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Mobility, Cooperation, and Emergent Social Complexity in the Late Neolithic Near East

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by

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ABSTRACT OF DISSERTATION

Mobility, Cooperation, and Emergent

Social Complexity in the

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Professor Elizabeth F. Carter, Chair

This dissertation elucidates cooperative socioeconomic behavior among agropastoralists at the Late Neolithic Halaf site of Domuztepe (ca. 6000-5450 cal. BCE) in southeastern Turkey. Using zooarchaeological and biogeochemical analyses of faunal refuse, I examine cooperation and its bearing on emergent social complexity in agropastoral production in day-to-day consumption and at instances of collective action— large feasting events. Data from this dissertation provide strong evidence for cooperation among people at several scales: among members within households and among households at Domuztepe and other sites, and at a sub-regional level within the Halaf cultural sphere, at a regional scale throughout the Halaf cultural sphere, and, more rarely, supra-regional interaction.

Evidence from large communal feasting events at Domuztepe indicates cooperation exceeding the household level. Faunal refuse, ceramic data, and food preparation facilities indicate these events were communal and comprised a large number of participants. Analyses and comparisons of zooarchaeological assemblages from daily consumption and three feasting assemblages from Domuztepe show changes in the scale of feasting events over time. At later events participants chose to slaughter animals that were more costly in their resource inputs, potential to produce secondary products, and impact on herd security. Biogeochemical data suggest that animals slaughtered in all contexts came from the same herding system. At these later events choices were made primarily for social rather than economic reasons. Biogeochemical studies of livestock, human, and dog teeth from daily consumption and feasting deposits at Domuztepe also indicate cooperation within the community. Different households made individual decisions to keep some stock — cattle, pigs, and some caprines — close to the site. These data also show that Halaf people practiced caprine husbandry encompassing greater geographic range and likely necessitating that some portion of the population be away from the site to care for these animals for some period of the year. This type of pastoral specialization, even if only temporary, would require a different type of cooperation. These data are correlated with artifactual data from Halaf sites throughout the cultural sphere, providing evidence for sub-regional exchange and cooperation among communities within sub-regions of the Halaf cultural sphere. Taken together these data elucidate emerging social complexity in the region.

This dissertation of Hannah Kwai-Yung Lau is approved.

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To my father, Herbert Gartow Lau, for nurturing my intellectual curiosity,

and for pushing me to reach the Castle in the Air.

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Table of Contents

List of Figures

List of Tables

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CHAPTER ONE: INTRODUCTION

During the Late Neolithic Halaf Period (c. 6100-5200 cal. BCE) people in Northern Mesopotamia were just beginning to experiment with altering the scale at which their social, economic, and political networks were structured. This dissertation examines the emergence of incipient social complexity at the Halaf site of Domuztepe (ca. 6000-5450 cal. BCE) in southern Turkey. I demonstrate that if we pay explicit attention to the scale of cooperation among people, we can identify changes in their relationships with one another and track the transformation of different forms of social organization. Cooperation can create the opportunity for the emergence of inequality and is essential for further social complexity. The Halaf period is one in which people experiment with different levels of integration. I specifically focus on evidence of cooperation in agropastoral production and consumption via zooarchaeological and biogeochemical analyses from faunal remains recovered at Domuztepe. I then demonstrate how evidence of cooperation and emergent inequality at Domuztepe correlate with evidence in the Halaf region for cooperation and coordination in raw material procurement, craft production, and the inception of accounting practices. Together these data indicate that at Domuztepe, and perhaps at some other population centers during the Halaf period, people began to experiment with new forms of social integration and organization.

1.1 Present Views of Social Complexity and Agropastoral Production in the Late Neolithic Halaf Period

One of the most studied examples of the emergence of social inequality and complexity is that of the Ancient Near East. Research has focused primarily on city-states in the late Chalcolithic Uruk period (e.g. Algaze 2005, 2008; Stein 1994) where inequality is clearly present. Scholars have also focused on the chiefdoms of the early Chalcolithic ‘Ubaid period (e.g. Stein and Rothman 1994), although when in this period chiefdoms first developed is contested (e.g. Akkermans and Schwartz 2003: 178). The period understudy here — the Halaf period — precedes the clear development of chiefdoms and states, when people were just beginning to experiment with altering the scale at which their social, economic, and political networks are structured. At present scholars are divided on how to interpret sociopolitical complexity among Halaf communities. Some envision that people of this period inhabited egalitarian village communities (e.g. Akkermans and Schwartz 2003), while others see the region as divided into full-fledged chiefdoms (Flannery and Marcus 2012; Watson and LeBlanc 1990).

Domuztepe is a large Halaf site that offers an excellent case study for examining the relationship between agropastoral cooperation and emergent social complexity. Excavations, which ran from 1995 to 2008 as a joint UCLA and University of Manchester project, and from 2008-2011 as a joint project between the University of Manchester and the British Museum, have yielded assemblages of faunal material from three feasting contexts as well as numerous domestic contexts. In this dissertation I employ a contextual, multi-scalar approach to integrate zooarchaeological and biogeochemical data from faunal assemblages at Domuztepe in order to examine agropastoral production and cooperation as exhibited through feasting among people associated with the site. Specifically I look at how ancient people managed their herded stock for both day-to-day consumption and for periodic large communal feasts, and how those behaviors become more elaborate over time. The regular and increasingly elaborate feasting events held at Domuztepe provided opportunities for relationships between participants to be transformed and for ambitious actors to experiment with establishing relationships of unequal power.

Despite disparate views of how to characterize sociopolitical complexity during the Halaf period, scholars do broadly agree that people in this period were often mobile and that more settled and more mobile parts of the population were frequently interacting, perhaps even integrated as social groups (Akkermans and Schwartz 2003; Akkermans and Duistermaat 1996; Bernbeck 2008, 2013; Frangipane 2007, 2013). There is little consensus, however, about the mechanics of the relationship between these parts of the population. Halaf period peoples are presumed to be moving among and between occupation sites, but such movement is interpreted as occurring within sociopolitical milieus that assume wholly different levels of sociopolitical complexity. Further, the geographic and social scale of this presumed interaction varies in different conceptions of Halaf sociopolitical organization. People may have been fully settled, fully mobile, or vacillated along the spectrum. Such mobility is important and of interest because it likely required Halaf-period people to establish cooperative relationships within and among different segments of the household, village, and even regional population to ensure that all members had access to necessary agropastoral and craft products they might need.

Halaf period peoples' coordination in agropastoral production has implications for reconstructing the agropastoral political economy. Halaf period people, at the most basic level, raised animals for the products they yielded: meat, hide, bone. Some taxa also provided secondary products: dairy, fiber and labor. But domesticated animal stock was also desirable for how those basic products could be increased and transformed. Domesticated animals are an excellent way of meeting subsistence needs because they are a form of "on the hoof" storage, where resources are ready and waiting for use. Stock animals thus represent energy capture over time. As such, domesticated animals can be valued as a form of wealth, representing considerable inputs of resources and potential expenditures. Halaf period people made their subsistence choices in tandem with crop cultivation, which provided equally essential and complementary products for both day-to-day subsistence and for how such products can be transformed for social and, perhaps, political, purposes. Ancient herders were conscious of the many ways surplus animals could be used.

People dictate the life of herded animals, managing all aspects of their care and reproduction and even when the animals' lives end. But herded animals also dictate human lifeways. These animals have particular needs of food and water, which may require their herders to move them over great distances. Meeting these needs can structure human mobility. Integrating these needs into other, competing kinds of labor, such as those related to crop cultivation and craft production, can alter social, economic, and political relationships among agropastoralists. In order to accommodate spending long periods of time in different geographic locations focusing on animal husbandry, herders must cooperate with others who can complete other necessary labors, such as tending crops, maintaining structures, or acquiring and producing tools and other crafts. Such cooperation may be organized at a household level, among households within a village, or among distinct and economically specialized communities. As the scale of such cooperation increases, so do potential returns. With an increase in returns, there are more opportunities for enterprising individuals or groups to harness these processes for their own status elevation as managers or as the beneficiaries of unequal access to particular resources.

In this dissertation I apply theoretical models from interdisciplinary work on cooperation and collective action to evaluate the dynamics of feasting at Domuztepe, and the emergence of inequality and social complexity in the prehistoric Ancient Near East. Below I provide an overview of relevant work in cooperation and collective action and how they have been applied to archaeology. I summarize the structure of cooperation and collective action in agropastoral production and consumption and outline the methods used in this dissertation to study these processes.

1.2 Cooperation and Collective Action in Archaeology

Understanding how and under what circumstances individuals are likely to cooperatehas been a central research question in many interrelated social science fields: economics (Olson 1965; Ostrom 1990, 2000), political science (Axelrod 1986), sociobiology (Axelrod and Hamilton 1981), and sociology (Oliver 1993). Anthropologists have long been concerned with cooperation within and among groups (e.g. Mead 1937) but recent discussions drawing on work in related disciplines focusing on cooperation and collective action have breathed new life into the topic within archaeology (Blanton and Fargher 2008; Carballo et al. 2011; Carballo 2012a, b; Stanish 2009, 2012), and have demonstrated that reframing discussions of cultural evolution as studies of cooperation is a profitable way to evaluate sociocultural change. Archaeologists frequently examine the products of cooperation and collective action. Thus theoretical paradigms stemming from cooperation and collective action literature provide a way of interpreting archaeologically-recoverable data in a manner that elucidates group dynamics at multiple social scales and in varying forms of social organization. This is because "cooperative undertakings are nested, segmentary, and fluid," (Carballo et al. 2012:6). The focus, thus, becomes not just the structures, nor just the actors but the interplay between them through cooperative action. At different scales of cooperation, the actors might be individuals, households, communities in a regional system, or factions within a larger social enterprise.

WHAT IS COOPERATION?

Cooperation is the process by which individuals or groups work together to achieve a common end. This common end is mutually beneficial for all members, but not all participants need to benefit equally for cooperation to occur. And in complex, interrelated systems of cooperative activity, the benefit need not be quid pro quo; participants might benefit from being part of a group defined by cooperative relationships if not immediately in every cooperative action. Finally, cooperation among participants is not inconsistent with conflict; indeed monitoring and sanctioning are important components for a functioning cooperative process.

People choose to cooperate with one another, but they do not necessarily cooperate with everyone. Studies in sociobiology explain how cooperative behaviors can evolve in the first place. Axelrod and Hamilton's study (1981) of the evolution of cooperation in organisms from bacteria to primates exemplifies this type of study. Using a Prisoner's Dilemma Game simulation they model how cooperation based on reciprocity begins and perpetuates itself among actors at any level of biological complexity. Their model predicts that cooperative behaviors gain footing either through kinship mechanisms, or when a cluster of "mutant strategies," including cooperative strategies, becomes a large enough proportion of the strategies used by actors to tip behavior from asocial to cooperative. Once in place these behaviors can take hold and become "evolutionarily stable." Cooperation, they found, flourishes when others notice uncooperative individuals and appropriate retaliation is taken. This behavior is found in organisms from the microbial level through humans.

Cooperation thus thrives when participants can monitor each other's behavior, and punish those who fail to act cooperatively. Conflict is thus a frequent part of the cooperation process. One means by which cooperation is monitored and maintained is through the development of norms (e.g. Axelrod 1986; Binmore and Samuelson 1994; Ehrlich and Levin 2005). Work on the evolution of norms has been interdisciplinary, and definitions of norms vary, generally encompassing expectations, values, and behaviors. Axelrod favors this definition: "A norm exists in a given social setting to the extent that individuals usually act in a certain way and are often punished when seen not to be acting in this way," (1986:1097). Other definitions from game theory suggest, "norms… are the solution to coordination games… built up from the choices of rational, self-interested individuals," (Boyd and Richardson 1994:73). Norms ensure that individual actors will engage in cooperative behavior, but social groups, it seems, must also have reinforcing mechanisms that ensure the norms are preserved. Axelrod (1986) identifies eight different mechanisms groups use to maintain norms: metanorms (where those who fail to punish norm violators are also punished), dominance, internalization, deterrence, social proof, membership, law, and reputation. Each of these mechanisms reinforces norms of sharing between people or internally within participants. For example, reputation works as a mechanism to ensure people conform to norms because it influences how others act towards the subject, including whether they are willing to cooperate with her/him. Internalization as a mechanism works differently; when norms become internalized within members of the community they may experience psychological pain by violating the norm, and thus be deterred from doing so (*Ibid.*: 1104). These insights offer important contributions to studying cooperation and collective action in archaeological case studies. They show us that cooperation can take hold and flourish when participants are either related to one another or can observe each other's behavior. The mechanisms Axelrod identifies are universal human traits, but are expressed differently in different cultural contexts. By focusing on the particular form these mechanisms are employed in specific cultural contexts aids in the identification of the social scale at which cooperation occurs. Studies of cooperation based on experiments, simulations and case studies, also show that certain mechanisms must be present to support cooperation. Carballo refers to the four most important mechanisms that promote cooperation as the "the Four Rs… (1) reciprocity, (2) reputation, (3) retribution, and (4) reward" (2013a: 11), in which he groups several empirically-identified mechanisms together.

WHAT IS COLLECTIVE ACTION?

Collective action research also emphasizes that people are able to organize at all levels of social interaction to achieve common ends. Collective action is, at its essence, "something people do together," (Oliver 1993:276). Collective actions are discrete events that are the product of cooperation among participants. Research on collective action has demonstrated that certain parameters must be met in order for it to occur successfully.

In order for collective actions to succeed, participants must find ways to ensure that some individuals are not able to reap its benefits without adequately contributing to the action. Olson's (1965) work on the logic of collective action has heavily influenced present discussions. Prior to Olson's work, most social scientists assumed if something were good for the collective body people would willingly contribute to it. Olson argued that, in fact, rational individuals would not willingly contribute:

> Indeed, unless the number of individuals in a group is quite small, or unless there is coercion or other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interests*. (1965:2, emphasis in the original)

In order for collective action to occur, then, the group must be small enough that free riders will be spotted, or there must be a means of rewarding participants that is excludable and/or punishing non-participants. Olson's "zero contribution thesis" (Ostrom 2000) has certainly been critiqued, particularly the assumptions underlying the use of "selective incentives" and group size (see Oliver 1993 for a summary of Olson's influences and critiques). Ostrom points out that collective action "contradicts observations of everyday life" (2000: 137) in myriad case studies. But it highlights a fundamental obstacle for many cases of collective action: how to compel individuals to participate.

The free-rider problem and the way different self-governing groups have dealt with it are often evident in Common-Pool Resource (CPR) dilemmas. A CPR is "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining the benefits from its use" (Ostrom 1990:30). CPRs include the classic dilemma of "the tragedy of the commons" (Hardin, G. 1968). In such cases, as Olson predicts, individuals will be tempted to free-ride on the contribution of others to the collective action. Ostrom's (1990, 1999, 2000; Gardner et al. 1990) work on the topic has demonstrated that collective action, despite these temptations, does occur. Certain factors like the size and heterogeneity of the group, how much the group depends on the good, and its relative scarcity can promote or hinder collective action (see Ostrom 1999:2 for all factors). In her survey of diverse case studies, Ostrom found that all successful, multi-generational self-organized groups that govern resources choose to invest in monitoring and sanctioning individual participants to combat free-riding (1990).

Ostrom bridged the gap between outcomes in many experimental settings and fieldwork by advocating the assumption that not all actors conform to the standard model of rational egoist (1999); multiple types of players exist, including those who will adopt social behavioral norms. She demonstrated that, "in non-market settings, when users of social norms can identify one another, norm-users can survive and even flourish," (1999:3). Social norms promote cooperation, as long as individuals feel confident that others are practicing them as well. Thus, communication among participants, particularly face-to-face communication, promotes cooperation, as does endogenous sanctioning.

Not all collective actions are CPR dilemmas, although the literature devoted to these sorts of problems is extensive. The broader definition of collective action — people working together to some collective end — encompasses many more types of behaviors. But the cases of CPR dilemmas, like those in cooperation, do highlight some of the important features in a system to promote or discourage people from acting together. These studies show us that it is not sufficient to assume all players are simply rational egoists; at least some players are likely to be predisposed to cooperate and are able influence others to do so as well. This is how people permit collective actions to take hold. These studies also show similar findings to studies in cooperation, namely that participants are more likely to work together when certain mechanisms are present to allow them to assess and monitor others' actions. Participants are more likely to cooperate with one another if they can communicate with one another, ideally face to face. If actors are able to see that others are following social norms, then those behaviors will flourish within the group. Further, participants are more likely to work with one another if they can punish those who fail to act in the group's interest. The ability to monitor and, if necessary, sanction others' behavior promote cooperation and collective action.

COOPERATION AND COLLECTIVE ACTION IN ARCHAEOLOGY

Archaeological research is well poised to contribute to the ongoing interdisciplinary discussions of cooperation and collective action. Collective actions are discrete events of cooperation, and are arguably more visible in the archaeological record. Archaeologists frequently examine ancient peoples' collective actions. Whenever we look at large-scale constructions (e.g. walls, earthworks, irrigation systems, public monuments), for example, we are looking at the product of people working together to produce something. Similarly, whenever we look at communal rituals, such as the remnants of feasting events, we are looking at remains of collective actions. Other types of collective actions, for example the distribution of common pool resources, may only be inferred from archaeological data or may be recorded in historic and ethnohistoric accounts. The archaeological manifestation of these collective actions may be more diffusely deposited. Cooperation is a process that we infer from the archaeological record. We infer such cooperative behavior, for example, when we look at archaeological cases with evidence of economic specialization, which can only work if participants who focus on different types of production intend to share the fruits of their labors with one another, whether by norms of food sharing, social practices of redistribution, or full blown exchange. These are specific case studies, which offer both greater time depth than those in other fields, and an perspective that differs from insights gained through models or experimental work.

In recent years several archaeologists have sought to explicitly frame archaeological studies to elucidate cooperation and collective action. Case studies focus on aspects of how cooperating groups grapple with (or fail to grapple with) issues frequently modeled in experiments and simulations of evolutionary cooperation such as free-riding (Eerkens 2012), reciprocity (Carballo 2012c), reputation building and the enforcement of social norms and punishments (Stanish 2009; 2012). Eerkens's case study (2012) focuses on changes in cooperative behaviors among people in Owens Valley California between 1500 and 700 BP. He argues that people in Owens Valley began to increasingly privatize access to resources as a way to mitigate issues of free-riders as the population became more sedentary and grew in. Eerkens cites changes in subsistence practices that employ individual rather than cooperative techniques and unequal access to interregional trade as indicators that intravillage cooperative links broke down during this period of demographic change. These changes, he argues, are evidence of a shift toward privatization. Interregional cooperation, however, seems to have increased during this period, as independent households sought to ensure access to resources unavailable in Owens Valley. Carballo's case study examines evidence of reciprocity among labor collectives in pre-Hispanic Central Mexico (2012c). Using ethnographic and ethnohistoric data Carballo shows how the reciprocity engendered by cooperative labor was likely a major structuring institution in Formative period life, and was closely tied to ritual. This system may also have laid the foundation upon which leaders were able parlay their role in coordinating cooperative projects into opportunities to distinguish themselves, thus creating inequalities that become more fully-expressed in the Classic period. Similarly, Stanish's case study (2009, 2012), explained in detail below, shows how ritual activity can promote cooperation by creating an opportunity for community members to assess each other (reputation building), reinforce social norms and punish violators. Collectively these three selected case studies demonstrate the ability of archaeological data to show how these conundrums played out in specific historical cases. These case studies answer the frustration that some have lodged about the epistemic validity of social theories based solely on controlled experiments and computer simulations, even those premised on specifically archaeological cases (e.g. Powers and Lehmann 2013).

A few archaeologists have explicitly set out to examine collective action. Blanton and Fargher's (2008) cross-cultural comparison of thirty societies across six geographic macroregions is perhaps the most comprehensive and explicit attempt to use collective action theory to evaluate anthropological data. They statistically evaluate all thirty societies along four parameters (public goods, bureaucratization, principal control and revenue sources) and determine that the assumptions of collective action theory find strong support. They develop a model (2008:254) arguing that the type of revenue source supplied by the taxpayers to the rulers is the causal determinant for broadly different forms of collective polities that emerge through bargaining between taxpayers and rulers. Other scholars have also undertaken studies aimed explicitly at identifying collective action in archaeological case studies. Saitta (2007; 2012) highlights a number of cases in the historical United States where researchers were able to identify collective action among groups united by race, gender and class. Roscoe (2012) also identifies collective action among groups, specifically focusing on how groups cooperate in times of conflict. Importantly, Roscoe points out that not all types of collective action result in long-term group formation (*Ibid.*: 60). Taken together these studies show how bringing explicit attention to collective action can bring social relationships to the foreground; they do not simply identify the products of the collective action, but also the social arrangements that create them.

1.3 Cooperation, Inequality, and Social Complexity

Cooperation has been present among all human groups, regardless of their social organization. It exists in tension with humans' desire to express dominance (Feinman 2012; Price and Feinman 2010). This tension has been ever-present in human groups, as summarized by Price and Feinman:

> the biological imperative for dominance behavior, common in our closest animal relatives, was dampened by a cultural mechanism. This mechanism, known as egalitarianism, reflects the importance of cooperative behavior in the emergence of culture, in learning and sharing knowledge, and in survival. Human society operates within this didactic tension between dominance and equality, between hierarchical and egalitarian, between modes of behavior that feature or privilege the group to those that accent individuals. (2010:3).

They argue that cooperation and egalitarian behaviors shaped early human societies, but that the inception of farming societies permitted dominance behaviors to be expressed and social inequality to arise (this is also arguably true among complex hunter-gatherers). They define social inequality as "the organizing principle of hierarchical structure in human society, [which] is manifested in unequal access to goods, information, decision making, and power," (2010:2). Price and Feinman argue that the manner in which these two tendencies – to cooperate and to dominate—are incorporated into new social arrangements shape the form of social inequality and leadership in different societies. Cooperation is not in opposition to inequality, but frames the form inequality may take; they favor the dual processual spectrum of corporate and network/exclusionary modes (Blanton et al. 1996, Feinman 1995) as the way of expressing the range of social arrangements that emerge in hierarchical societies.

As the social scale of cooperative activities grows, so do the opportunities for individuals or groups to find ways to profit from or manage these activities. Stanish (2009), through an examination of communal ritual in the Titicaca Basin in 1,400 BCE, demonstrates that by creating cooperative labor arrangements, managerial elites were able to emerge. This resulted in higher levels of cooperation and political integration and the codification of inequalities among participants in the system. But such integration was likely tenuous—if managerial elites were unable to meet the parameters that encourage cooperation such as fairness and meting out sanctions, the underlying cooperative system would collapse (2009: 117). Eerkens posits a similar scenario for c. 300 BP Owens Valley, California, where leadership at the village level may have emerged to promote cooperative behaviors by holding the ability to mete out punishment and enforce rules and norms (2012: 168). Village members may have decided it was worth the loss of some autonomy for the benefit of having one leader empowered to promote cooperative activities and punish those who violate norms of cooperation. Concomitant with the inception of local leadership Eerkens identifies an increase in the scope of intravillage cooperative ventures in some aspects of daily life: feasts, war parties and rabbit hunting (*Ibid.*: 165). Thus the need to foster cooperative behaviors can both create the opportunity for leadership, and leaders can simultaneously promote further cooperation.

In this dissertation I argue that by examining the development of cooperative relationships among ancient people we can trace the development of increasingly complex social interactions and, in some cases, social complexity. Social complexity is defined here following Feinman (2012: 37) as "the emergence of societies marked by hierarchical leadership and socioeconomic inequalities." Cooperation is essential for social complexity; cooperation among individuals does not necessitate the emergence of social complexity, but social complexity cannot occur without it. By focusing on ancient peoples' cooperative activities and the scale at which they occur (the household, among households within a community, among factions within a community, among communities, etc.) we can identify when and in what manner these networks grow and change. And as ancient people forge more complex networks of cooperation, cooperation at smaller scales endures, and continues to do so even after the other networks break down. This permits us to look at what types of cooperation are resilient to shifts in sociopolitical organization, and which are contingent on them.

Placing an emphasis on studying cooperation among ancient people bridges the gap between top-down and bottom-up explanations of social complexity. Studies of social complexity view the origins of social complexity from one of two perspectives (e.g., Janusek and Kolata 2004:405): those that see collective actions such as intensified production spurred and stewarded by some sort of authority figure and those who see collective action as the result of locally organized initiatives. These views are often presented in opposition to one another. Focusing on who is cooperating with whom to solve these collective action dilemmas can help reconcile these two types of explanations and allow us to tease apart overlapping social interactions.

COOPERATION, SOCIAL COMPLEXITY AND THE HALAF PERIOD

The Halaf Period is a transitional one for social organization, where different individuals and communities are experimenting with various forms of cooperation and sociopolitical organization. Such experiments are evident in cooperation in agropastoral production, in herding practices and in agropastoral consumption in the form of large feasting events, which served as points of redistribution within the cooperative system and as points of monitoring and reinforcing cooperative activities. Cooperation is also evident in sub-regional, regional and interregional trade in raw materials, and in the production and distribution of craft goods from these materials. In some cases, these experimentations may have permitted inequalities to develop and leaders to emerge, although their power may have been fleeting. The Halaf period marks the *beginning* of incipient complexity in the Ancient Near East.

In the succeeding sections I describe how cooperation and collective action in agropastoral production likely functioned, and how such cooperation would have been potently expressed in feasting events. I then describe the importance of feasts as opportunities for both group unification, monitoring, and as opportunities for aggrandizers to distinguish themselves and forge new types of social organization. Finally, I describe the methods by which cooperation and collective action are examined in this dissertation, and how these processes and activities may have created opportunities for enterprising individuals and groups to establish inequalities in access to resources or decision-making at different social scales.

1.4 Cooperation and Collective Action in Agropastoral Production and Consumption and its Implications for Social Complexity

COOPERATION IN AGROPASTORAL PRODUCTION

Assessing cooperation and collective action in how people produce the resources they consume is one avenue for exploring group dynamics at multiple social scales (e.g. among members within a village, intercommunity cooperation at micro and macroregional levels, and as a collective polity). Indeed, archaeological case studies emphasizing the role cooperation plays in groups and polities have frequently focused on resource production. Examples include the role of collective action in large-scale irrigation projects (Spencer 1993; Carballo et al. 2011), control over scarce water resources (Chabot-Hanowell and Lucero 2013) and the causal link between resource exploitation in determining forms of collective action identified by Blanton and Fargher (2008). These recent studies suggest that a profitable line of inquiry could make use of a large existing body of archaeological data about subsistence economies across the world and the role that intensifiable resource production can have in the formation of villages (Bandy and Fox 2010) and in the creation and maintenance of trans-egalitarian (Hayden 2009) and more complex forms of social organization (e.g. Johnson and Earle 2000; D'Altroy and Earle 1985).

Collective action in resource production, often aimed at reducing risk or at the intensification of resource production, frequently comes with some trade-offs for participants. In order to reap the benefits of the economies of scale that may prompt collective action in subsistence matters, participants may need to engage in some degree of, if not full-fledged, economic specialization (Stanish 2009). As a result, however, they lose their autonomy over their own subsistence, as they no longer produce all that they need for themselves. Different societies grapple with these issues through the establishment of cultural norms of food sharing, the development of a network of horizontal egalitarian relationships (Frangipane 2007), or the development of managerial elite (Stanish 2009). Examples from recent case studies (e.g. Carballo 2012c) that have reframed archaeological data to focus on the nature of cooperation and collective action suggest that if we can identify the motivation, form, and scale of cooperative resource production we may thereby be able to identify attendant social arrangements. This is an especially promising line of inquiry to elucidate the nature of social relationships during the Late Neolithic Halaf period, where it appears people were experimenting with innovative forms of cooperation and social organization.

AGROPASTORAL COOPERATION IN LATE NEOLITHIC NORTHERN MESOPOTAMIA

Agropastoralists in all contexts balance concerns of fecundity and herd security, labor requirements and costs of rearing animals, productive goals and cultural value placed on livestock as symbols of wealth or ritual significance (e.g. Dahl and Hjort 1976; Greenfield 1988; Lemonnier 1993; Payne 1973; Redding 1981, 1992; Russell 2012; Zeder 1991; 1994). Halaf herders raised domesticated animals to supply their households and communities with a combination of meat, dairy, fibers, and perhaps traction. Different households and communities chose to emphasize these different productive goals to varying degrees. To meet these ends, herders had to invest different types of labor to produce these resources, and such labor had to be conducted in tandem with other obligations. Agropastoral resources formed only a portion of Halaf period peoples' economy, along with craft production and hunting and gathering. To balance these competing obligations, Halaf period people would have scheduled their labor in coordination with one another within their households, within their communities or with other communities with whom they could reliably engage in exchange. Depending on their productive goals such coordination may have resulted in different types of risk-reducing and/or intensification strategies, perhaps requiring both inter- (Beyene 2010) and intra-community cooperation (Agrawal 1993; Næss et al. 2010).

Agropastoralists in the Ancient Near East were also faced with another parameter to consider when organizing their animal economy: the limits of arable land in their environs. Late Neolithic Halaf communities were distributed across Northern Mesopotamia in a geographic belt that broadly corresponds to the area where dry-farming is possible (i.e. receiving an annual rainfall of 200 mm per annum or more) (Akkermans 1993; Akkermans and Schwartz 2003; Watson 1982). In many parts of this zone, particularly in the south, however, the environment was characterized by arid steppe land, making farming precarious if not impossible (Louhaichi and Tastad 2010). Herders and cultivators in Northern Mesopotamia have historically been faced with a choice among several agropastoral strategies of how best to exploit these sometimes marginally productive zones. People in early farming societies in the Near East adopted a mixed farming-herding regime based on the cultivation of cereals and pulses and the husbandry of sheep, goats, cattle, and pigs. Agropastoralists during all periods made specific choices about what proportions of different crops or species to raise based on the amount of water and natural rangeland available to them (Dahl and Hjort 1976; Zeder 1991). In arid regions of the Near East inhabitants (past and present) frequently chose to focus on more drought resistant crops like barley and animals like sheep and goats which require less water or less quality browse than other domesticated taxa (Dahl and Hjort 1976) to cope with microregions where water and good grazing are more scarce.

The manner in which (agro)pastoralists in Ancient Northern Mesopotamia grappled with the environmental constraints of their region in any given period led to many different forms of cooperation among people within communities and among communities (Wilkinson 2003). Archaeological evidence indicates that at times inhabitants chose to rely on a mixed cultivating-herding system with relative autonomy, while at others, they chose to specialize in exploiting particular resources such as hunting or herding with the intent of cooperating with cultivators to acquire goods they needed. Such specialization may have been temporary (e.g. seasonal), with specialists returning to a more generalized subsistence strategy after amassing sufficient resources, or it may have been a permanent occupation. As described above, a focus on herding in particular may have required some Halaf period people to travel great distances for part of the year to find sufficient pasture to support large flocks without competing for arable land used for cultivation. And in order to focus on any particular resource, temporarily or permanently, people had to make trade offs, relying on other members of their household, their community, or other communities with whom they interacted to provide the resources they could not produce for themselves as a consequence of their focus. This fluidity in form and duration of cooperation is consistent with the theoretical framework delineated above.

Zooarchaeological and biogeochemical data analyzed in this dissertation indicate that at Domuztepe Halaf period people engaged in cooperative relationships with one another at a local and sub-regional level to produce animal products and maintain their herds. Such cooperative relationships were structured by the labor demands dictated by different aspects of agropastoral production – what primary and secondary products they aimed to produce – and the resource demands of their livestock in conjunction with the limits of their environment. Data from some other Halaf sites (detailed in Chapter Two) also indicate that inhabitants focused on particular agropastoral resources, which suggests such arrangements were not uncommon during this period.

COLLECTIVE ACTION IN AGROPASTORAL PRODUCTION: COMMUNAL RITUALS AND FEASTS

Communal ritual activity is another example of collective action. Communal rituals may vary among any number of parameters — the goals, form, number of participants — but in all cases they are "something people do together," a collective act. And frequently the goal also addresses a collective interest.

Ritual events are not only the product of cooperation among participants, they are also an important means of promoting cooperation beyond the ritual. Stanish (2009, 2012) has argued that rituals offer a means "to create and maintain cooperative organizations in intermediate societies" (2012: 87). In his model, political rituals involving feasts are the mechanism through which leaders constituting a managerial elite emerge. Leaders' power hinges on their ability to foster cooperative behavior among their group through persuasion rather than coercion (Stanish 2009). Stanish envisions that if there are 1) sufficient economic mechanisms to make cooperative arrangements more beneficial to individuals than individual labor and 2) a social mechanism that can ensure that such cooperation is both fair and beneficial, cooperative systems may proliferate. He suggests that ritual and ritually embedded feasts can function as these social mechanisms, where ritual beliefs "reinforce norms of fairness and reciprocity"

(2009:108) and thus can function as the punishment to discourage uncooperative individuals. If one violates norms of contribution, the ramifications are more than just social; they may be mediated by higher powers. Stanish identifies ritual taboos and magic as means of punishing or sanctioning cooperation. Ritual feasts function as the material benefits for cooperative individuals, redistributing resources produced in specialized production. Attendants are motivated to cooperate so as to avoid ritual punishment and reap the benefits given at the events.

It is clear from the studies in cooperation and collective action highlighted above that cooperation is more likely to occur if participants can communicate with one another directly, and thus monitor that each are cooperating. Participants are also more likely to cooperate with one another if they can sanction free riders and those who are uncooperative. These monitoring and sanctioning systems can take many forms and several mechanisms often operate simultaneously. Communal rituals offer the opportunity for communication, monitoring and sanctioning to occur. Individual participants come together at ritual events and thus have the opportunity to interact and communicate with one another face-to-face. They can observe one another's contributions to the collective action. And, as Stanish proposes, they can reap the benefits of cooperative production.

This study looks specifically at the production of agropastoral resources, so the role of food and feasting in social relationships is pivotal. Below I briefly discuss the role of feasting in political economy, and expand on how feasts function as a mechanism for promoting cooperation among participants.

FEASTING AND ITS IMPLICATIONS FOR POLITICAL ECONOMY

Food, a form of economic capital, is often manipulated to accrue symbolic capital. Food, as a biological imperative, is intimately and inextricably connected with social life and social identity (Atalay and Hastorf 2006; Twiss 2007). Atalay and Hastorf identify foodways as "the ultimate habitus practice" (2006:283). The effort to feed oneself occupies a primary place in human behavior cross-culturally, structuring one's lifeways, and one's labor (Pollock 2002; Welch and Scarry 1995). Food production and consumption can structure how people spend their days throughout the seasons, and the quest to produce, prepare, and consume food intersects, structures, and defines social relations. Changes in foodways can correlate with changes in social and political organization over time (Hastorf and Johannessen 1993).

What, when, with whom, and how we eat are defined by the sociocultural milieu in which we eat (Twiss 2007; Welch and Scarry 1995). As Twiss points out, food literally constitutes us, and thus serves as a powerful marker of identity:

> Food is an unusually powerful symbol of identity because foodways involve both the performance of culturally expressive behaviors and the literal incorporation of a material symbol. Food acquisition or production, distribution, consumption, and discard practices are all intimately intertwined with ideological and economic realities. They also offer a wide range of opportunities for group or self-identification. (2007:2)

Sharing of food is a powerful means of creating and reifying social relationships. Commensality, whether in quotidian contexts of daily meals or in more episodic events tied to feasts or public rituals, is a primary means by which groups define themselves. Ethnographic and historical examples show the cross-cultural ubiquity of the use of commensality to define social communities or sub-groups within existing communities (e.g. Adams 2004; Kirch 2001; Lev-tov and McGeough 2007; Potter 1997, 2000; Rosenswig 2007; Weissner 2001). Similarly food taboos can be another means of circumscribing one's social group (Hesse and Wapnish 1998; Russell 2012).

Feasts are a prime arena for the mobilization and manipulation of foodways and may be thus manipulated to achieve political purposes. Sometimes these events can alter existing social relations, resulting in the emergence of different forms of leadership and social inequality. Feasts are broadly defined as any events featuring the communal consumption of food and drink that differ in marked ways from daily meal consumption or food exchange without commensal consumption (Dietler and Hayden 2001:3). Various operational definitions emphasize specific aspects of the feast, such as food (Hayden 2001a), ritualization (Dietler 2001), or attendant guests (Russell 2012; Wiessner 2001).

Feasts offer a means for both creating and consolidating power in the hands of the organizers. These events are of integral importance to agency-based (Helwing 2003) or political explanatory models of the emergence of social complexity. If social complexity arises through, "a dynamic interaction between ambitious personalities and cultural institutions," (*Ibid.*:65) as these types of models posit, feasts afford a locus for such contact to occur — one that is often highly emotionally charged. They thus simultaneously promote social cohesion among the participants through the act of eating together and allow ambitious individuals or small groups to alter existing social relations. These ambitious personalities —sometimes called aggrandizers (Clark and Blake 1994; Hayden 2001a) — can use these opportunities to advance their political and economic interests.

Feasting behavior can be classified in a number of ways based on the form, function, or material contents of the feast (e.g. Hayden 2001a; Perodie 2001). Given the question of the role feasting can play in cases of emergent or transitional political complexity, it is of particular interest to consider the way public events create and manifest community relations and organization while simultaneously offering opportunities to change existing relations. Dietler's (2001) typology is particularly relevant here. Dietler delineates a three-part functional typology of feasts based on the way these events alter and reinforce social roles among individual participants. The three types of feasts are Empowering Feasts, Patron-Role Feasts, and Diacritical Feasts. Dietler defines Empowering Feasts as feasts that involve, "the manipulation of commensal hospitality toward the acquisition and maintenance of certain forms of symbolic capital, and sometimes economic capital as well," (2001: 76). Patron-Role Feasts comprise those that involve "the formalized use of commensal hospitality to symbolically reiterate and legitimize institutional relations of asymmetrical social power." (*Ibid.*: 82). This is the type of feast Dietler equates with the classic "redistributive feast." Empowering Feasts and Patron-Role feasts are similar in the manner in which they affect social relations. What differentiates an Empowering Feast from a Patron-Role Feast is not the manner in which commensal politics are altered, but in the explicit expectations for reciprocation in the minds of the guests and the hosts. The third type of feast in Dietler's typology is the Diacritical Feast, which "involves the use of differentiated cuisines and styles of consumption as a diacritical symbolic device to naturalize and reify concepts of ranked differences in the status of social orders of classes" (*Ibid.*: 85) In this type of feast, symbolic capital is predicated not on the quantity of commensal goods but on matters of style and taste. Further, the means by which the goal is achieved is different. Instead of creating and codifying asymmetrical relationships by creating reciprocal obligations, whereby one person provides a great deal of goods that the other cannot repay in kind, as occurs in the Patron-Role type feasts, in this type of feast ranked social relations are created by limiting who can participate. By feasting together the social unit is defining themselves as a group apart from everyone else.

FEASTS ARE A MECHANISM FOR PROMOTING COOPERATION

While cooperation in resource exploitation and labor in any context elucidates socioeconomic and political organization, this study pays particular attention to cooperation in resource production as it pertains to rituals, specifically feasts. Feasting by its nature entails explicit cooperation among participants, both through the preparation of food, stages, and other associated materials and through participation in the event. In the last decade there has been extensive discussion within anthropology on the role of feasts in community building and in the creation of inequality (e.g. Bray 2003; Dietler and Hayden 2001; Pollock 2011; Smith 2015). Feasts have been singled out as a prime milieu in which social and political relationships can be reified, amplified or even transformed (Clark and Blake 1994; Dietler 2001; Helwing 2003). Feasts function to both unify the social body and to permit the mobilization and manipulation of foodways by ambitious actors who can use feasts to achieve political ends, sometimes resulting in the emergence of different forms of leadership and social inequality.

