence interval.

individual from TsBC12 has a relatively high intra-individual range). What is noticeable, however, is the that individuals from GeT2 show a wider range of values.

When the intra-individual ranges are grouped by species (Figure B.6), the medians are very similar, but goats have a wider IQR than sheep or cattle. Looking at the histogram reveals that the distribution of goats' intra-individual ranges is bimodal. This is slightly surprising, as goats overall showed a much narrower range of variation in $^{87}Sr/^{86}Sr$. This indicates that while goats have a higher intra-individual ranges (indicating changing dietary inputs over time), the range of dietary inputs is more consistent between individuals than in the other species. In contrast, the limited number of cattle teeth tested all had intra-individual ranges below 2 x 10^{-4}.

When the intra-individual ranges are grouped by age (Figure B.6), the medians are similar (though the single individual from Group 1a has a relatively large intra-individual range). Group II shows are wider IQR, indicating a greater level of variability in intra-individual ranges. This, at least in part, reflects the fact that many of individuals with high intra-individual ranges (see below) belong to this age category. Kruskal-Wallis tests reveal that there are no statistically significant differences in the mean intra-individual range when grouped by species, age, or archaeological context.

There were eight individuals that had intra-individual $^{87}Sr/^{86}Sr$ ranges greater than 2 x 10^{-4} (Table B.1). These individuals can be grouped into three groups based on the shape of the plot of $^{87}Sr/^{86}Sr$ values: 1) decrease in $^{87}Sr/^{86}Sr$ over time, 2) increase in $^{87}Sr/^{86}Sr$ over time and 3) "deep V" plots, in which the mid-point value is considerably higher or lower than the end-points. Another study that performed $^{87}Sr/^{86}Sr$ intra-individual sampling of teeth from sheep at the Neolithic site of Catalhoyuk (Bogaard et al. 2014) found only one individual with an intra-individual range greater than 2 x 10^{-4} (#73: 2.3x 10^{-4}), the other sheep in the study had very narrow intra-individual ranges ($\leq$ 1.1x 10^{-4}).

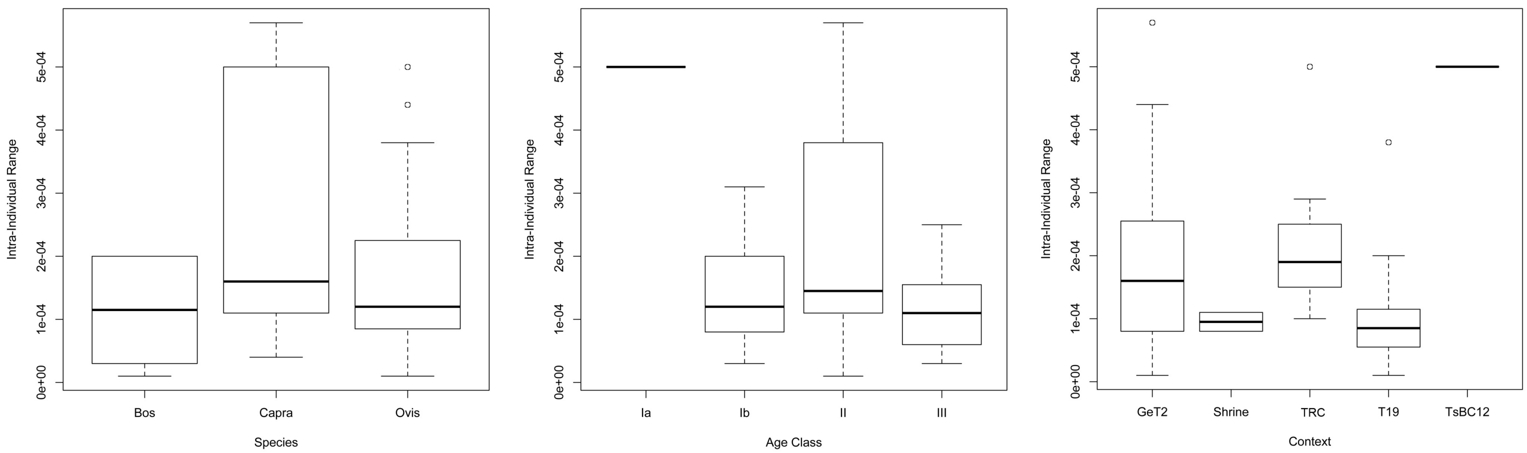


Figure B.6. Box plots of intra-individual ranges in $^{87}Sr/^{86}Sr$ values grouped by species, age, and archaeological context.

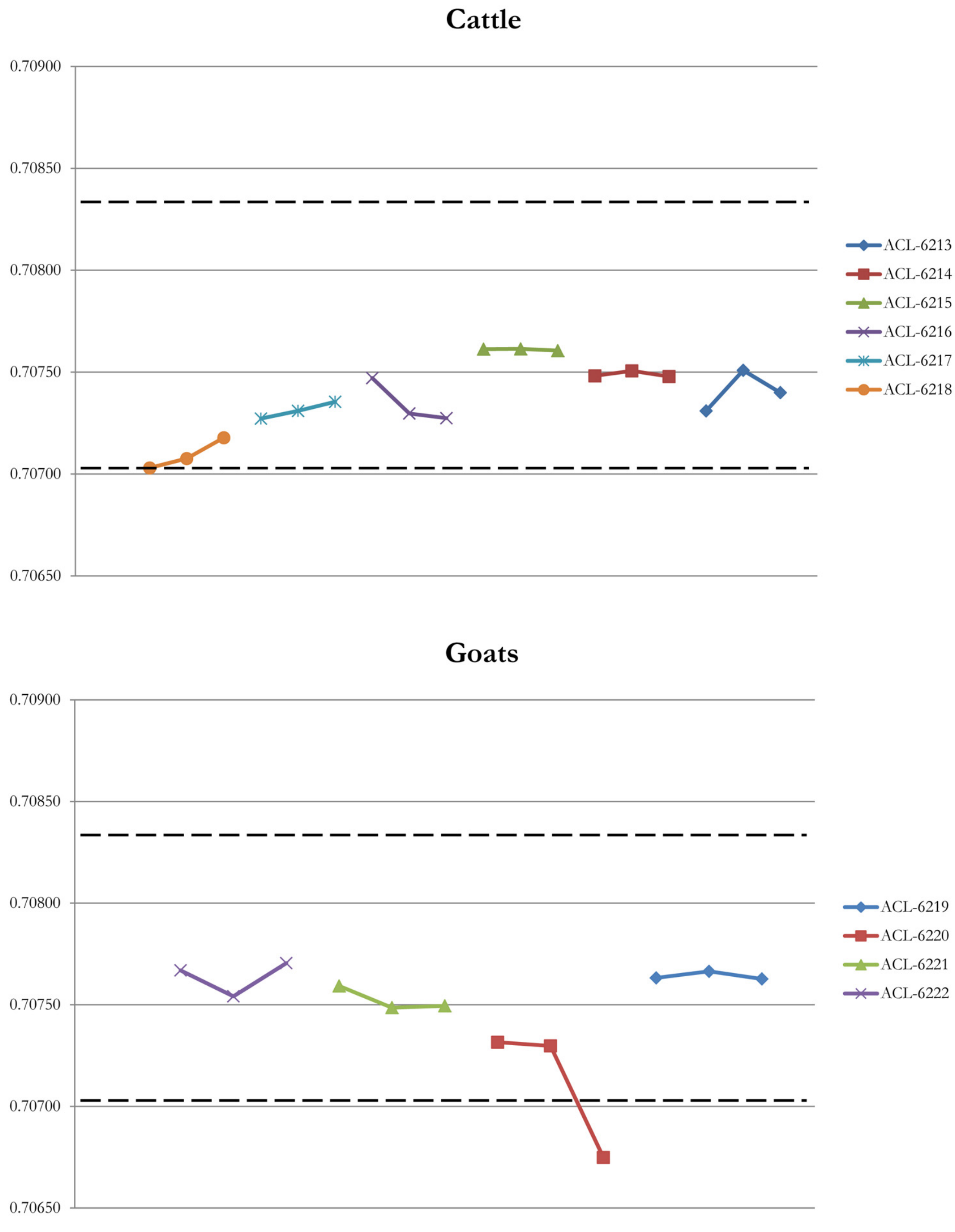


Figure B.7. Intra-individual $^{87}Sr/^{86}Sr$ values for cattle and goats.

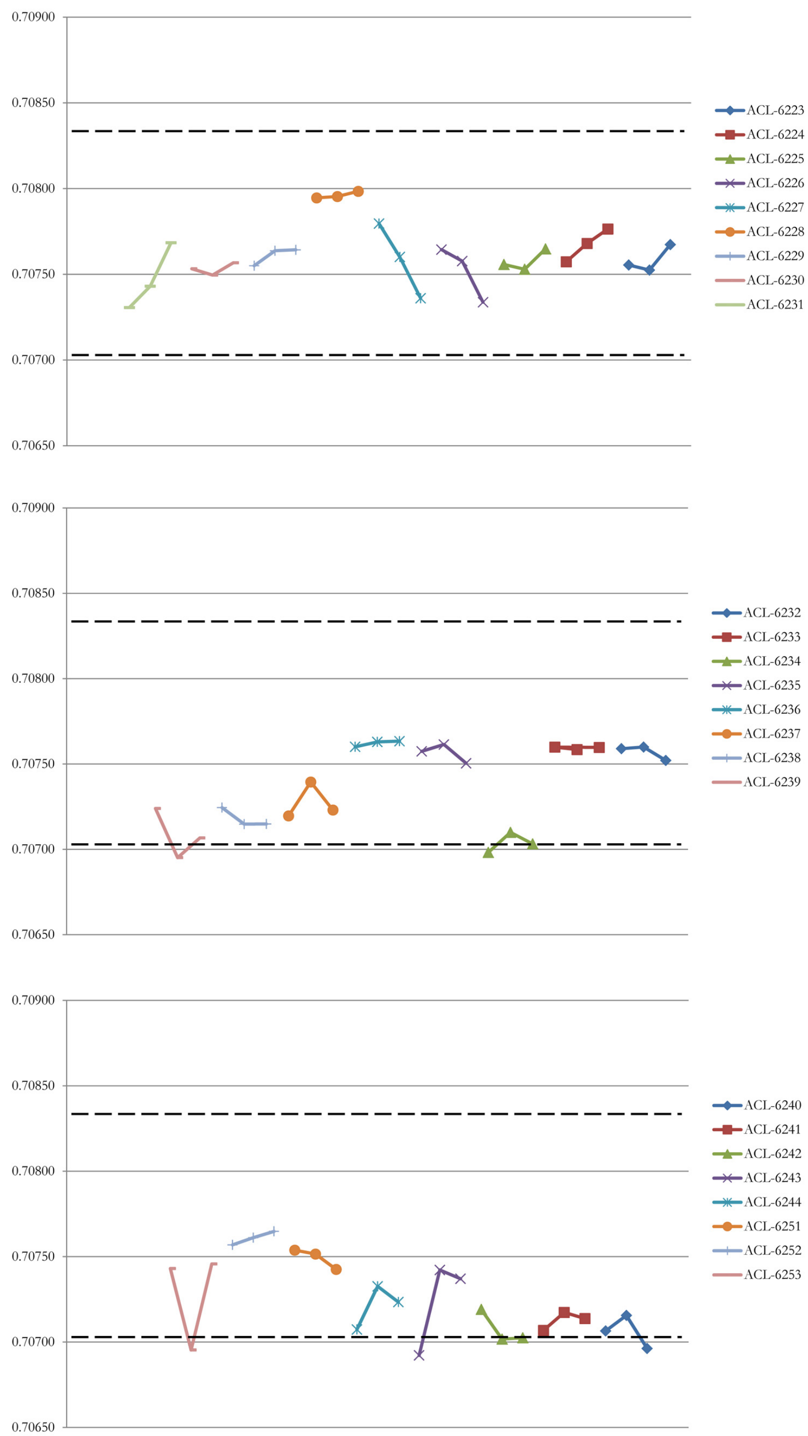


Figure B.8. Intra-individual $^{87}Sr/^{86}Sr$ values for sheep.

ACL Number	Species	Age Class	Context	Intra-individual range	Plot Shape
ACL-6220	Capra	II	GeT2	0.00057	Decreasing
ACL-6253	Capra	Ia	TsBC12	0.00050	Deep V
ACL-6243	Ovis	II	SLT	0.00050	Increasing
ACL-6227	Ovis	II	GeT2	0.00044	Decreasing
ACL-6231	Ovis	II	T19	0.00038	Increasing
ACL-6226	Ovis	Ib	GeT2	0.00031	Decreasing
ACL-6239	Ovis	Ib	SLT	0.00029	Deep V
ACL-6244	Ovis	III	SLT	0.00025	Increasing

Table B.1: Individuals with intra-individual $^{87}Sr/^{86}Sr$ ranges greater than 2 x 10^{-4}.

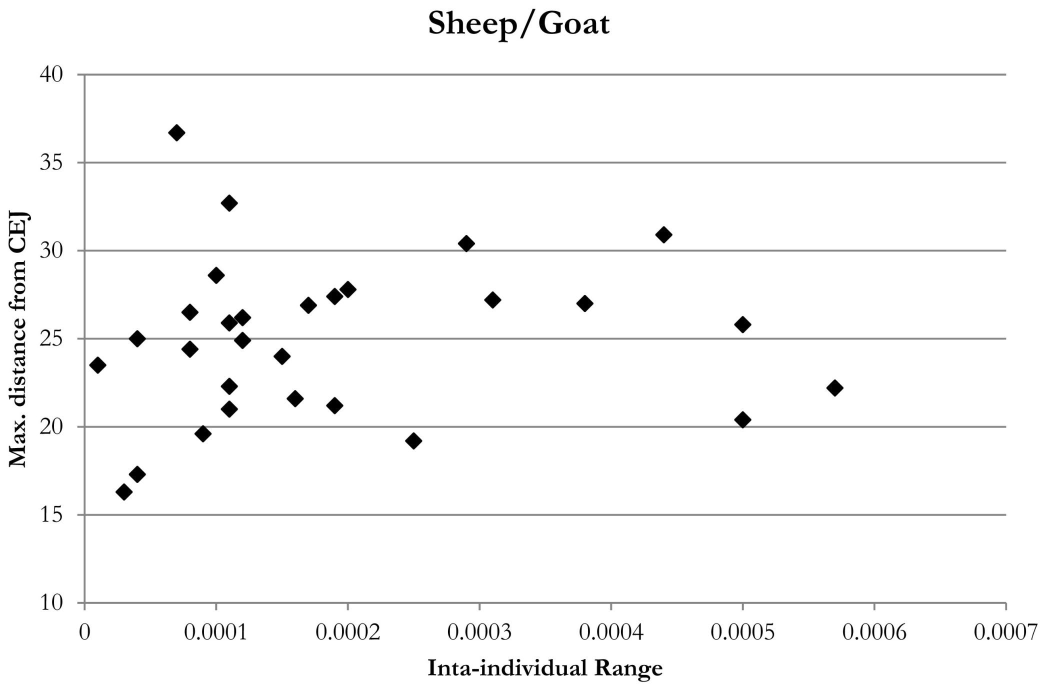
In contrast, a small study of cattle from prehistoric Britain showed a bimodal pattern of intra-individual ranges (Viner et al. 2010).

In order to assess the extent to which the intra-individual range was impacted by toothwear (which shortens the temporal record recorded across the tooth crown), the intra-individual ranges were plotted against the maximum distance from the CEJ (cattle were plotted separately from sheep and goats due to their larger crown heights). This plot (Figure B.9) reveals that there is no correlation between the intra-individual range and the maximum distance from the CEJ, indicating that toothwear was not a significant factor impacting these results.