Feasts, as Stanish (2009, 2012) has demonstrated, also provide the opportunity to distribute the results of cooperative production and the opportunity for participants to monitor one another. Participants can see what individuals contribute to the events, and may come away with some of the fruits of cooperative agropastoral production. Organizers can use these opportunities for display and creating social debts. And as noted earlier, feasts provide the context for the important face-to-face communication necessary to promote collective action that extends beyond the feasting events. These events are even more powerful when they occur at regular intervals, so that participants know they will regularly be able to reassess how strong other members' commitment is to collective action, thus diminishing the chance that free-riders will go undetected.

When feasting is repeatedly practiced and integrated into a seasonal cycle of events (e.g. into a ritual calendar, or to mark lifecycle events) preparations for feasts may be organized and planned far in advance (Smith 2015). Organizers and participants expect these events to occur at regular intervals, and thus manage their resources accordingly. And when feasts serve as the redistribution point for cooperative production, the planning and production for these events require even more coordination. These managerial decisions can give rise to leadership, and reinforce their position once they emerge.

1.5 Methods of Analysis and Summary of the Dissertation

Cooperation among agropastoralists should be archaeologically evident in archaeobiological data — in botanical and faunal remains recovered at archaeological sites. These are the archaeological remains of ancient peoples' choices of what to cultivate and raise. Halaf period herders' and cultivators' decision-making with regards to animal and plant management strategies should be governed by any cooperative obligations they face. This dissertation assesses such cooperation using data derived from zooarchaeological and biogeochemical analyses from different types of consumption contexts found in excavation at Domuztepe. By elucidating the forms and social scale of cooperation in both subsistence economy and in highly socially charged events such as ritual feasts, this project reconstructs political economy and social organization at Domuztepe, and more broadly across the region. I refer to several scales of geographic integration: Local (within the settlement), Sub-regional (within sub-regions of the Halaf Cultural sphere; this may vary in scale from small valley systems up to areas of about 300 square kilometers as described in Chapter Five), Regional (corresponding to the full extent of the Halaf cultural sphere), and Supra-regional (encompassing interactions with people outside the Halaf cultural sphere).

Process	Subject	Evidence	Social Scale of organization	Chapter
Cooperation	Agropastoral Production	Herding management choices	Local (Household-level)	3 and 4
		Herding across geographic distances	Local (Household-level or possibly households within the local area), Sub-Regional and Regional Scale	4
		Agricultural production	Local (Household-level and community-level)	2 and 5
	Direct Raw Material Procurement	Obsidian, Chipped Stone, Ground Stone, Bitumen, Shell, Metals	Sub-Regional, Regional and Supra-regional	5
	Craft Production	Ceramics	Local and Sub-Regional	5
		Seals	Local and sub-regional	5
		Personal Adornment	Local and Sub-regional	5
		Non-Utilitarian Items	Local and Sub-regional	5
	Shared Style in Material Culture	Ceramics, Glyptic, Architecture	Local, Sub-Regional and Regional	2
	Community-level storage and accounting	Community storage facilities, Systems of accounting (seals, sealings, tokens	Local (within village) and possibly sub-regional	2 and 5
Collective Action	Feasting and Communal Ritual	Feasting events, inclusive of preparation	Local (within village) and possibly Sub-Regional	3, 4, 5
	Large-scale Constructions	Platforms, communal buildings	Local (within village)	2 and 5

Table 1.1 Processes, Evidence and Scale of Organization Examined in this Dissertation

In Chapter Two I give an overview of the Halaf period, with particular attention to evidence of resource production. This chapter describes the homogeneity evident in some aspects of material culture and social practice found throughout a broad geographic region — the Halaf cultural sphere — as well as the great heterogeneity in subsistence, ritual and mortuary practices identified at different Halaf sites. Style in material culture may have functioned to communicate group affiliation (Frangipane 2007; Carballo 2012b: 21), which would have been an important means of signaling members' obligations of reciprocity to one another in cooperative endeavors. The widespread distribution of certain styles in material culture during the Halaf period may have served this purpose. The variation, however, in subsistence and ritual practice likely indicates that while widespread cooperation and interaction may have occurred at a broad sub-regional and regional level, people at individual sites were engaging in different types of local organization. This likely resulted in the different types of experimentation in social complexity evident during this period. I then describe the site of Domuztepe and situate it within the local contemporaneous landscape and within the broader Halaf cultural sphere.

In Chapter Three I analyze aggregate data from faunal assemblages at Domuztepe to identify which animals were selectively culled for different types of consumption. These data are the physical manifestation of Halaf period herders' decisions about animal management in any particular consumption scenario. Patterns evident in demographic profiling in different types of archaeological contexts provide proxy evidence for which management concerns were strongest in each case. Thus the planning and management evident in faunal assemblages from different contexts can be compared in order to see how those concerns were handled. For this dissertation I analyze a large assemblage (N= 13,523 specimens) of faunal material from temporally early feasting contexts at the site. I compare results from this aggregate assemblage to previously analyzed zooarchaeological material from the site, specifically from daily consumption practices (referred to in aggregate as Quotidian deposits) and from later feasting events. The results of these comparisons show that people at Domuztepe made markedly different choices in what animals to consume for daily meals and at feasting events. Evidence from the earlier feasting events indicate that these events served not only as a forum of collective action, promoting cooperation beyond the event itself, but also for a point of redistribution of resources produced in this system. Over time the scale of animal sacrifices included in such events grew, with participants choosing more costly stock (in terms of resource and labor requirements to produce) to slaughter, eventually even including people and dogs among feast offerings.

In Chapter Four I analyze mobility patterns in domesticated animals and consumed humans evident in biogeochemical data from strontium, oxygen, and carbon isotopes drawn from all four zooarchaeological assemblages detailed in Chapter Three. These data elucidate ancient peoples' herd management strategies and the networks of pastoral resources consumers at Domuztepe were accessing, both for daily subsistence and for special events. These data elucidate agropastoral cooperation in a regional context. Results indicate that Halaf period herders likely moved within sub-regions of the Halaf cultural sphere for herding some caprines (sheep and goats). Such long-distance herding would have necessarily been scheduled among other labor tasks, and may have been organized at both a local (within and among households) and perhaps sub-regional level. Other domesticated taxa — cattle, pigs, and some caprines — were more clearly herded at the local level, with likely individual households making choices to fit their specific needs. Detailied values for individual samples are provided in Appendix III.

In Chapter Five I correlate the zooarchaeological and bioarchaeological data with one another and with other aspects of Halaf economy such as sub-regional, regional and Supra-regional trade in obsidian, ceramics and rare materials. The acquisition of non-local raw materials at these different geographic and social scales and the attendant evidence of production of fine craft goods show cooperation beyond the local level. I also trace the development of administrative tools, which may have been employed to monitor cooperative behaviors.

In the conclusion (Chapter Six) I return to the models of social organization proposed for the Halaf period and reassess which are most appropriate in light of the cooperation and collective action evident through my analyses. I also show how these experimentations in inequality and increasing social integration and complexity that develop during the Halaf period become fully-expressed in more archaeologically recognizable forms of institutionalized inequality in the succeeding 'Ubaid period.

Methodological choices clearly influence the results of any type of archaeological analysis. Appendix I describes the research methods employed in the zooarchaeological analyses I undertook for this dissertation. In Appendix II, I describe the research methods employed in the biogeochemical study.

CHAPTER TWO: REGIONAL AND TEMPORAL OVERVIEW OF THE HALAF AND INTRODUCTION TO DOMUZTEPE

2.1 Cooperation At Varying Scales of Social Interaction

This dissertation traces interaction and cooperation among people at multiple social scales at the site of Domuztepe, Turkey. In order to understand such cooperation it is important to understand the geographical and cultural milieu in which this interaction takes place. The term "Halaf" denotes both a cultural horizon defined by a distinct suite of material culture found throughout the Northern portion of the Fertile Crescent and a chronological period (c. 6100-5200 cal. BCE) ascribed either to the late Neolithic (Akkermans 1993:3) or early Chalcolithic (e.g. Garstang 1953; Özbal 2011; Sagona and Zimansky 2009). The second section of this chapter describes the geography and environmental zones that comprise the Halaf cultural sphere. I also discuss the distribution of Halaf sites across the region and evidence of mobility among Halaf people indicated by this settlement pattern.

Halaf material culture is distinctive and found across a wide geographic range. It comprises specific styles of ceramics, architecture, lithics and ground stone, personal adornment, and imagery. Scholars rationalize the reason behind such widespread distribution of such homogeneous material in different ways, each figuring into different conceptions of sociopolitical explanation. But a common thread in many of these examples of distinct items is that style was used to communicate membership within one community or cultural entity among people who interacted infrequently (Frangipane 2007:162. See also Akkermans 1993:318-32; Verhoeven 2002). Signifying membership within a community would have also been an important means of signaling members' obligations to one another as members of a group; it functioned as a mechanism promoting reciprocity to one another in cooperative endeavors. The third section of this chapter details these characteristic Halaf styles. The fourth section of this chapter details a particular aspect of this material culture—innovations in administrative technology. These important developments were crucial for promoting wider scales of interaction among people reliant on one another for coordination in resource production and dissemination.

Despite great and widespread similarity in many aspects of Halaf material culture, evidence from Halaf sites vary significantly with respect to practices that would have framed daily life: in subsistence practices and in ritual practices, particularly mortuary practices. Thus, subsistence production and ritual events were experienced differently among people who were also part of one cultural sphere. There was also variation in material culture that occurs concurrently with the more emblematic Halaf material culture at some sites within the Halaf cultural sphere. The fifth section of this chapter compares and contrasts subsistence practices identified at different Halaf sites for which we have sufficient data. The sixth section describes variability in other aspects of material culture and in Halaf period peoples' ritual practices. This variation is significant for two reasons. First, variation in subsistence practices allowed different Halaf communities to focus intensely on different resources, either by segments of the population for short periods of time or with the intent of sharing or exchanging with other people in the Halaf cultural sphere. Second, the variation in subsistence and ritual practice likely indicates that while widespread cooperation and interaction may have occurred at a broad sub-regional and regional level, but people at individual sites engaged in diverse forms of local organization. This likely resulted in the different types of experimentation in social complexity evident during this period.

My goal in tracing cooperation and interaction is to identify emergent political complexity in Northern Mesopotamia during this period. I survey all current models of Halaf political complexity, which differ significantly in the way they envision sociopolitical organization. In order to identify which of these models is most plausible, I will examine one case study: Domuztepe. I describe the site, contextualizing it within the greater Halaf cultural sphere and surveying the archaeological assemblages I will be focusing on.

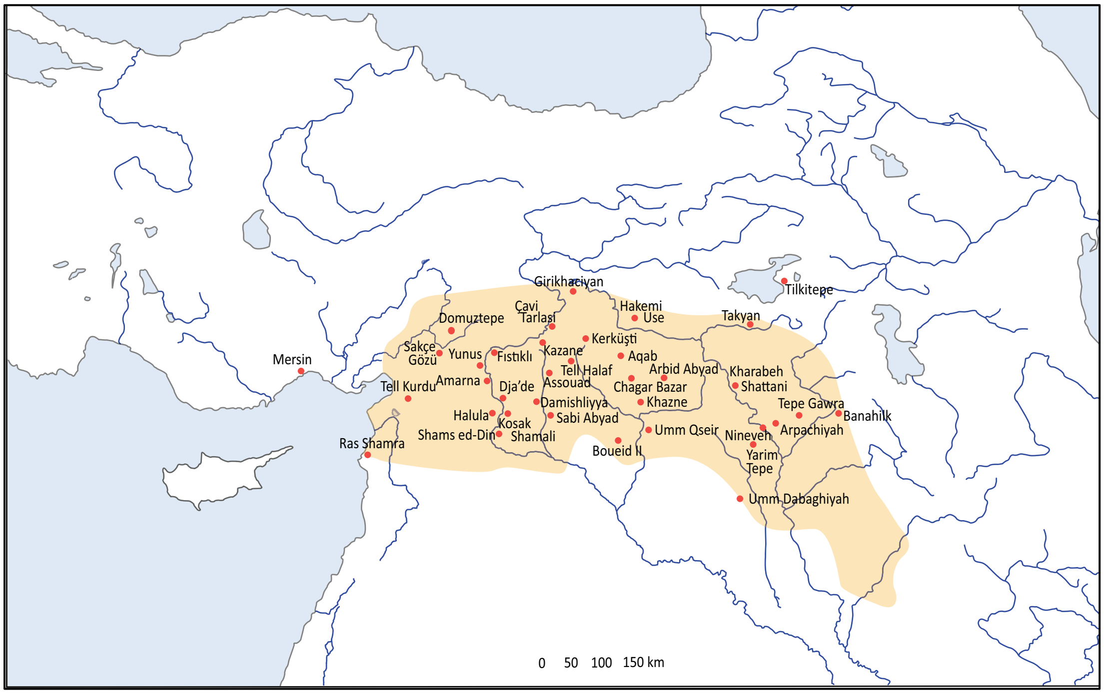

Figure 2.1 Map of Halaf Sites. The shaded area denotes extent of "Halaf Heartland" and shows some sites listed in the text. Map modified by author from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

2.2 Geography and Environment

Halaf sites are distributed throughout Northern Mesopotamia in what now constitutes modern Iraq, Syria, Lebanon, and southeastern Turkey. Sites that fall within the Halaf cultural sphere (the area of the distribution of Halaf material culture) are generally located in the alluvial drainage areas springing from the Tigris and Euphrates rivers, the piedmont zones of the northern Fertile Crescent and the steppe areas of the Jazira (Hole and Johnson 1986). The majority of sites are most frequently located in close proximity to water channels (Akkermans and Schwartz 2003:118) above the 300 mm isohyet range (Wilkinson 2003: 105). The 250 mm isohyet range is typically considered the lower bound of annual rainfall at which dry-farming is supported (McCorriston 1992). This shows that Halaf period people were committed to agropastoral subsistence, with different emphases on cultivation and herding depending on the site location. As I will describe later in this chapter some sites were likely seasonally inhabited for particular agropastoral purposes.

Paleoclimatic proxy data indicate that c. 6000 BCE, around the beginning of the transitional/early Halaf Period, the Eastern Mediterranean began one of the wettest periods of the Holocene (Roberts 2014; Rosen 2007). Prior to this period the area was characterized by a short cool, dry period triggered by the 8.2 ka climatic event. This event corresponds temporally with shifts in settlement at several Pottery Neolithic sites in Anatolia, such as the abandonment of Çatalhöyük East and the expansion of occupation into parts of Central Anatolia (Weninger et al. 2006). The return of a moister period may have made areas of Upper Mesopotamia that are precarious for dry-farming at present more reliable.

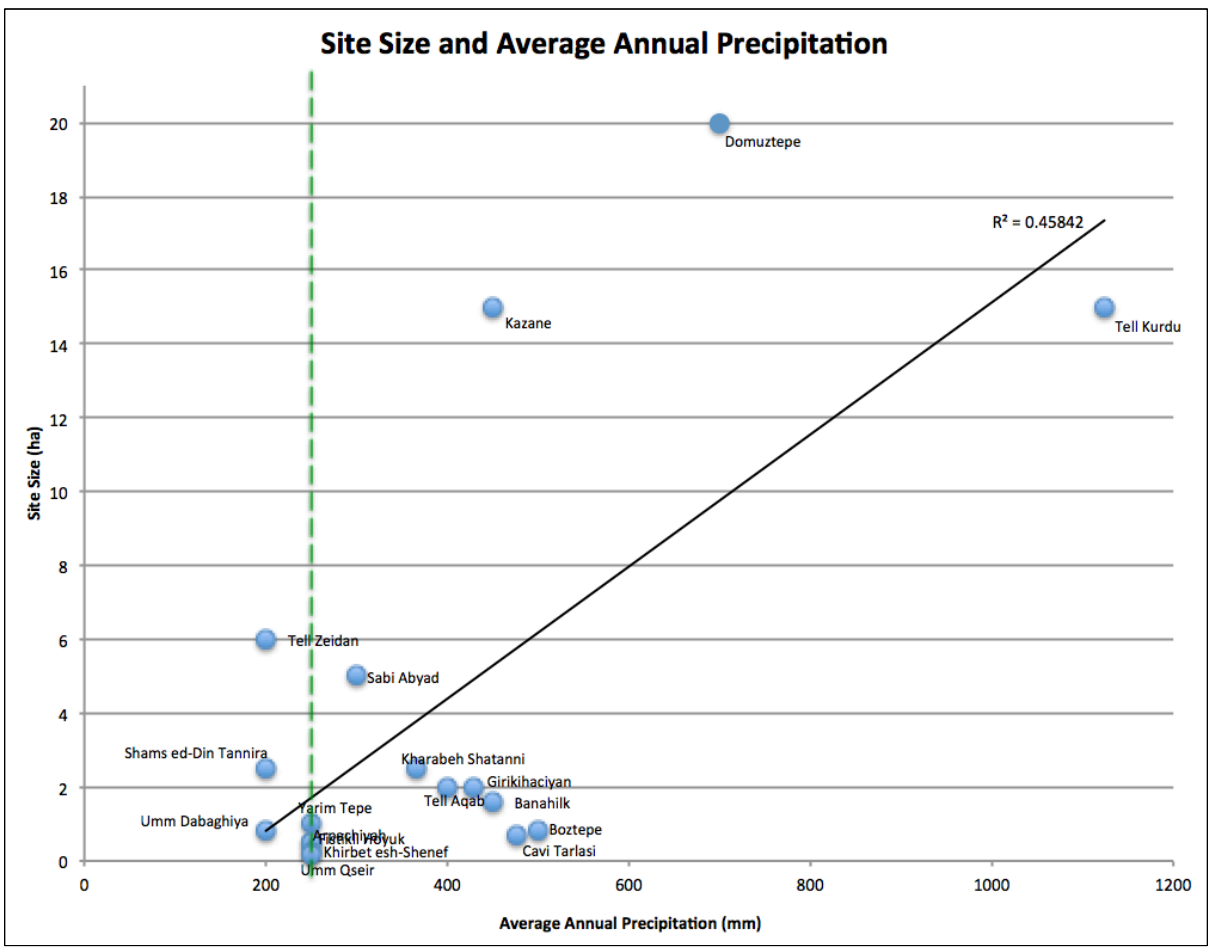

Figure 2.2 Comparing Site Size and Average Annual Precipitation (mm)

The majority of Halaf sites were small — a hectare or less in area. There are a small number of sites that we know exceed 10 hectares in area: Domuztepe, Kazane, and Tell Kurdu, although it is likely we underestimate the size of sites with significant overburden (discussed below). There is some relationship between site size and their location at more marginal ends of the dry-farming range (see Figures 2.1 and 2.2). Figure 2.2 shows the relationship between site size and average amount of precipitation (mm) the area receives annually today. In this figure there is a positive relationship between site size and average annual precipitation, but it is not a strong correlation. Several of the largest settlements (Kazane, Domuztepe, Tell Kurdu, Takyan, and Nusaybin) fall in areas that receive enough rainfall for dry-farming to be not only possible but also reliable (more than 400 mm annually). This makes some intuitive sense, as larger populations necessitate large supplies of food, and rainfall is important for producing all the main agropastoral resources consumed by Halaf people (see below). There is, however, at least one large sites that fall in the "marginal" area, denoted by the green line at the 250 mm per annum mark: Tell Zeidan (6 ha). Chagar Bazar may also fit in this category but the full size of the Halaf-period occupation is not definiteively defined. Perhaps this is because, as mentioned above, during the Halaf Period Upper Mesopotamia would have experienced less aridity, making these marginal areas more reliably able to support dry-farmed cultivation. Finally, just because sites were in less arid locations does not mean that settlements were larger.

Our understanding of the extent of settlement occupations is likely biased, however, by two opposing processes that impede our ability to estimate settlement sizes: on the one hand the issue of overburden from later occupations on many Halaf sites means that we have little sense of their spatial extent. As Lawrence and Ricci (2016) note, Halaf materials have been found at many sites with large later-period occupations and, thus, the extent of the Halaf period occupations are unknown. On the other hand, site size is only a reflection of the areal distribution of materials. It does not necessitate that the whole site was continuously and contemporaneously occupied (see Hole 2000 for a synthetic critique of constructing settlement hierarchies during this period).

Bernbeck (2008, 2013) argues that communities may have been multi-sited, practicing lifeways where mobility among focal and temporary sites was a constant "anchoring principle" of daily life. This is evident in both the types of architecture employed at some Halaf settlements and also in corroborating proxy data from faunal and paleoethnobotanical records (all discussed below). Most large plains within the Halaf cultural zone have at least one larger site, which may have functioned as a "focal" or anchor site for the more fluidly settled/mobile population.

Finally, not all geographical areas within the Upper Mesopotamia have been equally well surveyed (Akkermans and Schwartz 2003). Given that Halaf sites are often quite small, this likely means that numerous settlements have not been identified. Taken together, present data on settlement patterns indicate that most sites are small, with a few sites seemingly outstripping the rest in size. The largest sites known are on the edges of what has traditionally been viewed as the core "heartland" area of Halaf culture; Domuztepe, Kazane and Tell Kurdu are all located on the western edges of this distribution. At least some of these sites (Domuztepe and Tell Kurdu) appear to be continuously occupied throughout the territorial extent of the mound for several centuries (Campbell et al. 1999; Özbal 2006).

2.3 Halaf Material Culture

In this section I describe the main artifacts and styles associated with this corpus of material culture.

POTTERY

A corpus of painted pottery is, arguably, the defining aspect of the Halaf material culture complex. Named for the type-site of Tell Halaf in modern Syria (Oppenheim 1933), Halaf pottery is considered generally to be "homogenous" (Akkermans and Schwartz 2003:115) in style and "unmistakable" (Garstang 1953:102) and "easily distinguishable" (Özbal 2006: 35) over a broad spatial distribution. Halaf pottery is divided into two or three chronological periods: either early and late (Akkermans and Schwartz 2003) or Early, Middle, and Late (Campbell 2007b; Watkins and Campbell 1987). It is preceded at some sites by a unique Proto-Halaf/Transitional Halaf phase (e.g., Cruells and Nieuwenhuyse 2004; Nieuwenhuyse 2009) and a separate Halaf/'Ubaid transitional phase at the end (Davidson 1977; Davidson et al. 1981; Watkins and Campbell 1987; see Campbell and Fletcher 2006 for a summary for issues associated with defining this phase). Scholars have identified regional sub-phases; this diversity is discussed below.

Figure 2.3 Example of Halaf Vessel from Domuztepe. Photo courtesy Elizabeth Carter.

Halaf pottery assemblages consist of painted pottery that is generally characterized by fine, well-fired, mineral-tempered ceramics in a variety of forms (Akkermans 1987, 2013;

Nieuwenhuyse 2007; LeBlanc and Watson 1973:121 for basic forms). Characteristic vessels are highly decorated in black or reddish-brown mineral paints (Özbal 2006: 35), occasionally in polychrome (Sagona and Zimansky 2009:125) with geometric motifs (Akkermans 1993; Campbell 1992; Cruells and Nieuwenhuyse 2004a; Goff 1963; Nieuwenhuyse 2007, 2009; Davidson 1977; LeBlanc and Watson 1973). Halaf potters also use some naturalistic images, but much less frequently.

ARCHITECTURE

Round buildings termed *tholoi* are also considered a hallmark of the Halaf cultural horizon (Akkermans 2010; Huot 1994; Mallowan and Rose 1935; Perkins 1949). These freestanding structures are circular in plan, sometimes with a rectangular antechamber attached to them. Most are constructed of pisé, although occasionally mudbrick examples are recovered, either on stone foundations or directly on the ground. Halaf period peoples sometimes covered them with mud plaster and/or gypsum powder (Akkermans 2010: 22). They are generally presumed to have been domed structures, but some may have had flat roofs, or incorporated organic roofing materials (*Ibid*.: 22).

Tholoi vary in size and function both between sites and within sites. For example, the majority of the more than 75 tholoi structures at Yarim Tepe II are interpreted as domestic structures (Munchaev 1997). Yoffee has argued that the assortment of finds within them indicate they functioned as "women's workrooms," (Yoffee 2005:205); a more conservative view would argue that they were the loci of household craft production, such as spinning, and food preparation. At Tell Sabi Abyad a large tholos (6.75 m in diameter) was recovered alongside small (ca. 2.5m in diameter) tholoi (Akkermans and Verhoeven 1995:17). Akkermans (1987, 1993) interprets these smaller tholoi as "storage or kitchen units," indicated by their diminutive size, small doorways, interior contents (e.g. large quantities of burnt cereals), and by the fact that Halaf inhabitants coated the structures with a hard burnt plaster, possibly to seal them from vermin (1987:26). Tholoi at Girikihaciyan (Watson and LeBlanc 1990:39) and Arpachiyah (Mallowan and Rose 1935) are similarly diverse in size and function.

Tholoi were not the only architectural style employed at Halaf sites. Some sites also have rectangular structures similar to those in the preceding period, which were used alongside tholoi, whereas at other sites, tholoi dominate. Similar to the tholoi in construction, these rectilinear structures are frequently comprised of pisé or mudbrick walls, often on a stone foundation. They may have also had superstructures made of reeds or wood, as has been suggested based on images of buildings found on sherds at Domuztepe (Kansa et al. 2009b:910) and Karavelyan (Tekin 2011). Architectural remains from structures at Mersin (Garstang 1953) show impressions of wood and reed materials that may have once served as superstructures. Scholars have suggested that these differences in construction materials reflect the durations Halaf period people intended to inhabit buildings; pisé structures are thought to be constructed with "expedient technology" (Hopwood 2010:29). Exterior space created between buildings, particularly among freestanding rectilinear and tholoi structures would have forced inhabitants to carry out many of their daily activities outside (Hopwood 2010:30).

Not all structures were created equally at different Halaf sites; there is strong evidence of architecture at several sites that may have served a public function of some sort. At Tell Sabi Abyad and Khirbet esh-Shenef, for example, the majority of buildings appear to be tholos structures, but at each site researchers recovered one large rectilinear structure that likely served a public purpose (Akkermans and Schwartz 2003:116-117). The structure at Sabi Abyad was 18m by 10m in size. At Khirbet esh-Shenef the rectilinear building is unique among structures at the site, which were otherwise all circular. This building with a niched façade was centrally located within the settlement. At both Sabi Abyad and Khirbet esh-Shenef theses structures were sub-divided into many small rooms, which Akkermans and Schwartz suggest might have functioned as some sort of storage facility. Similar facilities were recovered at Yarim Tepe II and Cavi Tarlası (*Ibid*.: 117; Akkermans and Duistermaat 1996).

Other sites where Halaf pottery has been recovered, such as Tell Amarna (Cruells 1998) and Tell Damishliyya (Akkermans 1986; 1987), lack evidence of architecture. These sites may have had more temporary architecture composed of organic materials, perhaps indicative of restricted periods of occupation. Residents — short or long term — at Tell Damishliyya did, however, create numerous storage pits and seem to have inhabited the site repeatedly over time.

LITHICS

Chipped stone artifacts constitute another major category of Halaf material culture. Archaeologists have recovered a wide range of utilitarian stone tools at Halaf sites (see Akkermans and Schwartz 2003:131). Lithics were less sophisticated and more expedient than the preceding 7th millennium Pre-Pottery Neolithic B corpus (Akkermans 2013:26). Further, the ubiquitous projectile points (e.g. Cauvin 2000; Rosenberg 2003) found at preceding Pre-Pottery Neolithic B sites are recovered much less frequently, although certain new types of arrowheads are introduced during this period. Halaf people did produce some very finely crafted chipped and ground stone artifacts, such as stone vessels, axes and adzes, maceheads, and beads (e.g. Akkermans 1993; Akkermans 2013; Belcher 2011; Watson 1982).

The proportional and geographical distribution of obsidian within lithic assemblages is of particular interest for the information it yields about regional trade networks (Healey 2007). Obsidians represent large (e.g. 80% of the lithic assemblage at Tell Aqab, and 100% at Tilkitepe summarized in Healey 2007) portions of lithic assemblages at some Halaf sites, and smaller portions at others (Akkermans 1993:273; Watson and LeBlanc 1990:85) Obsidian occurs naturally in only a few sources in the Near East and, thus, obsidian objects can be analyzed to determine their source. Studies of obsidians from Halaf sites (Bressy et al. 2005; Healey 2007) indicate extensive interregional trade with source areas and distant communities throughout the Halaf. Evidence and implications of supra-regional, regional, and sub-regional exchange in obsidian and other materials and crafts are discussed in Chapter Five.

OTHER UBIQUITOUS SMALL FINDS

Small finds vary at different Halaf sites, but some trends are evident. First, in this period we see the initial development of copper-working on a very small scale. Halaf period peoples made small personal adornments out of copper, such as beads (e.g. Wengrow and Carter 2006), but at this point metalworking was "neither vital for subsistence nor yet fully valued as a prestige commodity," (Akkermans 2013: 26)

Other forms of personal adornments, particularly beads and labrets, are ubiquitous at Halaf sites (e.g. Akkermans 2013). These are most frequently made of stone, obsidian, clay, and shell (Campbell and Healey 2014; Healey 2013). Other media also demonstrate forms of personal adornment, particularly female figurines and anthropomorphic vessels (Croucher 2013). These artifacts show not only types of personal adornment that might be recovered archaeologically (e.g. jewelry) but also forms of bodily adornment that would have been temporary (e.g. painting) or may have been permanent but archaeologically lost with the decomposition of individuals: tattooing and aesthetic modification through scarring (Croucher 2013:193). Mortuary contexts also provide some evidence for cranial modification (*Ibid.*; Molleson and Campbell 1995).

Figurines found at Halaf sites shed light not only inhabitants' practices of personal adornment but also on ritual practices. Halaf period people made figurines out of a variety of materials: clay, bone, and stone. Zoomorphic figurines, particularly of bulls, and figurines depicting women are the most ubiquitous (Erdem 2013; Oates 1978; Perkins 1949). Some figurines are executed in a very naturalistic manner, while others vary from stylized to "extremely stylized," (Goff 1963:17). Many of the female figurines emphasize the figure's breasts and genitalia, which has led scholars to conclude that these objects were used in fertility rituals (*Ibid*.). However, figurines are recovered in both domestic and public contexts, which indicates that any ritual use of such objects was widespread and open (Akkermans 2013:27).

IMAGERY

Imagery on Halaf ceramics, glyptic, and other media bear great similarities across time and space. Halaf period people primarily favored geometric designs on both ceramic and glyptic objects. These designs are attested to in myriad combinations of lines, circles, checker-board patterns, dots, etc. Examples can be found in stylistic analyses undertaken by Goff (1963), LeBlanc and Watson (1973), Davidson (1977), and the excellent catalogue in Nieuwenhuyse (2007, 2009).

In addition to geometric designs, some naturalistic designs are also included on Halaf objects. These vary from both very naturalistic to stylized images of sheep and goat, birds, trees, and even people. For example, they retain certain motifs from earlier periods, such as the Samarran "Dancing Ladies" (Akkermans 1987: 29). Of particular note is the continued use of bucrania, images of bull heads found on multiple types of media and also as actual interred or displayed bull skulls throughout the Near East during the Neolithic.

2.4 Innovations in accounting technology

The development of the first accounting technologies is an important change in the economic, political, and social lives of Late Neolithic Near East people. Stamp seals, along with tokens, first appear in the late 7th millennium (pre-dating the Halaf period) at sites like Tell el-Kowm, Tell Ain-el-Kerkh, and Tell Boueid II (Akkermans and Duistermaat 1996; Dornemann 1986; Duistermaat 2010) in present day Syria. As Duistermaat (2010) demonstrates, accounting practices grow out of several existing forms of Early Pottery Neolithic media and technologies and become both widespread and more elaborate during the Halaf period.

SEALS

Stamp seals and sealings indicate that Halaf period people had a conception and necessity for accounting for goods. As Akkermans and Duistermaat argue, sealing systems have two purposes: "they define the property of a person or group of persons… [and] they explicitly deny outsiders access to this property," (1996:24). Thus individuals seal their property to demarcate what is theirs within a space shared by other members of the community.

Stamp seals are objects, usually constructed of stone, though other materials are attested (Duistermaat 2010), that bear an incised design on one surface and a handle on the back. Halaf stamp seal handles are frequently perforated, indicating that seals often functioned as a form of personal adornment in addition to their more pragmatic accounting purpose (Carter 2010; Charvat 1991; Croucher 2013). As with their pottery and other forms of aesthetic embellishment, Halaf period people favored geometric motifs and, to a lesser extent, some naturalistic elements on seals and sealings (Akkermans and Duistermaat 1997:22; Carter 2010; Carter et al. 2003; Goff 1963).

The best attested corpus of stamp seals and sealings comes from Tell Sabi Abyad, particularly those found in context in the Level 6 Burnt Village, dating to the "Transitional" proto-Halaf period. Excavations found more than 300 sealings, almost entirely from small rooms inside a large building interpreted as a storage facility likely used by members of the highly mobile community (Akkermans and Duistermaat 1996; Duistermaat 2010). Individuals sealed materials or tokens that represent them in small containers (e.g. baskets, vessels, and bags) within the rooms; this differs from later periods in Mesopotamia where seals are applied not only to objects but also to doorlocks, where pegs locking doors are covered with clay and sealed. Akkermans and Duistermaat argue that individuals or groups retained ownership over the sealed materials, and the large number of different sealings recovered is indicative of the widespread access to this technology. They envision this happening within the context of a population wherein some portion is highly mobile and perhaps store agricultural products they access when their rounds take them to the site for both economic and social purposes.

Seals, sealings, and their implication for regional interaction and exchange are more fully discussed in Chapter Five.

TOKENS

Halaf period people also used small objects interpreted as tokens (also called jetons) as some form of accounting. Tokens are thought to be devices to aid counting, memory, and record-keeping that were precursors to writing systems (Schmandt-Besserat 1992) or memory tools (Costello 2000). Neolithic people began using tokens c. 8000 BCE, and by the Halaf period they show up frequently. Tokens take a variety of forms. Most commonly, they are small clay objects fashioned into a variety of shapes such as spheres, disks, cones, pyramids, triangles, and in some rare cases, miniature vessels (Akkermans et al. 2006:131). In other cases they may come from repurposed and modified round sherds or similarly shaped stones (e.g. as at Kazane Höyük and Fıstıklı Höyük reported in Costello 2000). Occasionally, caches of them have been found in association with sealings, such as those found at Sabi Abyad in the transitional-period Burnt House (Akkermans and Duistermaat 1996; Akkermans and Verhoeven 1995) and the later (c. 5900-5800 BCE) Operation II cache, where approximately 1,600 clay tokens were found along with figurines and sealings intentionally buried in an abandoned house.

IMPLICATIONS

Accounting technologies were used to monitor goods stored in both private and communal storage facilities at Halaf sites. Monitoring is an important mechanism that promotes cooperative endeavors among people. The development of accounting technologies during the Halaf period perhaps correlates with an increasing need to formally monitor the products of agropastoral and perhaps also craft production at Halaf sites.

The implications in terms of social complexity of the presence of these accounting technologies are not clear. In later periods in Greater Mesopotamia, sealing systems were an integral part of elite administration techniques (Flannery and Marcus 2012; Schmandt-Besserat 1992); it is tempting to ascribe a similar role to such technologies in earlier periods. Undoubtedly the conception of private property and the ability to differentiate one person's or group's goods from another is essential for allowing some individuals to accumulate large amounts of goods, but the presence of authority figures is not a prerequisite (Akkermans and Duistermaat 1996, and Bernbeck comments within; Frangipane 2007). Akkermans and Duistermaat argue that this system, in fact, can be used to mitigate conflict within egalitarian communities (1996:42).

2.5 Subsistence Practices

Several plants and animals had long been domesticated (e.g. Zeder 2008; Zohary et al. 2012) and integrated into the local subsistence economy (for examples see Akkermans and

Schwartz 2003) by the Late Neolithic Halaf period in the Ancient Near East. Halaf period people varied in the extent they committed to the so-called "Neolithic package", adopting domesticated plant and animal resources in different proportions in their diets. Wild foods — both floral and faunal — remain important as both sources of food and raw materials for producing a myriad of objects and buildings, and also as symbols included in ritual activity. Akkermans has described Halaf people, particularly at smaller settlements that may have been inhabited only seasonally in some years, as practicing "varied and flexible subsistence" economies (2013:25). As is clear from other lines of evidence (e.g. architecture), at some Halaf sites people relied on constant occupation and reoccupation throughout the year to tend crops, while other aspects of the subsistence economy seem to be wholly predicated on mobility, particularly to herd animals and hunt wild game.

In this section I discuss the agropastoral and wild resources frequently used by Halaf communities. I also evaluate the diversity evident in the subsistence and ritual use of these resources across the distribution of Halaf sites, using zooarchaeological and paleoethnobotanical records from past excavations.

AGROPASTORALISM: DOMESTICATED PLANT RESOURCES

Halaf period people at sites for which we have published paleobotanical records consumed domesticated plants supplemented by wild gathered foods in varying proportions. These sites include Sabi Abyad (summarized in Akkermans 1993:210), Tell Aqab and Umm Qseir (McCorriston 1992), Kazane (Bernbeck et al. 1999), and Domuztepe (Kansa et al. 2009b). Inhabitants grew domesticated cereals, such as several species of wheat and barley, and various pulses, including lentil, field peas, chickpeas, and bitter vetch (Akkermans 1993; Kansa et al. 2009b; McCorriston 1992). These crops would have fed both the inhabitants at the site and their livestock as fodder when necessary. Additionally, Halaf period people at some sites seem to have cultivated flax, which was presumably used as both a food source and in textile production, oil production (McCorriston argues for oil and food production for Tell Aqab 1992:324), or both (Akkermans 1993:209).

Halaf period peoples' lives would have been structured largely by the labor scheduling necessitated by cultivating crops or whatever products they may have exchanged for crops. Halaf sites fall within areas where dry-farming is supported, and there is no present evidence for irrigation agriculture like that associated with 'Ubaid sites in Southern Mesopotamia. Halaf period farmers planted crops in the autumn (between October and December) and harvested in the spring (Akkermans 2013:24). Different sites show evidence of crop processing activities; at some sites cereals, for example, appear to have been cultivated nearby and cleaned and processed on site. Other sites, in contrast, show evidence of consuming cultigens that were not grown directly at the site. For example, bitter vetch was recovered in assemblages from the site of Umm Qseir (McCorriston 1992: 327). Umm Qseir is a small site on the Middle Khabur River, in an arid area. Ecological conditions could not support bitter vetch cultivation adjacent to the site. These crops were either brought with the inhabitants during their seasonal rounds or imported through some sort of exchange.

AGROPASTORALISM: FAUNAL RESOURCES

Animal stock were an essential part of Halaf economies. Halaf period people consumed animals in a variety of ways: they ate animals (primarily ungulates, avifauna, ichtyofauna, and Mollusca) in the form of meat, blood, and dairy and used their hides, bone, and, in some cases, wool, to produce necessary artifacts. Animal herders harnessed their labor as well. We have preliminary evidence of using cattle for traction in this period (Kansa et al. 2009b). Dogs were used for their companionship, protection, and skill as herders. Mammals serve as both a form of resource storage ("on the hoof") and also as a form of wealth that can be transferred between individuals or groups (Russell 2012)

Raising and caring for domesticated mammals — during the Halaf period sheep, goat, cattle, pigs, and dogs — requires yet more labor scheduling and planning. As this dissertation is about animal exploitation at a Halaf site that has primarily domesticated animals, in this section I discuss the four main consumed taxa. Present evidence from the Halaf period has only one clear case of dog consumption. This occurs at Domuztepe in a context described below that appears to be the product of ritual feasting. Thus dogs are omitted here as they were not raised in considerable quantities for consumption.

Sheep and Goat

Domestic sheep (*Ovis aries*) and goats (*Capra hircus*) are arguably the most important domestic livestock in the Near East. Present evidence suggests that people in the Fertile Crescent began initially managing and domesticating herds ca. 9,000 BCE (Zeder 2008:11598). Both taxa are ruminant bovids and their success as a focus of husbandry has largely been attributed to their ability to exploit broad ecological zones throughout the Near East, especially the arid steppelands that receive too little water to support extensive agriculture (Redding 1981). Both species are exploited for their primary (meat, bone, skins) and secondary (dairy, wool, dung) products, although there is still debate as to when secondary product exploitation began.

Sheep and goats have slightly different, but complimentary feeding ecology; sheep are grazers while goats are browsers. Goats are able to subsist in more marginal environments, with less food and more extreme temperatures than sheep, while still maintaining their fecundity (Clutton-Brock 1981:58; Redding 1981). The two genera also exhibit slight differences in terms of fecundity. Sheep reach first parturition by two years of age, although in exceptionally good conditions they can reach parturition at one year of age (Dahl and Hjort 1976; Redding 1981:96). Redding reports a birthing rate of 0.80 among Middle Eastern sheep. As ewes age, this rate increases for several years, with the incidence of twinning increasing. Goats similarly reach first parturition between one and two years of age. The majority of does begin kidding by 18 months of age (Dahl and Hjort 1976:92; Redding 1981:99). Twinning is more common among goats than sheep, and Redding reports an average yeaning rate of 1.2 goats per annum. Fecundity rates for both genera are highly affected by the animals' health, which in turn, is affected by nutrition, human management, and disease.

Herd management strategies for both genera are influenced by a number of factors including the environment (temperature, quality of rangeland, etc.) and the product herders desire most from the animals (meat, dairy, or wool). In the Middle East most herders mix the two genera based on these factors, and, thus, subsistence strategies in practice are highly variable. Still, broad kill-off patterns can be hypothesized that conform to each of the three main goals of husbandry. Additionally, few herders focus solely on one product from caprine husbandry. This further complicates the issue of identifying these patterns archaeologically, which is accomplished by examining kill-off patterns for both taxa in zooarchaeological assemblages. Finally, these goals must always be balanced with herders' concerns for herd security — that breeding rates will at least maintain the herd size, if not allow it to grow (Dahl and Hjort 1976; Redding 1981; Zeder 1991). In all cases herders ensure the security of their stock by preferentially slaughtering males in lieu of female animals. A small number of breeding males are sufficient to maintain stock rates (for a detailed discussion, including considerations of various breeds and ecological conditions, see Dahl and Hjort 1976).

Payne (1973) offers the following models of kill-off patterns for sheep and goats: If the primary goal of husbandry is energy extraction (i.e. meat) then herders are likely to kill younger males more frequently than females. In an ideal environment herders would wait to kill the animal until it reached its optimal weight as a sub-adult (approximately two or three years of age). In less ideal conditions, when production costs of keeping the animals alive are higher, the animals will be slaughtered younger. The animals would be culled throughout the year, with increases in slaughtering likely in times when other resources are more depleted, such as during the winter. If herders are focusing herding strategies on dairying, then all surplus juveniles (lambs and kids) not necessary for herd security will be culled, as opposed to allowing them to reach their optimal weight at a sub-adult age. Finally, if wool is the primary goal, herders keep more of the stock through adulthood, castrating excess male stock in lieu of culling them. Animals would preferentially be slaughtered as the quality of their wool decreased. These broader patterns are more nuanced based on how the herders choose to mix the two genera together within herds (see Redding 1981 for a comprehensive discussion).

Pigs

Pigs (*Sus scrofa*) are another major species in the Near Eastern suite of domesticates, although their distribution is more restricted than sheep, goats, or cattle. Pigs were first domesticated in southeastern Anatolia ca. 8,500-8,000 BCE (Zeder 2008:11598). While pigs are members of the same phylogenic order, *Artiodactyla*, pigs differ markedly from the ruminant bovids in both their physiology and behavioral ecology. As a result, pig husbandry in the Near East is profitable under more limited circumstances than caprine or cattle husbandry. Pigs lack sweat glands and thus are less tolerant of extreme heat. When temperatures are high, pigs reduce their body temperature by wallowing in water and mud or by seeking shade. Further, they require relatively high volumes of water. These physiological particularities mean they must always live in proximity to adequate water sources (Grigson 2007) or sufficient water provided for them. Pigs are found in the wild in areas that receive, at minimum, 200 mm of rainfall per annum throughout the Near East (Grigson 1987, 2007; Uerpmann 1987). The distribution of domestic pigs in the Near East at present is quite limited due to religious and cultural taboos against pork consumption, but archaeological evidence suggests that domestic pigs were largely restricted to this precipitation range in antiquity (Grigson 1987, 2007).

Pigs are omnivorous. Unlike ruminants, they are unable to consume high-cellulose plants. These plants abound in the semi-arid steppe environments of the Near East below the 200 mm isohyet mark. In more temperate parts, however, pigs can forage broadly. They also scavenge among human settlements much as dogs do (Clutton-Brock 1981:73). Their behavioral ecology constitutes a further limitation to pig husbandry; they do not naturally form herds as cattle and caprines. In the wild, sows and their young constitute family groups, while boars join these groups solely for rutting (*Ibid.*:74). Several scholars cite the animal's natural obstinacy as a major check against incorporating pigs into any lifeway marked by some degree of long distance mobility (Grigson 1987, 2007). While these behavioral features make pigs ill-suited for subsistence strategies predicated on frequent and long distance mobility, there is a positive side; pig husbandry requires minimal human labor since the animals do not need to be herded. Further, young pigs imprint onto humans and can easily be tamed (Cluttonbrock 1981; Rosenberg and Redding 1998).

When agropastoralists are able to cope with these physiological and behavioral limitations, pig husbandry can be very profitable. Pigs are ideally suited for small-scale sty management in sedentary village and urban settings. Here the animals are easily sustained on agricultural and household refuse and generally have access to adequate water and shade. Management issues are minimal. The animal's ability to consume refuse from human settlements is an important secondary benefit to pig husbandry for both nutritional and epidemiological reasons (Grigson 2007:99). Domestic pigs are exploited primarily for the meat they yield, which is both high in quality and abundance. Of the traditional suite of Near Eastern domesticates, pork boasts the highest caloric value and fat content (Grigson 2007; Zeder 1991:30). Pigs also yield hides and bone that can be used for tool production. Pig reproduction rates grossly outstrip those of domestic bovids. Pigs reach maturity at a younger age (8 months according to Redding 1992; see also Crabtree 1989:210; Grigson 2007) and give birth to large litters of as many as ten piglets per birth (Cluttonbrock 1981:73). While modern domestic breeds reproduce multiple times a year, evidence derived from modern populations of wild boars in Turkey suggest early domesticates likely produced one litter per year, usually in spring (Bull and Payne 1982). Even at this reduced rate, however, each breeding sow would produce more young per annum than ewes, does, or cows (see Redding 1992 for calculations of herd growth under extensive agriculture for pigs and caprines; see Dahl and Hjort 1976 for herd growth rates under pastoral systems for caprines and cattle).

The pig's high fecundity rate has major implications for the way people incorporate pig husbandry into their agropastoral subsistence strategies. Pigs function as both an "easily renewable resource" for protein (Grigson 2007:99) and as a means of risk management in their overarching agropastoral system — what Rosenberg and Redding (1998;67) refer to as a "low cost form of subsistence insurance." Thus pig remains have been interpreted as an example of a "poor man's food" in both historical (Cluttonbrock 1973) and archaeological contexts (e.g., Redding 1991, 1992). Crabtree argues that pigs' rapid and prolific reproductive rates make them an ideal species for new settlers seeking an expedient source of domestic meat (1989:210). Ethnographic accounts from Papua New Guinea (Lemonier 1993; Redding and Rosenberg 1998) illustrate how people take advantage of the animal's high fertility rate to finance large feasting events. While in these events people slaughter large numbers of pigs, this is carried out with minimal damage to herd security. The herd is replenished within a relatively short period of time.

Cattle

Domesticated cattle (*Bos taurus*) are the third important animal resource in the Near East. These animals provide a host of primary (meat, bone, hides, horns) and secondary (dairy, traction, dung) products and have been an integral part of Near Eastern economies since their domestication ca. 6500 BCE (Arbuckle and Makarewicz 2009). Domesticated cattle are differentiated from aurouchs (*Bos Primigenius)* based on metrical differences (domestic cattle are considerably smaller) and differential culling patterns (*Ibid.*; Clutton-Brock 1981:68).

Cattle, like sheep, are ruminant grazers. They require high volumes of both feed and water, as well as salt (though they will not eat salty vegetation). Dahl and Hjort (1976) report that cattle can be herded a maximum distance of 15-20 km per day among pastoralists. Sedentary communities could more easily supplement grazing requirements with fodder. Cattle graze in herds and can comfortably be mixed with smaller stock (Dahl and Hjort 1976: 253). Labor requirements for cattle husbandry vary based on availability of natural pasture, local topography, threat of theft, herding goals, and herd structure (e.g. are there more adult animals being kept alive for traction?).

Cattle have a lower fecundity rate than sheep or goats. Cows reach first parturition between two and four years, with three years being average. Gestation periods last approximately nine months, and calving rates are estimated at one calf per fourteen to twenty-two months, with eighteen months being normal (*Ibid*.: 35-36). These rates were, however, calculated among pastoral groups. Among sedentary communities such rates are likely slightly higher, particularly when the cattle's nutrition is supplemented with fodder.

Recent evidence from lipid analysis (Evershed et al. 2008) suggests cattle were the first taxa to be exploited for dairying in Anatolia. Culling patterns among cattle pastoralists intent on maintaining herd security indicate herders preferentially slaughter young bullocks around four to five years of age (Dahl and Hjort 1976:167). Older cows are slaughtered when they are no longer effective dairy producers, as are older bulls as their virility wanes (ca. ten years of age). In these herds the primary economic focus is dairy production, with meat functioning as a secondary focus. A similar culling pattern would be anticipated for herds where energy extraction is the primary focus, with perhaps a slightly higher number of cows being culled as sub-adults. Scholars (e.g. Watson and LeBlanc 1990) have also emphasized the importance that draught labor would have had during the Halaf, based on the correlation of sites with the distribution of plowable soils. In this case, one would anticipate a culling pattern wherein a larger portion of males is kept alive, perhaps as steers (Zeder 1991: 29).

Cattle husbandry would have required the greatest labor and resource inputs of any of the domestic taxa at Domuztepe, but they would also have provided more payoff in terms of meat, hides, dairy and traction. Cattle could have been herded in the flat plains, marshlands, and fallow fields around the site, and they could have been watered nearby. Grazing animals on fallow fields has the additional benefit of providing manure, which increases agricultural production. Inhabitants likely supplemented their stocks' diet with fodder. Paleobotanical data from coring of the Sağlık Göl Lake in the Kahramanmaraş valley indicate a spike in the presence of green alga (*Pediastrum boreanum*) that is contemporaneous with habitation at Domuztepe (Kansa et al. 2009b; Woldring et al. In Prep.). This alga has been linked to changes in nutrients within lakes. This change may be explained by the practice of herding cattle near the lake, with their dung providing the nutrient boost precipitating the growth of algal blooms.

HUNTING AND GATHERING

Halaf communities consumed and utilized wild plant resources in a variety of different contexts and in varying proportions at different sites and during different times of year. Indeed, evidence of wild plant and animal, fish, mollusk, and bird consumption has been an important indicator of the seasons during which sites were occupied during the Halaf period (McCorriston 1992; Zeder 1994). As with agropastoral production, hunting and gathering would have required specific planning, labor scheduling, and countless human-hours of effort for Halaf period people. While some hunting and gathering could have occurred opportunistically, many of these activities would have required coordinated labor, such as group hunting activities and large scale gathering of important seasonally available resources such as nuts and fruits. While these activities may have been performed by individuals, they still had to be scheduled within the litany of other tasks each household needed to perform regularly.

Wild Resources: Gathered Plants

Halaf period people made use of wood and wild plant resources from both the riparian and steppe-forest environments common in the area where Halaf material culture is found. This is evident in both fuel consumption and architecture. Evidence from charred plant remains (e.g. McCorriston 1992) shows that wild flora was used for fuel through burning dung fuel and, less common at many Halaf sites, wood (McCorriston 1992; Watkins and Campbell 1987). Impressions of matting (e.g. Mallowan and Rose 1935; Tobler 1950) and basketry (e.g. Akkermans and Duistermaat 1996), images of house constructions (e.g. the Domuztepe House pot Kansa et al. 2009b: 910), and remnants of burnt roofing materials (*Ibid.*) show that Halaf period people frequently used wood and reeds to construct both artifacts and structures which are rarely preserved archaeologically. Halaf period people may also have used wild plants in other crafts, such as dying textiles, which for which we are unlikely to recover direct evidence.

Paleoethnobotanical records indicate that, where available, Halaf period people harvested wild fruits and nuts. Fruits, such as berries, cherries, plums, and wild olives (Kansa et al. 2009b; McCorriston 1992; van Zeist and Bakker-Heeres 1984), would have supplemented peoples' diets seasonally. Nuts, such as almonds and pistachios, would have provided an important source of fat and protein as well. Halaf period people also consumed plants and tubers, such as purslane, which is still consumed in the region today. It can be difficult, however, to separate which foods were consumed and which were brought to the site as weeds and were discarded (van Zeist and Bakker-Heerse 1984).

Wild Resources: Hunted Fauna

Certain Halaf sites indicate that some Halaf period people focused intensively on hunting, while others focused almost exclusively on domesticated fauna, with wild resources providing only occasional supplements of meat, hides, and bone material. At other settlements the motives behind peoples' exploitation of wild fauna are less clear-cut. For example, at Shams ed-Din Tannira wild equids comprise a large portion of the faunal remains, but Uerpmann (1982) interprets this as evidence not of a major focus on wild resources, but a byproduct of farmers' efforts to protect their cereal crops from wild onagers. Hunting requires different types of labor coordination and resource input depending on taxa, environment, and hunting technology. The possibility that Halaf people moved between different sites to exploit different resource patches raises the question as to whether inhabitants at some sites seemed to rely more heavily on wild animal resources than others.

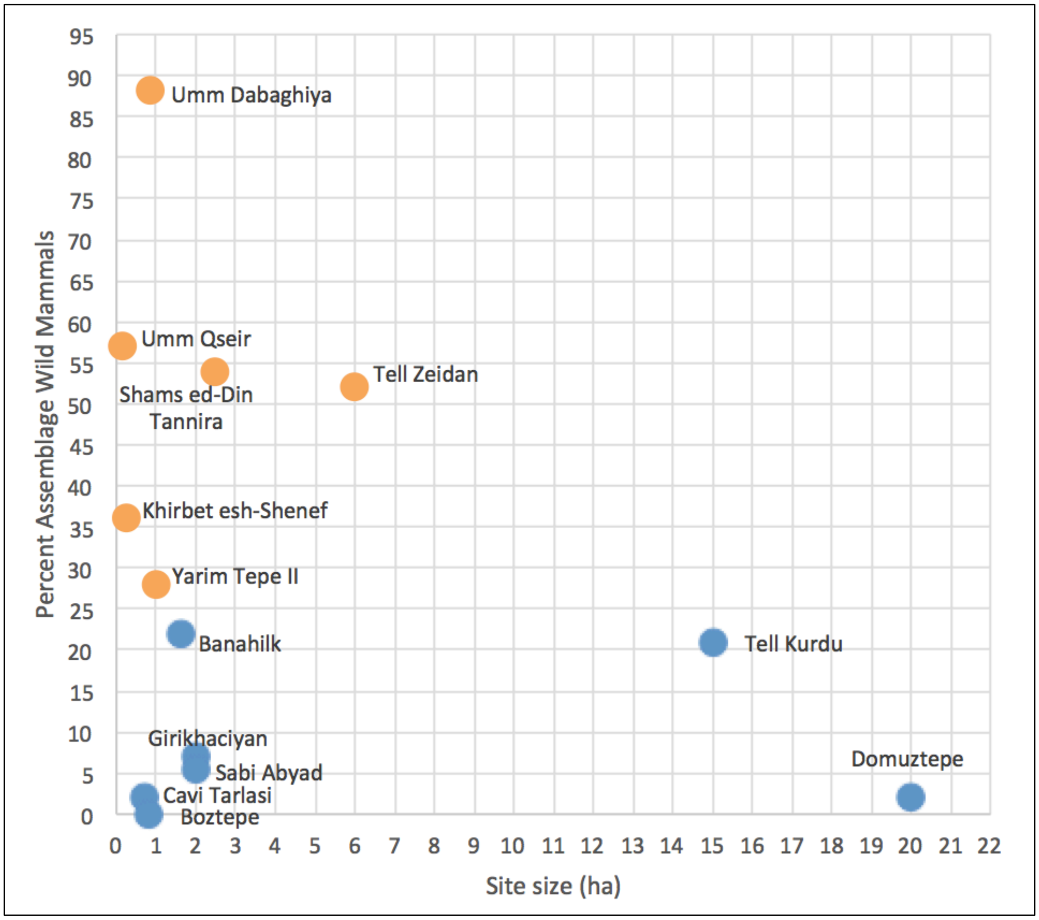

Figure 2.4 Percent assemblage comprised of wild mammalian taxa compared with site size. Orange markers denote sites located in areas that receive 250 mm precipitation per annum on average or less in modern records. Blue markers denote sites that receive more than 250mm precipitation per annum in modern records. Data from Cavallo 2002; Ducos 1991; Grossman and Hinman 2013; Hendrichs 1990; Kansa et al. 2009b; Laffer 1983; McArdle 1990; Schaffer and Boessneck 1988; Uerpman 1982; Zeder 1994

Figure 2.4 shows the relationship between site size and the percentage of the assemblage that is comprised of wild animals. There seems to be a strong ecological association with a reliance on wild fauna, particularly fauna that inhabit the steppe areas such as gazelles and onagers. Inhabitants at Umm Qseir (Zeder 1994), Tell Zeidan (Grossman and Hinman 2013), Shams ed-Din Tannira (Uerpmann 1982), and the slightly earlier site of Umm Dabaghiyah (Bökönyi 1973), all located in more marginal areas of the Halaf cultural sphere, relied heavily on wild fauna particularly from steppe environments. With the exception of Tell Zeidan, all of these sites are less than three hectares in size. Site size is less strongly correlated with consumption of hunted (mammalian) game than ecological zone is. Tell Kurdu (Özbal 2006) is a larger sites where residents consumed sizeable portions of wild game. It should also be noted that a comparison of fish and bird consumption might alter this picture, particularly for sites situated in riverine environments. Both can provide important food sources. Fish can be salted and dried for storage making them a good storable resource. Birds also yield feathers and bone that can be used in craft goods. Tell Kurdu is an example of this; excavations at the site recovered quantities of fish (largely catfish, *Clarias* sp.) comprising 10-20% NISP in some household areas (Özbal 2006:155), which would have both provided a significant dietary contribution and required inhabitants to engage in specific labor to acquire them. Özbal estimates that this proportion is actually likely higher but different screening practices were employed in the early years of work at the site. This would have had to be scheduled among other agropastoral tasks. Finally, Domuztepe, as will be discussed in Chapter Three, is the largest Halaf site with available faunal data. Inhabitants at Domuztepe consumed very little wild fauna (approximately 2% in all consumption contexts), relying almost entirely on domesticated stock for their meat consumption.

COMPARING ANIMAL ECONOMIES AT HALAF SITES

In order to understand agropastoral cooperation during the Halaf period, it is important to critically examine differences in Halaf animal economies among sites and to ascertain how much variability appears to be attributed to issues of recovery and analysis techniques, ecology and/or different choices among inhabitants in production goals. In this section I compare differences in domesticated animal economies from Halaf sites from published faunal reports.

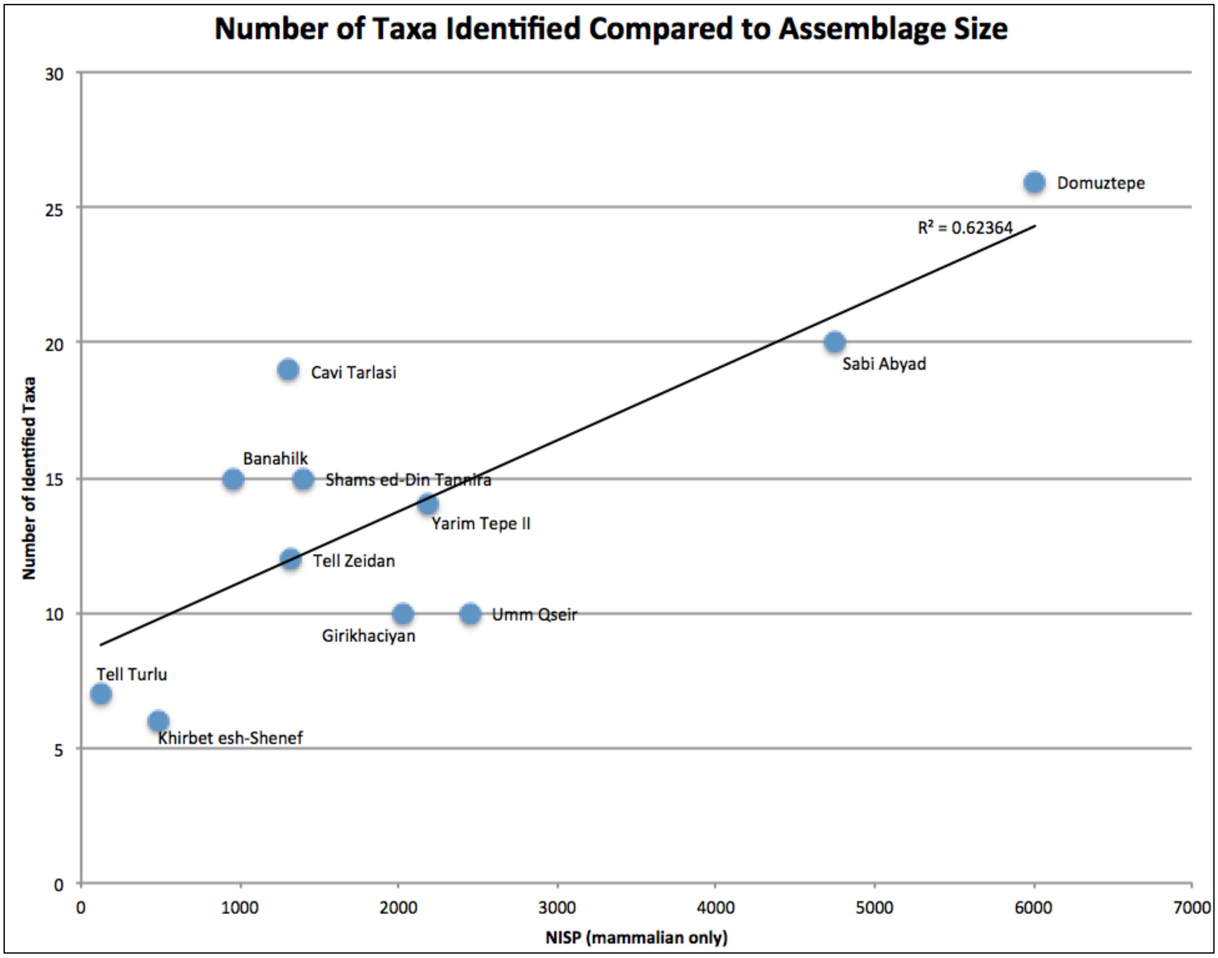

Figure 2.5 Number of Identified Specimens versus number of taxa identified to sub-family or better. Mammalian remains only. Data from Cavallo 2002; Ducos 1991; Grossman and Hinman 2013; Hendrichs 1990; Kansa et al. 2009b; Laffer 1983 McArdle 1990; Schaffer and Boessneck 1988; Uerpman 1982; Zeder 1994.

Figure 2.5 shows the number of identified specimens per assemblage compared with the number of taxonomic categories (sub-family or better) identified within the assemblage. The number of taxa within an assemblage is affected by number of factors including ancient people's animal management strategies, taphonomy, particularly fragmentation, the recovery methods employed during excavation (Payne 1972; Reitz and Wing 2008); the analysist's skill, and subjective choice in what constitutes an "identifiable fragment" (Lau and Kansa In Prep; Wolverton 2012). Methodological and analytical issues are discussed in detail in Appendix I. In order to remove some of the bias created by recovery methods, however, this analysis only includes mammal remains because fish, bird, reptile, and mollusk remains were unequally reported. This does not seem to be due, necessarily, to their absence at certain sites, but more to conventions in sieving and reporting that vary from excavation to excavation. Previous work by other scholars has shown that as the size of the assemblage increases, the number of identified taxa tends to increase (Reitz and Wing 2008). This holds true for the assemblages discussed here; there is a strong positive correlation between assemblage size (NISP) and the number of taxa identified

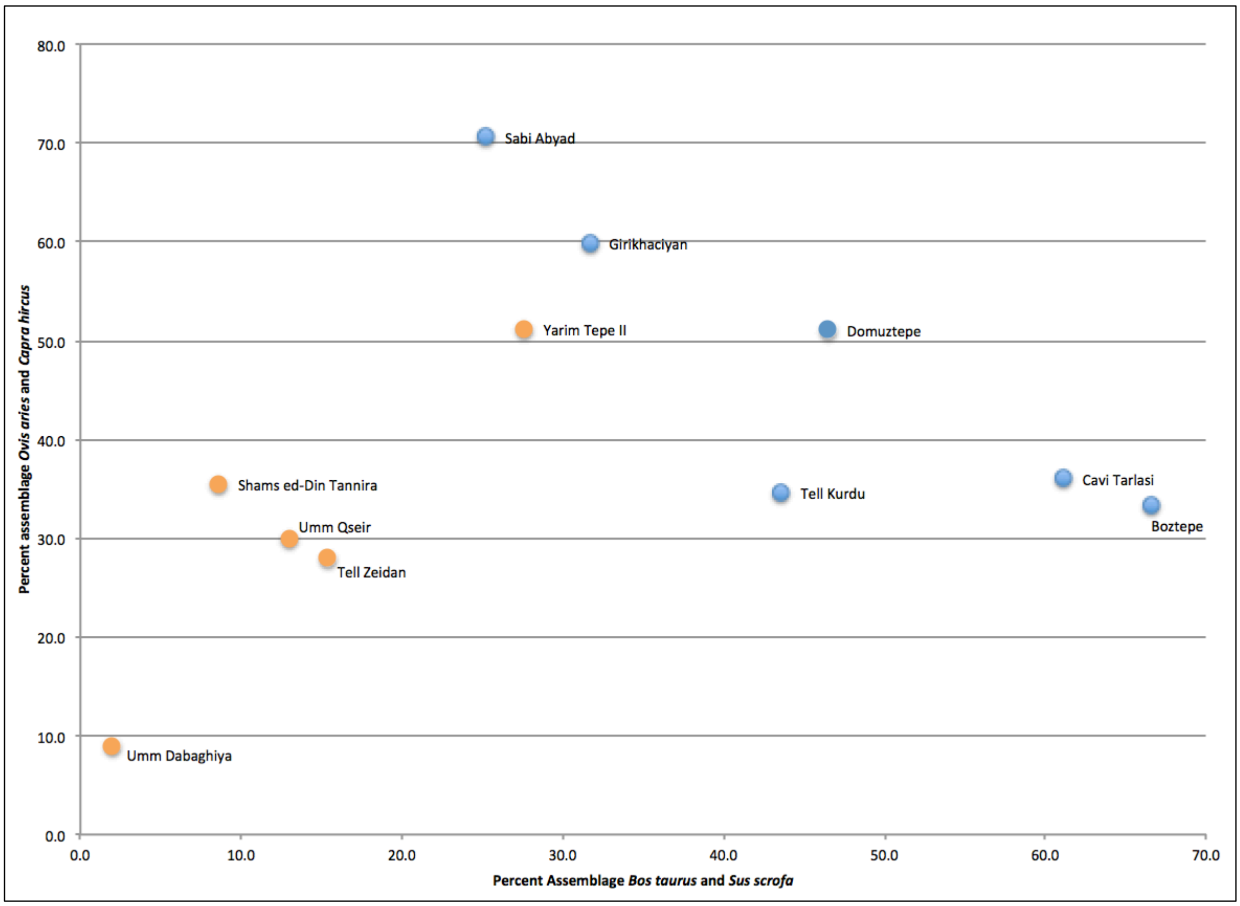

Figure 2.6 Percent Assemblage *Bos taurus* and *Sus scrofa* versus Percent Assemblage *Ovis aries/ Capra hircus*. Orange markers denote sites located in areas that receive 250 mm precipitation per annum on average or less in modern records. Blue markers denote sites that receive more than 250mm precipitation per annum in modern records. Data from Cavallo 2002; Ducos 1991; Grossman and Hinman 2013; Hendrichs 1990; Kansa et al. 2009b; Laffer 1983; McArdle 1990; Schaffer and Boessneck 1988; Uerpman 1982; Zeder 1994.

Animal economies vary among Halaf sites. Evaluating the choices Halaf period herders make for what kinds of domesticated animals they consumed and in what proportion at a given site helps to tease out differences in Halaf period peoples' production aims and environmental constraints. Figure 2.6 compares the amount of caprines versus cattle and pig that agropastoralists consumed at Halaf sites for which there are published faunal records. Caprines, as discussed above, require considerably less water than pigs or cattle, and offer two major secondary products: wool and dairy. Cattle offer dairy and, perhaps during this period, labor, while pigs are raised primarily for meat consumption. All four major domesticated taxa offer the additional primary products of blood, bones for craft production, and hides. Pig hides are thick and tough. Cattle hides exceed the other taxa in size.

From this figure it appears that there are two trends. There is a correlation between the amount of annual precipitation a site receives and the extent to which Halaf period people chose to include cattle and pigs in their animal economy; people at sites in more arid areas rely less on cattle and pigs than sheep and goat. This may, however be an artifact of a very small sample size. Among sites located in well-watered areas, however, inhabitants seem to be making a tradeoff between the species; the more heavily they rely on sheep and goat, the less heavily they rely on cattle and pigs.

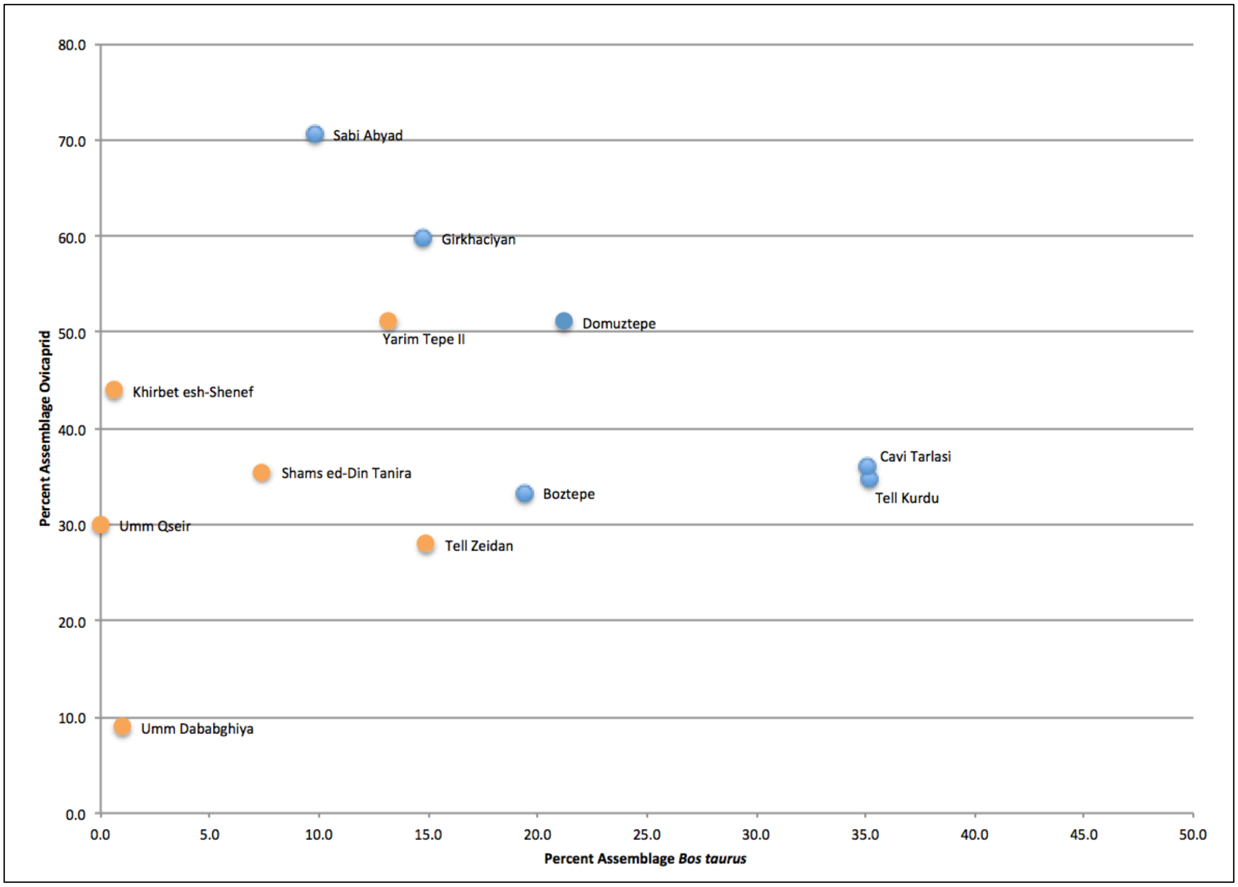

Figure 2.7 Percent Assemblage *Bos taurus* versus Percent Assemblage *Ovis aries/ Capra hircus*. Orange markers denote sites located in areas that receive 250 mm precipitation per annum on average or less in modern records. Blue markers denote sites that receive more than 250mm precipitation per annum in modern records. Data from Cavallo 2002; Ducos 1991; Grossman and Hinman 2013; Hendrichs 1990; Kansa et al. 2009b; Laffer 1983; McArdle 1990; Schaffer and Boessneck 1988; Uerpman 1982; Zeder 1994.

Caprines and cattle offer one important similar production aim: dairy. Figure 2.7 removes pigs, which have no secondary products to offer, from the comparison, showing the relative proportions of sheep and goat to cattle at Halaf sites. The same trends hold true for this comparison. Ecology seems to be an important determinant in how many cattle Halaf communities kept and consumed on site. Halaf period herders at sites located in more arid areas consumed less cattle. But even these sites have some cattle, which may speak to both food preferences among Halaf period agropastoralists and the use of cattle as draught animals although evidence in this period is marginal. Further, if some of these small arid-region sites are only or partially seasonally inhabited then cattle may have been there for labor or dairy purposes but not slaughtered on site and thus not detectable in the zooarchaeological record. Among sites in well-watered areas the trend identified in 2.5 holds true; Halaf period herders appear to make consumption tradeoffs between cattle and sheep and goat.

2.6 Diversity among Halaf Assemblages

The corpus of materials that are characteristic of Halaf assemblages is well-defined and widely distributed, but Halaf culture was not monolithic. At many sites Halaf pottery, architecture, and other materials are not the *only* iterations found in the corpus; there is heterogeneity. This heterogeneity is also evident in different subsistence practices at Halaf sites, which may be informed by ecology and individual inhabitants' production goals rather than some larger, organized strategy employed at a regional level. This variability is important for several reasons. Diversity in subsistence practices and ritual practices means that while people at Halaf sites were part of one cultural sphere, their day-to-day practices differed. With this variation in subsistence and ritual practices also came variation in labor scheduling and organization, variation in cooperative arrangements and in instances of collective action. And it also means potential variation in the ability of individuals at particular sites to benefit unequally from production and distribution of agropastoral resources. The diversity present in material culture is also important. It is an indicator of exchange relationships (discussed in Chapter Five). It may also be an indicator of overlapping relationships and identities. As discussed above, style in material culture was perhaps an important expression of group identity. Much of the variability in ceramic styles occurs on a sub-regional scale, distributed within restricted areas of the Halaf cultural sphere. These sub-regional styles may have been important for defining closer cooperative relationships among people inhabiting settlements near each other and moving within the same geographic areas.

VARIABILITY IN CERAMIC ASSEMBLAGES

Halaf ceramics are a well-defined corpus within assemblages (Nieuwenhuyse 2006), but ceramic corpora among Halaf sites vary considerably among a number of parameters: the ratio of painted to plain wares recovered, the regional Halaf style the plain wares fall into, and the extent to which other local corpora are used in tandem with Halaf ceramics. Beginning with the first variable, there are differences in the amount of plain and fine painted sherds recovered at Halaf sites. Recently excavated sites that fall within the "heartland" area (e.g. Tell Sabi Abyad in Syria) of the distribution of Halaf material culture may have upwards of 80% of their assemblage comprised of fine wares (Nieuwenhuyse 2009:82). Girikihaciyan, in contrast, has a much higher percentage of plain wares relative to painted pottery and fine wares (Watson and LeBlanc 1990). Watson and LeBlanc (1990:77) compared assemblages from six sites (Girikihaciyan, Banahilk, Aqab, Arpachiyah, Shams ed-Din Tannira and Turlu) and found that the percent of the assemblage comprised of plain wares versus fine wares varies considerably among the sites. Unfortunately, several of the key Halaf sites that were integral for defining the material culture complex were excavated in the 1930s and 1940s (e.g. Arpachiyah, relevant parts of Nineveh, Tell Halaf, portions of Chagar Bazar, Tell Hassuna, Tepe Gawra and Tell Brak, all summarized in Perkins 1949) when it was uncommon to record or save coarse wares and undecorated pottery. Thus we cannot reliably assess the difference in proportions of painted Halaf and unpainted and coarse wares at more recently excavated sites as older sites did not save this material. Ceramic corpora from these sites show that at some sites Halaf ceramics are used concurrently with more localized pottery traditions.

Halaf ceramics do not always comprise the majority of ceramic assemblages at sites within the distribution of Halaf material culture. It can be difficult to reconstruct the exact proportions of Halaf and non-Halaf wares at some of the early excavated Halaf sites due to curation and reporting practices, but more recent excavations have demonstrated that there is more regional variation in what proportion of a given ceramic assemblage is comprised by Halaf wares. Other types of ceramics include coarsewares, of which there has been little study, and regional ceramic types that exist concurrently with Halaf materials, such as Dark Faced Burnished Wares in Cilicia. Campbell reports that Halaf decorated pottery at sites in the Syrian and Iraqi Jazira comprise generally 40% of assemblages at Halaf site (1992:61). If only rims are considered (where decoration is often restricted) 75% of fine wares are decorated. As mentioned above, at Sabi Abyad, for example, 72-80% of the ceramics in the Early Halaf Strata are painted Halaf ceramics (Levels 3 to 1, corresponding with Balikh IIIB chronology reported in Le Miere and Nieuwenhuyse 1996). At Tell Kurdu, by contrast, painted Halaf ceramics do not form the majority of the assemblage (Özbal 2010:49).