B.4.3 Stable Oxygen Isotopes

B.4.3.1 Global Models for $\delta^{18}O$ in Precipitation

For stable oxygen isotope analysis, Armenia is *terra incognita*. The strongly continental climate of the region (Volodicheva 2002:356) means that there is considerable intra-annual variation in temperature. Unfortunately, the International Atomic Energy Agency (IAEA) does not collect climate data (including $\delta^{18}O$) for Armenia. The $\delta^{18}O$ values for various regions in Armenia can be modeled using isoscape prediction models based on worldwide



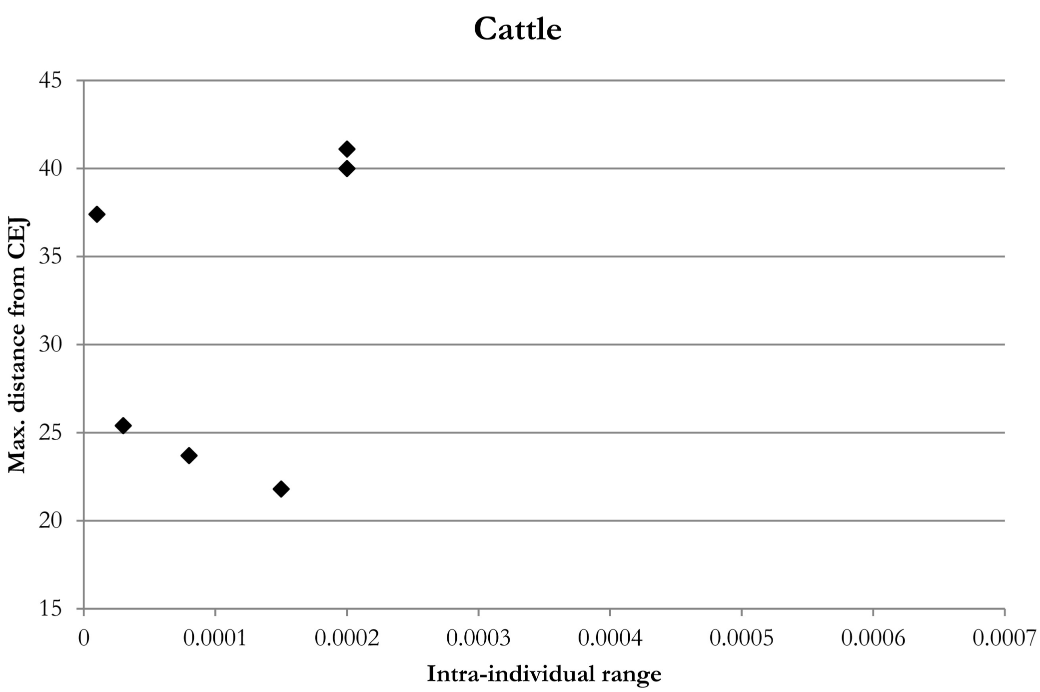


Figure B.9. Plot of intra-individual $^{87}Sr/^{86}Sr$ range versus maximum sample distance from the CEJ (mm).

historical climate data. I have used two different models (both based on the IAEA $\delta^{18}O$ data) to generate the expected annual range of $\delta^{18}O$ for the Tsaghkahovit Plain: the Online Isotopes in Precipitation Calculator (OIPC), which models the expected $\delta^{18}O$ in rainwater, based on latitude and altitude (Bowen and Wilkinson 2002; Bowen and Revenaugh 2003; Bowen et al. 2005), and the Regional Cluster-based Water Isotope Prediction (RCWIP) model, which combines regional and global isotope models to lower model uncertainty in regions lacking rich climatic data (Terzer et al. 2013; International Atomic Energy Agency 2015). For the Tsaghkahovit Plain, the OIPC model predicts an annual range in $\delta^{18}O$ in meteoric water of 6.5 (-11.0 to -4.5 $\delta^{18}O_{VPDB}$) and the RCWIP predicts an annual range of 8.7 (-11.5 to -2.8 $\delta^{18}O_{VPDB}$).

B.4.3.2 Stable Oxygen Isotope Results & Analysis

The results of incremental oxygen isotope analysis of specimens from the Tsaghkahovit Plain are presented in Table B.7. For sheep, the mean $\delta^{18}O$ values within each second molar range from -3.96‰ to -9.56‰, maximum values range from -0.09‰ to -6.22‰, and minimum values range from -4.56‰ to -12.33‰. For goats, the mean $\delta^{18}O$ values within each second molar range from -4.69‰ to -7.95‰, maximum values range from -0.64‰ to -4.75‰, and minimum values range from -7.58‰ to -10.86‰. For cattle, the mean $\delta^{18}O$ values within each second molar range from -4.61‰ to -13.26‰, maximum values range from -2.67‰ to -12.75‰, and minimum values range from -4.61‰ to -13.67‰.

A Shapiro-Wilks W test suggests that, for sheep, the minimum values for certain individuals are sufficiently different from the rest to be considered outliers (Table B.2). All of the other Shapiro-Wilks tests did not reach significance. Box plots of minimum values for sheep identify four outliers. Two individuals, ACL-6229 and ACL-6237, had

Species		W	p-value
Ovis	max	0.92934	0.094
	min	0.89372	0.016*
	mean	0.94025	0.165
Bos	max	0.85843	0.184
	min	0.93934	0.654
	mean	0.90113	0.381
Capra	max	0.97695	0.918
	min	0.89594	0.388
	mean	0.82159	0.120

Table B.2: Shapiro-Wilks test results.

unusually low minimum values (-12.3‰ and -12.33‰) and two individuals had unusually high minimum values, ACL-6233 and ACL-6227 (-7.88‰ and -4.65‰).

The sequences of $\delta^{18}O$ measured across the M2s generally show a sinusoidal pattern, with a few exceptions that are discussed below. This sinusoidal patterning most likely reflects the seasonal cycling of $\delta^{18}O$ in available water. In the winter, precipitation and ground water have lower $\delta^{18}O$ values and the highest values of $\delta^{18}O$ come in the summer. Visual inspection of the curves indicates that there is considerable variability between individuals in the horizontal location of the maximum and minimum $\delta^{18}O$ values. This suggests that the sample contains individuals that were born at different times of the year.

In order to more precisely determine the seasonality of birth for individual animals from the incremental intra-tooth $\delta^{18}O$ data, the data was normalized using the parametric equation first determined by Balasse et al. (2012b). This method fits a cosine function to the data and generates values for certain parameters. It relies on the fact that the cementum-enamel junction (which forms at ~1 year after birth) provides a constant point of reference, and then uses the nonlinear regression to estimate the function. Most usefully, it estimates the period of the cosine function, which since the M2 forms over a single annual cycle, is equivalent to a single year. This estimated period compensates for inter-individual differences in tooth length and the relative amount of tooth wear, and it allows the position of maximum δ^{18}O value to be expressed relative to the entire annual period (rather than the extant tooth enamel). However, enough of the annual signal must be retained to successfully fit the function. Work by Tornero et al. (2013:4054) has suggested that a minimum of 18 mm of tooth enamel is required to successfully fit the curves, which matches the initial selection criteria used in this study (> 20 mm of crown height).[5]

Balasse et al. (2012b)'s four parameter model was used, as both the initial study and subsequent work has indicated that, for M2s, the four parameter model is sufficiently precise (Tornero et al. 2013, 2015).[6] Table B.3 presents the values of the parameters A (amplitude, $(\delta^{18}O_{max}$-$\delta^{18}O_{min})/2$ in ‰), x_0 (delay, i.e. position in tooth crown where δ^{18}O is the highest), X (period), and M (mean in ‰), as well as the value of the Pearson's correlation coefficient (which estimates the level of fit between the model and the original data). Figures B.14, B.15, and B.16 present plots of the original data points with the curve generated by the model. Generally, the modeling produced very good results (R > 0.90), and the periods (X) generated for sheep M2s fell within the ranges estimated for both modern (Balasse et al. 2012b) and archaeological populations (Tornero et al. 2013). In two cases, ACL-6229 and ACL-6253, the model was unable to converge and estimate parameters - visual inspection of the plots suggests this is due to higher than usual irregularity in the sequential data.[7] In a few cases, the plots of sequential δ^{18}O values were

5. Additionally, plotting the estimated period (X) vs. the furthest distance from the CEJ of the incremental samples (a proxy for crown height) shows that crown height is not driving the estimated values for period ($R^2 = 0.13$).

6. Only in one case, ACL-6222, does it seem like the 8 parameter model might have produced a slightly better fit.

7. ACL-6229 is generally linear (with a slightly greater slope than the other individuals with flatter linear plots), and it is not entirely clear why. Seasonal mobility generally produces dampened seasonal variation, but without an upward or downward trend. ACL-6253 plots as a U-shaped curve, with a gross similarity to the plot of ACL-6252. This suggests that ACL-6253 may represent an individual born at a similar time ($x_0/X \approx 0.8$).

linear, not sinusoidal, or the model generated unreasonable values for X (too large or too short) or poor correlation coefficients (R < 0.90).

When the values of x_0/X are plotted by species (Figure B.10 & B.11), it becomes clear that sheep births were spaced out over nearly the entire annual cycle (86%). From the data, it appears that only ~2 months of the year were devoid of sheep births. In contrast, goats and cattle show a more restricted range of birth seasonality (40% and 24% of the cycle respectively). Potentially, the births of goats were divided into two seasons per year ($x_0/X \approx 0.4$ and $x_0/X \approx 0.8$). However, given the smaller number of goats and cattle included in the study, it is not possible to say whether this reflects the small sample size or real differences in birth seasonality.

Looking at the x_0/X values for sheep plotted by age class (Figure B.12), there are clear differences. Animals killed in the first year (Age class Ib, 6-12 months) show the widest range of birth seasonality (~80% of the annual cycle). Potentially, these births cluster into three separate birthing periods. In contrast, animals killed as sub-adults (Age Class II, 2-4 years) show a very narrow range of birth seasonality (10% of the annual cycle). Animals killed later on (Age Class III, 4+ years) show a moderate range of birth seasonality, covering ~40% of the annual cycle. When compared by archaeological context (Figure B.13), it is clear that both Gegharot and Tsaghkahovit have animals born across a wide range of seasons. The range of birth seasonality at the TRC is slightly less than at Gegharot overall, but given the small sample sizes, it is hard to determine if this is a result of sampling or due to LBA activities.

In addition to birth seasonality, incremental sampling of tooth enamel can shed light on the level of intra-annual variation in temperature. The intra-individual range of $\delta^{18}O$ in individuals in this study ranges from 0.92‰ to 11.25‰. Global models of $\delta^{18}O$ in precipitation suggest that the modern intra-annual range should be ~6.5-8.7‰. There are two major issues in linking intra-individuals $\delta^{18}O$ ranges to intra-annual ranges in

Individual	Species	A	x_0	X	M	x_0/X	Pearson's R
ACL-6213	Bos	1.2611	23.3993	34.9277	-9.0687	0.05	0.93
ACL-6214	Bos	0.33453	9.63538	15.07447	-13.29185	-	0.76
ACL-6215	Bos	1.9835	16.6579	38.8186	-7.2864	0.12	0.96
ACL-6216	Bos	1.5928	30.2813	69.7756	-7.0547	-	0.95
ACL-6217	Bos	2.447	17.6586	32.1728	-6.0189	0.14	0.99
ACL-6218	Bos	2.221	21.439	55.867	-5.361	-	0.96
ACL-6219	Capra	3.5884	11.1986	24.3041	-4.7093	0.32	0.99
ACL-6220	Capra	2.5318	10.0307	25.25	-4.8087	0.25	0.98
ACL-6221	Capra	3.3665	19.0674	24.7153	-6.3307	0.18	0.94
ACL-6222	Capra	2.3627	17.7326	21.8812	-4.8116	0.13	0.86
ACL-6223	Ovis	5.265	33.271	37.919	-4.248	0.16	0.99
ACL-6224	Ovis	5.9191	0.7847	35.3808	-5.7143	7.54	> 0.99
ACL-6225	Ovis	3.3246	9.047	22.6297	-6.7381	0.37	0.98
ACL-6226	Ovis	4.7367	3.281	37.9573	-5.5096	1.44	0.99
ACL-6227	Ovis	0.6991	9.9913	32.9612	-4.0266	-	0.74
ACL-6228	Ovis	4.1794	19.5194	33.5116	-5.1185	0.21	0.97
ACL-6229	Ovis	-	-	-	-	-	-
ACL-6230	Ovis	3.3367	10.412	33.1302	-6.145	0.32	0.96
ACL-6231	Ovis	3.4307	9.1121	29.3808	-6.294	0.38	0.99
ACL-6232	Ovis	3.4625	17.7009	33.1395	-6.3804	0.20	0.98
ACL-6233	Ovis	3.7993	12.6856	33.514	-6.302	0.30	0.99
ACL-6234	Ovis	4.9377	12.3398	35.3677	-7.4237	0.40	> 0.99
ACL-6235	Ovis	3.3731	16.5364	22.3095	-5.604	0.20	0.96
ACL-6236	Ovis	4.6807	8.8112	25.2794	-6.3382	0.53	0.98
ACL-6237	Ovis	4.3225	0.851	30.4137	-8.1833	5.08	0.99
ACL-6238	Ovis	3.1195	3.8342	35.4466	-6.7001	0.81	0.99
ACL-6239	Ovis	3.3664	10.1235	33.9678	-6.12	0.33	0.99
ACL-6240	Ovis	3.6488	11.1946	30.0952	-5.7604	0.33	0.99
ACL-6241	Ovis	4.7474	11.9597	34.0209	-7.3227	0.40	0.98
ACL-6242	Ovis	4.0274	11.1089	32.8911	-7.3895	0.36	0.99
ACL-6243	Ovis	3.2221	9.7099	29.4947	-6.5489	0.33	0.99
ACL-6244	Ovis	3.9674	15.733	26.4507	-5.1807	0.25	0.99
ACL-6251	Ovis	4.0093	12.1928	30.0023	-5.499	0.33	0.98
ACL-6252	Ovis	4.1527	31.2649	40.1376	-5.818	0.13	0.98
ACL-6253	Capra	-	-	-	-	-	-

Table B.3: **Modeling of sequential δ^{18}O series.** Results from the calculation of the best fit (by method of least squares) for combined variation of X (period), A (amplitude), x_0 (delay), and M (mean) when the model is applied to the sheep M2 $\delta^{18}O_{V-PDB}$ sequences. The Pearson's correlation coefficient (R) is also indicated.

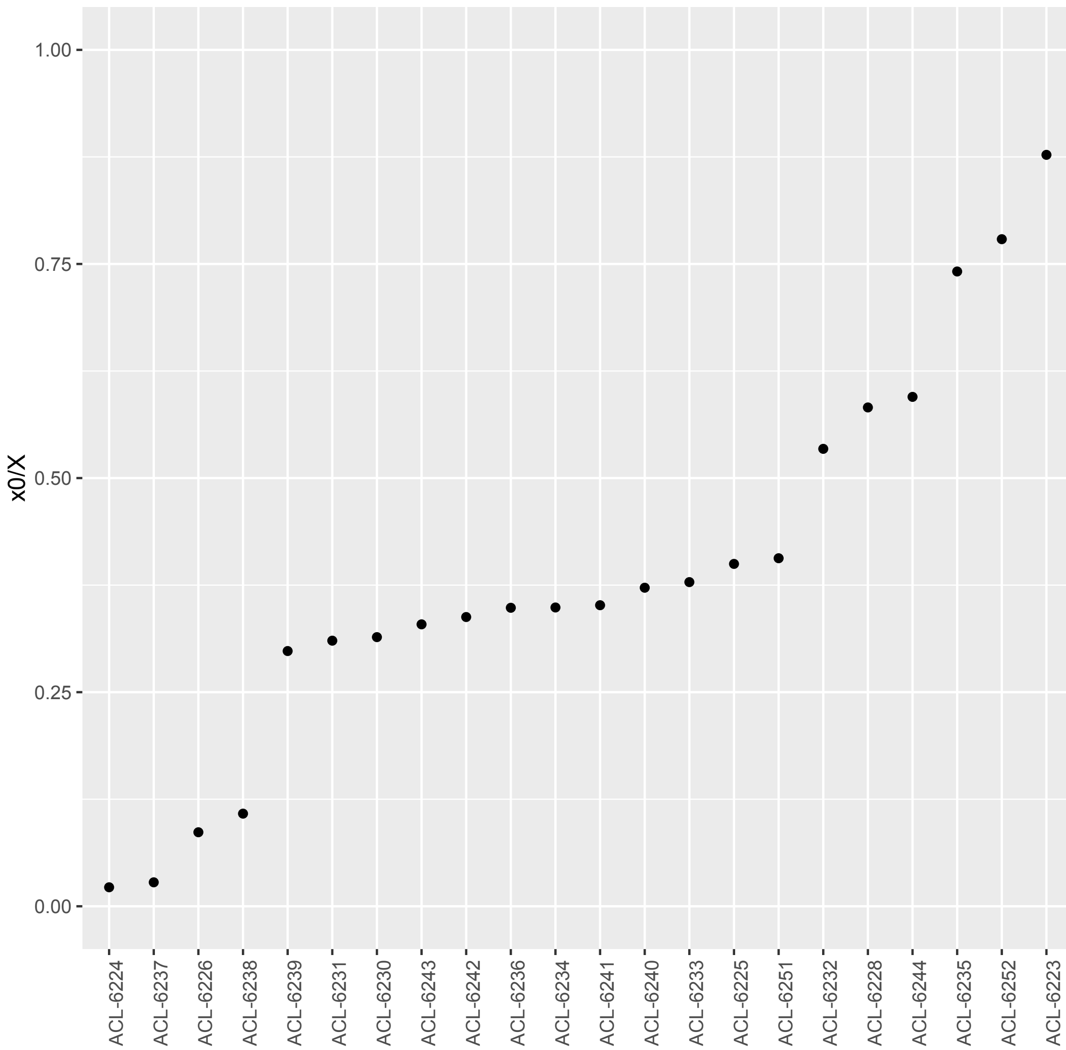


Figure B.10. Birth seasonality (x_0/X) for sheep.

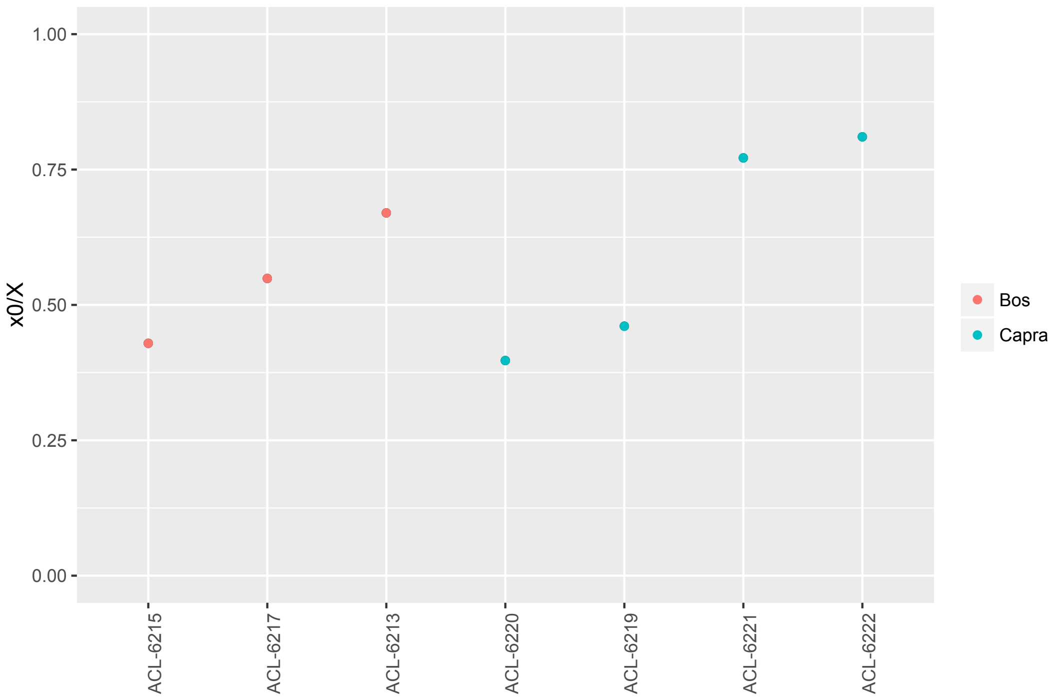


Figure B.11. Birth seasonality (x_0/X) for cattle and goats.

δ^{18}O. First, it is not clear whether the Late Bronze Age climate in the Tsaghkahovit Plain was equivalent to the current climate (for instance, Jude et al. (2016) suggest that the climate may have been cooler and drier in the Late Bronze Age). Second, the process of enamelization dampens the seasonal signal of variation in δ^{18}O (Balasse 2002; Balasse et al. 2012b).

The majority of intra-individual δ^{18}O ranges fall reasonably close to those estimates. As noted above, five individuals were not successfully modeled due to their linearity. Four of these individuals have the lowest intra-individual δ^{18}O ranges (ACL-6214, 6216, 6218, 6227), ranging from 0.92‰ to 3.94‰. One other individual, ACL-6229 was not able to be modeled, but had a higher intra-individual δ^{18}O range (6.08‰). In contrast, ACL-6224 had an unusually high intra-individual δ^{18}O range (11.25‰).

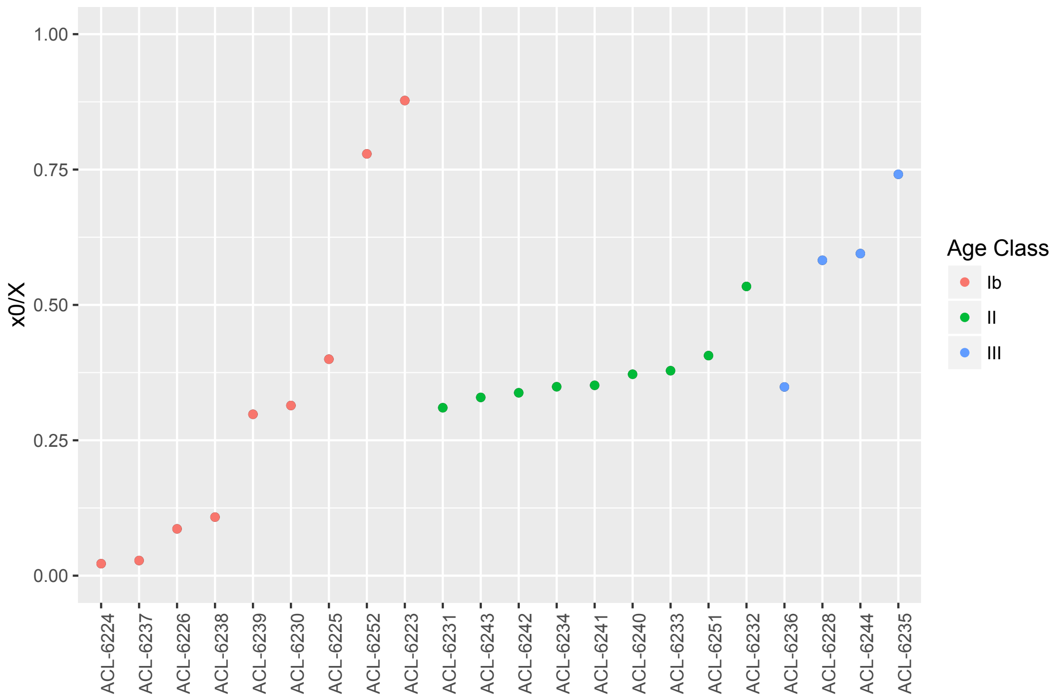


Figure B.12. Birth seasonality (x_0/X) for sheep by age class.

Despite the difficulties linking intra-individual variation in δ^{18}O to intra-annual variation in δ^{18}O in surface waters, looking at the intra-individual range can help identify individuals that may have been seasonally mobile. In a temperate climate, herd animals grazed in one locale over the course of a year should reflect the seasonal variation in δ^{18}O. In contrast, animals moved to different locations should show either increased or decreased season variation. Most models of herd mobility suggest that mobility should result in a dampening of the seasonal variation, since movement is oriented towards avoiding seasonal temperature extremes (Britton et al. 2009; Henton et al. 2010; Henton 2010; Bocherens et al. 2001). However, a dampened range of intra-annual variation in δ^{18}O may also reflect the consumption of water with an averaged season signal (such as from karstic springs, see Henton 2010:311). However, the Tsaghkahovit Plain is not located in an area

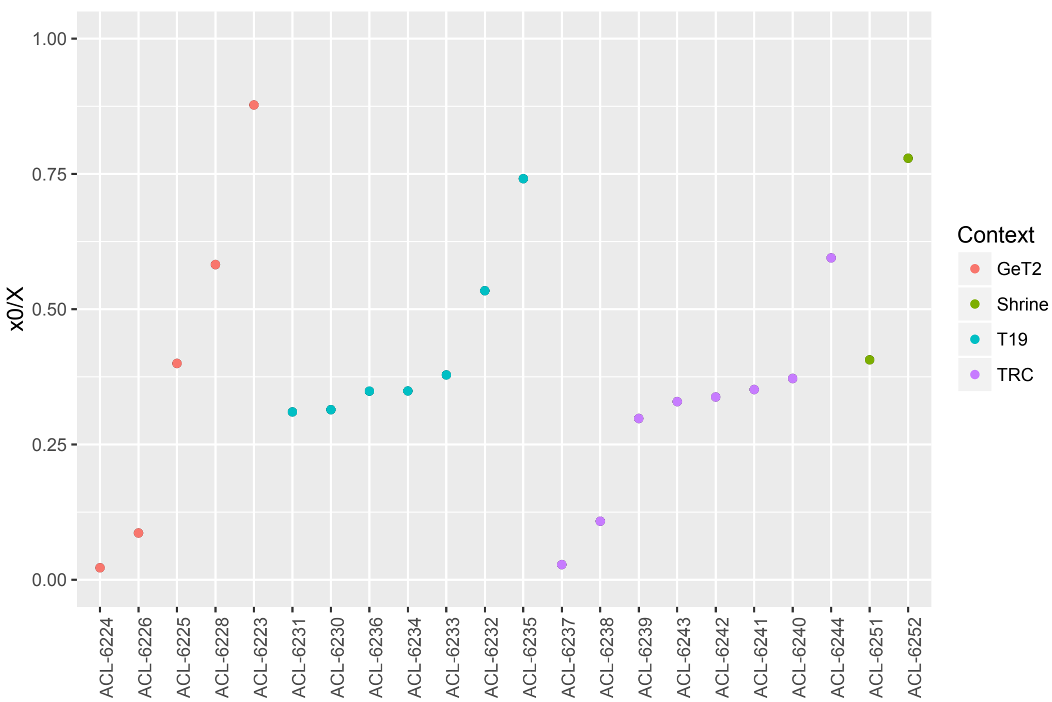


Figure B.13. Birth seasonality (x_0/X) for sheep by archaeological context.

of karstic geology (Volodicheva 2002:352-4), so dampened intra-individual signals most likely reflect mobility.

An analysis of intra-individual seasonal variation in δ^{18}O in the enamel from M2s of wild mouflon from an Epigravettian hunting site (Kalavan 1) in the mountains around Lake Sevan (Tornero et al. 2016) gives another potential estimate for expected intra-annual variation. The site is at a very similar latitude to the Tsaghkahovit Plain (40N), though at a lower elevation (1640 masl vs. ~2150 masl). This study recorded intra-individual ranges from 6.9-10.2‰, and the authors argue that these ranges reflect seasonal mobility between highland and lowland pastures around Lake Sevan, based on the comparison between variation in oxygen and carbon isotope signatures across M2s and M3s. Unfortunately, however, their study was unable to clarify exactly what degree of seasonal dampening is reflected in these ranges (Tornero et al. 2016:30-31). For now, it is worth noting that the ranges in these wild mouflon are greater than those predicted by the global precipitation models, suggesting that the models may underestimate the seasonal variation in the South Caucasus. Nevertheless, the individuals from this study with low inter-individual ranges still suggest dampening of the seasonal signal, which may either reflect higher elevations in summer pasture or a greater contribution of snowmelt (resulting in lower δ^{18}O in the summer) or the contribution of an isotopically stable water source. Analysis of intra-tooth stable carbon isotopes will help clarify these results.

Interestingly, three of the individuals with lower intra-individuals ranges are cattle. A number of studies have shown cattle having smaller ranges of intra-tooth variation in δ^{18}O compared to sheep (Balasse and Tresset 2007; Balasse et al. 2012a, 2013). Balasse et al. speculates that this may reflect differences in physiology, rather than environmental factors (including mobility) though the authors were not sure if this difference was a result of physiology or climate. However, many of these studies relied on M3s, which in general have proven slightly more variable and harder to interpret (due to questions about the length of the mineralization period in cattle). Cattle are obligate drinkers, in contrast to sheep, but this should not dampen seasonal signals unless they are drinking water than has a dampened signal. Moreover, ACL-6227, is a sheep and has a similarly small intra-tooth range of δ^{18}O values.

Thus, it seems that ACL-6214, 6216, 6218, and 6227 were either spatially mobile, spending the summer in a comparatively cool highland environment and winters in a comparatively warm lowland environment, or were drinking from a water source that was isotopically mixed. At the other end of the spectrum, ACL-6224 had a intra-tooth range of δ^{18}O that was much higher than the other individuals in the study and the predicted intra-annual ranges from the precipitation models. This suggests that this individual may have moved in such a way as to exacerbate the seasonal variation in temperature (and as a result seasonal variation in δ^{18}O).

B.4.3.3 Graphs of incremental stable oxygen isotope results and non-linear regression model

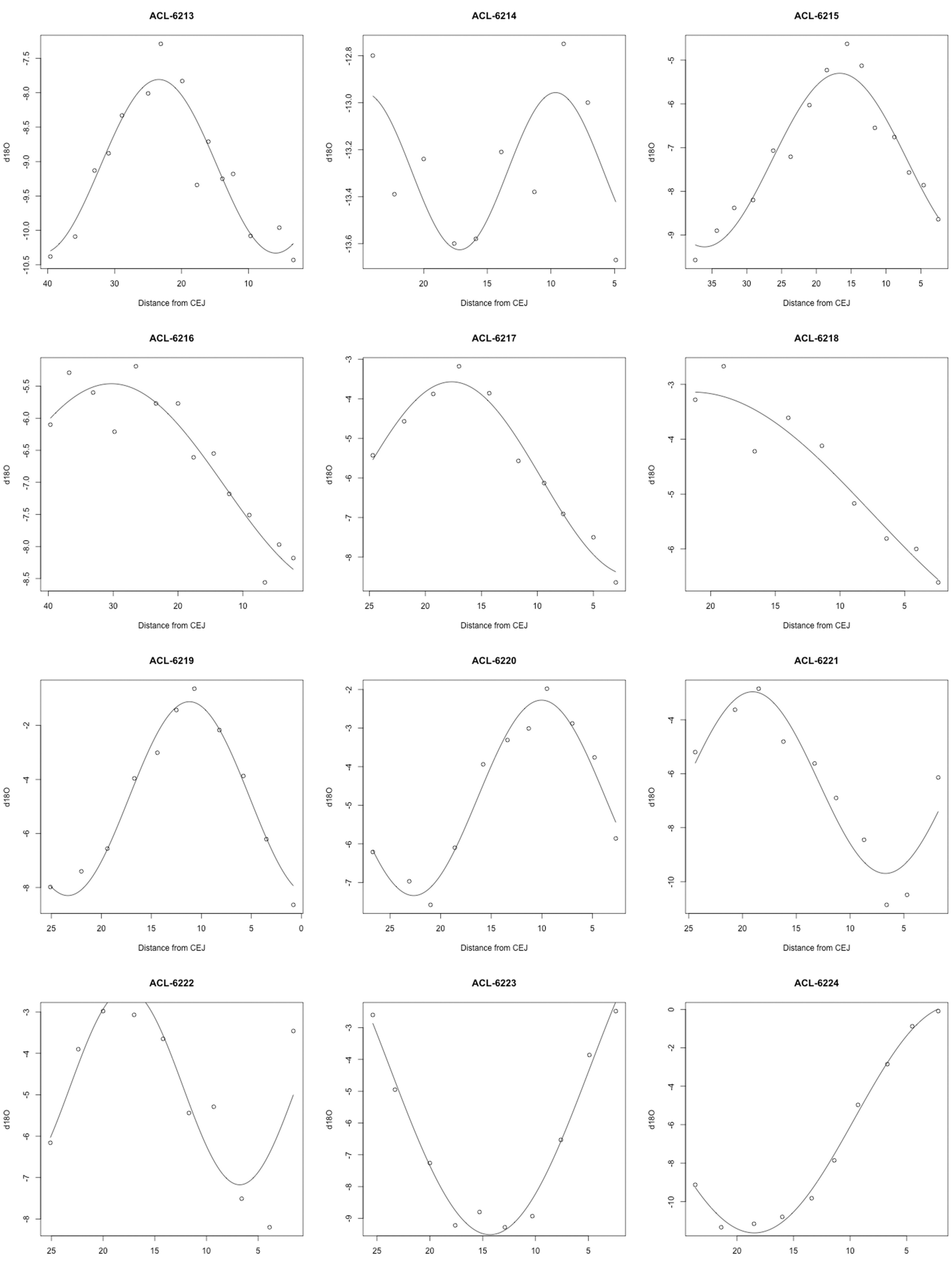


Figure B.14. Graphs of the results of incremental δ^{18}O analysis and non-linear regression modeling (ACL-6213-ACL-6224). The open circles represent measured δ^{18}O values and the line represents the modeled cosine function.