While ceramics that fit under the umbrella of Halaf style are found broadly throughout Upper Mesopotamia, there are regional and temporal variations in what Halaf ceramics look like. Initially researchers sought to divide Halaf material culture into different East and West regional traditions, largely based on ceramic evidence (Davidson 1977; Perkins 1949). Perkins argued for these distinctions based on perceived stylistic differences (Perkins 1949), as did Davidson (1977). Davidson broadly identified regional traditions of Halaf ceramics located around the Khabur, Mosul, and the Euphrates Valley (1977:340). Other sites on the fringes of these regions he felt were "affected" by Halaf ceramic traditions. Syro-Cilician sites fall within the distribution of the Halaf cultural sphere identified in this chapter (Figure 2.1) and are excellent examples of the variability with which Halaf ceramics are found within assemblages in the area. Later petrographic (Davidson 1977) and neutron activation analyses (Davidson 1981; Davidson and McKerrell 1976, 1980) suggest painted pottery was produced at a several centers and traded to nearby sites. Increased excavation and more recent analyses of both stylistic features (LeBlanc and Watson 1973) and petrographic and neutron activation analyses (Spataro and Fletcher 2010), however, have suggested even more diversity and circulation beyond a simple three-region categorization. Evidence for trade in ceramics and the implications such trade would have for sociopolitical relationships are discussed in Chapter Five.

VARIABILITY IN MORTUARY PRACTICES

Mortuary practices at Halaf sites are quite diverse (Akkermans 1989, 2007, 2013; Campbell 2007a; Erdem 2013) with regards to body treatment (inhumation, secondary interments, cremation), position, orientation, number of bodies interred per burial, type and amount of grave goods, and form of grave. This is not the result of a small sample size; burials are found at many Halaf sites. Burials occur both within settlements and outside of them, sometimes within the same settlement as at Arpachiyah (Hijara 1978) and the related sites of Yarim Tepe I and II (Merpert and Munchaev 1993a), where Yarim Tepe I functioned as a cemetery associated with the settlement at Yarim Tepe II. Intramural interments are more frequently, but not exclusively, children (Campbell 2007). Infants are occasionally found buried in pots, a practice that continues from the seventh millennium BCE into the Halaf period (Akkermans 2013:28).

Inhumations can occur in many different forms. Pit and chamber inhumations are ubiquitous, some with only one interred individual and some with multiple people. Occasionally Halaf period people prepared the dead wrapped in matting or textiles, and/or covered with ochre or charcoal. Body orientation is highly variable, as is body position. Cremations are also common, and some sites (e.g. Yarim Tepe) contain both inhumations and cremations. Burials frequently include some grave goods, mostly pottery and personal ornaments though other artifacts like stone vessels are occasionally included. The implications of these burial forms and items are contested. Akkermans argues that there is "little or no evidence for differences in status and social ranking on the basis of grave inventories, but age differentiation is suggested…" (Akkermans 2013:28). Flannery and Marcus, in contrast, interpret the differentiation among grave forms and goods as marked enough to indicate some status differentiation; they cite the occurrence of child burials at Yarim Tepe I and II with items like stone maceheads and seals as indicative perhaps of inheritable status and inequalities (2012:274).

Excavations at several Halaf sites have uncovered mass interments. At Tepe Gawra twenty-two individuals were found buried within an abandoned well (Tobler 1950). Campbell suspects another may have been found at Yumuktepe, where the excavator describes excavating large deposits of burnt bone, possibly cremated (Campbell 2007: 134). Domuztepe also has a notable mass interment, described in detail below.

Secondary interment of disarticulated body parts is another burial practice that, while not common, has been observed at several different sites. Skull interments have been found at Yarim Tepe II, as both single skulls and collections of skulls (Akkermans 1989). Skull interments have also been recovered at Arpachiyah, within vessels and in caches of multiple skulls (Hijara 1978: 125). Several skull interments have also been found at Sabi Abyad (Vos 2011:79). These practices are widespread throughout the Near East in earlier periods of the Neolithic.

Another rare practice that is attested to at multiple sites is the association with burials in houses that appear to be intentionally, perhaps ritually, set ablaze. Dead bodies were placed in ritually destroyed structures at both Sabi Abyad and Tell Bouqras (Akkermans 2008: 630). At Sabi Abyad two adults (one male, one female) were recovered with ten clay "torsos" with faunal material embedded in them including cattle ribs and wild sheep horn cores (Ibid). Deliberately destroyed buildings have also been recovered at Arpachiyah (Campbell 2000), but these lacked burials.

2.7 Views of Halaf Sociopolitical Complexity

The Halaf is characterized by increasing political and social complexity, but the nature of this complexity is disputed. The ubiquity of seals and sealings imply an increasing need to mark and control property, but this does not necessitate a centralized authority. Further, the distribution of sealings in large, presumably public buildings (e.g. buildings II and V in Sabi Abyad's Burnt Village) suggests that this occurred with some degree of community organization (Akkermans and Verhoeven 1995), but that access to sealing technology was broad. Long distance, interregional trade is inferred from the distribution of obsidians from various sources, from chipped stone artifacts and from painted ceramics (discussed in Chapter Five). Settlement patterns are more difficult to interpret given the different resolutions available within the geographical area associated with Halaf culture. Further, as discussed above, issues of both overburden and shifting settlements confound our sense of settlement size. But there do seem to be at least some sites that outstrip others in size and may even constitute a weak two-tiered or even three-tiered settlement hierarchy (Özbal 2011:179). This hierarchy is certainly economic, and it may have been political, as will be detailed below. The overall impression is one of comparatively small sites exploiting various resource patches and a small number of larger sites, which may have served a public function, such as communal storage (e.g. Akkermans and Duistermaat 1996; Duistermaat 2010) or ritual purpose (e.g. Campbell 2000).

But despite these similarities in material culture, there is also great variability among practices at Halaf sites. Subsistence practices vary along a spectrum of reliance on agropastoral and hunted and gathered resources. This is likely influenced by ecological factors and the production aims of the inhabitants. What is unclear is if this reflects the choices of individual groups or is part of a system integrated on a regional level. There is also great variability in the extent to which Halaf material culture is adopted at different settlements. This may reflect how much they participate in the social processes shaping the Halaf world or their placement within a settlement hierarchy if one does, indeed, exist. Finally, we see great variability in mortuary traditions. Mortuary traditions are often associated with ritual and are frequently expected by archaeologists to be more conservative than other aspects of social life. As described here, Halaf period people employed subsistence practices and mortuary practices in different combinations at different sites. Does this indicate that social practices were less unified than might be inferred from looking at the ceramic, lithic, glyptic and other artifactual corpora alone?

Scholars interpret the homogeneity in certain aspects of material culture and heterogeneity in others (subsistence practices, mortuary practices, the extent to which Halaf sites incorporate other local traditions in their material culture assemblages) in very different ways. There are proponents for strongly divergent models of sociopolitical complexity during this period. Akkermans argues that Halaf communities were egalitarian and autonomous communities. Forces that create social tension, such as increasing population and differential distribution of goods, were mediated by Halaf period people adopting lifeways with a high degree of mobility, close and perhaps fluid relations between sedentary and more mobile communities (Akkermans and Duistermaat 1997), and frequent community fission (Akkermans and Schwartz 2003: 149-153).

In a similar vein, Frangipane argues that Halaf communities were characterized by "horizontal egalitarian systems" wherein all community members had equal access to status and the capacity to make decisions. These capacities likely varied by social group (e.g. by age, gender, or community occupation) (Frangipane 2007: 153). To Frangipane, the distribution of small communities exploiting different resource patches suggests that the overall economic system was likely characterized by cooperation between groups. She explains the broad distribution of Halaf material culture as the result of frequent community fission and the creation of new villages, gradually spreading the cultural horizon over time. These fissions were a response to demographic pressure that perpetuated the egalitarian system, rather than sparking the inception of increasingly complex management systems. The maintenance of the overall Halaf culture was a means of strengthening and maintaining the sense of shared identity among separated but cooperating groups over a broad area.

In contrast, several scholars, particularly those steeped in the global comparative archaeology tradition, see at minimum ranked differentiation among members of Halaf communities (Flannery and Marcus 2012; Yoffee 1993, 2005), perhaps extending into chiefly societies (Redman 1978; Watson 1982; Watson and LeBlanc 1990). Watson (1982), Watson and LeBlanc (1990) and Redman (1978) have argued that Halaf societies were likely chiefly societies (*sensu* Service 1962). They argue that the widespread distribution of Halaf material culture with small local variations is evidence that many communities operated independently in one cultural system where markers of prestige and rank were mutually intelligible among different communities (Watson and Leblanc 1990:136).

In their book *The Creation of Inequality* Flannery and Marcus (2012) argue that inequality among individuals within Halaf communities is detectable, with possible chiefly centers such as at Arpachiyah. They suggest the existence of hereditary rank in the burial record, noting that there are different types of burials, and that some individuals are afforded more burial goods than others even within a single site's cemetery (they specifically cite the evidence from Yarim Tepe I and II). To Flannery and Marcus the most compelling evidence in the burial record is the recovery of burials of children and youths with items associated with administration, such as seals and mace heads, which imply "that some youths were being groomed to inherit their fathers' positions within Halaf society," (2012:274). They interpret evidence of exchange of fine ceramics and other luxury goods as long-distance elite exchange. Finally, they identify a two-tiered settlement hierarchy, with larger communities exerting influence on smaller surrounding communities. They identify Arpachiyah as an example of a possible chiefly center. They argue the presence of public buildings and the existence of a sealing system are evidence of the existence of an elite who can control the production and flow of goods.

Yoffee also views the Halaf period as one characterized by ranked differentiation, with possible chiefly centers. Borrowing Caldwell's (1964) term "interaction sphere" originally used to describe Hopwell communities in eastern North America, Yoffee argues that the broad distribution of Halaf material culture indicates that populations shared "social, ideological and trade connections," (2005:204; see also1993). Thus communities were culturally united but not politically unified on a regional basis. Yoffee's interpretation of the Halaf communities' interaction sphere is similar in mechanism to Frangipane's explanation for the widespread distribution of Halaf material culture; the imagery and shared designs reflect a "shared corpus of symbols," which are the manifestation of "a common code of values and beliefs… invented to facilitate the social interaction needed to exchange goods," (2004:204). Yoffee, however, argues that the agents of this exchange of shared material culture are local elites, who "sought to control the circulation of goods across vast geographical and social distances," (Yoffee 1993:265). The primary evidence for this is the circulation of pottery from large centers to hinterlands derives early NAA (Davidson and McKerrell 1976) and stylistic analyses (LeBlanc and Watson 1973), although the results of the NAA study has been brought under scrutiny (Galbraith and Roaf 2001). Yoffee also sees trade in obsidian, copper, and turquoise prestige goods as indicative of common symbols of power.

Figure 2.8 Image of Domuztepe from the Narlı Plain. Image courtesy Elizabeth Carter.

2.8 Halaf Domuztepe

Domuztepe is an aberration in the Halaf settlement pattern at 20 ha in size. Located in southeastern Turkey in Kahramanmaraş Province, the site represents the northern limit of the Halaf cultural sphere. Two main phases of occupation have been identified— a large 6th millennium BCE Halaf occupation and a more restricted 1st millennium CE occupation. There is no evidence of significant occupation during the intervening periods. The Late Neolithic material is the salient part of Domuztepe's life history for this study. Domuztepe was inhabited throughout all three subphases of the Halaf (Early, Middle and Late Halaf, spanning 6000-5450 cal. BCE). At present the extent of pre-Halaf occupations at Domuztepe are unknown. Excavations were conducted between 1995 and 2011 under the directorship of Elizabeth Carter (UCLA) and Stuart Campbell (University of Manchester) in conjunction in the final years with

Alexandra Fletcher (The British Museum). All the material in this study comes from those excavations. A renewed series of excavations began in 2014 with a Turkish-run team.

The site itself is located on the broad alluvial Narlı plain which today is a fertile and major crop producing area. To the north, south, and east of the site land is available for cultivation. Paleobotanical records indicate that mixed oak and pistachio steppe forests would have been found in the immediate vicinity (Carter et al. 1999; Kansa et al. 2009b). To the west of the site are low hills comprised of stony soils supporting only minimal vegetation cover. Between the hills and the site there was once a large marsh. Modern agriculture and water management have greatly altered the present environment, draining the marsh and canalizing existing waterways to support irrigation agriculture. The Aksu River runs approximately 2 km to the north of the site. The Kahramanmaraş plain currently receives 500-750 mm of rainfall per annum, comfortably within the range where dry farming is productive. Paleoclimatic indicators, as described above, suggest that the Halaf period was the wettest period of the Holocene and thus conditions at Domuztepe during the Halaf period would likely have exceeded modern averages in precipitation per annum.

Domuztepe was not an isolated site on the Narlı Plain. The Kahramanmaraş valley was surveyed between 1993 and 1997 by archaeologists under the direction of Elizabeth Carter of UCLA (Carter 1993, 1996; Carter et al. 1999a, b), with intensive surveys of selected portions of the study area focusing on the Neolithic occupations led by James E. Snead (Carter et al. 1999b), Çiğdem Atakuman Eissenstat (2004), and Bekir Gürdil (2002). These surveys coupled with the intensive excavations at Domuztepe (site KM 97) show the dynamics of local mobility and nucleation in the area (Figure 2.9).

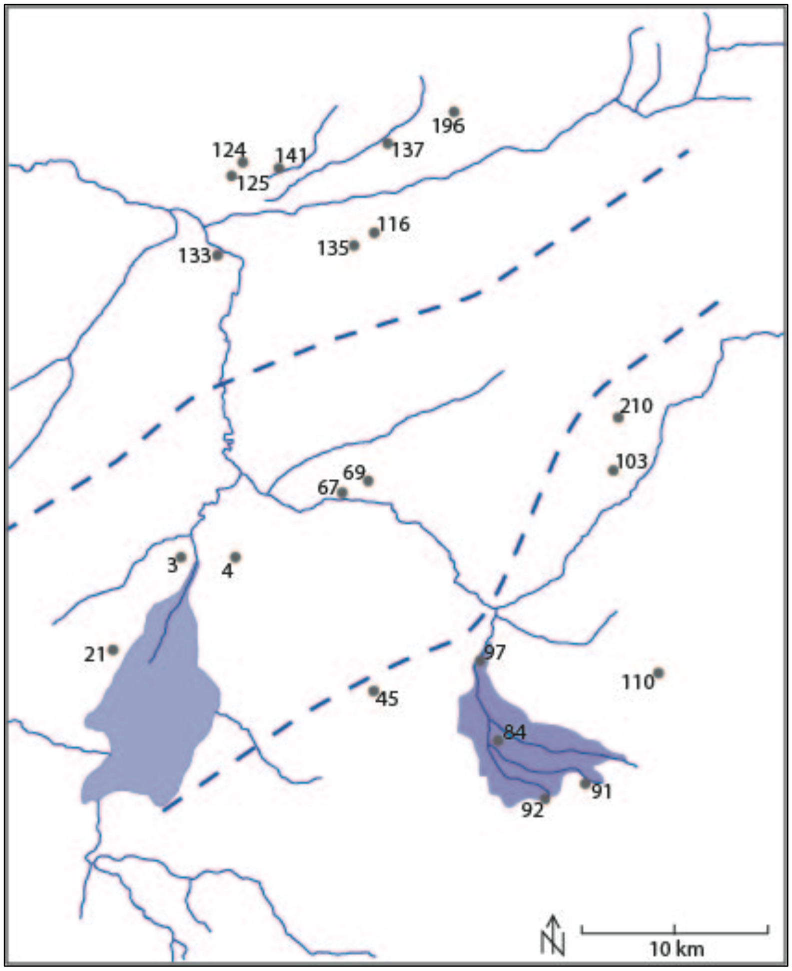

Figure 2.9 Halaf sites in the Karahmanmaraş Valley Survey Region. Adapted from Eissenstat 2004. Domuztepe is site KM 97.

The Kahramanmaraş valley is subdivided into four basins separated by natural geological boundaries and oriented toward specific natural conduits out of the study region. Settlement patterns during the Halaf period within these basins are detailed in Eissenstat (2004). One basin — the Western Basin — had only one site (KM 21). It is a multi-period site that includes a Halaf period occupation. The other three basins — the South-eastern Basin where Domuztepe is located, the Central Basin, and the North Basin — all have "communities" of 6^{th} millennium sites. Each basin has one site that pre-dates the Halaf period and which, Eissenstat posits, functioned as a sort of "community center that dominated the landscape of community formation," (2004:125). In the Central Basin this is site KM 67, with four other Halaf sites within the area. In the Northern Basin it is KM 125, though it is noted that this site is much smaller in size than the other two central sites. The Northern Basin has four additional Halaf sites, and all sites in the basin are less than one hectare in area. In the Southeastern Basin Domuztepe is the primary site. Four other Halaf sites ranging from less than one hectare to 2 hectares existed in the sub-region.

To summarize, the Halaf period in the Kahramanmaraş valley is one of nucleation within basins at certain long-occupied sites, with smaller sites existing around them that were occupied for shorter durations (*Ibid*.: 148). Rather than perceiving this as evidence of a clear settlement hierarchy within the basins and the valley, as Gürdil does (2002:149), Eissenstat suggests this may represent residential mobility (2004: 148). People moved between these relatively short-lived sites and longer-occupied centers, perhaps in order to deal with shifting agricultural objectives. In other words, Halaf period people within the basins of the Kahramanmaraş Valley maintained a commitment to particular settlements, moving between and among long-occupied sites and sites within their neighborhood, which may have offered some strategic benefit – access to certain agricultural land, for example. The proximity of marshland to Domuztepe would have restricted the amount of arable land immediately adjacent to the site; moving away from the main settlement for part or all of the year to tend crops elsewhere within the basin may have solved the problem of supporting the large population at Domuztepe, and alleviated social tensions that may come with close quarters at the site.

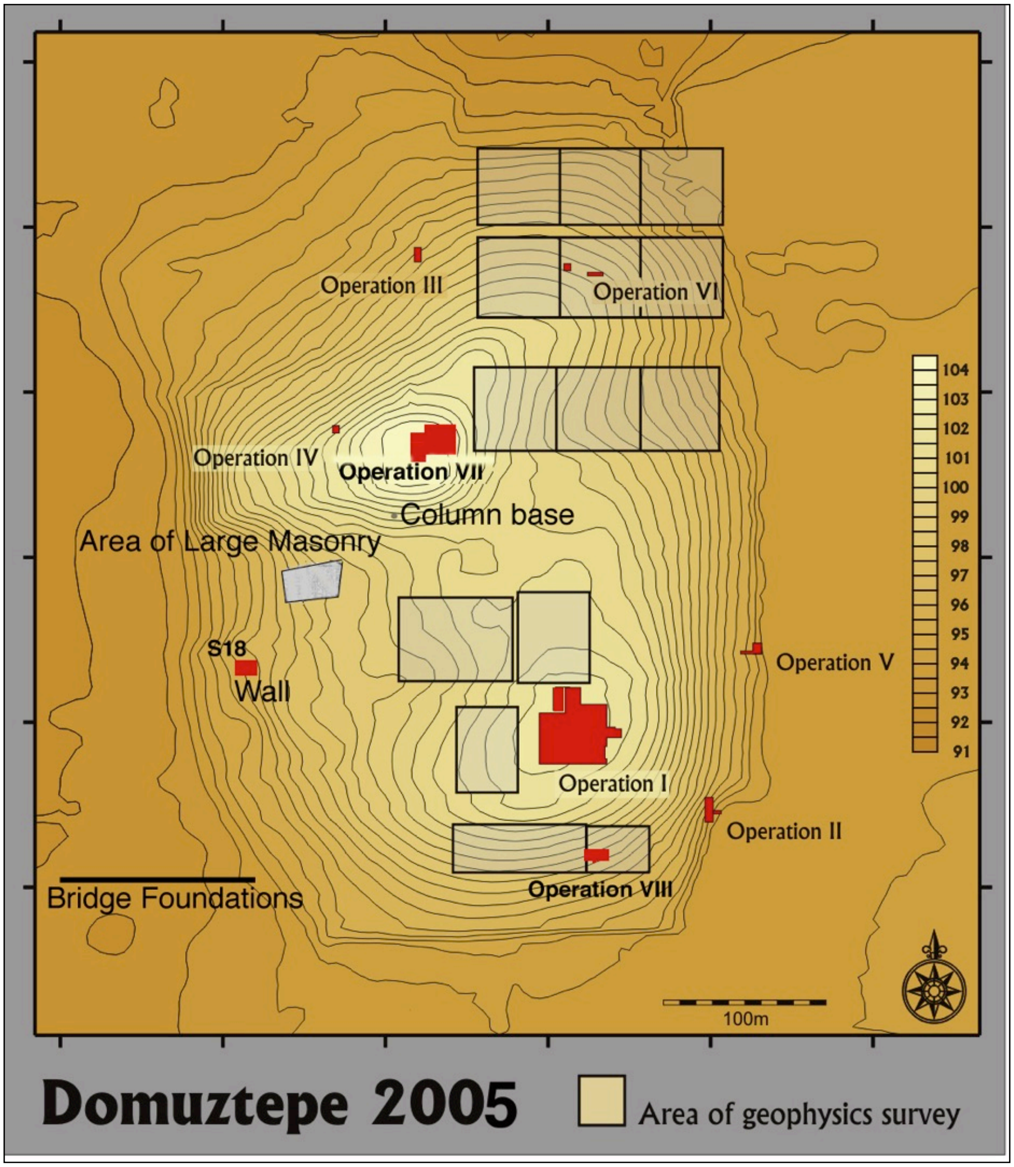

Figure 2.10 Map of Excavation Areas and Geophysical Survey at Domuztepe.
Image courtesy of Elizabeth Carter and Stuart Campbell.

Excavations were carried out in eight operations at the site over a course of 16 years of work (Figure 2.10). Operation I was the primary focus of excavations and offered the broadest horizontal exposure at the site. Survey and excavations at Domuztepe indicate the late Halaf village at Domuztepe comprised the entire mound, and excavators estimate that it may have supported a population exceeding 1,500 inhabitants (Kansa et al. 2009b). This is extremely large for this time period. Domestic architecture includes both rectilinear and round tholos buildings.

Early tholoi are "house-sized" (Carter et al. 2003:119), while later tholoi served as communal storage facilities (Carter et al. 2003; Kansa et al. 2009b). This mirrors the pattern of tholoi construction at Sabi Abyad (Akkermans 1987:26). The majority of the ceramics recovered at Domuztepe are comparable to the classic Halaf styles in shape, fabric, and decoration (Carter et al. 2003:129). A number of ceramics represent a local tradition (particularly the corpus of thick burnished jars) or indicate ties with other areas of the Near East such as the Levant and Amuq (Carter et al. 2003:129) (Figure 2.11).

Figure 2.11 Ceramics at Domuztepe. The pot on the left is an example of Halaf painted ware (DT Object #343). The jars on the right are examples of a local thick burnished jar type (DT Object #706). Images from Open Context archives for Domuztepe (Campbell and Carter 2006 reprinted with permission from Elizabeth Carter)

Small finds from excavations provide a wealth of information regarding daily life and regional interaction. Ground stone includes finely carved vessels in locally-sourced serpentine and imported obsidian (Campbell, B. 2013). Chert is the most ubiquitous chipped stone recovered (Campbell et al. 1999:103). Obsidian, constituting 7-19% of the chipped stone assemblage throughout the Halaf, was derived from at least six different sources in Central, Southeastern, and Northeastern Anatolia and the Southern Caucasus (Healey 2007, discussed further in Chapter Five) and attests to Domuztepe's integration into regional trade networks. Excavations have yielded a large corpus of seals and sealings (forty-four and four respectively) from Domuztepe, although none come from primary contexts (Carter 2010). The majority of the seals bear geometric designs and are similar to those found at other sites. While no caches of sealings or tokens have been found similar to Sabi Abyad, Carter points to the size of the settlement and communal storage facilities as indicative that similar practices may have occurred at Domuztepe (2010:164).

SUBSISTENCE PRACTICES AT DOMUZTEPE

Previous research on paleobotanical and faunal data at the site indicate that the inhabitants relied primarily on agropastoralism for subsistence, with some seasonal reliance on wild game and plant resources such as fruits and nuts (Kansa et al. 2009b: 911).

Among botanical remains einkorn and emmer wheat are the most ubiquitous of the domestic plant taxa thus far identified in flotation samples (N=221 from both primary and secondary contexts). Barley, free-threshing wheat, and a variety of pulses (grass pea, lentils, peas, and linseed) were important crops for both human consumption and fodder for domestic taxa. Faunal data suggests the inhabitants primarily relied on the traditional suite of Near Eastern domesticates — sheep, goats, cattle, and pigs — for their animal products, including meat, dairy, and fibers. Wild taxa account for only about 2% of the identified fauna in all time periods (Ibid: 903). The role fish and avifauna may have played in the Halaf subsistence system at Domuztepe has yet to be fully evaluated. Some avifauna and ichtyofauna collections have been recovered in handpicked portions of the assemblage and identified in all studies of heavy fraction to date (Kansa 2003 unpublished report).

Faunal data from four contexts have been analyzed thus far: material from domestic refuse ("Quotidian contexts"), the "Death Pit," and the Operation III "Feasting assemblage" and "Ditch". These contexts are described below, and the content of these assemblages are described in Chapter Three. Sarah Whitcher Kansa analyzed the Quotidian and Death Pit Assemblages (Campbell et al. 2014; Kansa et al. 2009a; Kansa et al. 2009b); Kansa and I worked together to analyze the Operation III material (Campbell et al. 2014; Lau and Kansa In Prep). I am responsible the majority of zooarchaeological analysis of the "Ditch" assemblage. Sarah Whitcher Kansa analyzed a portion of this assemblage (approximately 25%) prior to 2009. The details of these analyses are discussed in Chapter Three. A rigorous and innovative approach to data-sharing ensures that zooarchaeological analyses done by two different researchers can be compared and interpreted in a manner that accounts for inter-observer variability. Methodological considerations are discussed in Appendix I.

FEASTING PRACTICES AT DOMUZTEPE

Domuztepe not only clarifies our understanding of domestic life during the Halaf; it also provides the opportunity to explore the Halaf inhabitants' feasting and ritual activity. Excavators recovered three unique contexts related to such events —the Death Pit, the Operation III Feasting Assemblage and the Ditch. These group events have clear implications for understanding social interaction and cooperation at Domuztepe.

The Death Pit

Domuztepe is most noted for a distinct funerary deposit — the "Death Pit" — that is located in Operation 1 near another feature associated with feasting called the Ditch, which is described below. The deposit is a large, stratified feature filled with human and faunal remains, as well as cultural material, ash, stones, plaster, and mudbrick (Carter 2012; Erdem 2013; Carter et al. 2003; Kansa and Campbell 2002; Kansa et al. 2009a). The Death Pit postdates the Ditch.

Dates for the Death Pit from bone collagen place it at circa 5600 BCE (UCI AMS Dates 87102 and 290034-29008; analyses by Brian Damiata) and represents the final depositional activity in this portion of the site for a considerable period -- generations according to Carter et al. (2003). They argue that this speaks to the persistent use of this area for the purpose of communal or ritual activity.

Researchers have published several detailed analyses of the faunal and human remains derived from the Death Pit feature (Carter 2012; Carter et al. 2003; Gauld et al. 2012; Kansa and Campbell 2002; Kansa et al. 2009a). These reports emphasize interpret this feature as a feasting that not only included animals customarily consumed at Domuztepe (caprines, cattle, and pigs) but also humans (35 individuals at minimum) and domestic dogs. They point to evidence for cannibalistic behavior, including the distributional similarity in butchery marks, bone fragmentation indicative of marrow extraction, and "pot polish" (Kansa et al. 2009a) on both animal and human remains. Small finds include bone tools, lithics, beads, stamp seals, a figurine, and remains of plaster baskets (Kansa and Campbell, 2002; Kansa et al. 2009a; Carter et al. 2003). The pit itself measures approximately 3.5-4m in area and 0.75 m-1m in depth. It was cut into the large artificial terrace constructed in the northern portion of the excavation area. Structural and taphonomic analyses suggest that the deposit was created over a short period of time and sealed quickly. Afterwards there was a hiatus in occupation of that portion of the site for a period of several generations (Carter et al. 2003).

Operation III Feasting Deposit

This deposit is a large concentration of faunal remains interpreted as the result of the residents' repeated disposal of refuse from feasting in a localized area dating to ca. 5650-5500 BCE (Kansa and Campbell 2008; Campbell et al. 2014). The concentration has no clear association with an architecturally differentiated area or the large volume of ceramics and small finds associated with the Death Pit. It does, however, have a similar faunal signature in terms of species remains (discussed in more in Chapter Three). Kansa analyzed the majority of the Op III assemblage. Lau and Kansa analyzed an additional subset of the assemblage (roughly one-third) as part of the interanalyst variation study (see Appendix I AI.5, Lau and Kansa In Prep).

The Ditch

The focus of this dissertation is the Ditch. This feature is located on the northern edge of the Operation I excavation area. Prehistoric residents built an artificial terrace on this part of the site by deliberately filling abandoned structures with red clay soil and limestone plaster (Carter and Campbell 2007: 124). Geophysical survey indicates that this terrace may have extended at least 75 meters in length (Carter et al. 2003; Kansa and Campbell 2008). Excavators suggest this terrace was likely constructed using communal labor (Carter et al. 2003). Within the terrace is a large feature referred to as the "Ditch," which comprises a 20-m-long series of discrete deposits filled with cultural material and gleyed soil cut into the terrace. Three large ovens (ca. 1 by 1.25 meter) are located adjacent to the Ditch. These ovens appear to have multiple use phases (at least three), with the lowest phase of the ovens at the same level as the top level of the Ditch deposits. Bone collagen dates obtained from the Ditch material date the deposit to ca. 5892-5751 cal. BCE (2011 UCI AMS#s: 29004, 29005, 29006, 29007, 29008), predating the Death Pit assemblage.

Excavators recovered a particularly mass of small finds from the deposits that form the Ditch, including notable quantities of ceramics (see Figure 2.10), bone artifacts (N=62), lithics (worked stone N=11, ground stone N=7, polished stone N=1), stone bowls (N=46), beads (N=45), seals (N=17) and a sealing (N=1), spindle whorls (N=4) and figurines (N=2) (All data from Erdem 2014). The ceramic assemblage includes painted pottery and a large number of thick burnished vessels of unclear function. Carter and Campbell (2007) postulate that the Ditch was the locus for communal and/or ritual activities throughout the Halaf.

The Ditch fulfills all three criteria for distinguishing a feasting assemblage in the archaeological record. The commensal consumption of special food and drink are attested in a number of ways. The large number of thick-burnished vessels and painted pottery exceed household assemblages in quantity. The large ovens indicate that food preparation occurred in this area. Analogous structures have been used as evidence in other archaeologically attested feasting assemblages (e.g. as argued by Brown for Ceren in El Salvador, 2001). The faunal remains, described in Chapter Three, are also indicative of feasting. Prehistoric inhabitants clearly selected a spatially distinct feasting stage in that the deposits are cut into the artificial terrace, visible from much of the site. The spatial distinction is further indicated by the fact that the Death Pit is later cut into the terrace adjacent to the Ditch, as well as the occupational hiatus in the area for some time following the sealing of the Death Pit. This may suggest a socially inscribed degree of sanctity or reverence for the space. Finally, the abundant small finds and painted pottery indicate that prestige goods were incorporated into the activities that produced the Ditch assemblage. The details of these analyses are discussed in Chapter Three.

CHAPTER THREE: ZOOARCHAEOLOGIAL STUDY

3.1 Cooperation in Agropastoral Production

Agropastoral production requires herders to organize the labor necessary to raise their animals within the context of competing labor demands for other types of production (e.g. cultivating crops, making tools, hunting and fishing, etc.). In Chapter One I discussed how herding is integrated into broader labor demands and how such demands can make cooperation among members of a household, between factions, within a community, or among communities appealing and necessary. Scheduling and organization may occur at different levels of social organization. All participants may engage in all aspects of animal rearing or some may perform specialized tasks at certain times. Domesticated animals have different types of ecological, food, and herding requirements and caring for them necessitates that their caregivers make choices. To optimize their animal management strategies herders may again choose to distribute these labor demands within their household, or may cooperate beyond the household level.

This chapter examines cooperative relationships in two ways: directly through an examination of the remains of collective action events, which are discrete instances of cooperation, and indirectly through evidence of animal management strategies employed by residents at Domuztepe. I accomplish this by examining and comparing assemblages of animal bones from different contexts at the site. I discuss broad trends in what taxa agropastoralists at the site chose to raise, and how choices differed in what animals to cull for day-to-day consumption and communal feasting events. Combined, these data show what demands livestock at Domuztepe placed on their human caregivers.

3.2 Summary of Ditch Fauna

In this section I describe the vertebrate assemblage from the Ditch, including species frequency and pre- and post-depositional taphonomic effects that may be altering the assemblage. I then describe the four major taxa present in the assemblage – caprines (sheep and goats), pigs, and cattle – and summarize the demographic patterns evident within each, as well as body part recovery and evidence of anthropogenic taphonomic alteration. These last two measures further shed light on what might be missing from the assemblage, such as whole joints of meat removed by participants in the Ditch feasts to be consumed elsewhere, bones cooked or fractured so as to be unidentifiable at the species level, or removed and worked (Campbell and Carter 2006). I describe the evidence of hunting and fishing indicated in the Ditch assemblage. Finally, I look at changes in portions of the Ditch fauna that come from stratigraphically differentiated layers.

SPECIES FREQUENCY

Overall the assemblage analyzed here is composed of 13,523 fragments of bone. I analyzed 10,212 specimens, and Kansa analyzed 3311 specimens. Within this assemblage 9,798 specimens could be identified to size-class or a more specific taxonomic designation. Table 3.1 is the complete list of fauna from the Ditch assemblage that could be identified to a size class or more taxonomically specific category. This assemblage provides a sense of how much of the assemblage I consider identifiable, including parts of the body that are considered categorically unidentifiable to the level of species (see Appendix I AI.2 for description of what parameters were used for identification).

Taxon	Common Name	NISP
Size Class Only		
Small mammal		3
Small/Medium mammal		213
Medium mammal		1191
Medium/Large Mammal		211
Large mammal		424
Ungulata		
Medium Ungulate		31
Medium/Large Ungulate		1
Large Ungulate		1
Artiodactyla		
Bos taurus	Cattle	756
Ovis/Capra/Gazella	Sheep/Goat/Gazelle	43
Ovis aries/Capra hircus	Sheep/Goat	2762
Ovis aries	Sheep	818
Capra hircus	Goat	1128
Capra aegagrus	Wild Goat	1
Gazella subgutturosa	Gazelle	24
Ovis orientalis	Wild Sheep	3
Cervidae	Deer	56
Cervus elaphus	Red Deer	3
Dama sp.	Fallow Deer	24
Sus scrofa domesticus	Pig	1839
Sus scrofa	Wild Boar	1
Perissodactyla		
Equus hemionus/Equus asinus	Onager/Wild Ass	4
Carnivora		
Canis sp.	Canidae	2
Ursus arctos	Brown Bear	7
Vulpes sp.	Fox	1
Lagomorpha		
Lepus spp.	Hare	6
Rodentia		
Castor fiber	Eurasian Beaver	1
Avifauna	Bird	9
Ichtyofauna	Fish	34
Total		**9798**

Table 3.1 Summary of all Ditch fauna (NISP)

Table 3.2 and Figure 3.1 show the subset of the assemblage that can be identified to sub-family or better. This subset of the assemblage is the relevant information for comparison to the other faunal assemblages at Domuztepe.

Taxon	NISP	% Assemblage
DOMESTICATED TAXA		
Bos taurus	756	10.1
Ovis aries/Capra hircus	2762	36.9
Capra hircus	1128	15.1
Ovis aries	818	10.9
Sus scrofa	1839	24.6
Sub-Total	**7303**	**97.66**
WILD TAXA		
Capra aegagarus	1	<0.1
Cervidae	56	0.8
Cervus elaphus	3	<0.1
Dama sp.	24	0.3
Gazella subgutturosa	24	0.3
Ovis orientalis	3	<0.1
Sus scrofa	1	<0.1
Equus hemionus/ Equus asinus	4	0.1
Canis sp.	2	<0.1
Ursus arctos	7	0.1
Vulpes sp.	1	<0.1
Lepus spp.	6	0.1
Castor fiber	1	<0.1
Avifauna	9	0.1
Ichtyofauna	34	0.5
Sub-Total	**176**	**2.34**
TOTAL	**7479**	**100**

Table 3.2 Summary of Ditch Fauna identifiable to sub-family or better (NISP and Percent Assemblage)

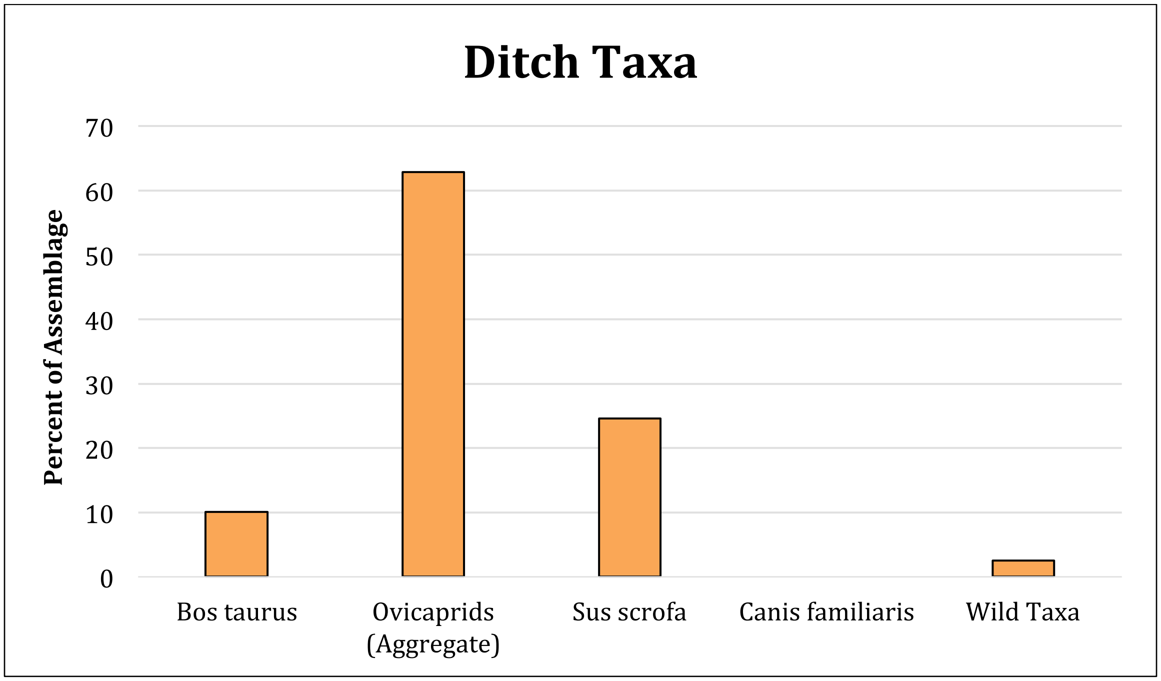

Figure 3.1 Ditch Taxa break down by percent assemblage. Caprines are aggregated as many of their skeletal elements cannot be differentiated among genera (see AI.2).