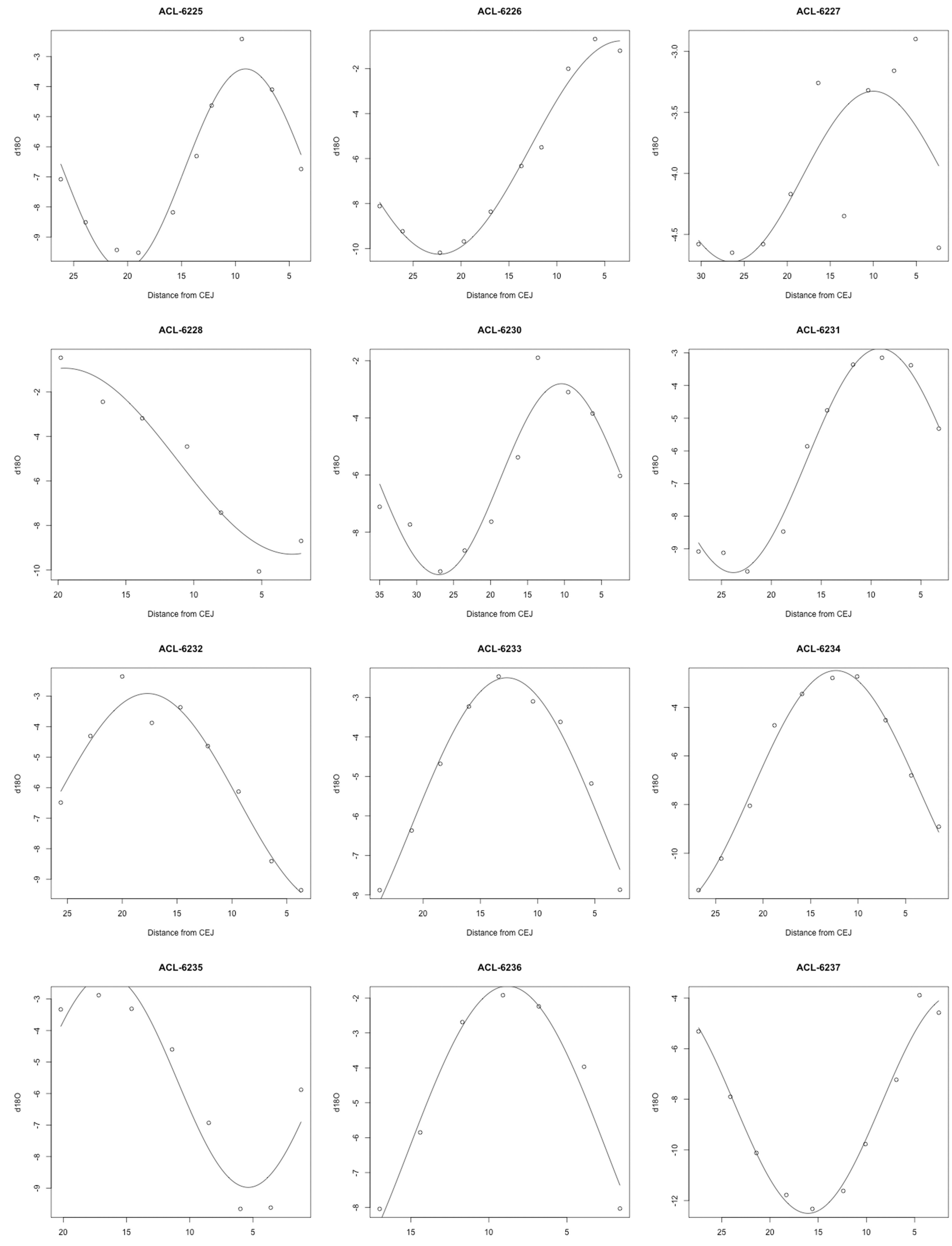


Figure B.15. Graphs of the results of incremental δ^{18}O analysis and non-linear regression modeling (ACL-6225-ACL-6237). The open circles represent measured δ^{18}O values and the line represents the modeled cosine function.

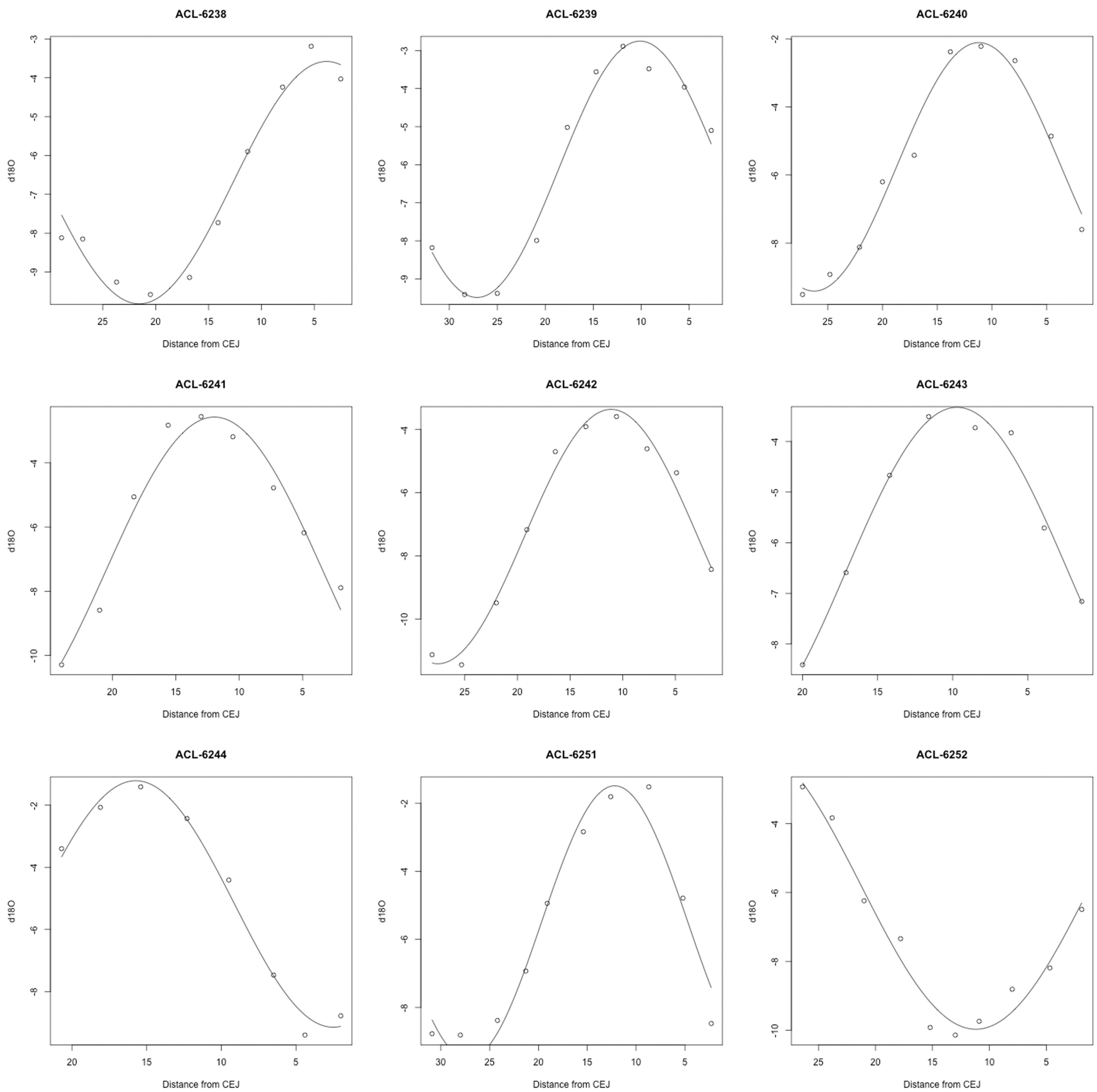


Figure B.16. Graphs of the results of incremental δ^{18}O analysis and non-linear regression modeling (ACL-6238-ACL-6244, ACL-6251-ACL-6252). The open circles represent measured δ^{18}O values and the line represents the modeled cosine function.

B.4.4 Tables of Isotopic Analysis Results

Table B.4: Archaeological samples analyzed for radiogenic strontium and stable oxygen isotopes.

Lab ID	Excavation ID	Species	Age Class	Context	Analyses
ACL-6203	CA-ARGE-T19.533.25	Bos	Ia	T19	Sr
ACL-6204	CA-ARGE-T19.107.611	Bos	Ia	T19	Sr
ACL-6205	CA-ARGE-GeT2.23.66	Capra	Ia	GeT2	Sr
ACL-6206	CA-ARGE-T19.107.68	Capra	Ia	T19	Sr
ACL-6207	CA-ARGE-T19.530.105	Ovis	Ia	T19	Sr
ACL-6208	CA-ARGE-GeT2.23.14	Ovis	Ia	GeT2	Sr
ACL-6209	CA-ARGE-T19.531.6	Ovis	Ia	T19	Sr
ACL-6210	CA-ARGE-GeT2.23.55	Ovis	Ia	GeT2	Sr
ACL-6211	CA-ARGE-T19.531.11	Ovis	Ia	T19	Sr
ACL-6212	CA-ARGE-GeT2.23.85	Ovis	Ia	GeT2	Sr
ACL-6213	CA-ARGE-T19.107.581	Bos	Ib	T19	Sr & O
ACL-6214	CA-ARGE-GeT2.23.434	Bos	Ib	GeT2	Sr & O
ACL-6215	CA-ARGE-GeT2.23.392	Bos	II	GeT2	Sr & O
ACL-6216	CA-ARGE-GeT2.23.395	Bos	II	GeT2	Sr & O
ACL-6217	CA-ARGE-T19.107.579	Bos	III	T19	Sr & O
ACL-6218	CA-TS-SLT10.6.569	Bos	III	SLT	Sr & O
ACL-6219	CA-ARGE-T19.107.210	Capra	Ib	T19	Sr & O
ACL-6220	CA-ARGE-GeT2.23.236	Capra	II	GeT2	Sr & O

Table B.4, continued. Archaeological samples analyzed for radiogenic strontium and stable oxygen isotopes.

Lab ID	Excavation ID	Species	Age Class	Context	Analyses
ACL-6221	CA-ARGE-T19.107.55	Capra	II	T19	Sr & O
ACL-6222	CA-ARGE-GeT2.23.230	Capra	III	GeT2	Sr & O
ACL-6223	CA-ARGE-GeT2.23.90	Ovis	Ib	GeT2	Sr & O
ACL-6224	CA-ARGE-GeT2.23.1	Ovis	Ib	GeT2	Sr & O
ACL-6225	CA-ARGE-GeT2.23.8	Ovis	Ib	GeT2	Sr & O
ACL-6226	CA-ARGE-GeT2.23.30	Ovis	Ib	GeT2	Sr & O
ACL-6227	CA-ARGE-GeT2.23.223	Ovis	II	GeT2	Sr & O
ACL-6228	CA-ARGE-GeT2.23.249	Ovis	III	GeT2	Sr & O
ACL-6229	CA-ARGE-T19.533.7	Ovis	Ib	T19	Sr & O
ACL-6230	CA-ARGE-T19.107.42	Ovis	Ib	T19	Sr & O
ACL-6231	CA-ARGE-T19.107.249	Ovis	II	T19	Sr & O
ACL-6232	CA-ARGE-T19.107.92	Ovis	II	T19	Sr & O
ACL-6233	CA-ARGE-T19.514.6	Ovis	II	T19	Sr & O
ACL-6234	CA-ARGE-T19.533.1	Ovis	II	T19	Sr & O
ACL-6235	CA-ARGE-T19.107.64	Ovis	III	T19	Sr & O
ACL-6236	CA-ARGE-T19.532.28	Ovis	III	T19	Sr & O
ACL-6237	CA-TS-SLT14.5.59	Ovis	Ib	SLT	Sr & O
ACL-6238	CA-TS-SLT10.6.774	Ovis	Ib	SLT	Sr & O
ACL-6239	CA-TS-SLT14.5.208	Ovis	Ib	SLT	Sr & O
ACL-6240	CA-TS-SLT10.6.806	Ovis	II	SLT	Sr & O

Table B.4, continued. Archaeological samples analyzed for radiogenic strontium and stable oxygen isotopes.

Lab ID	Excavation ID	Species	Age Class	Context	Analyses
ACL-6241	CA-TS-SLT10.6.900	Ovis	II	SLT	Sr & O
ACL-6242	CA-TS-SLT14.5.192	Ovis	II	SLT	Sr & O
ACL-6243	CA-TS-SLT14.5.202	Ovis	II	SLT	Sr & O
ACL-6244	CA-TS-SLT14.5S.13	Ovis	III	SLT	Sr & O
ACL-6245	CA-ARGE-K1.10.53	Ovis	Ia	Kurgan	Sr
ACL-6246	CA-ARGE-K2.108.118	Ovis	Ia	Kurgan	Sr
ACL-6247	CA-ARGE-K2.109.111	Ovis	Ia	Kurgan	Sr
ACL-6248	CA-ARGE-T22.16.12	Ovis	Ia	Shrine	Sr
ACL-6249	CA-TS-TSBC12.B02.10.1	Ovis	Ia	TsBC12	Sr
ACL-6250	CA-TS-TSBC12.B02.10.96	Ovis	Ia	TsBC12	Sr
ACL-6251	CA-ARGE-T22.16.5	Ovis	II	Shrine	Sr & O
ACL-6252	CA-ARGE-T27.60.29	Ovis	Ib	Shrine	Sr & O
ACL-6253	CA-TS-TSBC12.B02.10.37	Capra	Ia	TsBC12	Sr & O

Table B.5: Trace Element Concentrations.

Lab ID	Ca/P (molar)	U (ppb)	Lab ID	Ca/P (molar)	U (ppb)
ACL-6203	1.71	0.003	ACL-6230-K	1.86	0.012
ACL-6204	1.76	0.005	ACL-6230-L	1.83	0.028
ACL-6205	1.77	0.008	ACL-6230-M	1.87	0.058
ACL-6206	1.75	0.005	ACL-6231-K	1.81	0.038
ACL-6207	1.70	0.003	ACL-6231-L	1.83	0.011
ACL-6208	1.73	0.003	ACL-6231-M	1.83	0.013
ACL-6209	1.71	0.009	ACL-6232-K	1.82	0.022
ACL-6210	1.70	0.001	ACL-6232-L	1.85	0.023
ACL-6211	1.70	0.001	ACL-6232-M	1.85	0.003
ACL-6212	1.72	0.001	ACL-6233-J	1.84	0.005
ACL-6213-P	1.69	0.001	ACL-6233-L	1.81	0.007
ACL-6213-Q	1.69	0.001	ACL-6233-M	1.83	0.012
ACL-6213-R	1.71	0.001	ACL-6234-K	1.83	0.004
ACL-6214-K	1.78	0.004	ACL-6234-L	1.82	0.006
ACL-6214-L	1.72	0.002	ACL-6234-M	1.83	0.009
ACL-6214-M	1.76	0.001	ACL-6235-I	1.87	0.007
ACL-6215-P	1.68	0.001	ACL-6235-J	1.86	0.007
ACL-6215-Q	1.73	0.001	ACL-6235-K	1.88	0.011
ACL-6215-R	1.71	0.001	ACL-6236-H	1.88	0.012
ACL-6216-O	1.71	0.000	ACL-6236-I	1.86	0.003

Table B.5, continued. Trace Element Concentrations.

Lab ID	Ca/P (molar)	U (ppb)	Lab ID	Ca/P (molar)	U (ppb)
ACL-6216-P	1.73	0.001	ACL-6236-J	1.86	0.003
ACL-6216-Q	1.76	0.002	ACL-6237-K	1.89	0.005
ACL-6217-K	1.67	0.001	ACL-6237-L	1.87	0.006
ACL-6217-L	1.69	0.000	ACL-6237-M	1.90	0.007
ACL-6217-M	1.69	0.001	ACL-6238-K	1.86	0.001
ACL-6218-J	1.68	0.001	ACL-6238-L	1.88	0.002
ACL-6218-K	1.70	0.000	ACL-6238-M	1.91	0.002
ACL-6218-L	1.75	0.001	ACL-6239-K	1.87	0.006
ACL-6219-L	1.68	0.001	ACL-6239-L	1.87	0.002
ACL-6219-M	1.69	0.000	ACL-6239-M	1.89	0.002
ACL-6219-N	1.72	0.001	ACL-6240-K	1.85	0.003
ACL-6220-L	1.71	0.004	ACL-6240-L	1.85	0.002
ACL-6220-M	1.75	0.007	ACL-6240-M	1.88	0.003
ACL-6220-N	1.72	0.012	ACL-6241-J	1.86	0.003
ACL-6221-K	1.71	0.016	ACL-6241-K	1.84	0.003
ACL-6221-L	1.70	0.002	ACL-6241-L	1.88	0.004
ACL-6221-M	1.71	0.003	ACL-6242-K	1.85	0.003
ACL-6222-K	1.74	0.005	ACL-6242-L	1.84	0.001
ACL-6222-L	1.73	0.005	ACL-6242-M	1.87	0.002
ACL-6222-M	1.72	0.004	ACL-6243-I	1.84	0.002
ACL-6223-K	1.71	0.004	ACL-6243-J	1.84	0.001

Table B.5, continued. Trace Element Concentrations.