The Ditch assemblage is dominated by the traditional suite of Near Eastern domesticates – sheep, goat, cattle and pigs; these animals comprise 97.7% of the assemblage. Wild taxa in aggregate comprise only 2.3% of the assemblage. Deer (red deer and fallow deer) and gazelle are the most frequent wild taxa.

TAPHONOMY

In order to identify the patterns evident in the species recovered in the Ditch, it is important to evaluate what might be missing due to pre- and post-depositional taphonomic actors. Anthropogenic and non-anthropogenic factors can strongly alter the composition of any zooarchaeological assemblages (Lyman 1994). In this section I look at indices of recovery, which suggest how the assemblage may have been altered due to recovery techniques, as well as the effects carnivores and rodents and exposure may have had on altering the assemblage in antiquity. Anthropogenic taphonomic factors are considered in conjunction with the description of the most ubiquitous species below.

Recovery Index

Excavation and recovery practices can have a significant effect on recovery (Payne 1972). The Domuztepe Ditch assemblage was hand-picked. Payne (1972) showed that when excavators rely on hand-picking bones, small fragments are consistently missed. These elements are either recovered by sieving, or are lost when soil is removed from the context. Parts of the Ditch assemblage were wet-sieved but this material was not available for study. The heavy fraction assemblage could not be removed from the Kahramanmaraş Arkeoloji Müzesi to compare with a sufficient comparative collection (see Appendix AI.I for full discussion of recovery techniques employed at Domuztepe).

Arbuckle (2006: pp. 242-243) uses an index of recovery to assess how affected an assemblage might be due to recovery techniques for his work at sites in Central Anatolia spanning the Pottery Neolithic through Bronze Ages. Arbuckle calculates this index by determining the ratio of first and second phalanges, as these two elements occur in the same number within the skeleton, articulate with one another and are unlikely to be separated due to butchery practices. This index was calculated two ways: using the number of identified specimens (NISP_ of all first phalanges against second phalanges and using the minimum number of elements (MNE) of first phalanges versus second phalanges. The second index is intended to account for the possible increased fragmentation of the first phalange. Index values of 1.0 would indicate equal recovery of both first and second phalanges. An index value higher than 1.0 would indicate the smaller second phalanx was not recovered as frequently. Index values lower than 1.0 would indicate the first phalanx was not recovered as frequently. In a hand-picked assemblage, we expect an index value higher than 1.0, indicating that hand-collection recovered the larger first phalanx more often than the smaller, more elusive second phalanx.

I used this method to assess recovery in the Ditch assemblage at Domuztepe. The ratio of NISP of first phalanges to second phalanges is 488/243 for an index value of 2.01. I chose to calculate the MNE ratio using only phalanges that could be identified to sub-family or better (454/239) yielding an index value of 1.90. Both these index values are high; first phalanges were recovered at almost twice the rate of second phalanges. This does not seem to be strongly impacted by increased fragmentation of the second phalanx. This suggests that the assemblage described here is likely missing small elements and bone fragments, reducing the representation of small taxa (including very young individuals of larger taxa) and specific portions of larger taxa's skeletons. The contribution of smaller taxa like hares, beavers, mustelids, birds, and fish is perhaps thus being undervalued.

These hypotheses are confirmed in a small study[1] of material from heavy fraction studied by Kansa (personal comm.). This study indicated that the hand picked assemblage is missing some small wild fauna (particularly fish, but also hare, fox, and birds) and younger domesticated caprines and pigs, whose bones are smaller and more likely to be overlooked. This assemblage suggests that in the hand-picked fauna we are missing young goats and young pigs, which show up in greater frequency in sieved materials than in the hand-picked part of the assemblage. A full study of the material from sieving would ameliorate this issue and should be a future goal should it be possible to carry out more labwork at the Kahramanmaraş Museum.

Effects of Rodent and Carnivore Gnawing

[1] NISP = 560, 354 of which could be identified to family or more specific taxonomic category (Kansa, personal comm.)

Only a total of 52 specimens displayed any evidence of gnawing; this is less than 1% of the complete Ditch assemblage (0.53%). The majority of these gnaw marks appear to be the result of carnivores. This is evident in the presence of gnaw marks on recovered specimens consistent with the shape of puncture marks from carnivore dentition. Thirteen of the fifty-two gnawed specimens may have been digested (see Horwitz 1990:97 for a description of the physical features of bones that have been partially digested.) This is likely to have been the result of dogs and perhaps pigs scavenging through the assemblage. Dogs are frequent agents of taphonomic destruction in village settings in antiquity through the present. A small number of bones showed evidence of gnawing by rodents, characterized by a distinct pattern of two close parallel markings on the surface of the bone, often occurring in clusters of multiple parallel markings.

Evidence of Exposures

Fauna from the Ditch shows little evidence of weathering on the surface of the bone. Few bones in this assemblage show the cracking and flaking associated with bones that have been exposed for long periods of time (Behrensmeyer 1978). Rather, specimens are frequently heavily encased in accretions due to the depositional environment. When these are removed through cleaning, the surface of the bone maintains its integrity. Further, epiphyses and diaphysis and articulating elements (e.g. radii and ulnae) are frequently recovered and can be united with one another. Taken together these features suggest that animal bones in the Ditch context were likely deposited and sealed quickly. In some cases, such as where articulating bones or epiphyses and diaphyses can be reunited, the bones may have been deposited while still bound by soft tissue. This appears with greater frequency than I have seen in other assemblages.

Conclusions on Taphonomy

In summary, the Ditch assemblage is unlikely significantly biased by post-depositional taphonomic processes, such as scavenging by rodents, dogs and pigs, or breakage due to exposure and trampling. The assemblage, however, is likely biased by recovery practices. As a result, these data may underrepresent the contribution of small wild taxa and smaller skeletal elements of domestic taxa, particularly those of young animals.

SHEEP AND GOATS IN THE DITCH

Domesticated sheep (*Ovis aries*) and goats (*Capra hircus*) are the most ubiquitous taxa recovered in the Ditch, comprising in aggregate 62.86% of the assemblage. The ratio of sheep to goats is 1:1.36.

Caprine Age and Sex Distributions

Figure 3.2 shows the survivorship curve for sheep and goats in aggregate from the Ditch assemblage based on toothwear. Due to the unreliability of differentiating sheep and goats based on tooth morphology in all age classes (Zeder and Pilaar 2010) and the ambiguity in characteristics observed in the Domuztepe population (see Appendix AI.2) sheep and goat mandibles were looked at in aggregate.

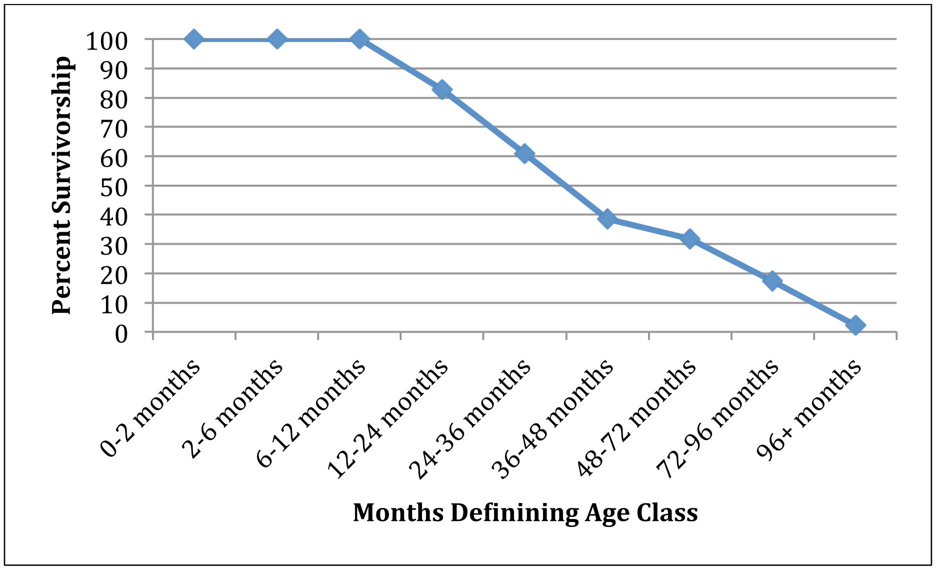

Figure 3.2 Caprine Survivorship based on Toothwear N=110 mandibles

Age data gleaned from 110 mandibles indicate no juveniles were culled (or at least, no juveniles were recovered in the Ditch assemblage). 60% of caprines, were, however, culled as sub-adults, before reaching 3 years of age (36 months). Only 40% of animals survived to adulthood, with only a very small portion living to 8 years of age, at which point they are presumably no longer reproductively viable.

These trends are further confirmed when evaluating sheep and goat demographic profiles based on epiphyseal fusion data. Figures 3.3 and 3.4 show what percentage of sheep and goat bones respectively within a given age class were recovered fused or unfused. Fused bones indicate that the animal from which they came lived beyond the age at which these bones typically fuse (see Appendix I AI.7 for a full discussion).

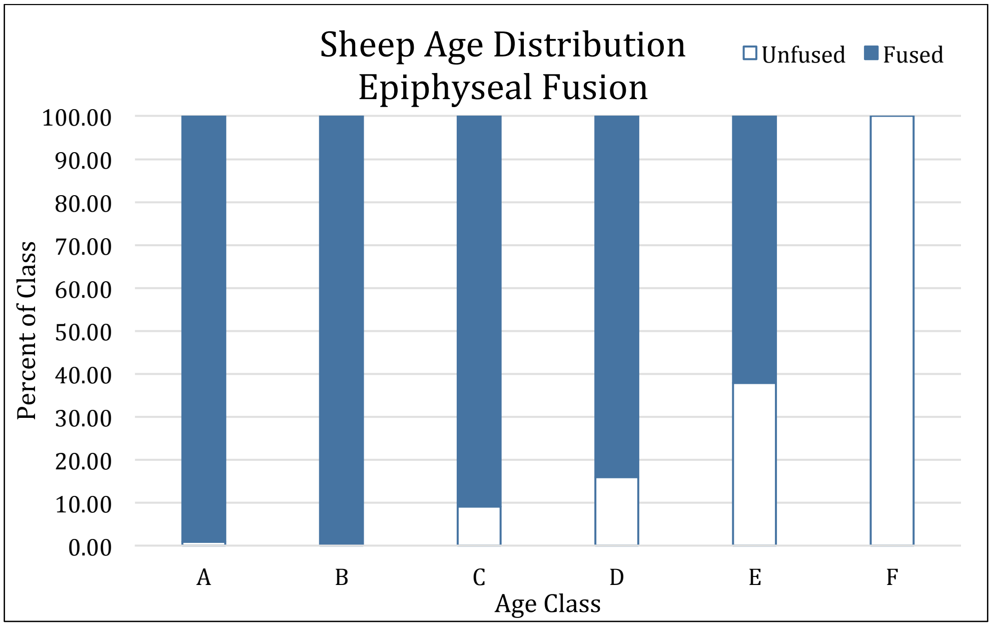

Figure 3.3 Demographic Summary of Sheep based on Epiphyseal Fusion. A class – 10 months defined by fusion of the proximal radius; B class—13 months defined by the fusion of the distal scapula and distal humerus; C class – 16 months, defined by the fusion of the proximal 1st and 2nd phalanges; D Class—28 months defined by the fusion of the distal tibia and distal metapodia; E class – 42 months, defined by the fusion of the proximal calcaneus, distal femur, proximal ulna, distal radius and proximal tibia; F class—42+ months defined by the fusion of the proximal humerus

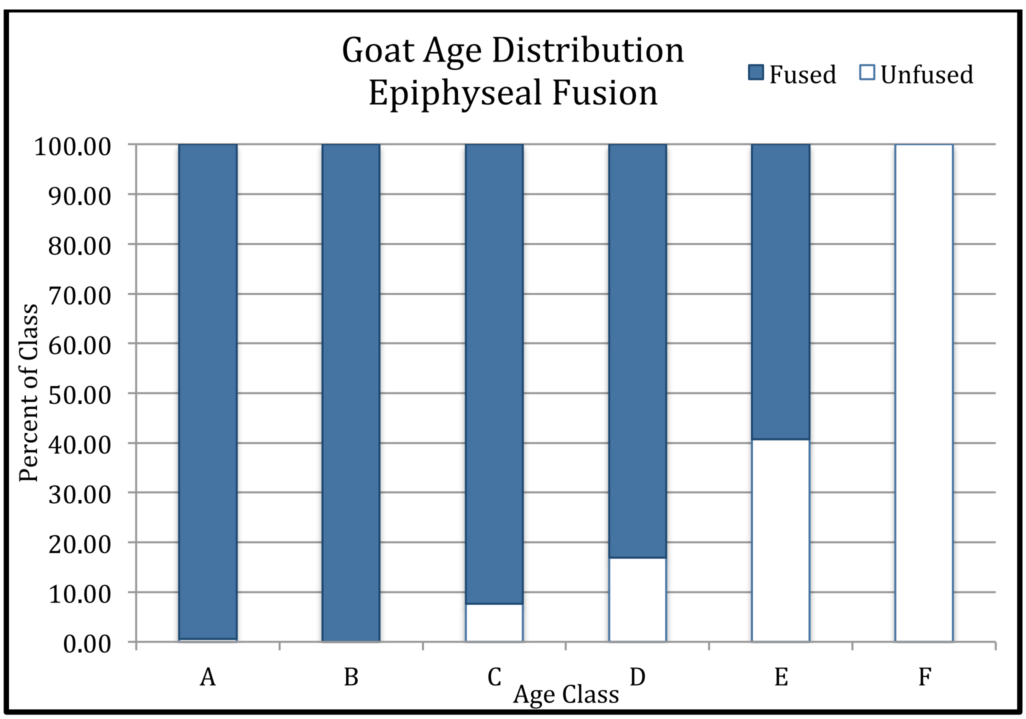

Figure 3.4 Demographic Summary of Goats Based on Epiphyseal Fusion. A class – 10 months defined by fusion of the proximal radius; B class—13 months defined by the fusion of the distal scapula and distal humerus; C class – 16 months, defined by the fusion of the proximal 1st and 2nd phalanges; D Class—28 months defined by the fusion of the distal

tibia and distal metapodia; E class – 42 months, defined by the fusion of the proximal calcaneus, distal femur, proximal ulna, distal radius and proximal tibia; F class—42+ months defined by the fusion of the proximal humerus

These results indicate that slightly more goats were culled before the age of 42 months, as indicated by the percentage of proximal calcani, distal femurs, proximal ulnae, proximal radii, distal radii and proximal tibiae recovered fused. No animals recovered seemed to live beyond 42 months, as indicated by fusion of the proximal humerus (N=16 for all caprines, including those that could not be identified to genera). Density mediated attrition based on the known density of these taxa (Lyman 1982; Ioannidou 2003) suggests that, regardless of fusion, this element, which is the sole defining element for this age class, is less likely to survive post-depositional taphonomic processes than many of the elements that define earlier classes, creating a biased result. Similarly, unfused bones of immature animals are less likely to be preserved due to their fragility, so it is possible that these data are underestimating the number of unfused bones in all age categories, meaning even more animals are being slaughtered as juveniles or sub-adults. These elements would also be smaller, and thus more likely overlooked in hand-collection.

Data from the Ditch indicate suggest that agropastoralists at Domuztepe preferentially culled males over females at a rate of 1.3:1 based on innominates of caprines in aggregate (N=114). Size distributions of goat phalanges and metapodia in the ditch assemblage suggest a similar preference for slaughtering males in this assemblage. These elements display strongly sexually dimorphic size differences (demonstrated in Zeder 2001 based on modern reference collections of goats from the Near East). Distributions of sheep metrical data from the Ditch Assemblage for these elements, however, yielded more ambiguous results.

Taken together these demographic data suggest that the participants in the Ditch events chose to preferentially slaughter goats over sheep, with a preference for sub-adult males over females. This choice is consistent with a strategy aimed at perpetuating herd security (Redding

1981; Zeder 1994). These choices are also as we would expect when the productive economic goal is meat consumption (see Chapter 2 for a more detailed discussion). In both cases, which are often simultaneous goals, the aim is to cull the most expendable portion of the herd without removing the animals needed for dairy production or perpetuating the herd. Additional data from the sieved material, based on observations from Kansa's study (personal comm.) suggest that we may be missing even more juvenile animals, and thus the full assemblage might show these preferences more strongly.

Body Part Distribution

Not all elements are recovered in equal number, or in the proportion in which they occur in the body. Post-depositional taphonomic processes (Lyman 1982; Ioannidou 2003) and recovery techniques (Payne 1972) may lower the recovery rate of certain elements over others. Prior to deposition elements of the body may be taken and consumed or discarded elsewhere; this may even be a means of meat sharing, as has been observed among feast participants in Papua New Guinea (Wiessner 2001). Certain limbs may be fractured beyond recognition to access marrow within. Table 3 shows the MNE distribution of caprine body parts recovered in the Ditch Assemblage.

Body Part	R MNE	L MNE
Upper Front		
Scapula	51	70
Humerus	64	87
Lower Front		
Radius	174	151
Ulna	84	80
Metacarpal	59	78
Upper Hind		
Femur	29	35
Lower Hind		
Tibia	29	40
Astragalus	122	103
Calcaneus	92	114
Metatarsal	96	86

Table 3.3 Caprine Body Part MNE Distribution

This distribution shows that the parts of the body associated with larger meat packages (upper front, upper hind, and the tibia portion of the lower hind) are less ubiquitous than areas of the body that we would expect to find equally frequently but bear less meat (the lower front, the lower hind, which might be separated from the tibia through butchery). The effects of density-mediated attrition alone cannot explain this pattern. If so we should find the proximal radius, for example, about as frequently as the distal humerus; here the ration of radii to humerii is 2.15:1. This may suggest that the larger meat portions are perhaps being consumed and certainly deposited elsewhere.

Evidence of Anthropogenic Taphonomic Processes

Animals consumed in the events that created the Ditch have undergone post-mortem, but pre-depositional processes associated with butchery and cooking. These processes are indicative of consumption at the site, and may also have affected what specimens survived to the point of recovery. 1.17% of caprine specimens bear butchery marks and 5.71% of caprine specimens show evidence of burning. But not all anthropogenic taphonomic processes leave cut marks or signs of burning. Most bones in the assemblage are broken, which is also the result of butchery. Bones that are stewed or roasted may not come in contact with flames, and thus may bear no characteristic marks of burning, but still have been subjected to cooking processes.

PIGS IN THE DITCH

Domestic pigs (*Sus scrofa*) comprise approximately a quarter (24.56%) of the Ditch assemblage.

Pig Age and Sex Distributions

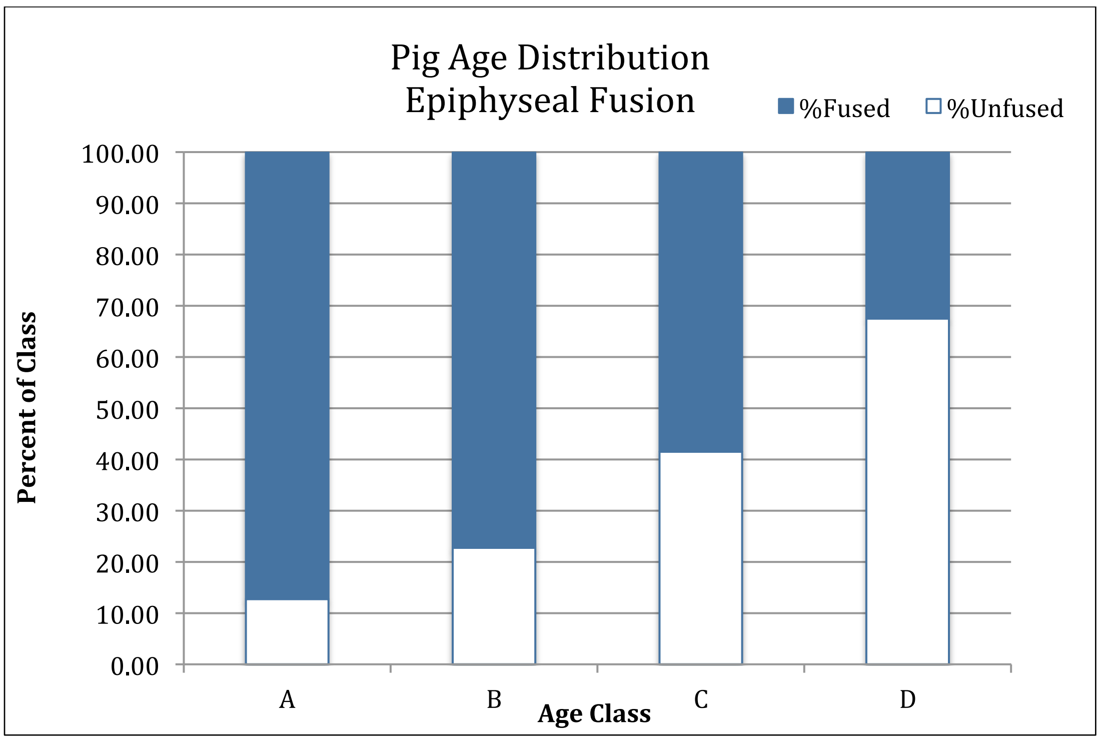

Figure 3.5 Demographic Summary of Pigs Based on Epiphyseal Fusion. A class – 12 months defined by fusion of the distal humerus, distal scapula, proximal radius, acetabulum, and 2nd phalanx; B class – 24 months defined by fusion of the 1st phalanx, distal tibia; C class – 30 months defined by fusion of the proximal calculous, distal metapodia, distal fibula; Class D – 42 months defind by fusion of the proximal and distal femur, distal radius, proximal and distal ulna, and proximal humerus.

Demographic profiles gleaned from epiphyseal fusion of long bones suggests that Halaf period herders at Domuztepe preferentially culled pigs between 2.5 and 3.5 years of age, with several animals living beyond the 42 month age-mark, at which point long bone data is no longer sensitive (Figure 3.5). Sex ratios of males to females based on canine teeth (following Mayer and Brisbin 1988) indicate that males were culled more than twice as frequently as females, at a rate of 2.3:1.

The demographic data for pigs indicate that people at Domuztepe selectively culled male pigs as adults. This is somewhat later than anticipated based on models of Ancient Near Eastern pig husbandry (Zeder 1994, 1998) and may indicate either a) a less intensive management strategy, perhaps using the adjacent marsh for pannage, similar to what has been described for the Romans (Clutton-Brock 1981) or ethnographically observed among farmers in Papua New Guinea (Wiessner 2001), which as Redding and Rosenberg have suggested might be an apt model for the Neolithic Near East (Redding and Rosenberg 1998) or b) this assemblage contains more hunted wild animals, but they are not distinguishable in metrical data due to confounding variables like sexual dimorphism. Possibly both scenarios are simultaneously affecting the assemblage.

Body Part Distribution

Body Part	R MNE	L MNE
Upper Front		
Scapula	17	10
Humerus	8	11
Lower Front		
Radius	25	20
Ulna	12	9
Metacarpal	4	6
Upper Hind		
Femur	7	8
Lower Hind		
Tibia	11	7
Astragalus	14	18
Calcaneus	8	10
Metatarsal	9	10

Table 3.4 Pig Body Part MNE Distribution

As among caprines, certain pig elements are found in greater frequency than others in the Ditch assemblage (Table 3.4). Lower front and lower hindlimb (below the tibia) elements are found with greater frequency than elements that comprise the larger meat packages. These sample sizes are, however, much smaller, and it is possible that these differences are an artifact of this disparity.

Evidence of Anthropogenic Taphonomic Processes

Only 0.49% of pig specimens show any indication of cutmarks, 2.56% of pig elements show indications of burning. These are lower than the rates for both caprines and cattle.

CATTLE IN THE DITCH

Cattle (*Bos taurus*) are the third most abundant taxon in the Ditch, accounting for 10.09% of the assemblage.

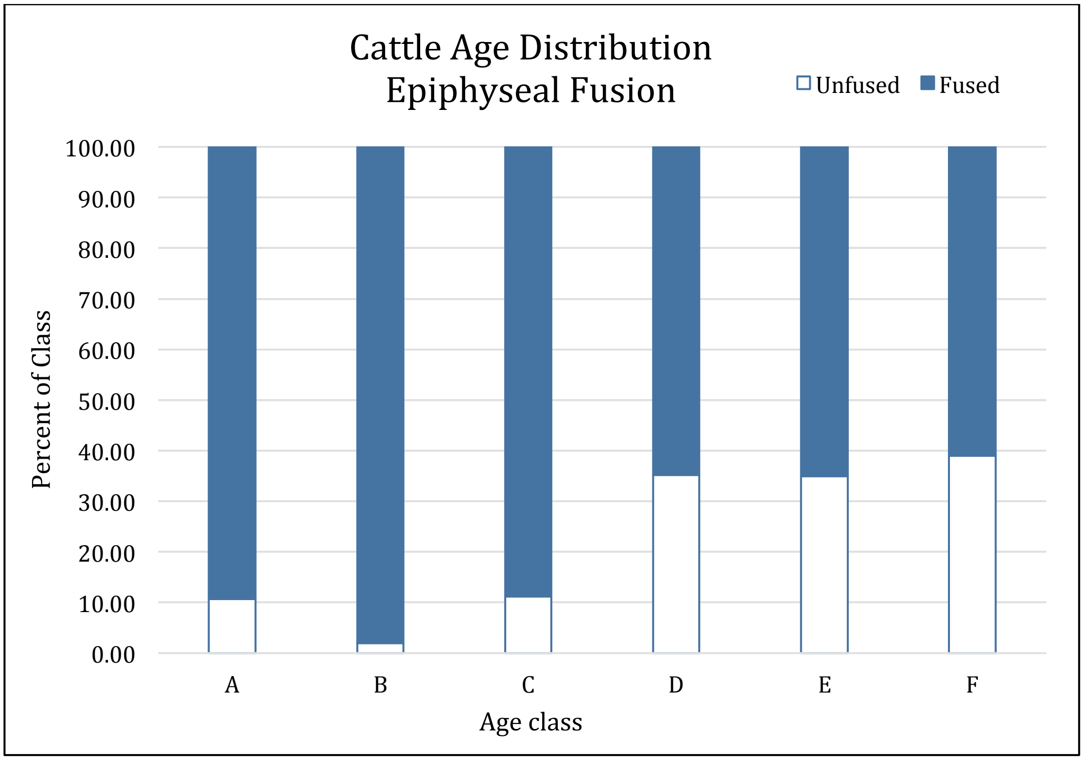

Figure 3.6 Demographic Summary of Cattle Based on Epiphyseal Fusion. A class—10 months defined by fusion of the distal scapula, acetabulum; B class—18 months defined by fusion of the distal humerus, proximal radius. C class—24 months defined by the fusion of the proximal 1st phalanx, proximal 2nd phalanx; D class – 36 months defined by fusion of the distal tibia, distal metapodia; E class – 42 months defined by fusion of the proximal calcaneus and proximal femur; F class— 48 months defined by fusion of the proximal humerus, distal radius, proximal and distal ulna, distal femur and proximal tibia.

Kill-off patterns reconstructed from cattle long bones indicate that Domuztepe herders allowed nearly all cattle to survive the first year of life. 30% to almost 40% of animals are culled as sub-adults (between 1 and 4 years of age). This is consistent with the kill-off pattern identified in the quotidian assemblage (see below) and follows models of herd security (Dahl and Hjort 1976; Zeder 1994). What deviates from these models, however is the sex distribution of cattle specimen in the Ditch. Female cattle were preferentially culled over males at a rate of 2.5:1. This is the opposite of what one would anticipate in herding systems aimed at both herd security and dairy production. This does, however, seem to mirror other feasting assemblages at Domuztepe (described below).

Body Part Distribution

Body Part	R MNE	L MNE
Upper Front		
Scapula	17	10
Humerus	8	11
Lower Front		
Radius	25	20
Ulna	12	9
Metacarpal	4	6
Upper Hind		
Femur	7	8
Lower Hind		
Tibia	11	7
Astragalus	14	18
Calcaneus	8	10
Metatarsal	9	10

Table 3.5 Cattle Body Part MNE Distribution

As with caprines and pigs it does seem that certain elements associated with low meat packages were found in greater frequency than those associated with more meat (Table 3.5). The meaty portions may be being removed from the area to be consumed elsewhere.

Evidence of Anthropogenic Taphonomic Processes

Cattle specimens from the Ditch, as with the caprine and pig specimens, bear some evidence of butchery and cooking. 2.25% of the cattle bones have cutmarks and 3.31% of the assemblage shows evidence of burning.

WILD FAUNA

Wild fauna make up only 2.34% of the Ditch assemblage. The largest portion of these specimens comes from deer (83 specimens) likely hunted near Domuztepe. Three genera comprising four species were found in the riparian environs near Domuztepe – red deer (*Cervus elaphus)*, fallow deer (*Dama dama* and *Dama mesopotamica*) and roe deer (*Capraeolus capraeolus*). Gazelle make up the second most abundant taxon among wild fauna. Wild sheep, goat and pigs (distinguished based on size, see A1.2) make small contributions to this assemblage; wild cattle (aurochs), however, were not recovered in the Ditch.

Many of the wild taxa found at Domuztepe are small mammals, birds and fish. These show up in small amounts in the Ditch assemblage, but this likely stems from the inability to examine heavy fraction from these contexts. Portions of gazelles and roe and fallow deer are also small enough that they may be overlooked during hand collection in excavation. Only a full study of the fauna from sieving will definitively demonstrate if this pattern truly reflects Halaf period subsistence strategies.

THE DITCH OVER TIME

The Ditch, as described in Chapter 2, was formed through complex processes, making stratigraphic differentiation for most of the feature impossible. But several distinct pits, however, can be defined. Figure 7 shows the percentage of the assemblage in each of these contexts.

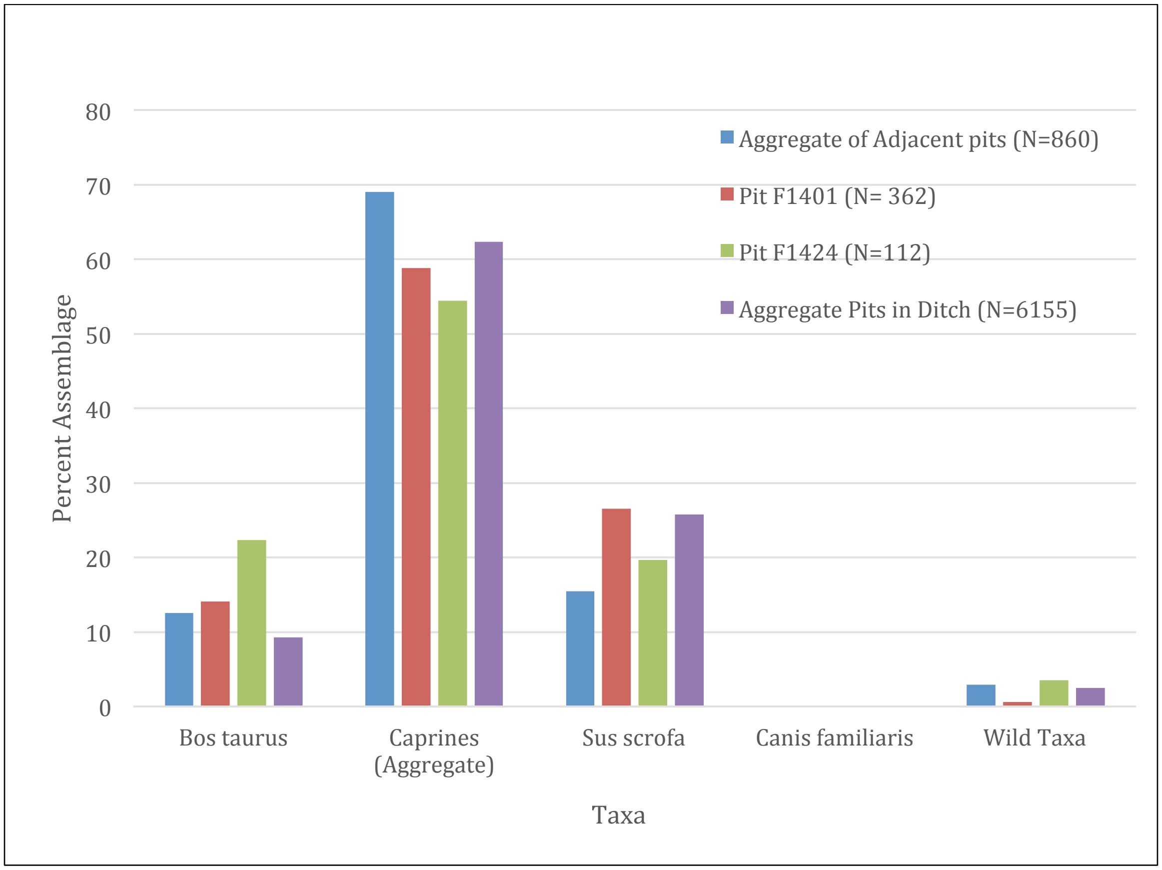

Figure 3.7 Species distribution within the Ditch Graph shows Percent of Assemblage

The Aggregate of Adjacent Pits category refers to pits located next to the Ditch within the terrace construction that predate the large Ditch features (Pit F1401, Pit 1424 and Aggregate Pits in Ditch). Pits F1401 and F1424 can be distinctly identified as unique cuts within the Ditch. Aggregate Pits in Ditch refers to the majority of cuts within the Ditch, which are discrete depositions that cannot be differentiated temporally due to the concurrent vertical and horizontal stratigraphy.

The early pits located next to the Ditch (Aggregate of Adjacent Pits) contain more cattle and caprines than the major Ditch assemblage but fewer pigs. Wild taxa are roughly consistent throughout all sub-differentiated areas within the Ditch. Distinct pits F1401 and F1424 both contain higher proportions of cattle and smaller proportions of caprines relative to the aggregate series of pits within the Ditch. Pit F1401 contains roughly the same proportion of pigs as the main portion of the Ditch, but Pit F1424 has a lower proportion of pigs. It should be noted that these first three sub-sets of the Ditch assemblage are considerably smaller in size than the larger aggregate of pits in the Ditch, and thus these patterns may be an artifact of sample size.

3.3 The Ditch Assemblage Compared to Other Assemblages at Domuztepe

The effort Domuztepe herders put into resource and labor coordination at Domuztepe is most clearly seen when comparing the three discreet feasting faunal assemblages at Domuztepe with one another, and with the baseline Quotidian assemblage (Table 3.7 and Figure 3.8).

Taxon	Quotidian NISP	Quotidian %Assem.	Death Pit NISP	Death Pit %Assem.	Op III NISP	Op III %Assem.	Ditch NISP	Ditch %Assem.
Bos taurus	1278	21.18	732	36.69	223	33.74	756	10.09
Ovis aries/ Capra hircus	2684	44.47	850	42.61	239	36.16	2762	36.88
Ovis aries	210	3.48	68	3.41	37	5.60	818	10.92
Capra hircus	186	3.08	70	3.51	26	3.93	1128	15.06
Sus scrofa	1529	25.34	204	10.23	127	19.21	1839	24.56
Canis familiaris	16	0.27	34	1.70	0	0	0	0.00
Bos taurus cf *primigenius*	1	0.02	3	0.15	0	0	0	0.00
Equus asinus/ Equus hemionus	1	0.02	0	0.00	0	0	4	0.05
Equus sp.	1	0.02	1	0.05	1	0.15	0	0.00
Canis sp.	5	0.08	5	0.25	2	0.30	2	0.03
Canis sp., *Canis lupus*	3	0.05	0	0.00	0	0	0	0.00
Canis aureus	0	0.00	1	0.05	0	0	0	0.00
Capra aegagrus	0	0.00	1	0.05	1	0.15	1	0.01
Capreolus capreolus	3	0.05	1	0.05	0	0	0	0.00
Castor fiber	1	0.02	0	0.00	0	0	0	0.00
Cervus elaphus	5	0.08	1	0.05	2	0.30	3	0.04
Cervidae	29	0.48	5	0.25	0	0	56	0.75
Dama dama	5	0.08	0	0.00	1	0.15	24	0.32
Gazella sp.	7	0.12	0	0.00	0	0	24	0.32
Lepus spp.	5	0.08	1	0.05	0	0	6	0.08
Martes cf *martes*	1	0.02	0	0.00	0	0	0	0.00
Ovis orientalis/ Capra aegagrus	1	0.02	0	0.00	0	0	0	0.00
Ovis orientalis	3	0.05	0	0.00	0	0	3	0.04
Sus Scrofa	11	0.18	0	0.00	0	0	1	0.01
Panthera pardus	1	0.02	0	0.00	0	0	0	0.00
Ursus arctos	5	0.08	2	0.10	0	0	7	0.09
Vulpes vulpes	11	0.18	0	0.00	0	0	1	0.01
Rodentia	6	0.10	2	0.10	1	0.15	0	0.00
Tesundines	4	0.07	0	0.00	0	0	0	0.00
Aves	11	0.18	10	0.50	1	0.15	9	0.12
Anatinae	4	0.07	0	0.00	0	0	0	0.00
Fish	8	0.13	4	0.20	0	0	34	0.45
Grand Total	**6035**	**100**	**1995**	**100**	**661**	**100**	**7478**	**100**

Table 3.6 Species Frequency (NISP and Percent Assemblage) for all Assemblages at Domuztepe

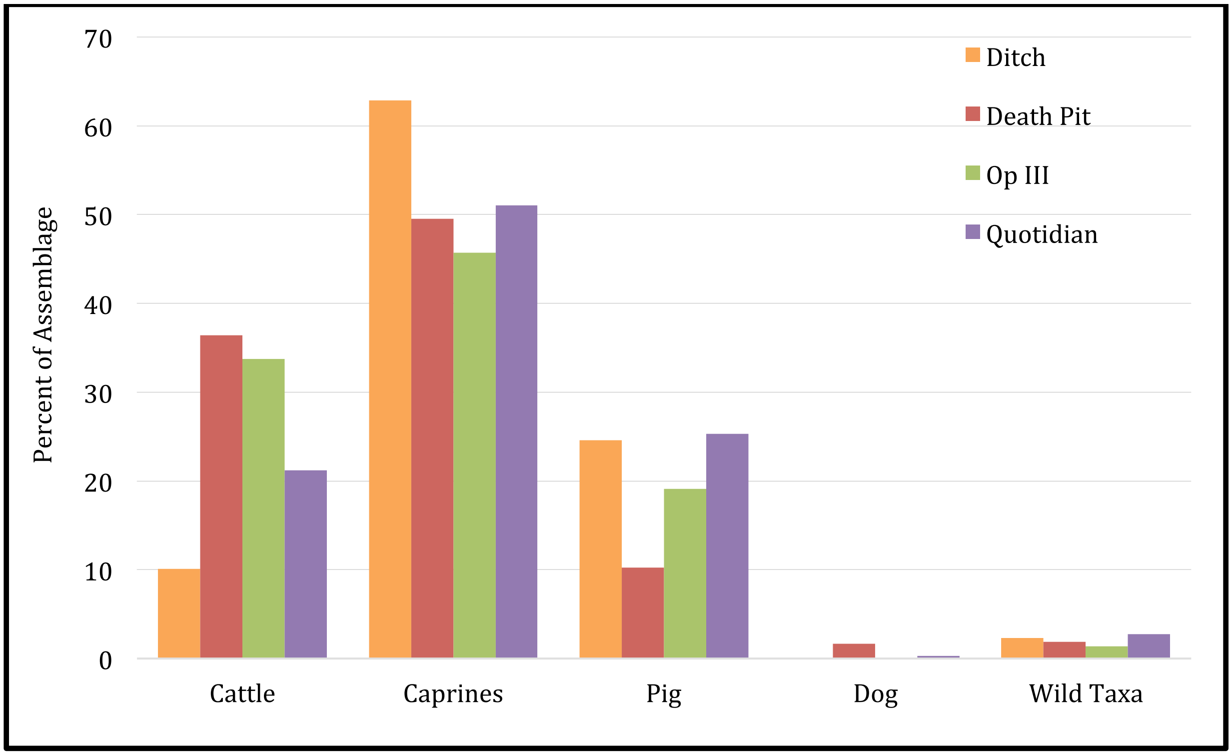

Figure 3.8 Species distribution within each context. Graph shows Percent of Assemblage

The Ditch assemblage shows statistically significant differences (demonstrated using a Test of Equal or Given Proportions with the Holms Correction performed in R; See Appendix I AI.11) in taxonomic make up when compared to the other three major assemblages. These results are summarized in Table 3.8. In addition to differences in taxon frequency, there are differences in the demographic make up specific assemblages, indicating that Domuztepe herders chose animals to include in these discrete contexts. These differences are discussed below

		Quotidian	Death Pit	Op. III
Bos taurus	**Death Pit**	< 0.001	—	—
	Op III	< 0.001	0.19	—
	Ditch	< 0.001	< 0.001	< 0.001
Canis familiaris		**Quotidian**	**Death Pit**	**Op. III**
	Death Pit	< 0.001	—	—
	Op III	0.365	0.003	—
	Ditch	< 0.001	< 0.001	—
Ovis aries and Capra hircus		**Quotidian**	**Death Pit**	**Op. III**
	Death Pit	0.252	—	—
	Op III	0.03	0.192	—
	Ditch	< 0.001	< 0.001	< 0.001
Sus scrofa		**Quotidian**	**Death Pit**	**Op. III**
	Death Pit	< 0.001	—	—
	Op III	0.0019	< 0.001	—
	Ditch	0.3305	< 0.001	0.0046
Wild Taxa (aggregate)		**Quotidian**	**Death Pit**	**Op. III**
	Death Pit	1.00	—	—
	Op III	1.00	1.00	—
	Ditch	1.00	1.00	0.82

Figure 3.7 Results from Test of Equal or Given Proportions. Value is adjusted-P value.

THE DITCH COMPARED TO QUOTIDIAN ASSEMBLAGES

Faunal remains from mundane, domestic contexts (e.g. midden deposits, floors) comprise an assemblage of 6,035 bones and teeth identified to the taxonomic level of sub-family or better (Kansa et al. 2009a, b). The patterns recognized in the archaeobiological data constitute the baseline of the day-to-day exploitation of plants and animals at Domuztepe; I define all unique contexts, such as the Death Pit and the Operation III feasting deposit, relative to these more typical assemblages of refuse from everyday meals and work animals.

The Quotidian faunal assemblage at Domuztepe is dominated by the traditional suite of Near Eastern domesticates: sheep, goats, pigs, cattle, and dogs. Caprines in aggregate (sheep and goat) dominate the assemblage during all periods. The caprine specimens reveal important economic goals of the inhabitants of Domuztepe. Kansa (Kansa et al. 2009b) identifies a preferential exploitation of sheep, where 80% of both male and female sheep survive to maturity. She suggests that this indicates an economic strategy for which the primary goal of caprine husbandry was wool production, with dairy and meat providing secondary, though still important, resources. Pigs constitute approximately 25% of the assemblage in all occupation phases during the Halaf period. Kill-off patterns obtained from tooth wear and epiphyseal fusion data suggest residents generally killed pigs at a young age, consistent with a strategy of maximal meat exploitation. Cattle, exploited for meat, dairy, and traction are the third most abundant group in mundane deposits. Kansa identified a preponderance of female cattle within the assemblage based on metrical data and morphological distinctions in the innominate (Kansa, personal comm.; See Appendix I.7 for explanation of how demographic profiles were constructed). Inhabitants mostly chose to slaughter cattle in adulthood. Together age and sex data indicate that inhabitants at Domuztepe chose to cull a few young male cattle between age two and three, but the majority of animals, both male and female were kept to adulthood and culled by six years of age. This is consistent with a management strategy aimed at dairy production (more females kept to adulthood) and labor, although evidence of intensive draft labor in bone pathologies is scant. Wild animal taxa were found in small quantities throughout all time periods.

Differences between the Ditch and the Quotidian Deposits

Figure 3.9 shows the species frequency by percentage of assemblage between the Ditch and Quotidian fauna. There are statistically significant differences in the frequencies of two of the four major taxa and aggregate wild fauna between the Ditch and Quotidian. The Ditch assemblage is marked by significantly fewer cattle remains and significantly more caprine remains. There is also a statistically significant difference in the amount of dog recovered in these two deposits. Pig and wild fauna, however, show no significant difference in quantity between the two assemblages.

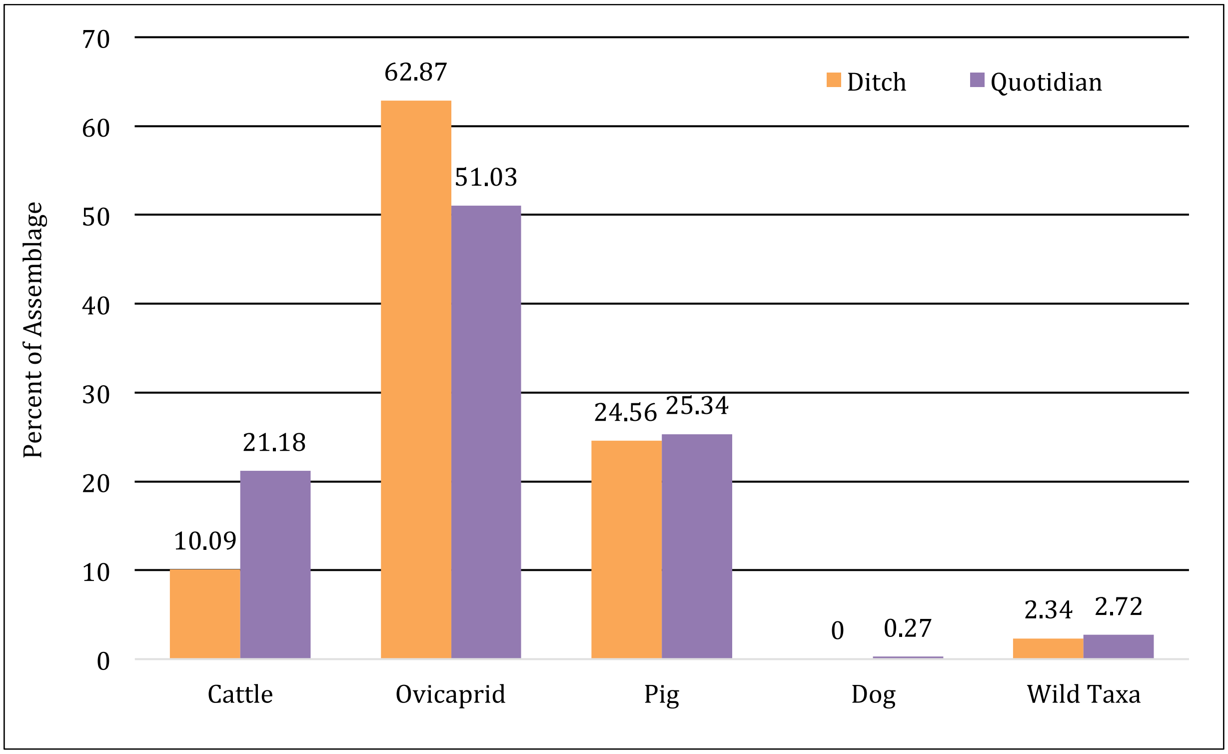

Figure 3.9 Species Frequency of Ditch and Quotidian Assemblages Figure shows Percent of Assemblage

In the Quotidian deposits sheep are found slightly more frequently than goats, with a ratio of 1.13:1. In addition to differences in species frequency recovered in the Ditch and Quotidian deposits, there are differences in demographic profiles. Among sheep and goats Kansa reports that 80% of both male and female sheep survived into adulthood, while goats were culled more frequently as sub-adults suggesting the maintenance of sheep for wool (Supplement B in Kansa et al. 2009b). In the Ditch, in contrast, both sheep and goats appear to be culled primarily as sub-adults, with male animals being culled more frequently than females. This suggests that the choices made in these feasting contexts deviate from the primary economic goal of wool production at Domuztepe. When making choices in what to include in these contexts, however, Halaf period herders did choose to cull animals in a manner consistent with what would perpetuate herd security. There may, however, be a confounding variable at play: density mediated attrition. As discussed above, immature animal bones are more friable, and thus more susceptible to a host of taphanomic processes. As the Quotidian assemblage shows more indication of exposure than the Ditch assemblage (Kansa, personal comm), it is possible that these smaller bones were not preserved, and the preference we see in allowing animals to reach an older age is, in actuality, the result of a biased assemblage.

Cattle in the Ditch and Quotidian deposits (Kansa, personal comm.) exhibit similar mortality profiles, with the majority of animals surviving into adulthood, beyond age four. Domuztepe herders, however, preferentially slaughtered female cattle to consume in the Ditch events; in Quotidian deposits males are preferentially culled, and at generally younger ages. This later pattern is consistent with goals of both herd security and dairying. This means that in the Ditch scenario participants chose to go against the economic interests that govern their day-to-day subsistence economy. This loss would have been significant in that female cattle produce not only dairy products but offspring as well. However, overall, cattle were culled relatively less frequently than other taxa. Perhaps the symbolic power of culling female cattle was only a part of the performance associated with Ditch feasting events.

Pigs comprise roughly the same percentage of both assemblages. There are differences, however, in the mortality profiles associated with the species in the two cases. Pigs in Quotidian deposits are most frequently culled as juveniles, or young adults. This is further confirmed by Kansa's flotation study, which suggests that the hand-picked assemblages at Domuztepe miss some juvenile pig specimens (personal comm.). This culling pattern is the opposite of what is apparent in the Ditch. The Ditch has generally better preservation of more friable elements, suggesting this is not an artifact of taphonomic processes. Perhaps Halaf people used different criteria to choose which animals to cull in these two contexts. The sight and quantity of meat afforded by a full-size adult pig may have been desirable in feasting consumption contexts.

THE DITCH COMPARED TO THE DEATH PIT

Faunal and human remains from the Death Pit offer strong evidence for an intensive consumptive event. This assemblage included not only animals traditionally used for food at Domuztepe — caprines, cattle, and pigs — but evidence for the consumption of dogs and at least 35 humans. Researchers have published several detailed analyses of the faunal and human remains derived from the Death Pit context (Campbell et al. 2014; Gauld et al. 2012; Kansa et al. 2009a, 2009b). Kansa et al. (2009a) that point to evidence for cannibalistic behavior, including the distributional similarity in butchery marks, bone fragmentation indicative of marrow extraction, and pot polish (the beveled edge which appears on fragments of bone as it is stirred while cooking in ceramic vessels) on both animal and human remains.

The differences in the proportions of species in this faunal assemblage compared to those from mundane contexts are of particular interest here. Kansa identified a higher proportion of cattle and canid remains and far fewer pig remains in the Death Pit feasting deposit (see Figure 3.8). These variations indicate which animals were given a higher economic and cultural value and thus were considered more suitable for a large ritual feasting event. This is perhaps mirrored in the frequent use of bucrania on pottery, and as decoration on other media, and the longstanding association of bucrania and ritual in Anatolia and Levant (Cauvin 2000) during the Pre-Pottery Neolithic (e.g. at Mureybet) and earlier ceramic Neolithic (e.g. at Çatalhöyük).

Kansa (2009a). identified an MNI in the Death Pit of 11 cattle, with a 7:1 ratio of females to males; 21 caprines (where proportions of sheep and goats were nearly equal); 8 pigs; and 6 dogs. Domuztepe peoples' choice to slaughter such a large number of prime-age cattle shows that they not only accepted the immediate loss in terms of dairy production, but also the loss of future production by the offspring of these animals. If the primary consideration was to maintain herd security, then we would expect them to keep the most productive animals (Dahl and Hjort 1976; Redding 1981; Zeder 1994). Their choice is not a "rational" economic choice and indicates that other criteria entered into animal management strategies in this context.

Differences between the Ditch and the Death Pit

There are statistically significant differences (Test of Equal or Given Proportions with the Holms Correction) in the relative quantities of all taxa in the Ditch and Death Pit assemblages, with the exception of the proportion of wild taxa in both assemblages in aggregate. Figure 3.10 shows the relative percent of the assemblage each taxon comprises. Note that in this graph, unlike Table 3.6 and Figure 3.8, humans are included in this figure, as human bones constitute a large proportion of the Death Pit assemblage. Figure 3.11 shows the percentage of each taxon excluding humans.

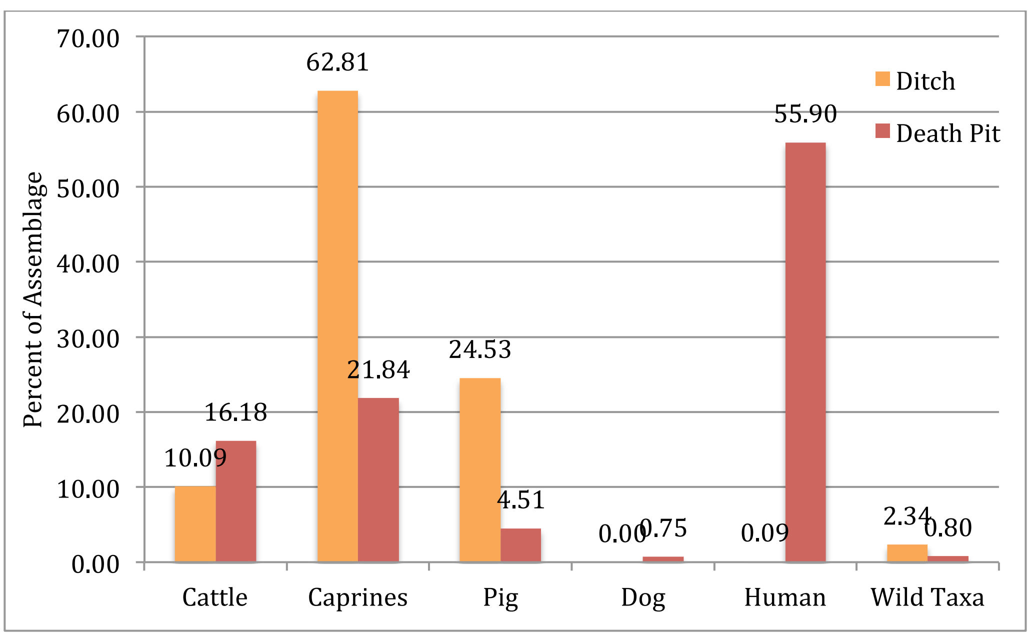

Figure 3.10 Species Frequency of Ditch and Death Pit Assemblages including humans. Graph shows Percent of Assemblage

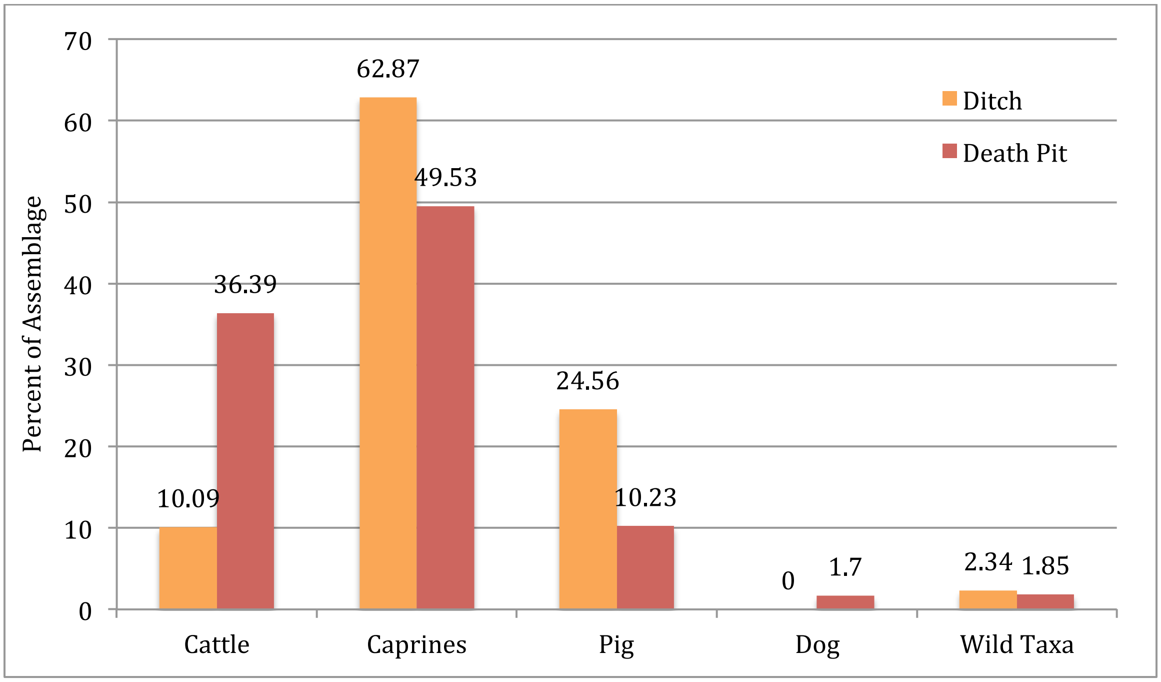

Figure 3.11 Species Frequency of Ditch and Death Pit Assemblages excluding humans. Graph shows Percent of Assemblage.

The Death Pit contains two species bearing evidence of consumption that are not found in the Ditch: domestic dogs (*Canis familiaris*) and humans (*Homo sapiens*). These taxa constitute 0.75% and 55.9% of the assemblage respectively. The inclusion of humans and dogs in this assemblage is perplexing. Dogs, while raised for food in many places around the world, and throughout time, were never a major food source at Domuztepe, or in the Near East more broadly. Rather, scholars (e.g. Larson et al. 2012) believe dogs were domesticated in many parts of the world, perhaps unintentionally, for companionship and to aid in hunting. Following domestication of caprines, they also proved useful herders. It is also unusual for humans to be consumed as a food item. While there is abundant evidence of humans being processed for food in the Death Pit assemblage, there is no evidence for cannibalism elsewhere at Domuztepe. It is unclear whether these people were willingly sacrificed or if they were dispatched violently, the culmination of some form of conflict (see Campbell et al. 2014; Carter 2012; Gauld et al. 2012; Kansa et al. 2009b for fuller discussions). No other cases of cannibalism have been recorded at other Halaf period sites, although the description of a deposit at Mersin (in Level XIX, described in Garstang 1953) bears some similarity to the Death Pit. Excavators recovered a large deposit of burnt bones, including human teeth, and some ceramics. Garstang interpreted the deposit as a mass cremation, but unfortunately the description of the deposit at Mersin is limited.

The relative proportions of cattle remains differ significantly between the two assemblages of the Ditch and the Death Pit. Cattle are a larger proportion of the Death Pit assemblage. The demographic profile, however, is the same in both contexts; herders preferentially culled adult animals, selecting prime-age females over males. This reinforces the pattern that at large scale consumptive events herders chose to sacrifice animals that were essential to their daily economic goals.

Caprines and pigs are both more abundant in the Ditch assemblage than the Death Pit assemblage. Where specimens could be differentiated among genera, sheep and goats were nearly equal in proportion in the Death Pit assemblage; this differs from the Ditch where goats outnumber sheep with a ratio of 1.36:1. Sample sizes for caprines and pigs in the Death Pit were too small to construct reliable demographic profiles.

THE DITCH COMPARED TO OP. III FEASTING ASSEMBLAGE

The Operation III Assemblage is a large concentration of faunal remains, preliminarily interpreted by Kansa and Campbell (2008) as the result of residents' repeated disposal of refuse from feasting in a localized area within Operation III. The concentration has no clear association with an architecturally differentiated area or the large volume of ceramics and small finds associated with the Death Pit and the Ditch. People at Domuztepe did prefer the consumption of cattle in this context, choosing to cull pigs in small proportions and caprines in dramatically smaller proportions than in Quotidian deposits and the Ditch. Among cattle remains MNI constructed based on more meaty parts of carcasses yield higher values than those based on elements that yield little meat (e.g. phalanges, cranial material) and are often waste from butchery. This suggests that this assemblage is in fact the remains of one or perhaps repeated feasting events, rather than the refuse associated with the preparation of an event. The parts consumed by inhabitants are present, rather than the parts discarded in preparing joints of meat.

Differences between the Ditch and Op. III

As Figure 3.9 illustrates, there are statistically significant differences (Table 3.8) in the quantities of caprines, cattle, and pigs recovered in the Ditch and the Op III assemblages. There are no statistically significant differences in the proportion of dogs and wild taxa in these two assemblages.

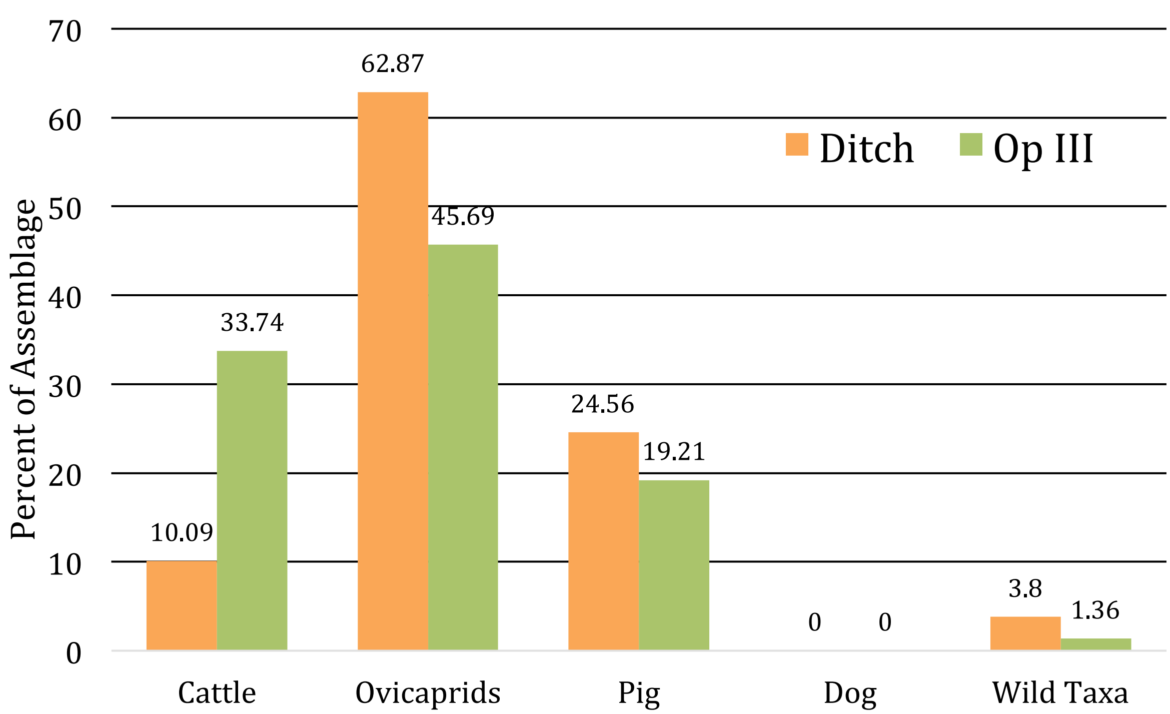

Figure 3.12 Species Frequency of Ditch and Op. III Assemblages. Graph shows Percent of Assemblage2

Cattle comprise 33.74% of the Operation III assemblage, which is much more than the Ditch assemblage. This is the opposite of the pattern found in the Ditch assemblage, where meaty joints are seemingly consumed and discarded elsewhere. Caprines are much more abundant in the Ditch than in Operation III. Unlike the cattle, the caprine remains in Op. III do not exhibit a distribution in body part frequency (MNE) that strongly deviates from what would be expected in the skeleton (Campbell et al. 2014); there is no overabundance of particular parts of the carcass.

3.4 Comparing the Death Pit, Op. III and Quotidian Deposits to One Another to identify differences in consumption practices in different social contexts

Differences between the other contexts are also enlightening about Domuztepe herders animal management strategies. Below I compare the taxonomic composition of the other contexts to one another. This was done using Tests of Equal or Given Proportion (see Appendix I.11). Table 3.9 gives the adjusted p-values from these comparisons.

COMPARING QUOTIDIAN CONTEXTS AND THE DEATH PIT

There are statistically significant differences in the proportion of cattle, pigs, and dogs. Cattle comprise a larger proportion of the Death Pit assemblage than the quotidian assemblage, as do dogs. Pigs constitute a much smaller portion of the Death Pit assemblage. There is no proportional difference between these two contexts for caprines or wild taxa.

COMPARING QUOTIDIAN CONTEXTS AND THE OP III ASSEMBLAGE

When comparing the Quotidian assemblage with the Operation III assemblage there are statistically significant differences in the proportion of cattle, caprines, and pigs. The Operation

III assemblage has a larger proportion of cattle than the Quotidian assemblage, and smaller proportions of caprines and pigs. There was no difference in the proportion of dogs and wild fauna in these assemblages.

COMPARING THE DEATH PIT AND THE OP. III ASSEMBLAGES

As noted above, there are some similarities between how the Death Pit and Op. III Assemblages compare with the Ditch, but how do they compare to one another? There are differences in the proportion of pigs and dogs between these two assemblages. Pigs comprise a smaller proportion of the Death Pit than the Op. III assemblage, and dogs concomitantly comprise a larger proportion of the Death Pit assemblage. There is no statistically significant difference in the proportion of cattle, caprines, and wild fauna between the two assemblages.

3.5 CONCLUSIONS

To summarize the results of the macroscale zooarchaeological analysis show there were clear differences in what domesticated animals were selectively culled in each context, between instances of collective action (feasts) and daily consumption, and among these collective actions. Within the Ditch there are indications of behaviors that speak to cooperation among participants within the events. The distribution of MNE for caprines, and to a lesser extent pigs and cattle, is the opposite of what one would anticipate based on the number of each element in the body and density mediated attrition. Two scenarios may plausibly explain this, and may have been simultaneously true. In scenario 1 the Ditch assemblage was the refuse of food preparation rather than consumption. This may be supported by the limited evidence of anthropomorphic alteration on the bones recovered in the Ditch and the proximity of these deposits to the large ovens. In scenario 2, the meaty parts of the animals were perhaps taken away and consumed either in another area or shared among inhabitants in smaller, maybe household settings rather than consumed communally. If so these body parts would likely end up deposited in Quotidian deposits, thus enriching those assemblages.

These assemblages allow us to track the evolution of such communal feasting events over time. Domuztepe feasting events became more costly over time. In later events (the Death Pit and Op III) the animals inhabitants culled required more resources inputs to grow and perhaps more coordination among participants for raising the resources to support them and grappling with the losses. At earlier commensal events, represented in aggregate by the Ditch, participants preferred caprines for consumption, selectively slaughtering more males than females and at a younger age. In these cases Halaf period people preferentially chose animals that would place the security of their herd in less jeopardy—using the comparatively expendable animals. Interestingly, participants did not seem to favor pigs, even though pigs are only useful for primary products (meat, bone, hide) making them arguably even more expendable. Among cattle, however, participants at earlier commensal events at Domuztepe chose the most important animals to conserve for herd security and dairying purposes – prime-age females. These cullings occurred with less relative frequency, but may have still conveyed to participants strong symbolic messages of plenty and been an important part of the feast performance.

In later events represented by the Death Pit and Op III participants consume proportionally more cattle, which required greater inputs of time, resources and labor to raise. Further, they seem to have preferentially slaughtered females, which both runs counter to herd security goals and would seem more costly in terms of lost production of milk. The addition of humans and dogs in the Death Pit further complicates the picture. These activities appear to have been restricted to only one specific context at the site, but occurred within the same geographic location as earlier commensal activities recorded in the Ditch.

What inhabitants ate day-to-day at Domuztepe differed from what participants consumed at large commensal events. The Quotidian assemblage also provides important information about Domuztepe inhabitants' animal management practices more broadly, beyond the collective action events encapsulated in these feasting assemblages. These data indicate that people at Domuztepe relied primarily on domesticated taxa. Wild taxa formed only a small though appreciable portion of the diet in all contexts at Domuztepe. A more in-depth study of heavy fraction samples, however, might nuance this picture. Zooarchaeologican analyses at Domuztepe presently likely underappreciating the amount of birds and fish that were part of the subsistence economy. These data indicate that inhabitants focused primarily on caprine herding with evidence of a focus on secondary products — wool and dairy. Pigs and cattle were also important parts of Domuztepe inhabitants' economy. Both species were raised as a source of protein, and inhabitants also focused on cattle to consume their secondary products (dairy and labor). These herding goals necessitated specific practices, which inhabitants had to balance with one another and with other agricultural tasks and other labors. Biogeochemical results described in the next chapter (Chapter Four) elucidate how these tasks were organized geographically. From these data I infer aspects of the social organization of animal management.

CHAPTER FOUR: BIOGEOCHEMICAL STUDY RESULTS

4.1 Cooperation in herding practices

In this chapter I examine herding practices at Domuztepe by studying biogeochemical indicators of ancient animals' mobility and diets. These data contextualize the animal management strategies identified in Chapter Three within the geographic and cultural landscape in which they occurred. Together these two lines of proxy data elucidate how herders organized their animal management activities.

Isotopic analyses of animal remains from archaeological sites are proxy data for ancient people's mobility and animal management practices. Herded animals only move by the agency of their caretakers. Their diet is dictated by the choices their herders make of where to graze them or what fodder to feed them. Thus by tracking the paleomobility and paleodiet of herded animals, one tracks the paleomobility and dietary decisions of their caretakers. In this chapter I describe results from radiogenic strontium, and stable oxygen and carbon isotopic analyses from caprine, cattle and pig teeth from all four zooarchaeological assemblages (the Quotidian assemblage, the Ditch, the Death Pit and the Op. III Assemblage), and human and dog samples from the Death Pit. For each taxonomic group, I determine whether or not animal remains from feasting deposits represent a different population from animals in Quotidian deposits. I then look at covariability among taxa and isotopes, and offer a possible holistic picture of how agropastoralists structured their herding practices.

4.2 Strontium

SOURCES OF STRONTIUM AND INCORPORATION INTO SKELETON

Biogeochemical analyses of strontium have become a well-established means of investigating mobility of ancient people and animals (Bentley 2006; Pollard et al. 2007).

Strontium occurs as four stable isotopes, of which two (^{87}Sr and ^{86}Sr) are used to assess mobility. All rocks have a characteristic amount of ^{87}Sr, which is a radiogenic isotope. It occurs both naturally and is produced when an isotopic form of rubidium (^{87}Rb) decays (Ericson 1985; Faure and Mensing 2004; Pollard et al. 2007:174). Thus in any rock the quantity of ^{87}Sr is the product of both the amount of naturally occurring ^{87}Sr and that which is produced by the decay of ^{87}Rb in the rock. The resultant total amount is related to the minerals that comprise the rock and the time at which it formed. Thus all geological formations have a particular quantity of ^{87}Sr, which is typically expressed as a ratio to ^{86}Sr. This ratio can be used as a geochemical signature to establish provenance of rocks and the organisms that incorporate this signature via the food chain.

Strontium isotopes are incorporated into animals' and peoples' teeth and bones through what they consume. The manner in which this occurs is complex, the result of mixing from various sources; these processes are well summarized in Bentley (2006). Briefly, strontium from bedrock enters the food system through weathering. As bedrock weathers it is incorporated into soils and groundwater, imparting on them the same unique $^{87}Sr/^{86}Sr$ ratio that is found in the original bedrock. Rivers and alluvial environments incorporate a mix of upstream sources of strontium, and thus display an average signature of $^{87}Sr/^{86}Sr$ from these sources. Strontium from these sources enters the food chain through plants that grow in these soils and which are fed from groundwater or river water. Animals consume the plants and the strontium is thus passed on through the food chain. Strontium, unlike the light stable isotopes described below, does not undergo significant fractionation through biological processes, and thus will be incorporated with the same ratio as the source. The $^{87}Sr/^{86}Sr$ value that is present in the bones and teeth of any animal represents the average of the $^{87}Sr/^{86}Sr$ of all of the food and water they consume at the time at which that skeletal element formed.

Strontium is incorporated into dental enamel when the tooth forms, and remains unchanged throughout the life of the animal. Strontium is similar to calcium and thus can substitute for calcium in the minerals that comprise bones and teeth (Pollard et al. 2007). Enamel in teeth form over a set period of time, and, unlike bone, undergoes no restructuring after its formation (Hillson 1986). Thus the $^{87}Sr/^{86}Sr$ value found in enamel is a snapshot of the strontium inputs consumed during that brief window of formation, and can be used to establish where that animal may have been (or at least eating from) during that period of time.

Archaeologists have used strontium to look at paleomobility in humans and animals in a wide variety of geographical and cultural contexts. Ericson's (1985) study of human mobility among the Chumash was the first to employ this sort of biogeochemical analysis. Since this initial application, strontium isotopic analysis has been used to elucidate mobility in South America (e.g. Knudson et al. 2005), North America (e.g. Ezzo et al. 2002), Europe (e.g. Bentley et al. 2002), Africa (Cox and Sealy 1997) and Asia (e.g. Bentley et al. 2005). Many of these studies (e.g. Knudson et al. 2014) analyze both bone, which remodels over the course of one's lifetime, and tooth enamel to look at changes in mobility not only relative to the local area but also over the lifespan of individuals. Analysis of $^{87}Sr/^{86}Sr$ has also been used to identify mobility in animals (Bentley et al. 2002; Meiggs 2007, 2009). Isotopic analyses of both wild and domesticated animals are often used to determine the local signature for a given geographical location (Bentley 2006) or home range for a particular taxon (Meiggs 2009). Identifying paleomobility among domesticated animals allows researchers to reconstruct ancient herding practices (Meiggs 2007, 2009). This study looks exclusively at the $^{87}Sr/^{86}Sr$ values that are found in the adult teeth of domesticated animals from all four assemblages (the Quotidian assemblage, the Ditch, the Death Pit and the Op. III Assemblage) and humans and one dog from the Death Pit.

DOMUZTEPE AND ITS ENVIRONS: BIOLOGICALLY-AVAILABLE STRONTIUM

The geology of Southern Anatolia is complex and highly variable (Brinkmann 1976). Domuztepe and its environs are located in an area of frequent tectonic activity, where the Arabian, African and Turkish plates meet (Arger et al. 2000; Chorowicz et al. 1994). The site is located just east of the East Anatolian fault on the Arabian platform on the broad Narli plain, which is comprised of alluvium. In such alluvial settings, the strontium signature is the result of the repeated deposition of sediments from upstream, as well as the weathering of local bedrock. The bedrock that crops out nearby to the west of the site consists of Miocene basalt and Eocene and Paleocene limestone (Atak 1994; 1:100,000-scale Geological Map #44). These are located adjacent to an Upper Cretaceous ophiolitic nappe. To the east across the alluvial plain are more Eocene and Oligocene limestone formations, followed by Miocene basaltic formations with pockets of Oligocene limestone and old alluvium.

Halaf period agropastoralists may have pastured their animals directly adjacent to the site on the alluvial plain and low dolomitic limestone hills to the north, south, and west of the tepe, or many hundreds of kilometers away as part of seasonal rounds. Ethnographic accounts describing different herd-management strategies in the region (Bates 1973) and the broader Near East (e.g. Mashkour 2003; Redding 1981; Sweet 1963) help contextualize the possible geographic extent of herding activities, suggesting they can encompass a range of hundreds of kilometers.

The broader geological regime is diverse (Bigöl et al. 1989; 1:2000000 Türkiye Jeologi Haritası map). To the northwest, where the modern city of Kahramanmaraş is situated, is a plain of Miocene age. The Ahir Dağı borders the plain, which is a Paleozoic-Mesozoic green schist formation. To the northwest and western edge of the plain are Jurassic-Cretaceous formations. The area directly south of the study area consists of Basic and Ultrabasic rocks and some Upper Cretaceous ophiolitc masses. To the southeast and east of the study area the region is characterized by substrate that is only identified as Paleogene in age, where there are identifiable Oligo-Miocene layers, with pockets of Plio-Quartenary material. This pattern extends on the Turkish side of the border to the area around Ceylanpınar.

Ancient herding practices do not conform to modern political borders. Thus the geological composition of modern Syria is also of interest. The basic and ultrabasic rocks and the Upper Cretaceous ophiolite extend south into the northwestern corner of Syria, where Cretaceous chalky limestones, sandstones and dolomites dominate the area, broken with veins of Jurassic limestones and marls, and Pleistocene alluviaium (Mikhailov1986; 1:1,000,000-scale geological map). To the southeast towards Aleppo, the area consisits primarily of Pliocene sandstones, limestones, clays, marls and marine clays. followed by Helvetian limestones. Throughout this area there are outcrops of both Helvetian and Middle Miocene basalts. Southeast toward Manbij and extending to the other side of the Euphrates the area is primarily composed of Upper Eocene chalky limestones and marls, with small areas of Middle Miocene basalts and Helvetian limestones.

Overall the general trend is similar with Eocene, Oligocene and Miocene carbonates adjacent and to the southeast and east of the site into what is presently Northern Syria. Throughout there are outcroppings of Miocene basalts. The terrain is considerably more variable as one moves toward the Amanus mountains to the southwest and to the Taurus Mountains to the north and west. These areas are characterized by Paleozoic and Mesozoic geological formations, separating plains of Oligio-Miocene date around the modern city of Kahramanmaraş and to the southwestern coast.

The most relevant archaeological study of strontium in the region is David Meiggs's dissertation work on caprine herding at Pre-Pottery Neolithic Gritille (2009), located east of

Domuztepe on the Euphrates River in Turkey's Adiyaman province. Meiggs also sampled fauna from Çayönü, Göbekli Tepe, and Titriş Höyük.

RESULTS

Baseline Samples

Samples of small mammals with narrow home ranges are important sources for determining the local $^{87}Sr/^{86}Sr$ values in a given area (Bentley 2006). This is because these animals consume all their food and water from local sources, and thus their enamel and bone should reflect the local underlying geology as it is incorporated through the food chain. Many studies use either modern collected samples (Ezzo et al. 1997) or archaeologically-derived teeth to establish the baseline (Bentley et al. 2002).

For this study, enamel of teeth from small mammals (rodents and a mustelid) that were recovered from heavy-fraction samples from Quotidian deposits and the Death Pit held at UCLA were analyzed. Unfortunately, the sample size was small (N=9) as the majority of the recovered material is held in Turkey and it was not possible to export it. Modern samples were not selected due to the alteration in drainage patterns in more recent times, such as damming, which could significantly affect the manner in which strontium enters the local groundwater and food chain through weathering. Additionally, much of the area around the site has been under cultivation. The use of modern fertilizer has also been shown to alter $^{87}Sr/^{86}Sr$ values as it changes the strontium signature of the soil and thus the strontium content in living animals' teeth (Bentley 2006).