Lab ID	Ca/P (molar)	U (ppb)	Lab ID	Ca/P (molar)	U (ppb)
ACL-6223-L	1.72	0.003	ACL-6243-K	1.85	0.001
ACL-6223-M	1.71	0.004	ACL-6244-I	1.83	0.002
ACL-6224-K	1.71	0.006	ACL-6244-J	1.84	0.001
ACL-6224-L	1.71	0.001	ACL-6244-K	1.84	0.001
ACL-6224-M	1.72	0.002	ACL-6245	1.83	0.005
ACL-6225-K	2.20	0.005	ACL-6246	1.89	0.005
ACL-6225-L	1.78	0.003	ACL-6247	1.86	0.007
ACL-6225-M	1.74	0.001	ACL-6248	1.85	0.001
ACL-6226-K	1.79	0.001	ACL-6249	1.88	0.062
ACL-6226-L	1.78	0.001	ACL-6250	1.92	0.081
ACL-6226-M	1.82	0.001	ACL-6251-K	1.84	0.002
ACL-6227-K	1.80	0.001	ACL-6251-L	1.86	0.001
ACL-6227-L	1.80	0.001	ACL-6251-M	1.88	0.001
ACL-6227-M	1.81	0.001	ACL-6252-K	1.91	0.002
ACL-6228-H	1.85	0.001	ACL-6252-L	1.85	0.001
ACL-6228-I	1.81	0.001	ACL-6252-M	1.89	0.001
ACL-6228-J	1.83	0.001	ACL-6253-J	1.88	0.023
ACL-6229-I	1.83	0.005	ACL-6253-K	1.87	0.009
ACL-6229-J	1.84	0.001	ACL-6253-L	1.89	0.035
ACL-6229-K	1.86	0.001			

Table B.6: $^{87}Sr/^{86}Sr$ results for archaeological enamel samples from the Tsaghkahovit Plain.

Lab ID	Bone ID	Species	Age Class	Context	Tooth Type	Distance from CEJ (mm)	$^{87}Sr/^{86}Sr$
ACL-6203	CA-ARGE-T19.533.25	Bos	Ia	T19	M1	-	0.70759
ACL-6204	CA-ARGE-T19.107.611	Bos	Ia	T19	M1	-	0.70756
ACL-6205	CA-ARGE-GeT2.23.66	Capra	Ia	GeT2	M1	-	0.70754
ACL-6206	CA-ARGE-T19.107.68	Capra	Ia	T19	M1	-	0.70756
ACL-6207	CA-ARGE-T19.530.105	Ovis	Ia	T19	M1	-	0.70751
ACL-6208	CA-ARGE-GeT2.23.14	Ovis	Ia	GeT2	M1	-	0.70768
ACL-6209	CA-ARGE-T19.531.6	Ovis	Ia	T19	M1	-	0.70743
ACL-6210	CA-ARGE-GeT2.23.55	Ovis	Ia	GeT2	M1	-	0.70754
ACL-6211	CA-ARGE-T19.531.11	Ovis	Ia	T19	M1	-	0.70753
ACL-6212	CA-ARGE-GeT2.23.85	Ovis	Ia	GeT2	M1	-	0.70763
ACL-6213-P	CA-ARGE-T19.107.581	Bos	Ib	T19	M2	3.5	0.70740
ACL-6213-Q	CA-ARGE-T19.107.581	Bos	Ib	T19	M2	21	0.70751
ACL-6213-R	CA-ARGE-T19.107.581	Bos	Ib	T19	M2	41.1	0.70731
ACL-6214-K	CA-ARGE-GeT2.23.434	Bos	Ib	GeT2	M2	7.2	0.70748
ACL-6214-L	CA-ARGE-GeT2.23.434	Bos	Ib	GeT2	M2	15.2	0.70751
ACL-6214-M	CA-ARGE-GeT2.23.434	Bos	Ib	GeT2	M2	25.4	0.70748
ACL-6215-P	CA-ARGE-GeT2.23.392	Bos	II	GeT2	M2	3.9	0.70761
ACL-6215-Q	CA-ARGE-GeT2.23.392	Bos	II	GeT2	M2	19.7	0.70761
ACL-6215-R	CA-ARGE-GeT2.23.392	Bos	II	GeT2	M2	37.4	0.70761
ACL-6216-O	CA-ARGE-GeT2.23.395	Bos	II	GeT2	M2	5	0.70727
ACL-6216-P	CA-ARGE-GeT2.23.395	Bos	II	GeT2	M2	22	0.70730
ACL-6216-Q	CA-ARGE-GeT2.23.395	Bos	II	GeT2	M2	40	0.70747
ACL-6217-K	CA-ARGE-T19.107.579	Bos	III	T19	M2	5.6	0.70735
ACL-6217-L	CA-ARGE-T19.107.579	Bos	III	T19	M2	15.1	0.70731
ACL-6217-M	CA-ARGE-T19.107.579	Bos	III	T19	M2	23.7	0.70727
ACL-6218-J	CA-TS-SLT10.6.569	Bos	III	SLT	M2	8.2	0.70718
ACL-6218-K	CA-TS-SLT10.6.569	Bos	III	SLT	M2	14.9	0.70708
ACL-6218-L	CA-TS-SLT10.6.569	Bos	III	SLT	M2	21.8	0.70703
ACL-6219-L	CA-ARGE-T19.107.210	Capra	Ib	T19	M2	2.5	0.70763
ACL-6219-M	CA-ARGE-T19.107.210	Capra	Ib	T19	M2	15.1	0.70766
ACL-6219-N	CA-ARGE-T19.107.210	Capra	Ib	T19	M2	25	0.70763
ACL-6220-L	CA-ARGE-GeT2.23.236	Capra	II	GeT2	M2	2.8	0.70675
ACL-6220-M	CA-ARGE-GeT2.23.236	Capra	II	GeT2	M2	11.2	0.70730

Table B.6, continued. $^{87}Sr/^{86}Sr$ results for archaeological enamel samples from the Tsaghkahovit Plain.

Lab ID	Bone ID	Species	Age Class	Context	Tooth Type	Distance from CEJ (mm)	$^{87}Sr/^{86}Sr$
ACL-6220-N	CA-ARGE-GeT2.23.236	Capra	II	GeT2	M2	22.2	0.70732
ACL-6221-K	CA-ARGE-T19.107.55	Capra	II	T19	M2	3	0.70749
ACL-6221-L	CA-ARGE-T19.107.55	Capra	II	T19	M2	12.3	0.70749
ACL-6221-M	CA-ARGE-T19.107.55	Capra	II	T19	M2	21	0.70759
ACL-6222-K	CA-ARGE-GeT2.23.230	Capra	III	GeT2	M2	2.9	0.70771
ACL-6222-L	CA-ARGE-GeT2.23.230	Capra	III	GeT2	M2	11.8	0.70754
ACL-6222-M	CA-ARGE-GeT2.23.230	Capra	III	GeT2	M2	21.6	0.70767
ACL-6223-K	CA-ARGE-GeT2.23.90	Ovis	Ib	GeT2	M2	5.1	0.70767
ACL-6223-L	CA-ARGE-GeT2.23.90	Ovis	Ib	GeT2	M2	13.3	0.70752
ACL-6223-M	CA-ARGE-GeT2.23.90	Ovis	Ib	GeT2	M2	24	0.70755
ACL-6224-K	CA-ARGE-GeT2.23.1	Ovis	Ib	GeT2	M2	3.5	0.70776
ACL-6224-L	CA-ARGE-GeT2.23.1	Ovis	Ib	GeT2	M2	11.1	0.70869
ACL-6224-M	CA-ARGE-GeT2.23.1	Ovis	Ib	GeT2	M2	21.2	0.70757
ACL-6225-K	CA-ARGE-GeT2.23.8	Ovis	Ib	GeT2	M2	5	0.70765
ACL-6225-L	CA-ARGE-GeT2.23.8	Ovis	Ib	GeT2	M2	12.9	0.70753
ACL-6225-M	CA-ARGE-GeT2.23.8	Ovis	Ib	GeT2	M2	24.9	0.70756
ACL-6226-K	CA-ARGE-GeT2.23.30	Ovis	Ib	GeT2	M2	7.1	0.70734
ACL-6226-L	CA-ARGE-GeT2.23.30	Ovis	Ib	GeT2	M2	16.9	0.70758
ACL-6226-M	CA-ARGE-GeT2.23.30	Ovis	Ib	GeT2	M2	27.2	0.70764
ACL-6227-K	CA-ARGE-GeT2.23.223	Ovis	II	GeT2	M2	3.9	0.70736
ACL-6227-L	CA-ARGE-GeT2.23.223	Ovis	II	GeT2	M2	15.9	0.70760
ACL-6227-M	CA-ARGE-GeT2.23.223	Ovis	II	GeT2	M2	30.9	0.70780
ACL-6228-H	CA-ARGE-GeT2.23.249	Ovis	III	GeT2	M2	2.7	0.70798
ACL-6228-I	CA-ARGE-GeT2.23.249	Ovis	III	GeT2	M2	9.1	0.70795
ACL-6228-J	CA-ARGE-GeT2.23.249	Ovis	III	GeT2	M2	17.3	0.70795
ACL-6229-I	CA-ARGE-T19.533.7	Ovis	Ib	T19	M2	3.1	0.70764
ACL-6229-J	CA-ARGE-T19.533.7	Ovis	Ib	T19	M2	11.3	0.70764
ACL-6229-K	CA-ARGE-T19.533.7	Ovis	Ib	T19	M2	19.6	0.70755
ACL-6230-K	CA-ARGE-T19.107.42	Ovis	Ib	T19	M2	5.5	0.70757
ACL-6230-L	CA-ARGE-T19.107.42	Ovis	Ib	T19	M2	20	0.70750
ACL-6230-M	CA-ARGE-T19.107.42	Ovis	Ib	T19	M2	36.7	0.70753
ACL-6231-K	CA-ARGE-T19.107.249	Ovis	II	T19	M2	4.5	0.70768
ACL-6231-L	CA-ARGE-T19.107.249	Ovis	II	T19	M2	16.1	0.70743
ACL-6231-M	CA-ARGE-T19.107.249	Ovis	II	T19	M2	27	0.70731
ACL-6232-K	CA-ARGE-T19.107.92	Ovis	II	T19	M2	5.6	0.70752
ACL-6232-L	CA-ARGE-T19.107.92	Ovis	II	T19	M2	14	0.70760
ACL-6232-M	CA-ARGE-T19.107.92	Ovis	II	T19	M2	24.4	0.70759

Table B.6, continued. $^{87}Sr/^{86}Sr$ results for archaeological enamel samples from the Tsaghkahovit Plain.

Lab ID	Bone ID	Species	Age Class	Context	Tooth Type	Distance from CEJ (mm)	$^{87}Sr/^{86}Sr$
ACL-6233-J	CA-ARGE-T19.514.6	Ovis	II	T19	M2	4	0.70760
ACL-6233-L	CA-ARGE-T19.514.6	Ovis	II	T19	M2	23.5	0.70760
ACL-6233-M	CA-ARGE-T19.514.6	Ovis	II	T19	M2	11.6	0.70758
ACL-6234-K	CA-ARGE-T19.533.1	Ovis	II	T19	M2	2.7	0.70703
ACL-6234-L	CA-ARGE-T19.533.1	Ovis	II	T19	M2	14.5	0.70710
ACL-6234-M	CA-ARGE-T19.533.1	Ovis	II	T19	M2	26.2	0.70698
ACL-6235-I	CA-ARGE-T19.107.64	Ovis	III	T19	M2	3.5	0.70750
ACL-6235-J	CA-ARGE-T19.107.64	Ovis	III	T19	M2	12.2	0.70761
ACL-6235-K	CA-ARGE-T19.107.64	Ovis	III	T19	M2	22.3	0.70757
ACL-6236-H	CA-ARGE-T19.532.28	Ovis	III	T19	M2	2	0.70763
ACL-6236-I	CA-ARGE-T19.532.28	Ovis	III	T19	M2	10.2	0.70763
ACL-6236-J	CA-ARGE-T19.532.28	Ovis	III	T19	M2	16.3	0.70760
ACL-6237-K	CA-TS-SLT14.5.59	Ovis	Ib	SLT	M2	4.2	0.70723
ACL-6237-L	CA-TS-SLT14.5.59	Ovis	Ib	SLT	M2	16	0.70739
ACL-6237-M	CA-TS-SLT14.5.59	Ovis	Ib	SLT	M2	27.8	0.70720
ACL-6238-K	CA-TS-SLT10.6.774	Ovis	Ib	SLT	M2	6	0.70715
ACL-6238-L	CA-TS-SLT10.6.774	Ovis	Ib	SLT	M2	16.9	0.70715
ACL-6238-M	CA-TS-SLT10.6.774	Ovis	Ib	SLT	M2	28.6	0.70724
ACL-6239-K	CA-TS-SLT14.5.208	Ovis	Ib	SLT	M2	6.6	0.70707
ACL-6239-L	CA-TS-SLT14.5.208	Ovis	Ib	SLT	M2	17.7	0.70695
ACL-6239-M	CA-TS-SLT14.5.208	Ovis	Ib	SLT	M2	30.4	0.70724
ACL-6240-K	CA-TS-SLT10.6.806	Ovis	II	SLT	M2	3.2	0.70696
ACL-6240-L	CA-TS-SLT10.6.806	Ovis	II	SLT	M2	14.6	0.70716
ACL-6240-M	CA-TS-SLT10.6.806	Ovis	II	SLT	M2	27.4	0.70707
ACL-6241-J	CA-TS-SLT10.6.900	Ovis	II	SLT	M2	3.8	0.70714
ACL-6241-K	CA-TS-SLT10.6.900	Ovis	II	SLT	M2	14.7	0.70717
ACL-6241-L	CA-TS-SLT10.6.900	Ovis	II	SLT	M2	25.9	0.70707
ACL-6242-K	CA-TS-SLT14.5.192	Ovis	II	SLT	M2	3.3	0.70702
ACL-6242-L	CA-TS-SLT14.5.192	Ovis	II	SLT	M2	15.7	0.70702
ACL-6242-M	CA-TS-SLT14.5.192	Ovis	II	SLT	M2	26.9	0.70719
ACL-6243-I	CA-TS-SLT14.5.202	Ovis	II	SLT	M2	2.4	0.70737
ACL-6243-J	CA-TS-SLT14.5.202	Ovis	II	SLT	M2	10.6	0.70742
ACL-6243-K	CA-TS-SLT14.5.202	Ovis	II	SLT	M2	20.4	0.70692
ACL-6244-I	CA-TS-SLT14.5S.13	Ovis	III	SLT	M2	2.5	0.70723
ACL-6244-J	CA-TS-SLT14.5S.13	Ovis	III	SLT	M2	10.6	0.70733
ACL-6244-K	CA-TS-SLT14.5S.13	Ovis	III	SLT	M2	19.2	0.70707
ACL-6245	CA-ARGE-K1.10.53	Ovis	Ia	Kurgan	M1	-	0.70755

Table B.6, continued. $^{87}Sr/^{86}Sr$ results for archaeological enamel samples from the Tsaghkahovit Plain.

Lab ID	**Bone ID**	**Species**	**Age Class**	**Context**	**Tooth Type**	**Distance from CEJ (mm)**	^{87}**Sr**/^{86}**Sr**
ACL-6246	CA-ARGE-K2.108.118	Ovis	Ia	Kurgan	M1	-	0.70747
ACL-6247	CA-ARGE-K2.109.111	Ovis	Ia	Kurgan	M1	-	0.70743
ACL-6248	CA-ARGE-T22.16.12	Ovis	Ia	Shrine	M1	-	0.70763
ACL-6249	CA-TS-TSBC12.B02.10.1	Ovis	Ia	TsBC12	M1	-	0.70744
ACL-6250	CA-TS-TSBC12.B02.10.96	Ovis	Ia	TsBC12	M1	-	0.70785
ACL-6251-K	CA-ARGE-T22.16.5	Ovis	II	Shrine	M2	4.8	0.70743
ACL-6251-L	CA-ARGE-T22.16.5	Ovis	II	Shrine	M2	19	0.70752
ACL-6251-M	CA-ARGE-T22.16.5	Ovis	II	Shrine	M2	32.7	0.70754
ACL-6252-K	CA-ARGE-T27.60.29	Ovis	Ib	Shrine	M2	3.5	0.70765
ACL-6252-L	CA-ARGE-T27.60.29	Ovis	Ib	Shrine	M2	14.1	0.70761
ACL-6252-M	CA-ARGE-T27.60.29	Ovis	Ib	Shrine	M2	26.5	0.70757
ACL-6253-J	CA-TS-TSBC12.B02.10.37	Capra	Ia	TsBC12	M2	5	0.70746
ACL-6253-K	CA-TS-TSBC12.B02.10.37	Capra	Ia	TsBC12	M2	14.7	0.70695
ACL-6253-L	CA-TS-TSBC12.B02.10.37	Capra	Ia	TsBC12	M2	25.8	0.70743

Table B.7: Results of the incremental δ^{18}O analysis of archaeological faunal teeth.

Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)
ACL-6213-A	3.3	-10.43	**ACL-6223-A**	2.4	-2.48	**ACL-6235-D**	8.5	-6.93
ACL-6213-B	5.4	-9.96	**ACL-6223-B**	4.9	-3.86	**ACL-6235-E**	11.4	-4.60
ACL-6213-C	9.7	-10.08	**ACL-6223-C**	7.6	-6.53	**ACL-6235-F**	14.6	-3.31
ACL-6213-D	12.3	-9.18	**ACL-6223-D**	10.3	-8.93	**ACL-6235-G**	17.2	-2.88
ACL-6213-E	13.9	-9.25	**ACL-6223-E**	12.9	-9.28	**ACL-6235-H**	20.2	-3.33
ACL-6213-F	16	-8.71	**ACL-6223-F**	15.3	-8.80	**ACL-6236-A**	1.6	-8.03
ACL-6213-G	17.7	-9.34	**ACL-6223-G**	17.6	-9.22	**ACL-6236-B**	3.9	-3.97
ACL-6213-H	19.9	-7.83	**ACL-6223-H**	20	-7.26	**ACL-6236-C**	6.8	-2.24
ACL-6213-I	23.1	-7.29	**ACL-6223-I**	23.3	-4.95	**ACL-6236-D**	9.1	-1.92
ACL-6213-J	25	-8.01	**ACL-6223-J**	25.4	-2.60	**ACL-6236-E**	11.7	-2.69
ACL-6213-K	28.9	-8.33	**ACL-6224-A**	2.2	-0.09	**ACL-6236-F**	14.4	-5.85
ACL-6213-L	30.9	-8.88	**ACL-6224-B**	4.5	-0.88	**ACL-6236-G**	17	-8.04
ACL-6213-M	33	-9.13	**ACL-6224-C**	6.7	-2.85	**ACL-6237-A**	2.5	-4.58
ACL-6213-N	35.9	-10.09	**ACL-6224-D**	9.3	-4.97	**ACL-6237-B**	4.5	-3.89
ACL-6213-O	39.6	-10.38	**ACL-6224-E**	11.4	-7.86	**ACL-6237-C**	6.9	-7.23
ACL-6214-A	4.9	-13.67	**ACL-6224-F**	13.4	-9.83	**ACL-6237-D**	10.1	-9.77
ACL-6214-B	7.1	-13.00	**ACL-6224-G**	16	-10.80	**ACL-6237-E**	12.4	-11.62
ACL-6214-C	9	-12.75	**ACL-6224-H**	18.5	-11.16	**ACL-6237-F**	15.6	-12.33
ACL-6214-D	11.3	-13.38	**ACL-6224-I**	21.4	-11.34	**ACL-6237-G**	18.3	-11.78
ACL-6214-E	13.9	-13.21	**ACL-6224-J**	23.7	-9.13	**ACL-6237-H**	21.4	-10.12
ACL-6214-F	15.9	-13.58	**ACL-6225-A**	3.9	-6.74	**ACL-6237-I**	24.1	-7.90
ACL-6214-G	17.6	-13.60	**ACL-6225-B**	6.6	-4.10	**ACL-6237-J**	27.4	-5.32
ACL-6214-H	20	-13.24	**ACL-6225-C**	9.4	-2.42	**ACL-6238-A**	2.5	-4.03

Table B.7, continued. Results of the incremental δ^{18}O analysis of archaeological faunal teeth.

Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)
ACL-6214-I	22.3	-13.39	**ACL-6225-D**	12.2	-4.63	**ACL-6238-B**	5.3	-3.19
ACL-6214-J	24	-12.80	**ACL-6225-E**	13.6	-6.31	**ACL-6238-C**	8	-4.24
ACL-6215-A	2.5	-8.64	**ACL-6225-F**	15.8	-8.18	**ACL-6238-D**	11.3	-5.90
ACL-6215-B	4.6	-7.86	**ACL-6225-G**	19	-9.52	**ACL-6238-E**	14.1	-7.73
ACL-6215-C	6.7	-7.57	**ACL-6225-H**	21	-9.43	**ACL-6238-F**	16.8	-9.14
ACL-6215-D	8.8	-6.76	**ACL-6225-I**	23.9	-8.51	**ACL-6238-G**	20.5	-9.58
ACL-6215-E	11.6	-6.55	**ACL-6225-J**	26.2	-7.08	**ACL-6238-H**	23.7	-9.26
ACL-6215-F	13.5	-5.13	**ACL-6226-A**	3.4	-1.21	**ACL-6238-I**	26.9	-8.15
ACL-6215-G	15.6	-4.63	**ACL-6226-B**	6	-0.69	**ACL-6238-J**	28.9	-8.12
ACL-6215-H	18.5	-5.23	**ACL-6226-C**	8.8	-2.01	**ACL-6239-A**	2.7	-5.10
ACL-6215-I	21	-6.03	**ACL-6226-D**	11.6	-5.50	**ACL-6239-B**	5.5	-3.96
ACL-6215-J	23.7	-7.21	**ACL-6226-E**	13.7	-6.33	**ACL-6239-C**	9.2	-3.48
ACL-6215-K	26.2	-7.07	**ACL-6226-F**	16.9	-8.36	**ACL-6239-D**	11.9	-2.89
ACL-6215-L	29.1	-8.20	**ACL-6226-G**	19.7	-9.68	**ACL-6239-E**	14.7	-3.56
ACL-6215-M	31.8	-8.38	**ACL-6226-H**	22.2	-10.18	**ACL-6239-F**	17.7	-5.02
ACL-6215-N	34.3	-8.90	**ACL-6226-I**	26.1	-9.23	**ACL-6239-G**	20.9	-7.99
ACL-6215-O	37.4	-9.57	**ACL-6226-J**	28.5	-8.11	**ACL-6239-H**	25	-9.38
ACL-6216-A	2.2	-8.18	**ACL-6227-A**	2.4	-4.61	**ACL-6239-I**	28.4	-9.41
ACL-6216-B	4.4	-7.97	**ACL-6227-B**	5.1	-2.90	**ACL-6239-J**	31.8	-8.18
ACL-6216-C	6.6	-8.56	**ACL-6227-C**	7.6	-3.16	**ACL-6240-A**	1.8	-7.60
ACL-6216-D	9	-7.51	**ACL-6227-D**	10.6	-3.32	**ACL-6240-B**	4.6	-4.86
ACL-6216-E	12.1	-7.18	**ACL-6227-E**	13.4	-4.35	**ACL-6240-C**	7.9	-2.64
ACL-6216-F	14.5	-6.55	**ACL-6227-F**	16.4	-3.26	**ACL-6240-D**	11	-2.22
ACL-6216-G	17.6	-6.61	**ACL-6227-G**	19.6	-4.17	**ACL-6240-E**	13.8	-2.38

Table B.7, continued. Results of the incremental δ^{18}O analysis of archaeological faunal teeth.

Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)
ACL-6216-H	20	-5.77	**ACL-6227-H**	22.8	-4.58	**ACL-6240-F**	17.1	-5.42
ACL-6216-I	23.4	-5.77	**ACL-6227-I**	26.4	-4.65	**ACL-6240-G**	20	-6.20
ACL-6216-J	26.5	-5.19	**ACL-6227-J**	30.3	-4.58	**ACL-6240-H**	22.1	-8.12
ACL-6216-K	29.8	-6.21	**ACL-6228-A**	2.1	-8.70	**ACL-6240-I**	24.8	-8.92
ACL-6216-L	33.1	-5.60	**ACL-6228-B**	5.2	-10.07	**ACL-6240-J**	27.3	-9.51
ACL-6216-M	36.8	-5.29	**ACL-6228-C**	8	-7.43	**ACL-6241-A**	2	-7.89
ACL-6216-N	39.7	-6.10	**ACL-6228-D**	10.5	-4.46	**ACL-6241-B**	4.9	-6.18
ACL-6217-A	3	-8.64	**ACL-6228-E**	13.8	-3.19	**ACL-6241-C**	7.3	-4.78
ACL-6217-B	5	-7.50	**ACL-6228-F**	16.7	-2.45	**ACL-6241-D**	10.5	-3.19
ACL-6217-C	7.7	-6.91	**ACL-6228-G**	19.8	-0.47	**ACL-6241-E**	13	-2.56
ACL-6217-D	9.4	-6.13	**ACL-6229-A**	0.5	-12.30	**ACL-6241-F**	15.6	-2.83
ACL-6217-E	11.7	-5.57	**ACL-6229-B**	3.7	-11.53	**ACL-6241-G**	18.3	-5.06
ACL-6217-F	14.3	-3.86	**ACL-6229-C**	6.4	-10.83	**ACL-6241-H**	21	-8.59
ACL-6217-G	17	-3.18	**ACL-6229-D**	9.1	-8.22	**ACL-6241-I**	24	-10.29
ACL-6217-H	19.3	-3.88	**ACL-6229-E**	11.7	-9.56	**ACL-6242-A**	1.6	-8.43
ACL-6217-I	21.9	-4.57	**ACL-6229-F**	14.2	-9.28	**ACL-6242-B**	4.9	-5.37
ACL-6217-J	24.7	-5.43	**ACL-6229-G**	16.8	-8.55	**ACL-6242-C**	7.7	-4.61
ACL-6218-A	2.4	-6.61	**ACL-6229-H**	19.9	-6.22	**ACL-6242-D**	10.6	-3.59
ACL-6218-B	4.1	-6.00	**ACL-6230-A**	2.5	-6.03	**ACL-6242-E**	13.5	-3.91
ACL-6218-C	6.4	-5.81	**ACL-6230-B**	6.2	-3.85	**ACL-6242-F**	16.4	-4.70
ACL-6218-D	8.9	-5.17	**ACL-6230-C**	9.5	-3.10	**ACL-6242-G**	19.1	-7.17
ACL-6218-E	11.4	-4.12	**ACL-6230-D**	13.6	-1.90	**ACL-6242-H**	22	-9.49
ACL-6218-F	14	-3.61	**ACL-6230-E**	16.3	-5.38	**ACL-6242-I**	25.3	-11.45
ACL-6218-G	16.6	-4.22	**ACL-6230-F**	19.9	-7.63	**ACL-6242-J**	28.1	-11.13

Table B.7, continued. Results of the incremental δ^{18}O analysis of archaeological faunal teeth.

Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)
ACL-6218-H	19	-2.67	**ACL-6230-G**	23.5	-8.64	**ACL-6243-A**	1.4	-7.16
ACL-6218-I	21.2	-3.28	**ACL-6230-H**	26.8	-9.37	**ACL-6243-B**	3.9	-5.71
ACL-6219-A	0.8	-8.64	**ACL-6230-I**	30.9	-7.73	**ACL-6243-C**	6.1	-3.83
ACL-6219-B	3.5	-6.21	**ACL-6230-J**	35	-7.11	**ACL-6243-D**	8.5	-3.73
ACL-6219-C	5.8	-3.87	**ACL-6231-A**	3.2	-5.32	**ACL-6243-E**	11.6	-3.51
ACL-6219-D	8.2	-2.17	**ACL-6231-B**	6	-3.38	**ACL-6243-F**	14.2	-4.67
ACL-6219-E	10.7	-0.64	**ACL-6231-C**	8.9	-3.15	**ACL-6243-G**	17.1	-6.59
ACL-6219-F	12.5	-1.43	**ACL-6231-D**	11.8	-3.36	**ACL-6243-H**	20	-8.41
ACL-6219-G	14.4	-3.01	**ACL-6231-E**	14.4	-4.76	**ACL-6244-A**	2	-8.78
ACL-6219-H	16.7	-3.96	**ACL-6231-F**	16.4	-5.86	**ACL-6244-B**	4.4	-9.40
ACL-6219-I	19.4	-6.56	**ACL-6231-G**	18.8	-8.47	**ACL-6244-C**	6.5	-7.47
ACL-6219-J	22	-7.40	**ACL-6231-H**	22.4	-9.69	**ACL-6244-D**	9.5	-4.41
ACL-6219-K	25.1	-7.98	**ACL-6231-I**	24.8	-9.12	**ACL-6244-E**	12.3	-2.43
ACL-6220-A	2.7	-5.86	**ACL-6231-J**	27.3	-9.08	**ACL-6244-F**	15.4	-1.41
ACL-6220-B	4.8	-3.76	**ACL-6232-A**	3.7	-9.36	**ACL-6244-G**	18.1	-2.07
ACL-6220-C	7	-2.88	**ACL-6232-B**	6.4	-8.41	**ACL-6244-H**	20.7	-3.40
ACL-6220-D	9.5	-1.98	**ACL-6232-C**	9.4	-6.13	**ACL-6251-A**	2.3	-8.47
ACL-6220-E	11.3	-3.01	**ACL-6232-D**	12.2	-4.64	**ACL-6251-B**	5.2	-4.79
ACL-6220-F	13.4	-3.31	**ACL-6232-E**	14.7	-3.37	**ACL-6251-C**	8.7	-1.52
ACL-6220-G	15.8	-3.94	**ACL-6232-F**	17.3	-3.88	**ACL-6251-D**	12.6	-1.81
ACL-6220-H	18.6	-6.10	**ACL-6232-G**	20	-2.36	**ACL-6251-E**	15.4	-2.84
ACL-6220-I	21	-7.58	**ACL-6232-H**	22.9	-4.31	**ACL-6251-F**	19.1	-4.94
ACL-6220-J	23.1	-6.97	**ACL-6232-I**	25.6	-6.49	**ACL-6251-G**	21.3	-6.93
ACL-6220-K	26.7	-6.21	**ACL-6233-A**	2.8	-7.87	**ACL-6251-H**	24.2	-8.38

Table B.7, continued. Results of the incremental δ^{18}O analysis of archaeological faunal teeth.

Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)	Lab Number	Distance from CEJ (mm)	$\delta^{18}O_{VPDB}$ (‰)
ACL-6221-A	1.8	-6.14	**ACL-6233-B**	5.3	-5.18	**ACL-6251-I**	28	-8.81
ACL-6221-B	4.7	-10.49	**ACL-6233-C**	8	-3.62	**ACL-6251-J**	30.9	-8.77
ACL-6221-C	6.6	-10.86	**ACL-6233-D**	10.4	-3.10	**ACL-6252-A**	1.9	-6.49
ACL-6221-D	8.7	-8.45	**ACL-6233-E**	13.4	-2.47	**ACL-6252-B**	4.7	-8.19
ACL-6221-E	11.3	-6.90	**ACL-6233-F**	16	-3.23	**ACL-6252-C**	8	-8.81
ACL-6221-F	13.3	-5.62	**ACL-6233-G**	18.5	-4.68	**ACL-6252-D**	10.9	-9.74
ACL-6221-G	16.2	-4.81	**ACL-6233-H**	21	-6.37	**ACL-6252-E**	13	-10.14
ACL-6221-H	18.5	-2.85	**ACL-6233-I**	23.8	-7.88	**ACL-6252-F**	15.2	-9.92
ACL-6221-I	20.7	-3.63	**ACL-6234-A**	1.5	-8.91	**ACL-6252-G**	17.8	-7.34
ACL-6221-J	24.4	-5.20	**ACL-6234-B**	4.4	-6.80	**ACL-6252-H**	21	-6.24
ACL-6222-A	1.6	-3.46	**ACL-6234-C**	7.1	-4.53	**ACL-6252-I**	23.8	-3.83
ACL-6222-B	3.9	-8.20	**ACL-6234-D**	10.1	-2.73	**ACL-6252-J**	26.4	-2.93
ACL-6222-C	6.6	-7.51	**ACL-6234-E**	12.7	-2.79	**ACL-6253-A**	1.5	-6.62
ACL-6222-D	9.3	-5.29	**ACL-6234-F**	15.9	-3.45	**ACL-6253-B**	4.3	-7.30
ACL-6222-E	11.7	-5.44	**ACL-6234-G**	18.8	-4.74	**ACL-6253-C**	7.4	-9.12
ACL-6222-F	14.2	-3.65	**ACL-6234-H**	21.4	-8.05	**ACL-6253-D**	11.4	-8.35
ACL-6222-G	17	-3.07	**ACL-6234-I**	24.4	-10.22	**ACL-6253-E**	13.5	-8.84
ACL-6222-H	20	-2.98	**ACL-6234-J**	26.8	-11.52	**ACL-6253-F**	16.2	-10.48
ACL-6222-I	22.4	-3.90	**ACL-6235-A**	1.2	-5.88	**ACL-6253-G**	18.9	-9.24
ACL-6222-J	25.1	-6.16	**ACL-6235-B**	3.6	-9.62	**ACL-6253-H**	21.6	-6.81
			ACL-6235-C	6	-9.66	**ACL-6253-I**	24.7	-4.75

APPENDIX C

GEGHAROT KURGAN 2 – EXCAVATION & ANALYSIS

Kurgan 2 was excavated over the course of two seasons (2013 & 2014) by myself and Ruben Badalyan. The human remains recovered were analyzed by Maureen Marshall, and Roman Hovasepyan analyzed the paleobotanical remains recovered from the whole vessels. Excavations began in June of 2013. Unfortunately, due to the short length of the season and the complicated nature of the stratigraphy in the central chamber, excavations were not completed. At the end of the 2013 season, several whole vessels and a few bronze artifacts were removed from both chambers and the remaining artifacts were covered with plastic and backfilled. At the beginning of the 2014, we removed the backfill and plastic, and continued excavation. As a result, it was not possible to expose the entirety of the situations in the lower levels of both chambers. However, excavations notes, photographs, and drawings allow for the reconstruction of relationships between artifacts and architecture exposed in the different seasons.

The kurgan consisted of a central cist chamber and a smaller, satellite chamber to the west that were surrounded by a cromlech ring and topped by an earthen mound covered in small stones (Figure C.1). The cromlech was constructed of large basalt and granite stones, with the stones used to construct the northern half being on average a little larger than those in the southern. In a section in the northwest quadrant of the cromlech (just north of the western chamber) the line of the circle is slightly offset. There were no tuff stones, unlike in Kurgan 1, where the northern point of the circle was marked by a solitary red tuff stone. Outside of the circle of large boulders was an outer ring composed of smaller rocks that extended out roughly 0.5 m from the cromlech. Interestingly, some of the stones used to

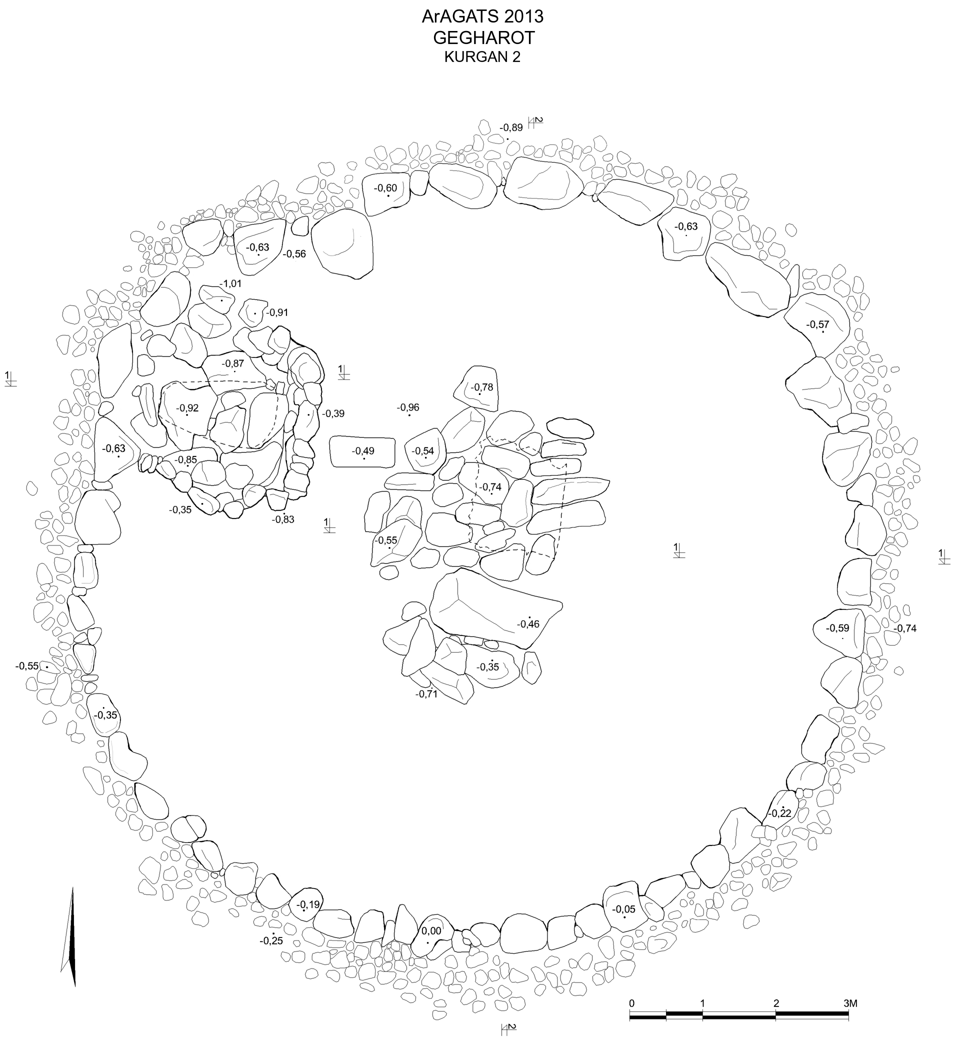


Figure C.1. Drawing of the cromlech and chambers of Kurgan 2. Drawing courtesy of Lilit Ter-Minasyan.

construct this outer ring were white, chalky stones, creating a very striking visual pattern. The kurgan mound was also covered with a layer of small stones, which extended over the entire mound (with the exception of a small area on the western edge of the circle, where the stones were absent at the surface). As with the outer ring, a number of the stones used to cover the kurgan mound were the distinctive white chalky stones. Near the ring of the cromlech, there appeared to have been a deeper layer of stones covering the mound. This layer then thinned out towards the center of the mound. It is possible that this is related to the method of construction of the kurgan mound.

Excavation of the kurgan mound revealed the presence of two chambers – one to the west and one in the center. The central chamber was offset slightly to the north of the center of the cromlech. In general, material densities from the kurgan mound were very low (a small handful of ceramics, bones, and lithics), with two exceptions. The first was a complete innominate (hip bone) from a red deer (*Cervus elaphus*) that was found in the northeastern part of the southeast quadrant. The other exception was a (possibly intrusive) child burial located between the western and central chambers. The interment was capped by a large rectangular worked/dressed stone that was sitting just below the surface of the kurgan mound. Underneath the large stone was another layer of three stones covering the burial.

The potentially intrusive burial was of a young child (the skeleton was quite small, and had unfused elements and deciduous teeth). It was a primary burial containing a single body which was articulated (save for a few ribs that had gone askew, perhaps from the pressure of the overlying stones). The body was in a semi-flexed position with the knees semi-flexed (approximately 120 degrees). The positioning of arms appears to have been hands on the pelvis, given the position of the ulna and radius, but it is also possible they were on the sides. Given that the skull was crushed in on itself, it is difficult to determine the position of the head, though it appears from the position of the lower eye socket that it was likely in a normal position (i.e. looking straightforward). The body was deposited on its right side. The grave was oriented E-W, and consisted of two large stones above the earth covering the body which was then covered by a single worked/dressed stone that was approximately the size of the burial and sitting just under the top of the kurgan (a small part of the stone was visible on the surface). The head was most likely facing south. The matrix surrounding the body is a medium brown silty clay loam (the same matrix as the rest of the kurgan mound. The body (save for the cranium) was resting on a light tan clay.The post-depositional movement seems to have been limited for much of the post cranial skeleton. The radii and ulnae were articulated, as were the tibia and fibula. Some of the ribs were in place, but others were pushed up near the head. Part of the upper spine was completely articulated. The cranium was crushed, with the frontal bones pushed in between the orbital sockets. The lower (right) humerus was recovered just under the mandible.

There were no objects included in the grave that could help us date the burial.[1] The fact that the rocks covering the top of the kurgan mound were not absent in the vicinity of the burial, the location of the burial between the two chambers, and the fact that the body was resting on top of the clay surface surrounding the capstones of the central chamber suggests that the people who buried the child may have been familiar with the original construction of the kurgan. That being said, the construction of the grave itself suggests that the kurgan mound (at least the earthen mound) was already constructed. The way the stones covering the burial were floating in the matrix implies that it was dug into the earthen mound after it was created, even as there was no clear evidence in the soil matrix for the construction of the pit into which the body was placed.

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1. In 2014, a tooth was collected from this individual for radiocarbon dating (Ar/Ge.K2.6.C14.01), but it has not been analyzed yet.

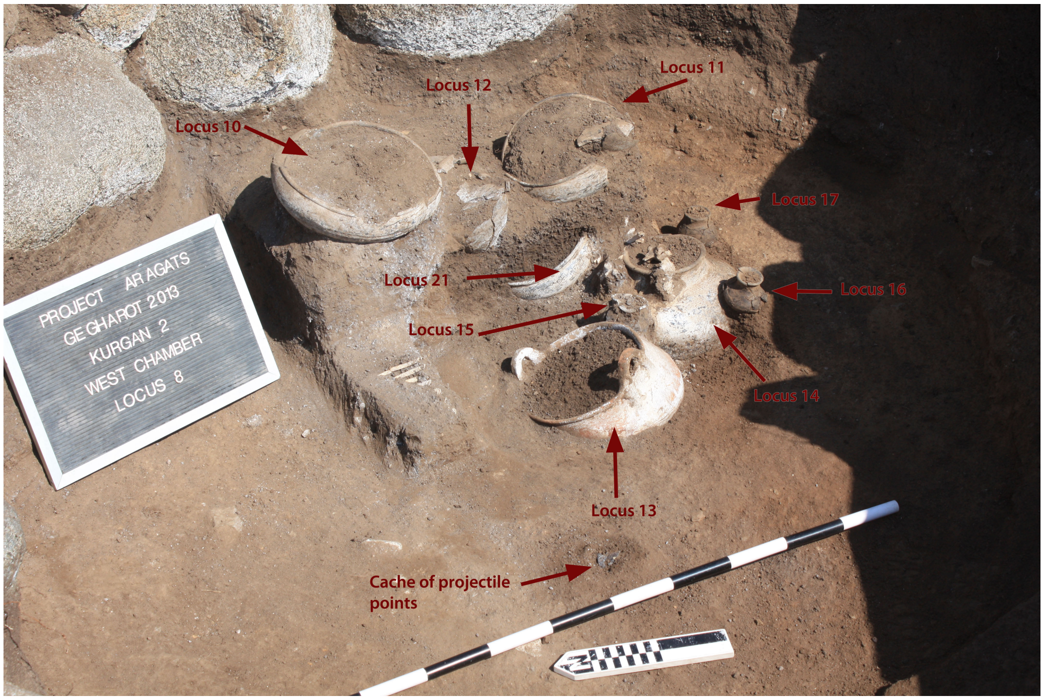


Figure C.2. Upper layer of vessels in the western chamber (with the lower layer partially exposed).

C.1 Western Chamber

The western chamber consisted of a roughly semi-circular stone 'fence' that surrounded the south, east and north sides of the chamber, with the western boundary of the chamber marked by the cromlech itself (Figure C.5). The fence consisted of 3-4 courses of stones along the eastern side, with fewer courses of stones on the northern and southern parts of the construction. The chamber was covered by a group of large capstones, an upper layer of two large stones, below which was a lower group of three capstones running E-W. Just beneath the capstones were the rims of the first layer of complete vessels (Figure C.2). This layer consisted of 3 crushed whole vessels (Loci 10, 11, 12) located on the eastern side of the chamber. These vessels date stylistically to the MB-LB transition, which parallels the vessels found in the western chamber of Kurgan 1.

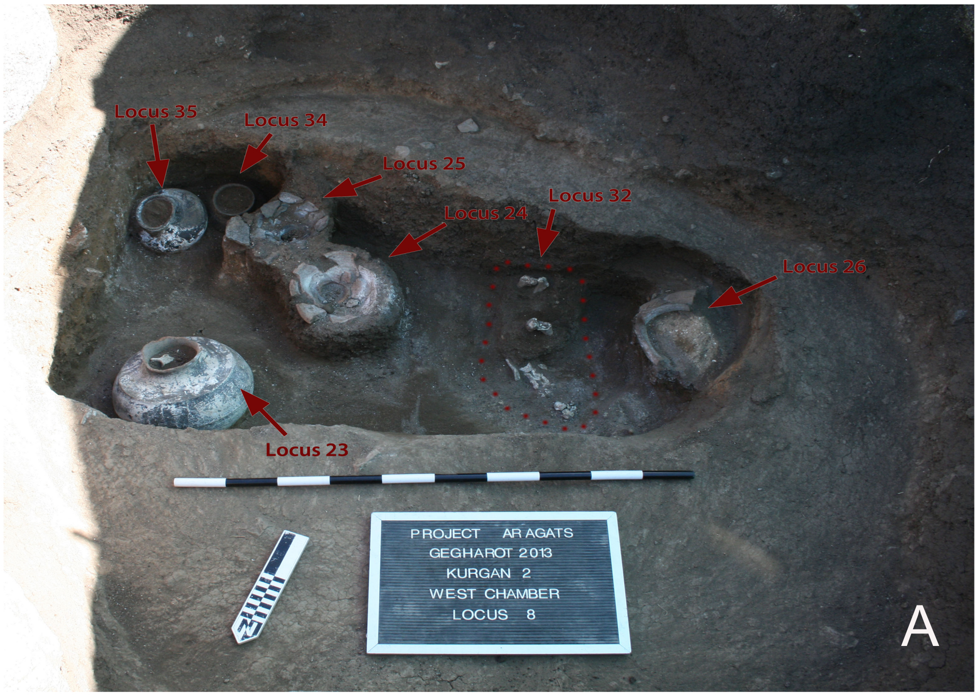
Figure C.3. Middle layer of vessels in the western chamber.

Just below this group was another group of whole vessels (Figure C.3) also dating to the MB-LB transition, which included a cauldron-shaped open vessel (Locus 13) and a large closed vessel with 4 "ears" (Locus 14), on top of which rested 4 small vessels (Loci 15, 16, 17, 19), a large open vessel (Locus 21), and another small vessel (Locus 22). In addition to the ceramics, this layer in the western chamber also included articulated animals remains – a set of articulated caprine vertebrae as well as a part of a sheep scapula and some medium mammal ribs resting on top of Locus 14 and a set of articulated medium mammal ribs found just to the west of and below the level of Locus 10. It was in the western part of the chamber, in this middle layer of objects, that we found a cache of 11 translucent obsidian arrowheads (Ar/Ge.K2.8.L.01-11) and then just below that, a bronze sword (Ar/Ge.K2.8.M.01). The calibrated C14 date for the sword in the western chamber is 1897-1323 cal BCE.

Further excavation revealed that the walls of the pit were not straight, but rather were slightly bell-shaped, as the pit grew wider as it continued down. In general, the matrix in this locus was a medium brown sandy clay loam with lots of gravel. The matrix varied in the level of clay content, with some areas being very clayey. In the lower portion of the pit excavated in 2014, the matrix was a mottled dark brown and tan clayey matrix, which contrasted with the softer dark brown matrix that marked the boundary of the pit. The bottom of the pit was marked by a tan clay surface, similar to the sides of the pit. Underneath the middle layer of vessels, we discovered another, lower layer of pots (Figure C.4). This group consisted of two broken vessels (Locus 24 & 25), one located just under Locus 14, that were left in-situ at the end of the 2013 season.

Excavations in the 2014 season revealed that these vessels were a black and red pair of censers. In addition, another vessel (Locus 23) with a steeply angled shoulder was found in the northeast corner of the pit, and two smaller vessels (Locus 34 & 35) were found in the southeastern corner. In the western end of the pit were pieces of a broken thick-walled vessel (Locus 26) that was also left in-situ. In this layer, we also found another set of articulated ribs (large mammal) as well as part of a caprine scapula, and part of a caprine humerus, and a set of right and left goat humeri resting on top of Locus 23. The upper layer of large mammal ribs was just below the rim of Locus 22 but then continued down to the level of the shoulder of Locus 23, with the order being (from uppermost to lowest): large mammal ribs, goat humeri, caprine scapula and humerus, and then the second set of large mammal ribs resting directly on the shoulder of Locus 23.

Excavations resumed in 2014, and as work progressed, it quickly became clear that the bones discovered at the end of the season in 2013 were actually two complete juvenile sheep (Locus 108 and 109), which partially extended below Locus 26 (Figure C.4). The individuals in Locus 108 and 109 were aged 8-12 months, based on tooth eruption and fusion of the post-cranial elements (Silver 1969; Payne 1973; Noddle 1974). Further excavation, after the removal of the crushed upper portion of the censers, also revealed a walnut-shaped vessel (Locus 105) just south of the censers (Locus 24 and 25), and a small



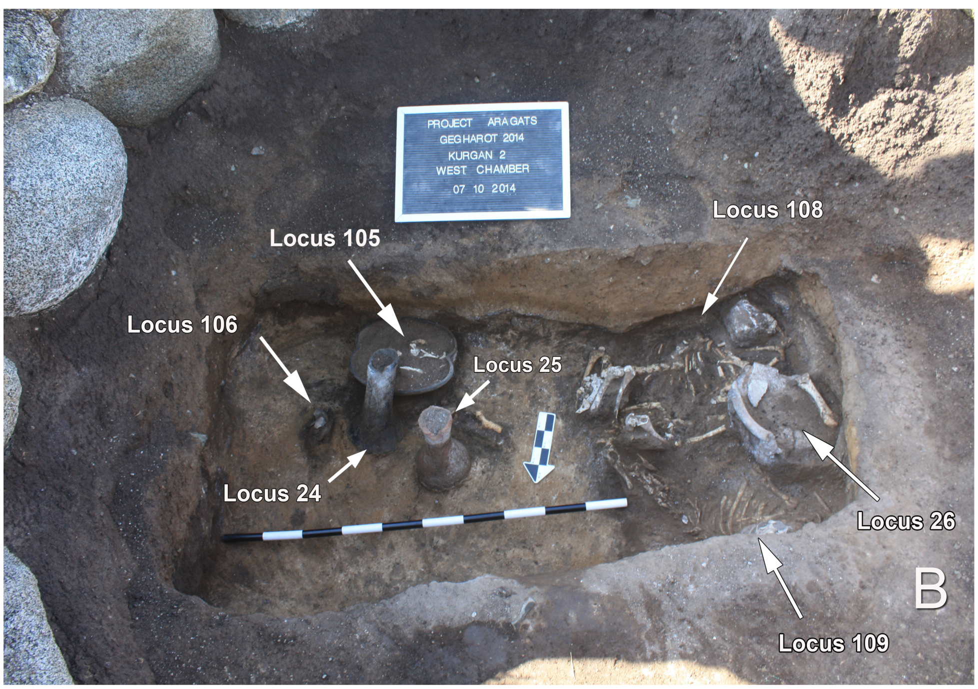


Figure C.4. a) Lower layer of vessels in the western chamber at the end of the 2013 season. b) Vessels and whole sheep in the lowest layer in the western chamber.

crushed cup (Locus 106) to the east of Locus 25. A few faunal remains (caprine femur, medium mammal humerus, ribs and vertebra) were found around the concentration of vessels in the southeastern-central portion of the pit. These vessels and the articulated sheep skeletons were resting on a packed surface composed of tan-orange clay that comprised the bottom of the pit.