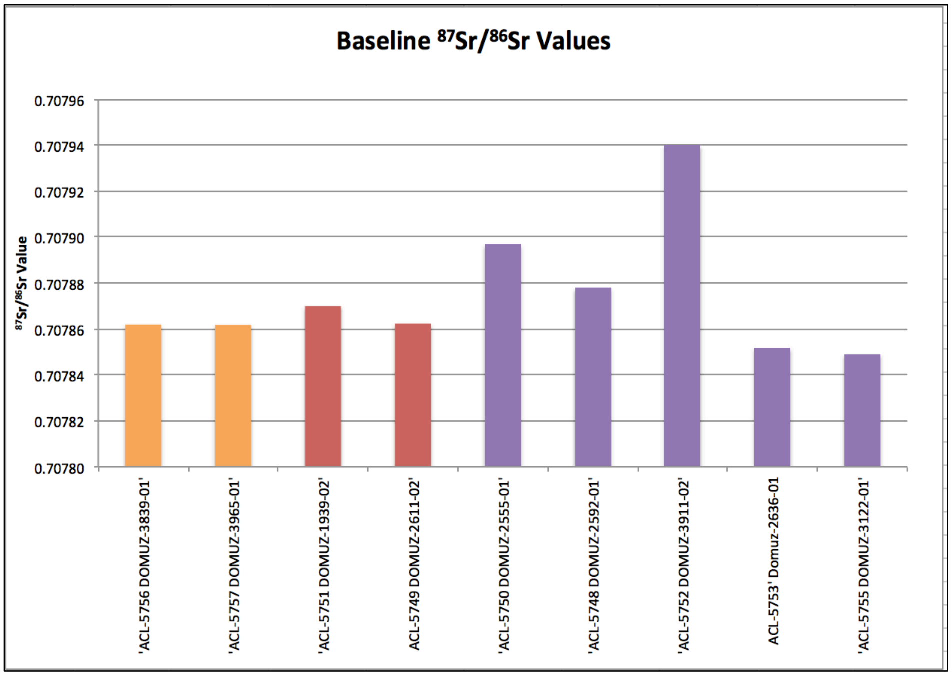

Figure 4.1 Baseline $^{87}Sr/^{86}Sr$ results N= 9; Orange = Ditch Samples, Red = Death Pit Samples, and Purple = Quotidian Samples.

ACL and Sample Number	Taxon	Tooth	$^{87}Sr/^{86}Sr$
'ACL-5756 DOMUZ-3839-01'	Rodentia	Incisor	0.70786
'ACL-5757 DOMUZ-3965-01'	Rodentia	Molar	0.70786
'ACL-5751 DOMUZ-1939-02'	Rodentia	Incisor	0.70787
'ACL-5749 DOMUZ-2511-02'	Rodentia	Incisor	0.70786
'ACL-5750 DOMUZ-2555-01'	Rodentia	Incisor	0.70790
'ACL-5748 DOMUZ-2592-01'	Rodentia	Incisor	0.70788
'ACL-5752 DOMUZ-3911-02'	Rodentia	Incisor	0.70794
'ACL-5753 DOMUZ-2636-01'	Mustelidae	Molar	0.70785
'ACL-5755 DOMUZ-3122-01'	Rodentia	Incisor	0.70785

Table 4.1 Baseline $^{87}Sr/^{86}Sr$ results N=9, σ=0.000029

The baseline samples exhibit a very narrow range in $^{87}Sr/^{86}Sr$ values, varying between 0.70785 to 0.70794 with a standard deviation of 0.000029. The local range is defined as the mean baseline value plus and minus two standard deviations: $^{87}Sr/^{86}Sr_{local}$ = 0.70781 – 70793 (following Price et al. 2002).

Sheep and Goats

Figure 4.2 gives the values for all sheep and goat's teeth that were sampled from Domuztepe. As noted in Appendix I, teeth were not used, as in some studies, to differentiate among genera.

There is considerable debate among scholars about which morphological attributes can be reliably used to differentiate between sheep and goats (Halstead and Collins 2002; Zeder and Pilaar 2010). Both Kansa and I found within the Domztepe population many mandibles were ambiguous; some teeth showed some genera's characteristics, while other teeth display the other genera. Further, these criteria do not work well for very young or very old animals. Thus using mandibles differentiated by genera to construct species-specific demographic profiles would be incomplete, omitting animals on both ends of the age spectrum. This is particularly problematic in certain assemblages at Domuztepe where sheep appear to have been kept to older ages for wool production.

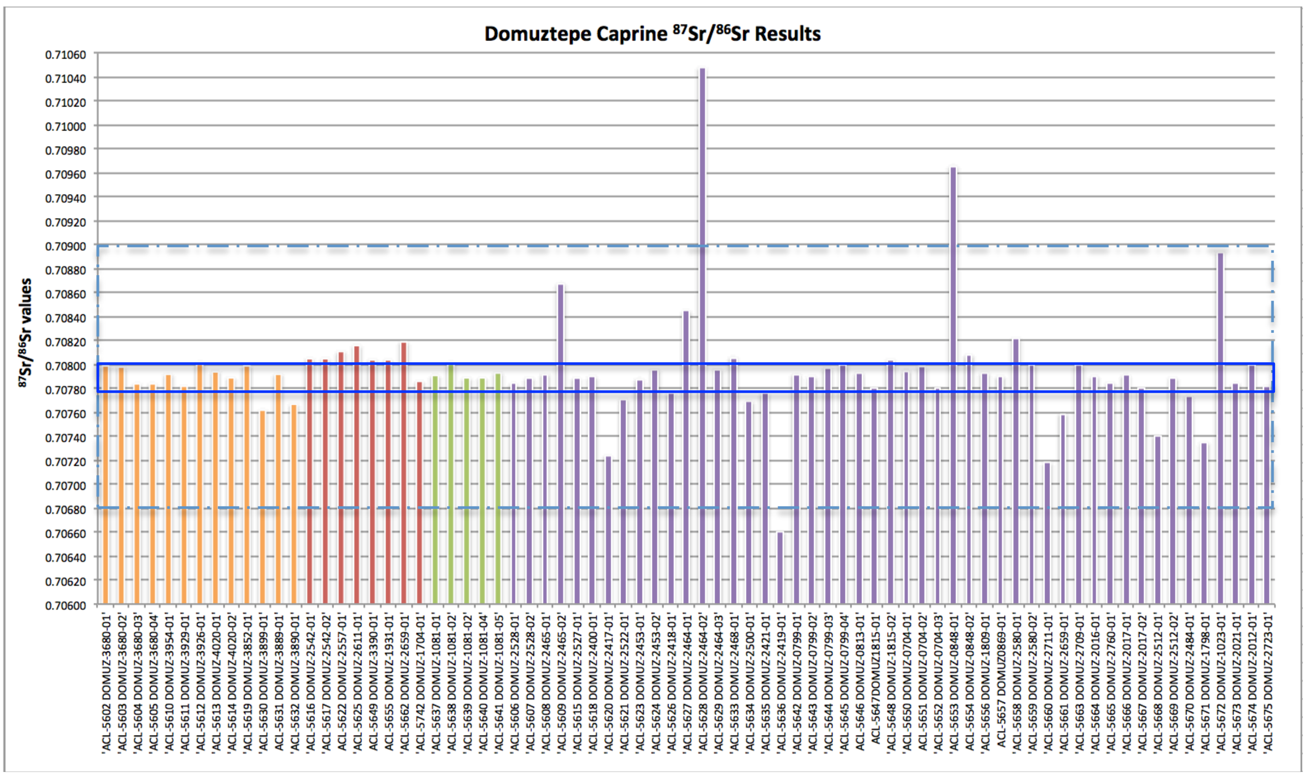

Figure 4.2 Caprine $^{87}Sr/^{86}Sr$ results N= 75, σ=0.00046; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples. Blue rectangle denotes range produced by the baseline samples. Dotted line denotes variation that is still likely 'local' in character based on where meaningful variation can be interpreted (following Knudson et al. 2016).

The mean for the caprine samples from all contexts is $^{87}Sr/^{86}Sr=0.70795 \pm 0.00046$ (1σ, n=75). This is quite close to the local range established by the baseline samples. Examination of Figure

4.2 shows that the majority of samples, regardless of what context they are drawn from, fall within the local range or within one one-thousandth of the local range, which has been demonstrated to be the level of meaningful variation necessary for interpretive results in anthropology (Knudson et al. 2016). There are, however, several notable outliers who exhibit an $^{87}Sr/^{86}Sr$ value much lower or much higher than the local range defined by the rodent teeth. These samples (ACL-5609, ACL-5627, ACL-5628, ACL-5636, ACL-5653, ACL-5660, ACL-5668, ACL-5671, ACL-5672) may have consumed some non-local food, or may have spent time in non-local areas. Three of these samples (ACL-5636, ACL-5628 and ACL-5653) do show meaningful variation suggesting they likely spent the period of enamel formation in another region. All outliers come from Quotidian contexts. This is likely because the Quotidian sample size is larger than the other datasets.

Samples from the aggregated feasting contexts (i.e., the Ditch, the Death Pit and Op III) were compared with samples drawn from quotidian contexts in order to assess whether the $^{87}Sr/^{86}Sr$ values suggest that the animals consumed in feasting deposits and in day-to-day consumption were from independent populations. As the data are non-parametric, a Mann-Whitney-Wilcoxon test in the software package R Studio was used to test for independence. The resultant p-value ($p=0.17$) was greater than the 0.05 significance level threshold; thus the null hypothesis is not rejected. It is presumed that these animals did not come from statistically independent populations. This suggests that caprines in all contexts were consuming foods with the same strontium signature. This indicates they are part of the same herding system, with the few exception of the aberrant individual animals that are noted above.

Cattle

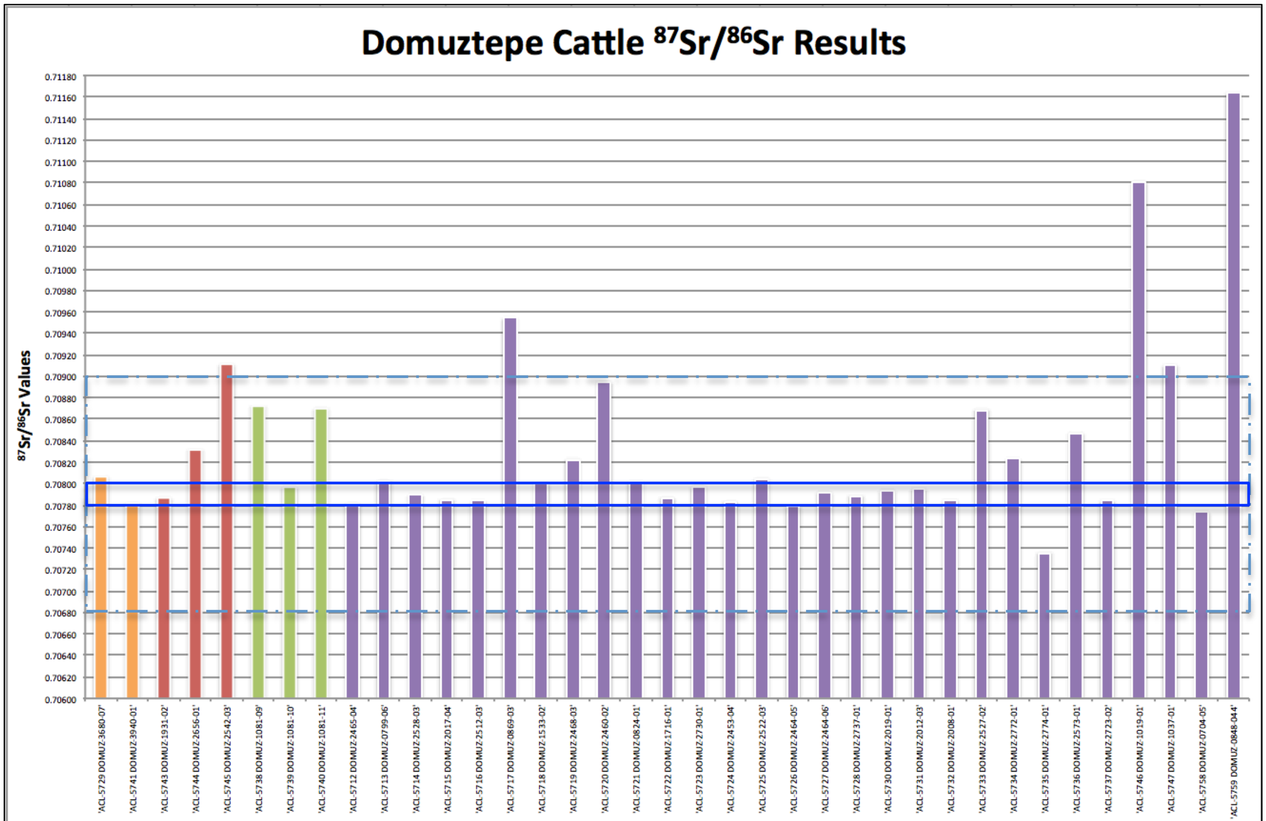

Figure 4.3 Cattle $^{87}Sr/^{86}Sr$ results N= 37, σ=0.00085; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples. Blue rectangle denotes range produced by the baseline samples. Dotted line denotes variation that is still likely 'local' in character.

Cattle samples from all contexts have a mean $^{87}Sr/^{86}Sr$ value of 0.7083± 0.00085 (1σ, n=37). The mean is slightly higher than the local range, which is fully encompassed within the ± 1σ range. Visual inspection of the data shows, as with the caprines, the majority of samples fall within or very nearly within the local range, with several outliers skewing the mean higher and one skewing it lower. The outliers are: ACL-5745, ACL-5738, ACL-5740, ACL-5717, ACL-5720, ACL-5733, ACL-5735, ACL-5736, ACL-5746, ACL-5747, ACL-5759. These samples can be found in two different feasting contexts (the Death Pit and Op III) as well as quotidian deposits. Among these only five (ACL-5745, ACL-5717, ACL-5746, ACL-5747, and ACL-5759) deviate at the third decimal place. As with the caprine samples, a Mann-Whitney-Wilcoxon test was performed to determine whether the feasting contexts in aggregate are from the same population as the quotidian samples. The resultant p-value (p=0.30) indicates that the samples are not from independent populations; inhabitants are consuming animals from the same herding system in both types of social contexts.

Pigs

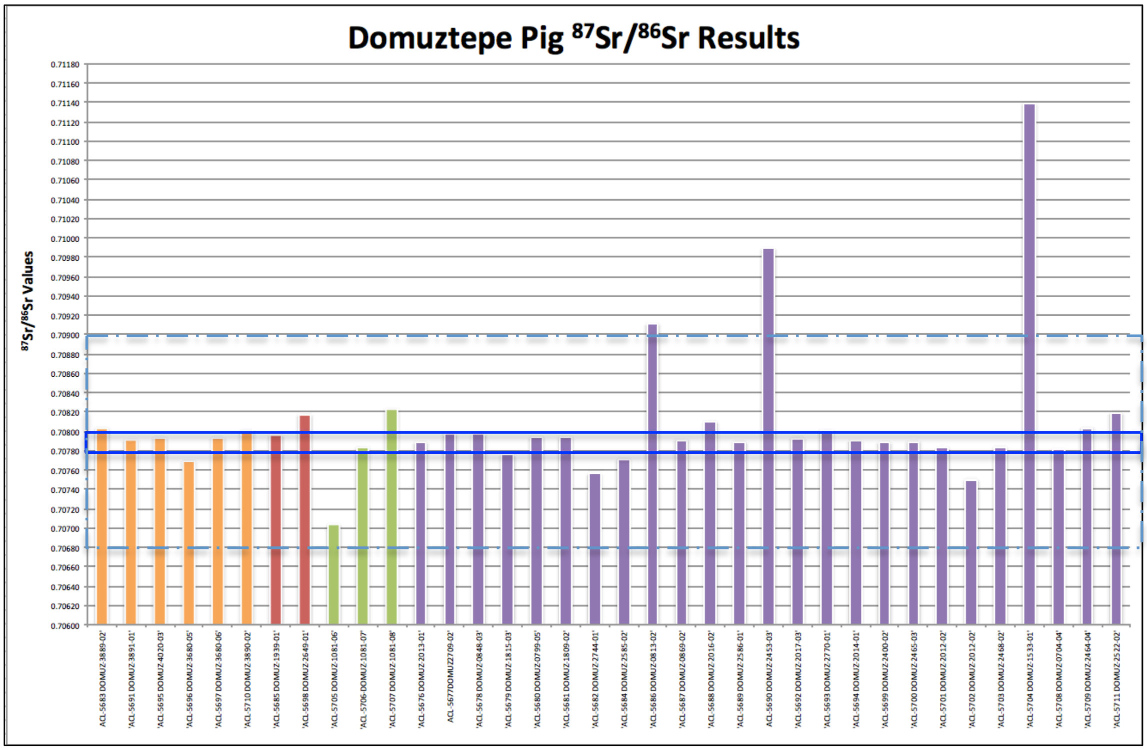

Figure 4.4 Pig $^{87}Sr/^{86}Sr$ Results. N= 36 ; σ=0.0007189. Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples. Blue rectangle denotes range produced by the baseline samples. Dotted line denotes variation that is still likely 'local' in character.

Samples of pig's teeth exhibit a mean $^{87}Sr/^{86}Sr$ value of 0.07807 ± 0.00072 (N=36, 1σ). This falls within the local range, with only four samples exhibiting values that deviate strongly from the baseline range: ACL-5705, ACL-5686, ACL-5690, and ACL-5704. One of these four samples one is from the Op III deposits, the rest come from quotidian contexts. Of these samples, only three samples (ACL-5686, ACL-5690, and ACL-5704, all from quotidian contexts) yield values that deviate at the third decimal point. As above, the aggregate feasting and quotidian sample assemblages were tested using a Mann-Whitney-Wilcoxon test to determine if they are from statistically independent populations. As with the other taxa, the resultant p-value ($p=0.85$) does not meet the threshold to reject the null hypothesis. Thus the samples are presumed to be from a single population.

Humans and Dog

Figure 4.5 shows the results for analyses of seven human teeth and one dog's tooth for $^{87}Sr/^{86}Sr$ values. All these specimens come from the Death Pit, which is the only context with evidence for the consumption of humans and dogs.

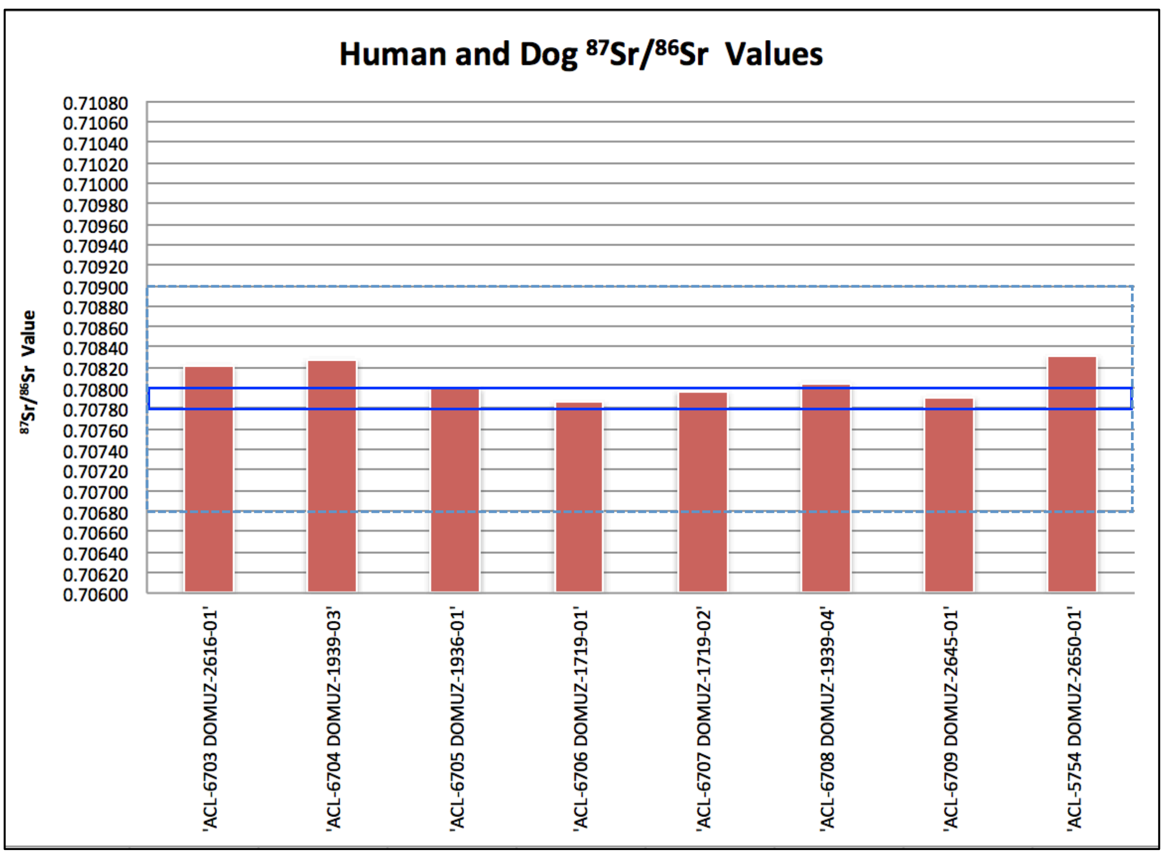

Figure 4.5 Human and Dog $^{87}Sr/^{86}Sr$ Results N=8. Blue rectangle denotes range produced by the baseline samples. Dotted line denotes variation that is still likely 'local' in character.

Human and dog samples have a mean value of 0.70808 ± 0.0017 (N=8, 1σ). While three of the samples (two humans and the one dog) yielded $^{87}Sr/^{86}Sr$ values outside the baseline samples, they do not deviate at the third decimal point. This indicates that all humans and the dog sampled spent the period of enamel formation within the same geologically defined zone as Domuztepe.

SUMMARY

The majority of samples, regardless of their species or context, yield $^{87}Sr/^{86}Sr$ values consistent with the $^{87}Sr/^{86}Sr$ range for Domuztepe. This indicates that animals and people consumed at Domuztepe were largely locally raised at least in a geological sense; they consumed foods grown on the same types of geological formations as those underlying the site. Among the herded taxa a small number of animals raised in other areas can be identified within each taxonomic group. Theses animals of different origin were no more likely to be consumed in feasting contexts than in Quotidian contexts.

4.3 Oxygen

SOURCES OF OXYGEN AND INCORPORATION INTO SKELETON

Analyses of $\delta^{18}O$ values from bones and teeth have also been employed by archaeologists to assess paleomobility. Oxygen occurs in three stable isotopic forms: ^{16}O, which is the most abundant form, ^{17}O and ^{18}O (Pollard et al. 2007:169). Throughout the earth's hydrological system, the ratio of $^{18}O/^{16}O$ varies depending on precipitation and temperature (Dansgaard 1964), altitude, and latitude. Studies of this ratio in animals, expressed as $\delta^{18}O$, aim to determine where a given animal may have acquired water sources, thus functioning as another means of provenancing samples. This is often done in tandem with analyses of $^{87}Sr/^{86}Sr$.

Oxygen isotopic systems are very complicated. Comprehensive syntheses of these processes are described in Knudson (2009) and Meiggs (2009). Briefly, as water moves through the earth's hydrological system, the ratio of $^{18}O/^{16}O$ changes due to fractionation. ^{18}O has a larger mass, which makes it relatively more resistant to evaporation. As ^{16}O is preferentially lost through evaporation, the remaining water is enriched with ^{18}O relative to ^{16}O. This results in a higher $\delta^{18}O$ value for the relatively enriched sample. There is a linear relationship between precipitation and temperature (Dansgaard 1964), wherein water's $^{18}O/^{16}O$ becomes more positive as air temperature rises. $^{18}O/^{16}O$ is negatively correlated with altitude (Meiggs 2009:172).

Animals get their water from both direct consumption and dietary inputs from the plants they eat. As Meiggs summarizes, the manner in which plants take in water is very complex, but broadly plants follow expected regimes dictated by altitude, latitude and temperature (2009). Dietary inputs of $\delta^{18}O$ can also be enriched when food or water is cooked above 300° (Munro et al. 2007; Wilson et al. 2007), or when an animal consumes its mothers' milk (Wright and Schwarz 1998).

Oxygen incorporated into skeletal elements (bone, teeth, dentine) reflects the variation of water sources that have been consumed by the individual during the time the element is formed or remodeled. Unlike strontium, however, oxygen is not incorporated unmodified from sources into the skeleton; physiological fractionation occurs altering the value found in skeletal elements relative to those found in the sources of oxygen. Studies of modern animals consuming known plant and water sources have demonstrated this, and scientists have determined how to correct for this deviation between ingested water and the resultant $\delta^{18}O$ value found through analysis of enamel.

DOMUZTEPE AND ITS ENVIRONS: ASSESSING LOCALLY AVAILABLE OXYGEN SOURCES

Domuztepe lies at 557 meters above sea level. Assuming this elevation and using the Online Isotopes in Precipitation Calculator (Bowen 2015), the monthly average $\delta^{18}O_{VSMOW}$[2] in precipitation at the site has an estimated range from -9.1‰ in January to -3.0‰ in August, with an annual average of -6.9‰. These data come from records from the Global Network for Isotopes in Precipitation, which has recorded data globally from precipitation monitoring stations since the early 1960s (*Ibid*.). Following the methodology of Meiggs (2009:174, 223) – who estimated the monthly average $\delta^{18}O_{VSMOW}$ in precipitation in several parts of Southeastern Anatolia — an expected range of values for samples of enamel was determined assuming that the animals at Domuztepe consumed all their water primarily from meteoric sources. Meteoric water is any water derived from precipitation. More specifically, this range was determined by determined by using equations to adjust for species-specific fractionation from Delgado-Huertas et al. (1995) and Bryant et al. (1996) for caprines and cattle, Longinelli (1984) for pigs and Iacumin et al. (1996) and Luz et al. (1984) for humans. These results were then used to make inferences about water sources the animals may have accessed, and its implications for herding practices. It was anticipated that animals that derive water from sources at higher elevations, such as the nearby Amanus or Taurus Mountains would have more depleted $\delta^{18}O$ values relative to those who received water exclusively from the local environment around the site. This would suggest a herding strategy where animals were taken to the mountains to access pasture during the more arid summer months as has been ethnographically recorded (Bates 1973). Conversely if animals received their water from more southern locations, such as the Syrian steppe, it was anticipated that higher $\delta^{18}O$ values would to be found in teeth. As the samples taken from

[2] VSMOW refers to the Vienna Standard Mean Oceanic Water reference standard, which is used to define fresh water.

Domuztepe fauna are bulk samples, only broad variance in herding practices can be assessed. Bulk samples take enamel from the full length of the tooth crown, and thus record the average for the whole time of tooth formation. This is opposed to linear sub-sampling, which samples smaller bands within the tooth crown. Linear sub-sampling permits a comparison of particular periods of enamel formation, but is quite costly as many more samples are needed (see Appendix II.II for a complete discussion).

RESULTS

Sheep and Goats

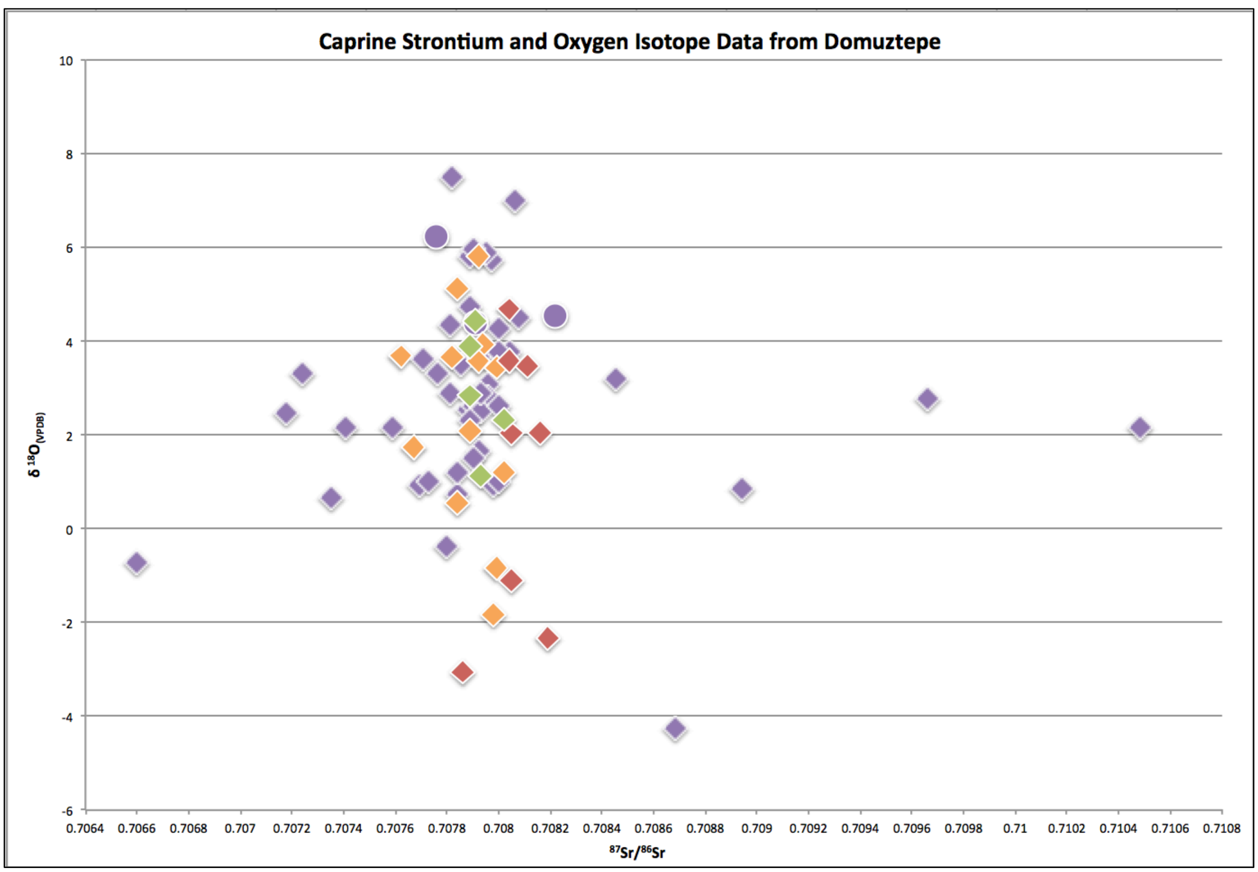

Figure 4.6 Caprine $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ Results N=75; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples. Samples possibly enriched by formation prior to weaning marked as circles.

Caprines exhibit a range of $\delta^{18}O_{VPDB}$[3] values from -4.24‰ to 7.51‰, with a mean of 2.65 ‰ ± 2.22‰ (N=77[4], 1σ). A Mann-Whitney-Wilcoxon test was used, as for the strontium studies, to determine whether or not the samples are from independent populations based on context (feasting in aggregate versus quotidian deposits). The resultant p-value ($p=0.36$) indicates the samples come from one population. This is visually evident in Figure 4.6. Variation among samples may stem from interannual variation in precipitation over the course of the occupational period at Domuztepe. But even samples from the Death Pit show variability in $\delta^{18}O$ values. These animals were deposited in a very narrow period of time, and would have been raised in overlapping years, so the variation likely reflects different herding practices rather than significant interannual variation in precipitation.

Three samples in this data set could not be confidently assigned as a first or second molar as they were recovered loose within the assemblage (ACL-5626, ACL-5658, ACL-5666). If these teeth are, in fact, first molars, they may have mineralized prior to weaning (see comparison of different eruption times as summarized in Meiggs 2009:112-113) and may therefore have $\delta^{18}O$ values that are enriched due to the consumption of mothers' milk. These three samples are marked with circles in Figure 4.6. All fall in the upper range of the data, but only one appears to be an outlier (ACL-5626).

Models can be used to compare $\delta^{18}O$ caprine results with ones we would expect to find in enamel from caprines if they consumed only water from meteoric water (following Meiggs 2009). These estimates are based on modern precipitation records, which are more arid than during the Halaf period. Models like this are constructed based on fractionation rates of $\delta^{18}O$ in caprine

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[3] Sample results from NAU were reported in $\delta^{18}O_{VPDB}$. Much hydrological data, however, is reported relative to the $\delta^{18}O_{VSMOW}$ standard. Conversions were made following Coplen et al. (1998): $\delta^{18}O_{VSMOW} = (1.03091 \times (\delta^{18}O_{VPDB})) + 30.91$.

bone and teeth (Bryant et al. 1996; Delgado Huertas et al. 1995) observed in modern sheep and goats. These are based on experimental data, and thus with each equation there is a margin of error that gets further magnified when equations derived from bone samples are transformed to enamel samples. Thus while these models can help us frame our understanding, they represent data transformations and should be used with caution only to identify major trends.

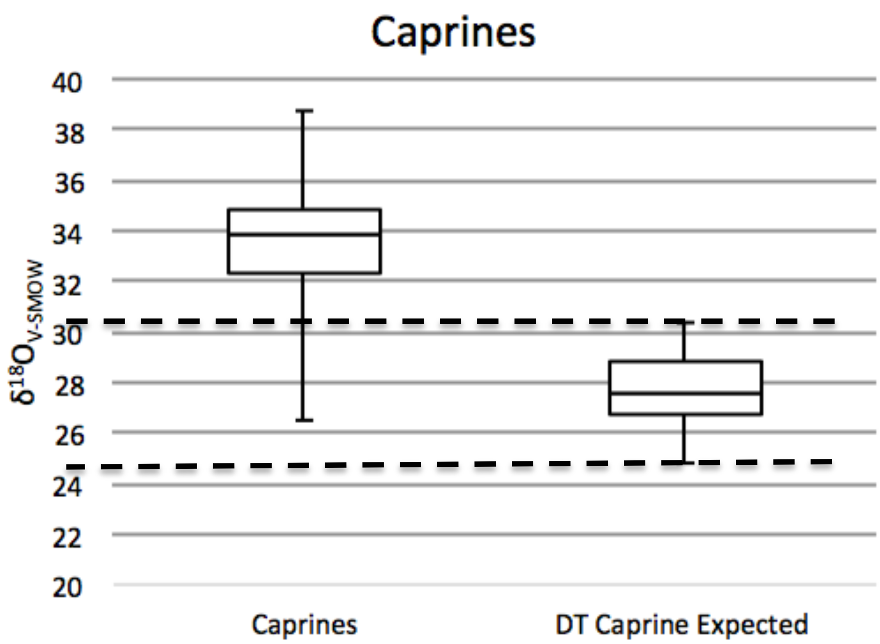


Figure 4.7 Comparison of $\delta^{18}O_{VSMOW}$ for Caprines at Domuztepe with Expected Values. Expected values estimated from the range of average annual precipitation at Domuztepe, using appropriate conversion equations.

With these caveats in mind, Figure 4.7 shows a comparison between caprine samples from Domuztepe and the expected values if the animals' primary source of water was meteoric water around Domuztepe. Caprine samples exhibit a range of $\delta^{18}O_{VSMOW}$ values that exceed the predicted annual range for caprine expected enamel. Caprine values are strongly enriched relative to the predicted range, which may have even been even further depleted during the Halaf period. The second, third, and fourth quartiles do not overlap with the predicted annual range at all; only seven samples overlap in the first quartile. Two of the seven samples that fall within the DT Caprine Expected range had $^{87}Sr/^{86}Sr$ values that deviated from the local range (ACL-5609 and ACL-5636). The rest exhibit $^{87}Sr/^{86}Sr$ values within the baseline range.

Though these models do not decisively show it, the enriched values $\delta^{18}O_{VSMOW}$ indicate that these animals are getting their water from sources other than meteoric water at the site itself during the period of enamel formation. These values even exceed the range in their second and third quartiles that Meiggs reported for an estimated annual range for caprines at the Khabur Euphrates confluence, south of the study area (2009:223), also within the Halaf cultural sphere. Perhaps at least some caprines were spending periods of time to the south and southeast of Domuztepe during the period during which their teeth enamel formed.

Cattle

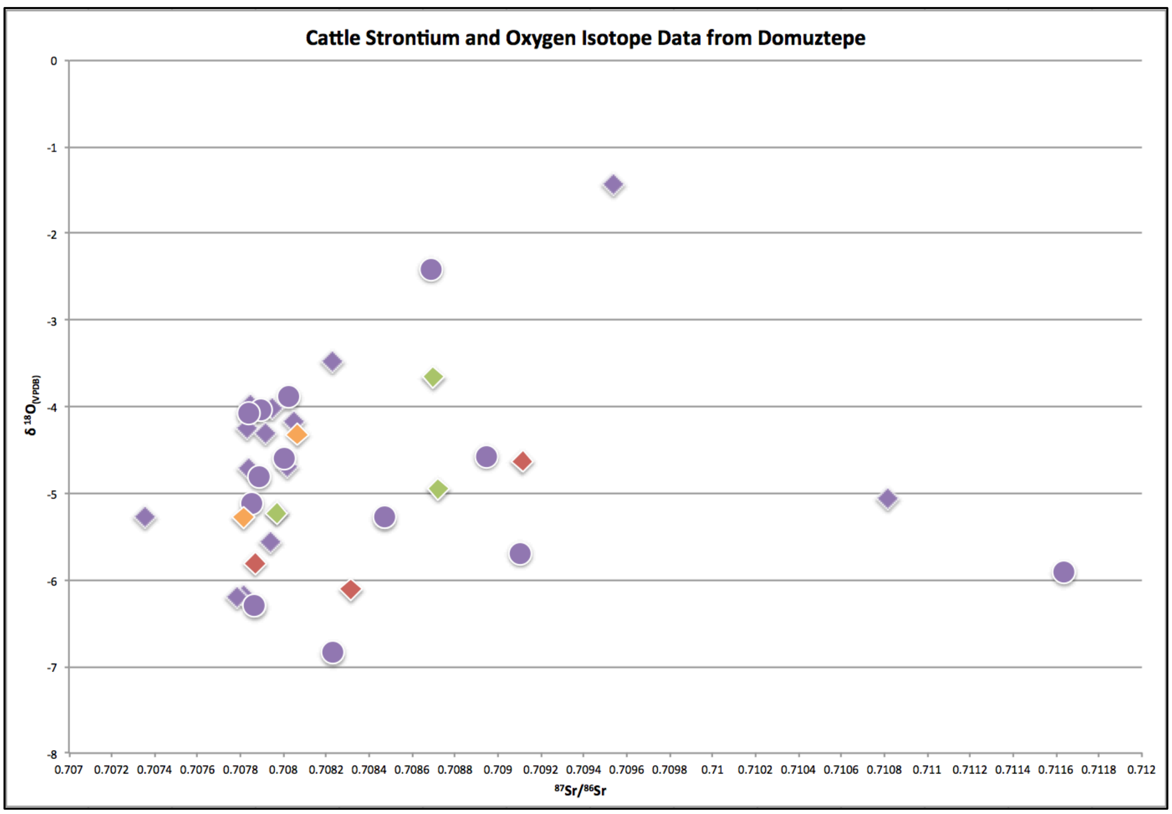


Figure 4.8 Cattle $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ results N= 36; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples. Circular markers denote samples possibly enriched due to mineralization prior to weaning.

Cattle teeth range in $\delta^{18}O_{VPDB}$ from -6.84‰ to -1.84‰, with a mean of -4.78 ± 1.09‰ (N=36, 1σ). This is a much narrower range than that gleaned from caprine samples, though this may be an artifact of the difference in sample size. The results of the Mann-Whitney-Wilcoxon test to determine whether samples from feasting and quotidian contexts came from different populations yielded a p-value of 0.52; there is no statistical differentiation among populations by context.