To summarize, the lowest layer of artifacts in the western chamber consisted of whole vessels – a closed mouth, angled shoulder vessel (Locus 23 – 2211.197 masl), two censers (Locus 24 & 25 – 2211.170, 2211.199 masl), a broken thick walled vessel (Locus 26 – 2211.211 masl), two smaller jars (Locus 34 & 35 – 2211.113, 2211.170 masl), a walnut-shaped vessel (Locus 105 – 2211.113 masl), and a small cup (Locus 106 – 2210.945 masl) – as well as two articulated juvenile sheep (Locus 108 & 109) and assorted other disarticulated faunal remains. The articulated sheep were placed along the southern and northern edges of the pit in the western half. The heads had been separated from the rest of the body and placed on top of the proximal axial skeleton. The northern sheep (Locus 109) had its right hind leg severed at the knee (the patella was articulated with the femur), and then the lower part of the limb was placed beneath the innominate and the left leg. The two animals were arranged more or less symmetrically, mirroring each other along the E-W axis of the pit. Then Locus 26 was placed on top of the forelimbs of the two sheep, perhaps with a small rock (found underneath the vessel) placed underneath to stabilize it. In addition, there were animals remains on the shoulder of Locus 23, around the bases of Loci 24, 25, and 105, as well as inside of vessels (Locus 26 and 105). These remains included an articulate set of large mammal ribs, a caprine femur that had been cut in half before being placed by Locus 105. Inside Locus 105 were medium mammal vertebrae and large and medium mammal ribs. Inside of Locus 26, there was a goat humerus.

C.2 Central Chamber

The central chamber was covered by a large pile of stones, which was offset to the north from the center of the cromlech and located to the north of the large white stone (Figure C.5). Around the borders of this pile of rocks (and covering some of the rocks) was a thick layer of clay. The upper part of the pile consisted of a layer of medium- to large-sized rocks, mostly resting on a thin layer of soil, underneath which we found two very large slabs of rock that were not lying flat horizontally but instead were lifted up at one end because they were resting on a large rock. These may have been the capstones from the original chamber construction that were then displaced/replaced at a later point in time. The area of stones underneath this was smaller in extent than the upper level of stones. While cleaning around these rocks, we found a bone from a very large bird. After removing the stones, the edges of a pit feature were visible, defined along the southern, eastern and western borders by a ring of rocks, but the northern boundary (where there was a gap in the stone ring) was difficult to establish. There was an arc of clay visible in the horizontal exposure (forming part of the clay covering the rocks on top of the central chamber) that did not quite complete the circle. While continuing to remove stones, we found one that may have been a standing stone, originally resting against the large white capstone.

The central chamber was initially constructed by digging a large pit. It is not possible to say precisely when this occurred, though likely it was during the Late Bronze Age. At some point, possibly in the Early Iron Age, stone walls were constructed along the southern side (Locus 37) and the southern half of the western side (Locus 38) of the large pit. The sides and floor of the pit were lined with orange/tan clay, partially covering the lowest course of the stone walls. At the bottom of the pit, in the southern half, the lower body (Figure C.6), a female over 50 years of age, was laid down, oriented N-S, on top of a bronze knife (Ar/Ge.K2.104.M.02). The body had a bronze ring (Ar/Ge.K2.104.M.01) and another

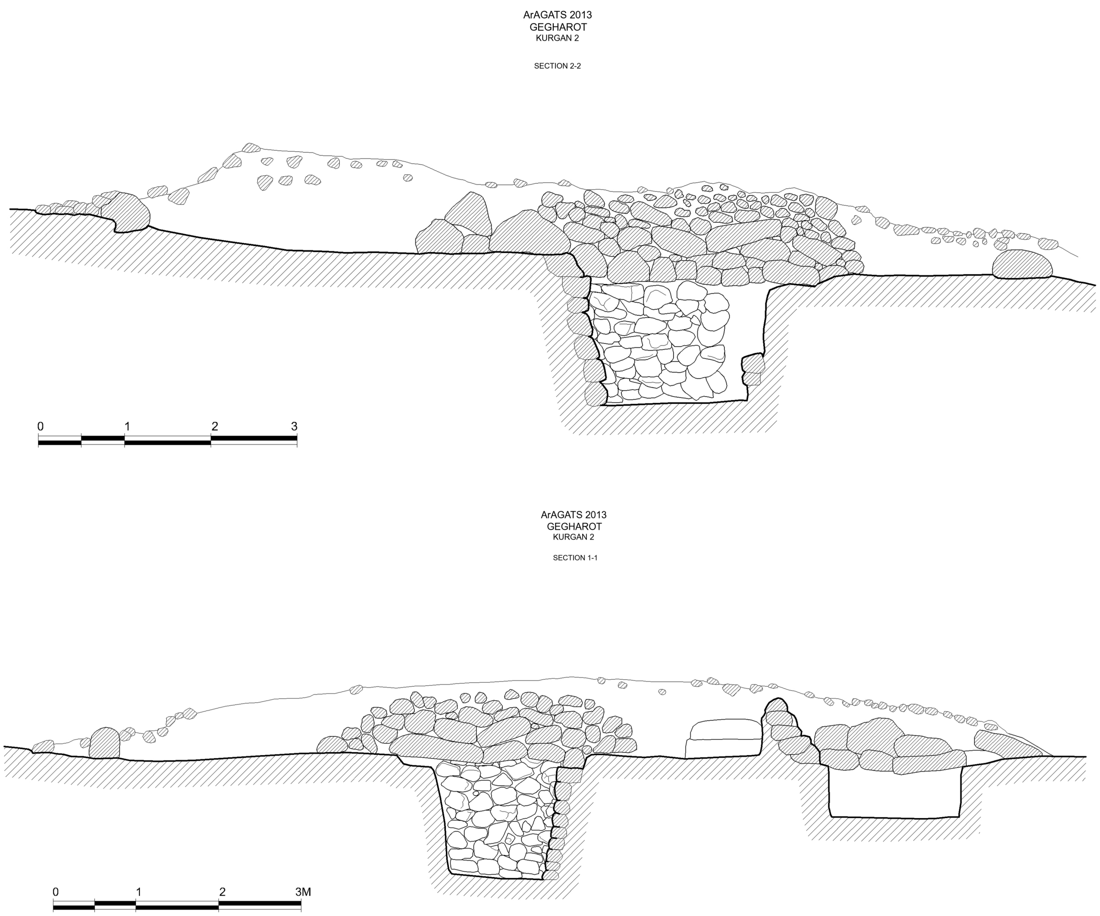


Figure C.5. Section drawings of Gegharot Kurgan 2 (courtesy of Lilit Ter-Minasyan). a) N-S section. b) E-W section.

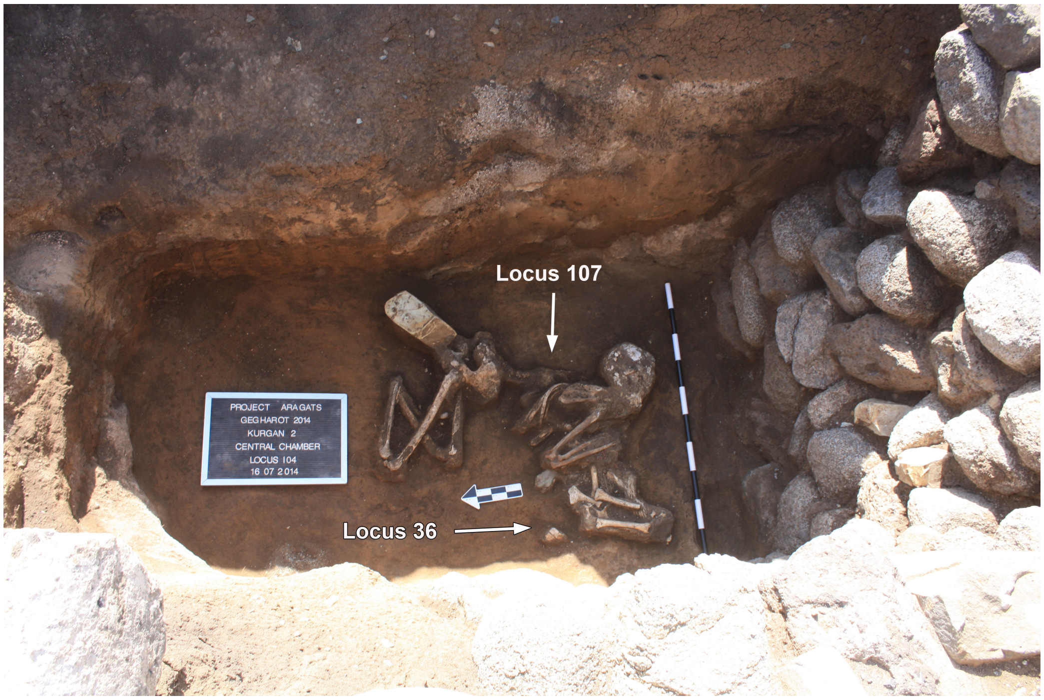


Figure C.6. Lower body in the central chamber.

piece of bronze personal adornment (Ar/Ge.K2.104.M.03) on its skull. Unfortunately, a very large rock fell on top the skull after internment, crushing it and making it difficult to assess the original location or shape of the bronze artifact. There was a group of carnelian and paste beads on the right arm of the lower body, and from the skull we recovered a gold bead (Ar/Ge.K2.104.M.04) as well as a group of small black biconical faience/paste beads. In addition, large numbers of carnelian and paste beads were recovered from the soil surrounding the body, which suggests that the body may have been dressed in or covered by a beaded garment.

The upper body, a young male (20-23 years old), was placed in the middle of the central chamber, oriented E-W (Figure C.7). The level of this body was above the level of the lower body, and was laid over the legs of the lower body. A white chalk stone was placed in between (both horizontally and vertically) the pelvises of the two individuals. This individual was buried with a carnelian, bronze, and gold bead necklace and a bronze belt and dagger (Ar/Ge.K2.18.M01-02). A large white chalk stone was placed on the knees of the body, the bronze belt was around this stone. Near the bodies, four whole vessels (Locus 28, 29, 30, and 31) were placed in the SW corner of the chamber, along with a set of animal remains. These remains consisted of one articulated left sheep lower hindlimb (patella, tibia, and calcaneus), an articulated right caprine lower forelimb(radius and carpals – the radius showed signs of butchery), below and to the side of which were a sheep scapula, and a medium mammal femur, innominate and ribs. North of this, near to the bronze knife, there was a large grey/green faience bead (Ar/Ge.K2.104.PA.01). On the shoulder of one of the vessels (Locus 31), was a group of 47 carnelian beads, and between Locus 30 and 31 there was a bronze pin (Ar/Ge.K2.18.M.04). Intermediate between the lower and upper bodies, along the eastern wall of the chamber, we found a concentration of paste and carnelian beads, likely another necklace. Just north of the head of the upper body, there was a large, restricted Early Iron Age vessel, with an equid tooth resting on its shoulder.

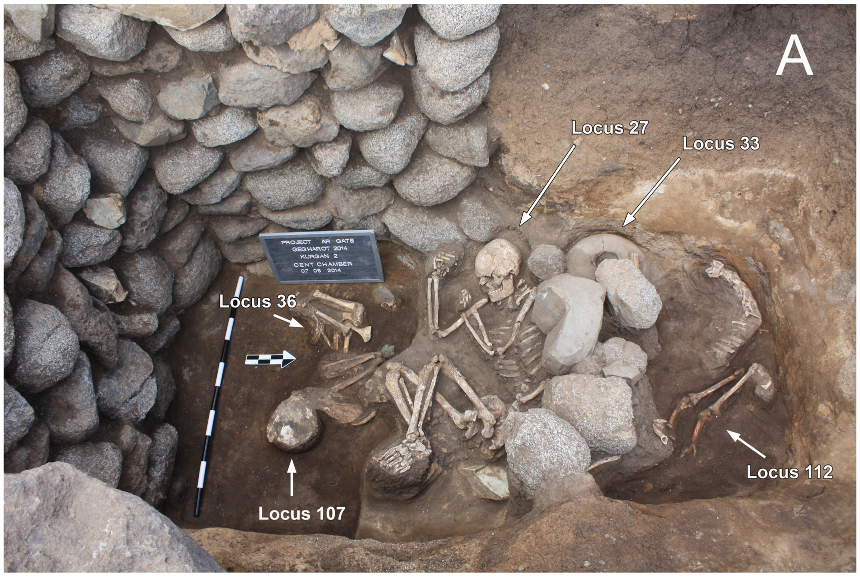
In the northern half of the chamber, a whole sheep, with its head and forelimbs removed, was placed in on its back, with its legs folded back and lying on top of the rib cage. This animal was between 2.5-3.5 years of age, according to epiphyseal fusion. The phalanges were missing, and there were butchery marks on the astragalus, which indicates that animal was skinned and then partially butchered (removal of head and forelimbs), before being placed whole into the chamber. These remains were not resting on the clay floor, but above it, in the dark-brown mottled clay-loam matrix that filled the chamber. This may suggest that the sheep was placed in after the chamber was partially filled. However, the matrix in between the upper and lower burials and the relative levelness (in the horizontal plane) of the upper body indicates that after the placement of the lower body and the vessels on the prepared clay surface, the chamber may have been partially filled with soil before the second body and the artifacts from the northern part of the chamber were placed in (as they were also sitting above the prepared clay surface) (Figure C.8). After the whole chamber

Figure C.7. Upper body in the central chamber.

had partially filled with soil, a line of rocks either fell or was intentionally placed on top of the spine of the upper body (Locus 27). Quoting from Marshall's 2014 report:

> "[the] line of rocks is essentially on the ribs and vertebra of locus 27 [upper body]. It is possible that locus 27 slumped backward under this "wall" during post-depositional and decomposition processes. However, that would mean that the soil on the other side of the "wall" was not well packed and allowed for slumping. Another possibility is that these rocks are somehow "wall fall" although there is not obvious part of the western wall from which they may have fallen. A third possibility is that the stones were placed on top of locus 27 intentionally."

The third dagger (Ar/Ge.K2.18.M.03) was resting in the fill, just above this line of rocks (Locus 39). Then the chamber was closed and covered somewhat haphazardly with quite a few large rocks.



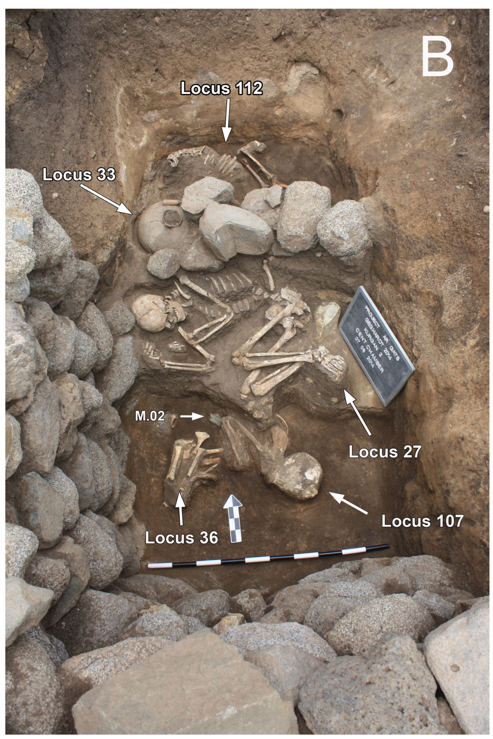


Figure C.8. The central chamber, showing the relationship between the upper and lower bodies.