In this assemblage fourteen of the teeth were only assigned to the category of M1/M2 as they were loose teeth within a lot. This is due to the fact that fewer full cattle mandibles were exported from the excavations and were thus inaccessible for this study due to changes in curation practices at the Kahramanmaraş Arkeoloji Müzesi. These teeth are shown in Figure 4.8 with circular markers. If any of these teeth are first molars rather than second molars, they may be enriched due to their mineralization prior to weaning (Grigson 1982a). Several of these samples do appear to be on the upper distribution of the $\delta^{18}O_{VPDB}$ samples from Domuztepe, but not all. Most of these samples fall within the same range of values as found in second and third molar and third and fourth premolars, which are unlikely to have been affected by consumption of mother's milk.

Figure 4.9 compares the results from Domuztepe cattle samples with expected values for cattle based on modern precipitation data. As discussed for caprines, models like this must be used with caution. Cattle expected values are derived from relevant equations in D'Angela and Longinelli (1990) and Bryant et al. (1996).

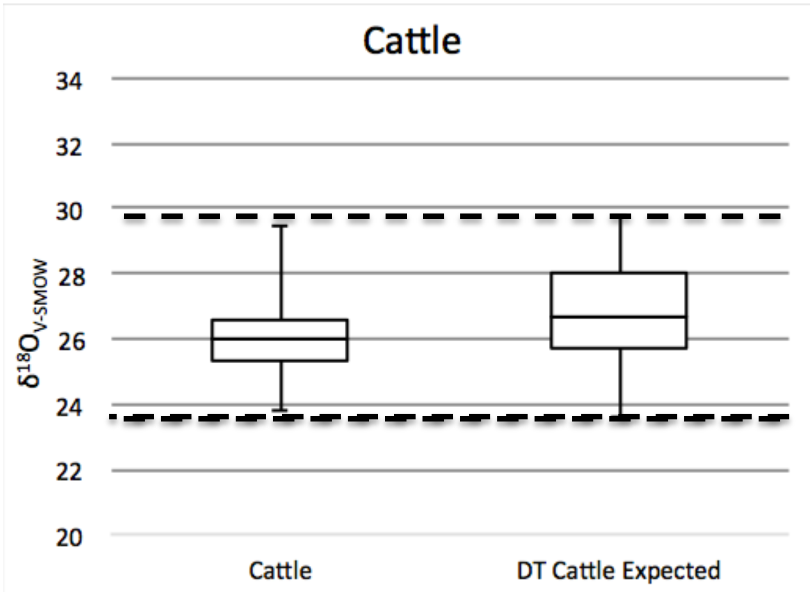


Figure 4.9 Comparison of $\delta^{18}O_{VSMOW}$ for Cattle at Domuztepe with Expected Values Expected values estimated from the range of average annual precipitation at Domuztepe, using appropriate conversion equations.

In this model, cattle samples from Domuztepe exhibit $\delta^{18}O_{VSMOW}$ values that overlap the range of values expected for cattle that received their water primarily from meteoric water at the site. This includes samples that yielded $^{87}Sr/^{86}Sr$ values that deviated from the local range, although several of these outlier $^{87}Sr/^{86}Sr$ samples correspond to samples that exhibit the lowest and highest $\delta^{18}O_{VSMOW}$ values. This model suggests that the majority of cattle received their water either from meteoric sources around Domuztepe or vegetation with signatures parallel to the meteoric precipitation. They may also have been consuming water from the nearby wetlands or Aksu River. This is supported by correlating evidence from pollen cores at Sağlık Göl approximately 15km west of Domuztepe. Woldring et al. (In Prep) report a peak in *Pediastrum boreanum* in cores from the area. They posit that this type of algal bloom may stem from changes in the nutrient composition of the marsh, possibly from animal dung deposited in the wetland. This peak coincides with the final Halaf occupation at the site, and subsides following the site's abandonment. This correlating evidence also indicates that cattle were watered and grazed in the area adjacent to the wetlands. Samples that exhibit $^{87}Sr/^{86}Sr$ values outside the local range but with similar $\delta^{18}O_{VSMOW}$ values may come from locales with similar precipitational regimes, such as the areas to the south and east as highlighted by Meiggs (2009).

Pigs

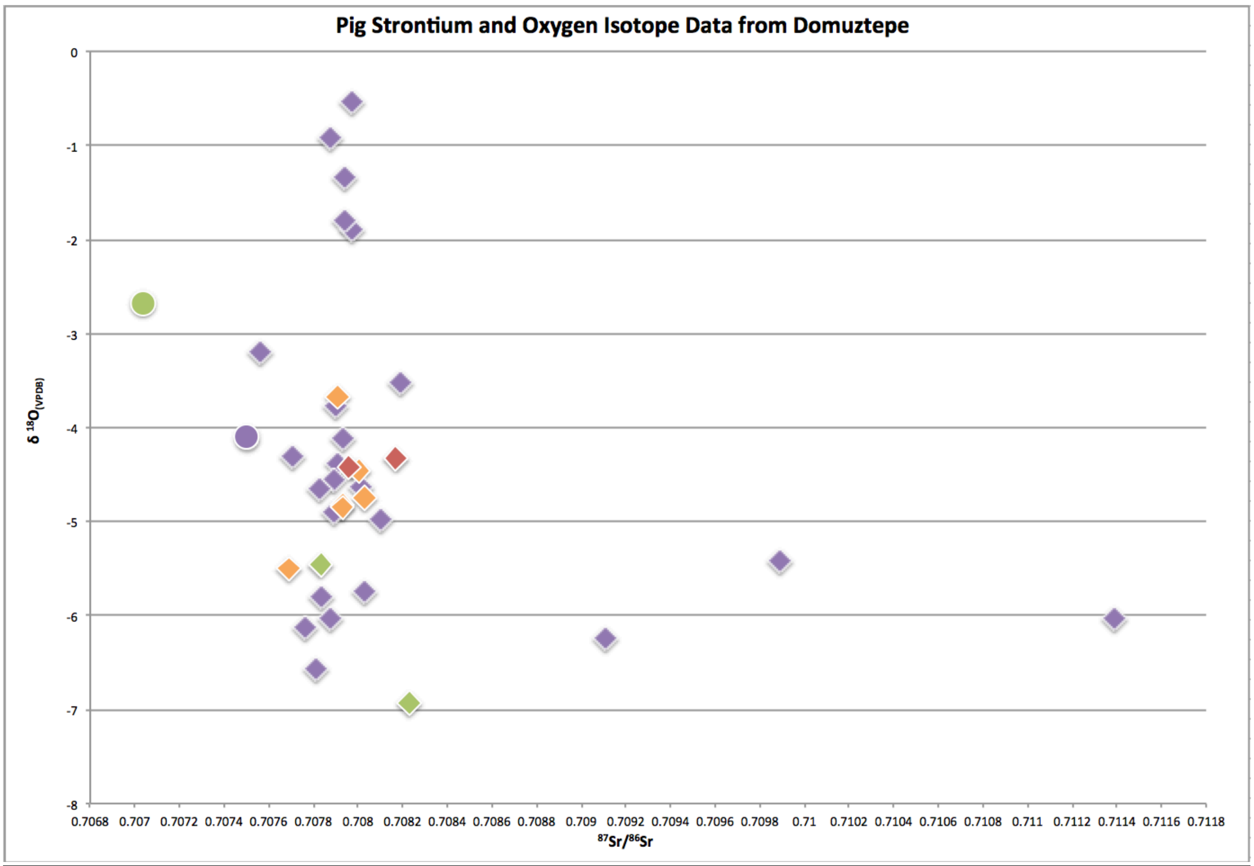


Figure 4.10 Pig $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ results N= 36; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples.

Pig's teeth exhibit a range in $\delta^{18}O_{VPDB}$ of -6.93‰ to -0.91‰, with a mean of -4.37±1.58‰ (N=36, 1σ). This range is slightly larger than that of cattle, but still much smaller than those of caprines, suggesting that pigs drew water from much more restricted sources than sheep and goats. There is substantial overlap in $\delta^{18}O$ values with cattle. Again a Mann-Whitney-Wilcoxon test was used to determine whether or not samples from feasting and quotidian contexts were drawn from different populations based on their $\delta^{18}O$ values. The resultant p-value ($p=0.62$) indicates these samples are not from distinct populations.

Some samples in these data sets may have enriched $\delta^{18}O$ values for several reasons. Two samples (marked as circles in Figure 4.10) may be enriched because the selected tooth forms early in the pig's life. Weaning in modern populations can occur within days or weeks of birth, but evidence from feral domestic pigs and wild pigs suggest this may occur between 14 and 17 weeks (Jensen 1986). Ancient pigs were likely closer to their wild progenitors. It is worth nothing that these teeth do not exhibit the most enriched values in the whole data set. Second, as will be discussed below, pigs at Domuztepe likely consumed refuse around the site and kitchen scraps, which would have included cooked food. Cooking, especially boiling, will enrich the $\delta^{18}O$ in the water or food that was incorporated into the skeletal elements of the consumer. Samples affected by enrichment will yield higher $\delta^{18}O$ values than local meteoric water due to the preferential evaporation of ^{16}O relative to ^{18}O through these processes.

As with the Domuztepe caprines and cattle, models were constructed that compared $\delta^{18}O$ values from pig samples to expected values based on modern precipitation (Figure 4.11). As with the previous taxa, these models should be treated as indicating patterns, not as conclusive evidence. Values of $\delta^{18}O_{VSMOW}$ and estimated enamel values from modern precipitation were derived from relevant formula in Longinelli (1990) and Bryant et al. (1996).

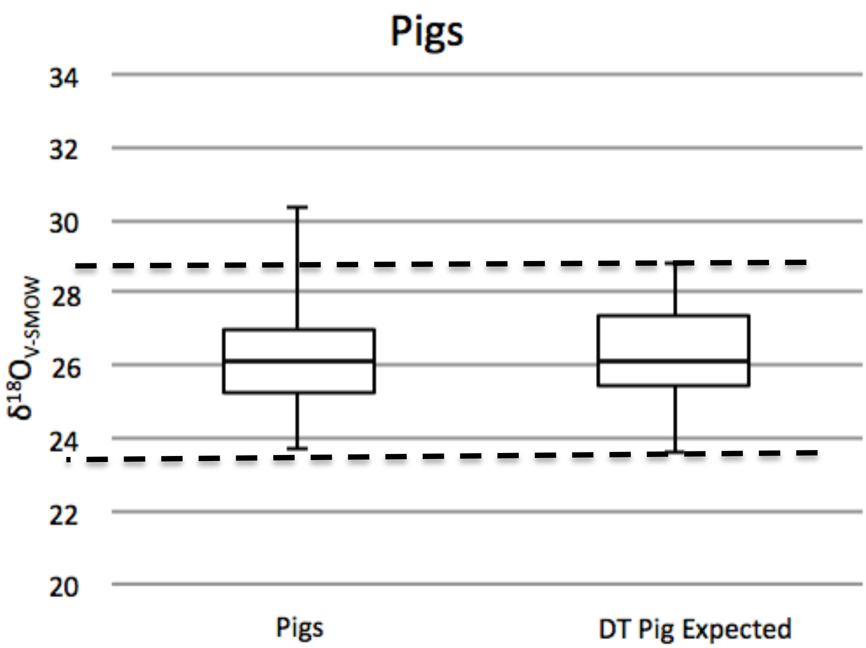


Figure 4.11 Comparison of $\delta^{18}O_{VSMOW}$ for Pigs at Domuztepe with Expected Values Expected values estimated from the range of average annual precipitation at Domuztepe, using appropriate conversion equations.

This model suggests pigs exhibit a range of $\delta^{18}O_{VSMOW}$ values that largely overlap with the range of expected values for pigs consuming primarily meteoric water at Domuztepe. The bulk of the samples cluster around, and slightly above the average annual value of precipitation for Domuztepe for pig's enamel. As mentioned above, samples of pigs' enamel may be enriched from consumption of cooked food and from teeth that developed prior to weaning. The expected range may be enriched as well because it is based on modern precipitation. None of the samples with $^{87}Sr/^{87}Sr$ values that deviate from the local range exhibit $\delta^{18}O_{VSMOW}$ values outside of the expected range. These models reinforce the interpretation that the majority of the animals were watered near the site, or in locales within the same geological substrate and precipitation regime. Pigs receive the majority of their water through direct ingestion, with some contribution coming from feed. Pigs at Domuztepe likely consumed water from similar sources as cattle at the site. They may also have contributed to the algal bloom identified by Woldring et al. (In Prep.).

Humans and Dog

Figure 4.12 shows the results of the distribution of $\delta^{18}O_{VPDB}$ and $^{87}Sr/^{86}Sr$ values for humans and dogs that were recovered from the Death Pit. Table 4.10 gives the values for all human and dog samples in both $\delta^{18}O_{VPDB}$ and $\delta^{18}O_{VSMOW}$.

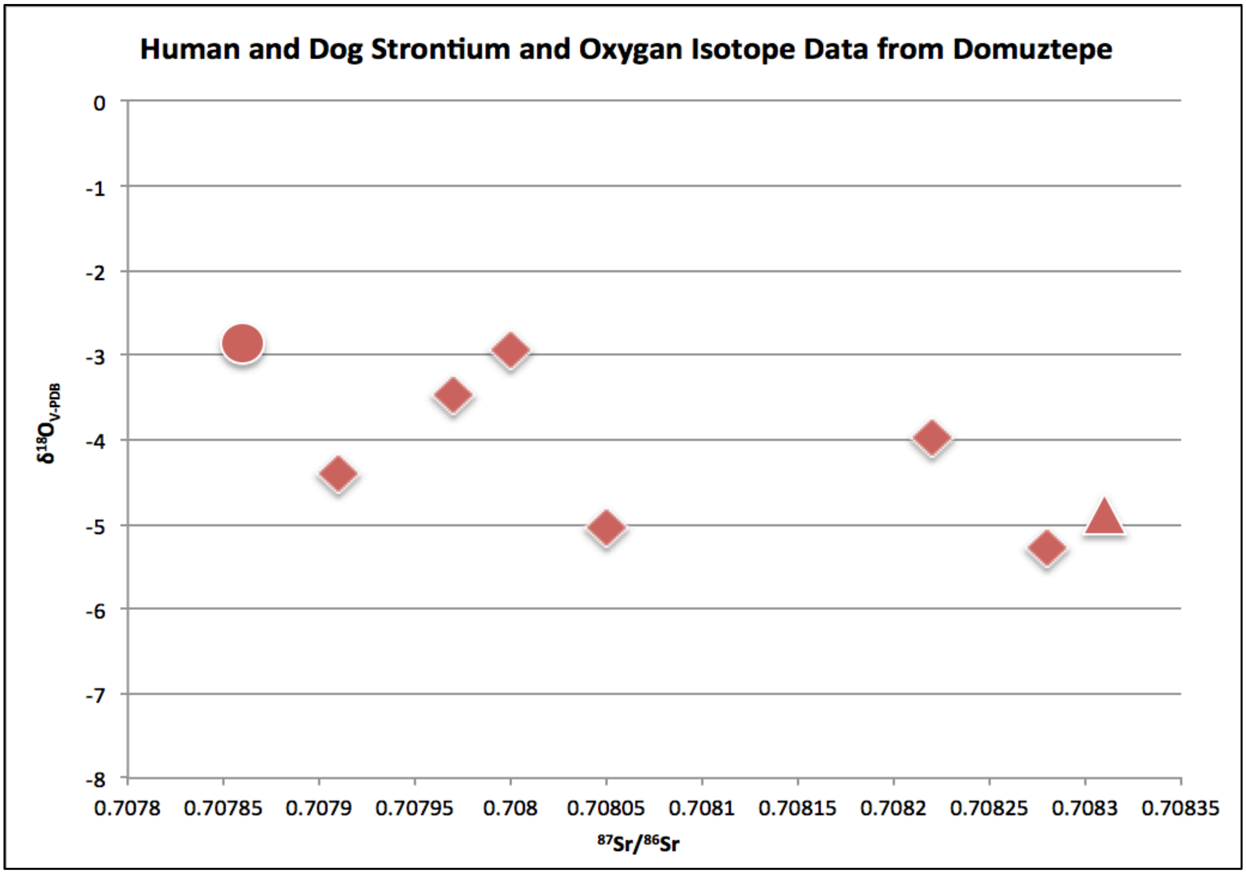


Figure 4.12 Human and Dog $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ Results N= 8; Diamonds denote human samples, circular marker denotes human sample that may be enriched due to formation prior to weaning, triangle denotes dog sample. All samples come from the Death Pit Feasting Context.

Humans exhibit a mean value of $\delta^{18}O_{VPDB}$ =-3.99 ± 0.97‰ (N=7, 1σ).

One sample, ACL-6796, comes from a first molar. First molar crown formation in humans begins at 10 weeks of age, prior to weaning and thus may be enriched in its $\delta^{18}O$ value (Wright and Schwarz1998; see also Knudson 2009:173 for a review). Human samples may also be affected by consuming cooked foods, which would contribute to a more enriched $\delta^{18}O$ value.

Figure 4.13 shows actual and expected values for humans (fractionation equations from Longinelli 1984 and Bryant et al. 1996). The single dog sample was not included because it is an isolated data point. Results from humans fall comfortably within estimated values based on average annual precipitation at Domuztepe.

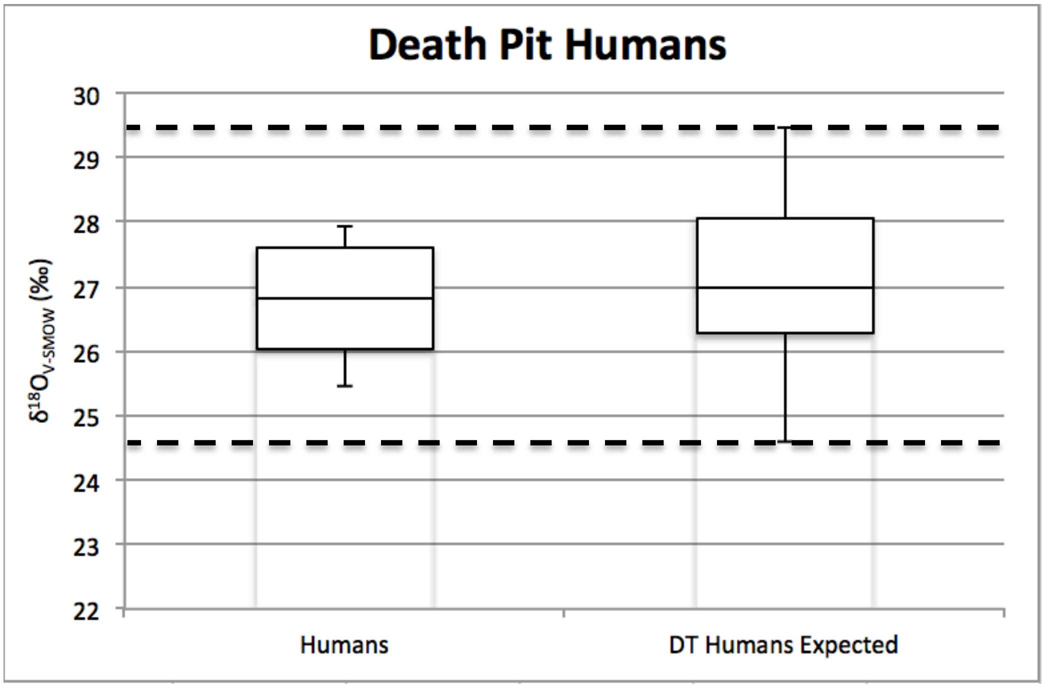


Figure 4.13 Comparison of $\delta^{18}O_{VSMOW}$ for Humans at Domuztepe with Expected Values Expected values estimated from the range of average annual precipitation at Domuztepe, using appropriate conversion equations.

SUMMARY

In summary $\delta^{18}O$ values are similar for cattle, pig and humans, even when accounting for species-specific differences in fractionation. The range of $\delta^{18}O$ values from these species' samples are consistent with expected values for local meteoric water, indicating that they likely consumed precipitation from sources and plant matter close to the site. Caprines, in contrast, exhibit a greater range of $\delta^{18}O$ values, some of which are considerably enriched relative to other taxa. This indicates that at least some caprines in this study consumed water from different sources and areas with different precipitation regimes.

4.4 Carbon

SOURCES OF CARBON AND INCORPORATION INTO SKELETON

Carbon, unlike strontium and oxygen, is used as a paleodietary indicator rather than a paleomobility indicator, although these phenomena are of course linked. Carbon has two stable isotopes: ^{12}C and ^{13}C, which have been used by archaeologists and scholars in other disciplines to reconstruct diet. Analysis of $\delta^{13}C$ in conjunction with nitrogen (specifically $\delta^{15}N$) have been used to assess the consumption of marine and terrestrial protein sources (Schoeninger et al. 1983) and relative amounts of nitrogen-fixing plants (Pollard et al. 2007:171-2)

Germane to this study, $\delta^{13}C$ in animal bone and enamel can also be used to evaluate subjects' relative consumption of plants using different mechanisms of carbon fixation. There are three types of plants, C3, C4 and CAM plants, which are differentiated from one another by how they photosynthesize. C3 plants comprise the largest group and are found in a broad range of habitats. CAM plants (largely succulents) and C4 plants are less common and are adapted for habitats that are arid and experience high light intensity (Simpson 2010:429). Due to the different manners in which they photosynthesize (for a summary see Simpson 2010) these different plant groups produce different $\delta^{13}C$ ranges. C3 plants generally produce values more negative than -23.6‰, while C4 plants yield values less negative than -15.6‰ (Winter 1981:100). CAM plants yield intermediate values between C3 and C4 plants.

Archaeologists have successfully employed $\delta^{13}C$ to explore the consumption of C3 and C4 plants in humans (e.g. Bartelink 2009) and animals (e.g. Bocherens et al. 2001). Shifts in human and animal $\delta^{13}C$ values have been used to track the introduction of C4 crops (e.g. Buikstra and Milner 1991; Emery and Thornton 2008). The $\delta^{13}C$ value has also been used to track herding and foddering routines. Makarawicz and Tuross (2006) were able to identify foddering practices in which herders fed domesticated caprines vegetation collected during summer months, which contained larger proportions of C4 plants than are present in the environment during the winter.

The $\delta^{13}C$ signature of foods consumed by a subject is reflected in their bones and enamel. A comprehensive summary can be found in Meiggs (2009:143-144) but broadly, dietary inputs of carbon sources are incorporated into the skeleton and enamel in a systematic manner, but the processes depend on the physiological particularities and feeding ecology of the species. Species-specific fractionation has been determined through experimental work. These studies determined the systematic variation (enrichment or depletion) that occurs between body tissue and diet for a variety of species and tissues (e.g. Cerling and Harris 1999).

The percentage of C3 and C4 plants in the diet of herded animals were estimated following Meiggs (2009:164) in order to compare among and within taxonomic groups differences in vegetation consumption. Tables AIII.8 to 12 in Appendix III contain the specific value by sample. Experimental studies (e.g. Cerling and Harris 1999; Passey et al. 2005) have demonstrated the differences between dietary $\delta^{13}C$ and enamel $\delta^{13}C$ values, which are systematically enriched. These models used enrichment values for ruminants reported in Cerling and Harris (1999:352) and for pigs reported by Passey et al. (2005:1466). The $\delta^{13}C$ range for C3 and C4 diets were defined by Winter (1981).

DOMUZTEPE AND ITS ENVIRONS: ASSESSING LOCAL VEGETATION

Paleoethnobotanical (Kansa et al. 2009b) and palynological (Woldring et al., In Prep.) analyses from Domuztepe and its environs provide the most useful record of the available C3 and C4 vegetation accessible to people and their animals at Domuztepe. Paleoethnobotanical remains recovered at Domuztepe may also directly speak to what animals consumed as they may represent the remnants of dung fuel. Dung is typically collected from animal stock, dried, and used to fuel fires for cooking, and craft production purposes (Miller 1984). Since the material is carbonized in the fire, seeds are more likely to be preserved, and thus recovered and analyzed by archaeologists. Preliminary results suggest that the high quantity of cereal chaff in the archaeobotanical assemblage may have been deposited through burning of dung fuel. Dung fuel may also be the source of some seeds of both crops and wild grasses, and sea club-rushs in the assemblage (Kansa et al. 2009b:908). Kansa et al. (*Ibid.*) note, however, that it is difficult to distinguish between human food and animal fodder and present results from Domuztepe are somewhat ambiguous. Wood charcoal is abundant in the assemblage and palynological evidence suggests that the area was well wooded (Woldring et al., In Prep.). A study of plant microremains from dental calculous found on pig's teeth at Domuztepe (Weber and Price 2015) indicate that at least pigs were consuming processed cereals, grasses, and acorns. Some of these cereals were cooked, which indicates that pigs were feeding on household refuse; the authors found this in both morphologically domesticated and morphologically wild pigs, suggesting wild boars may have fed on refuse near the settlement (Weber and Price 2015:4).

All crops consumed by both people and animals at Domuztepe are C3 plants. Among wild taxa, there are both C3 and C4 plants, and several families that contain both types of plants, but which cannot be distinguished to a more specific taxonomic level. C4 plants may include taxa found in fields and waste areas (e.g., some species of amaranths and mouse ear, as well as orache, dodder, and purslane) and wetland areas (e.g., some species of sedges and spike-rush, as well as dock/knotweed). All of these species are found in archaeobotanical samples at Domuztepe (Kansa et al. 2009b: 904-905).

RESULTS

Sheep and Goat

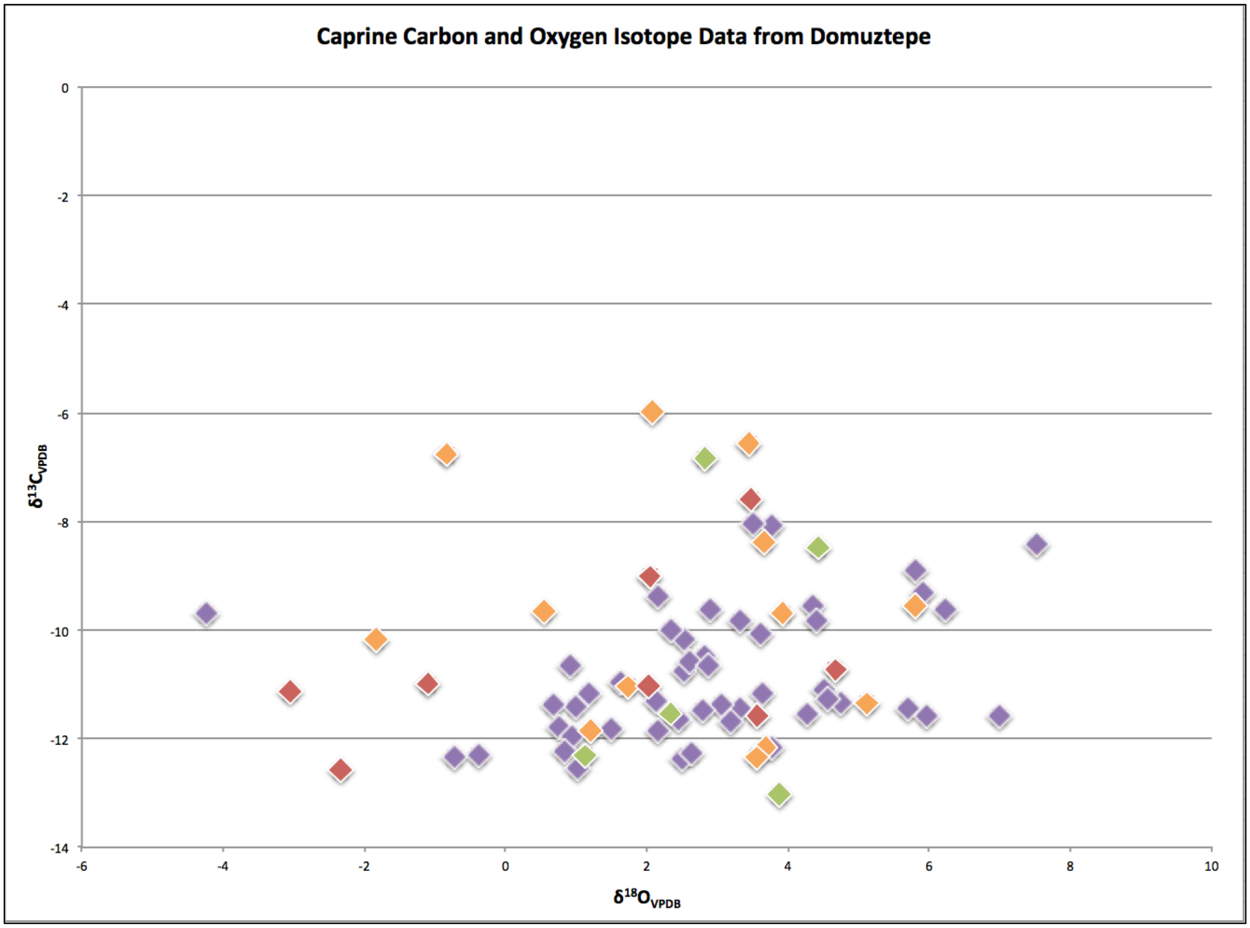


Figure 4.14 Caprine δ^{13}C and δ^{18}O Results N= 77; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples.

Caprine samples range in δ^{13}C value from -5.99‰ to -13.03‰, with a mean value of -10.59 ±1.56‰ (n=75, 1σ). A Mann-Whitney-Wilcoxon test to assess whether samples from feasting and non-feasting contexts are from independent populations again indicates the animals in all contexts come from one population (p=0.20).

The δ^{13}C data from Domuztepe caprine samples indicate the animals primarily consumed C3 plants, with a dietary average of 14.5% of the diet coming from C4 plants. This group aggregates sheep and goats together, some of the variation evident in Figure 4.14 may stem from the fact that sheep are grazers and goats are browsers, and thus have different feeding ecologies. As described above, C3 plants comprise the majority of plants in the area, including all crops grown at Domuztepe. Sheep and goat were likely feeding off open rangeland, fallow fields, and perhaps fodder, likely around the site and for caprines in other environs, based on the $\delta^{18}O$ data. This is also indicated by the paleoethnobotanical data, which showed considerable amounts of cereal chaff in assemblages at the site. Chaff could have entered the assemblage either if used for fodder at the site itself, or if inhabitants burned caprine dung as fuel.

Cattle

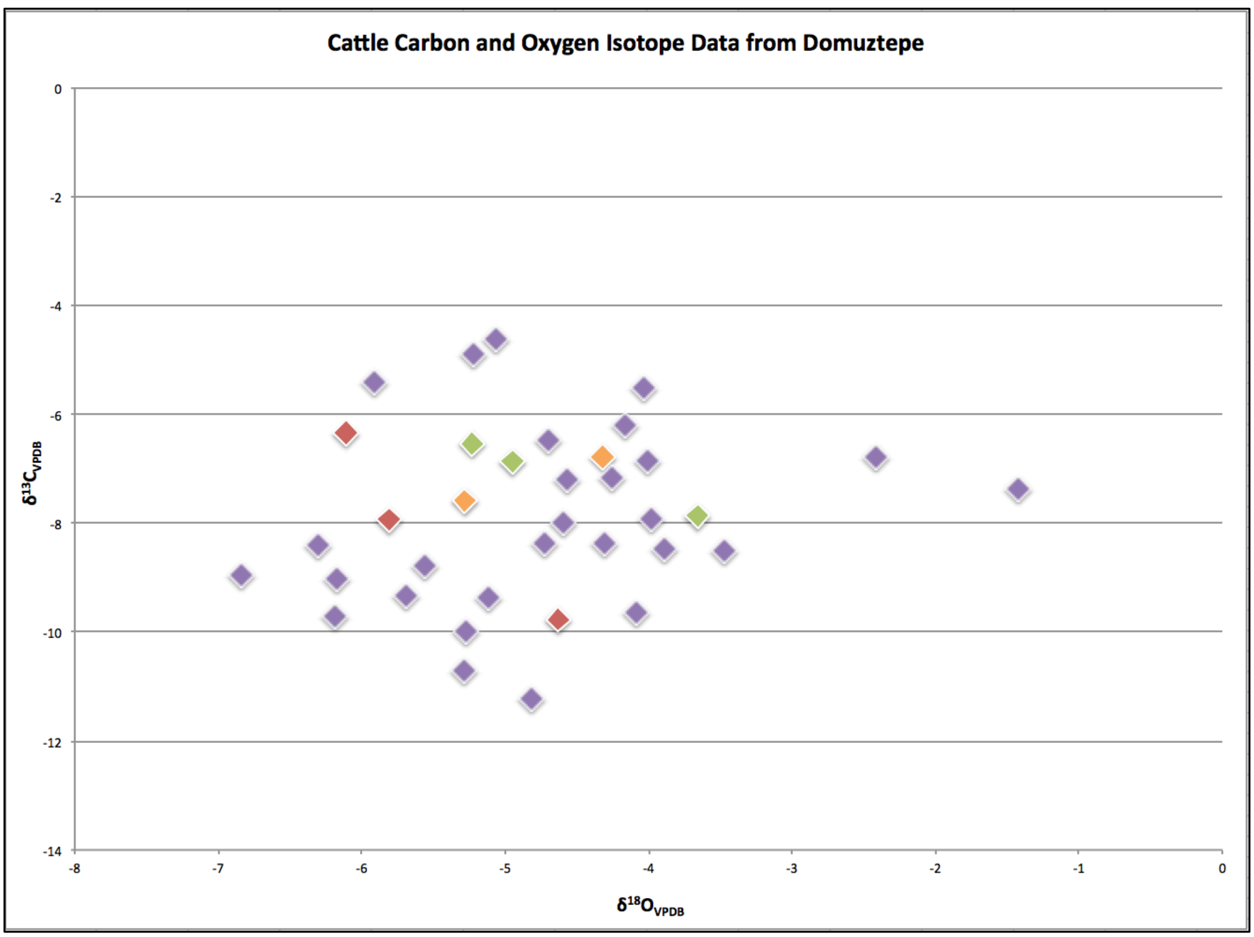


Figure 4.15 Cattle $\delta^{13}C$ and $\delta^{18}O$ Results N= 36; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples

Cattle samples range from $\delta^{13}C$ -11.21‰ to -4.65‰ with a mean value of -7.86 ± 1.59‰ (N=36, 1σ). The Mann-Whitney-Wilcoxon test was performed to determine if animals from feasting and quotidian contexts came from the same population. The resultant p-value (p=0.30), as with previous tests on $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ in cattle, indicate that the samples were derived from one population.

Cattle exhibit the most enriched $\delta^{13}C$ values of the three herd animals, with an estimated dietary average of 35% C4 plants consumed. Given that the $\delta^{18}O$ values indicate that cattle were likely consuming most of their water from sources and vegetation near Domuztepe, it seems that cattle were grazed in areas with more abundant C4 plants than other taxa near the site. C4 plants are present in both field and waste areas, and probably in wetland areas near the adjacent marshland. Domuztepe agropastoralists seeking to keep their animals for both draught and dairying purposes may have kept the animals close to the site, choosing to feed them a combination of fodder from cereal production refuse, and to graze them on fallowing fields and the uncultivatable lands, perhaps near the marshland. This is further supported by the evidence of algal bloom in pollen cores discussed above (Woldring et al., In Prep). Four of the eleven samples for cattle that exhibit $^{87}Sr/^{86}Sr$ values that deviate from the local range also exhibit $\delta^{13}C$ in the lowest quartile. This may be due to the fact that wherever these animals were from they were not herded in areas with as frequent quantities of C4 flora. Two of the samples, ACL-5746 and ACL-5759, with aberrant $^{87}Sr/^{86}Sr$ values exhibit relatively highly enriched $\delta^{13}C$ values, including the maximum value.

Pigs

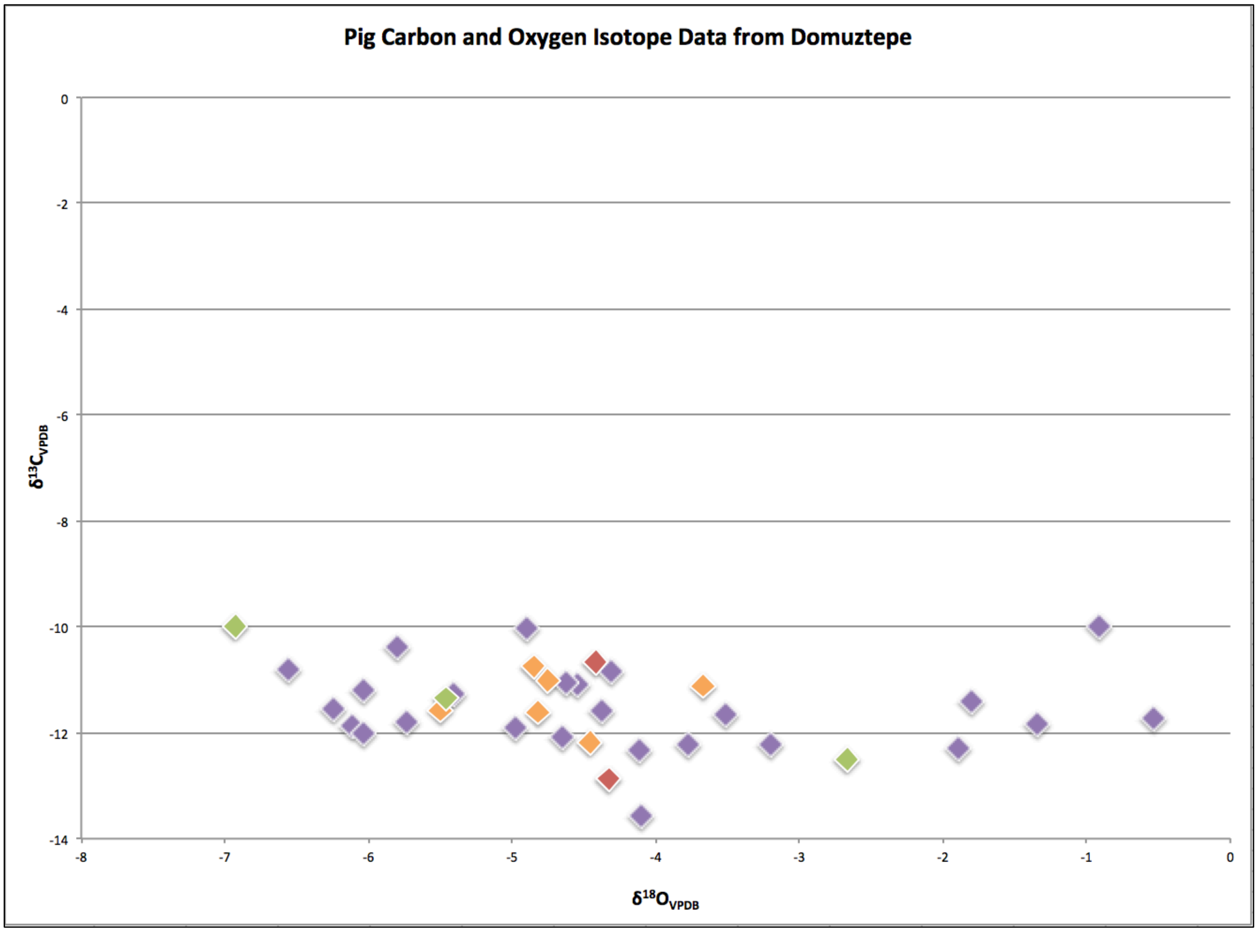


Figure 4.16 Pig $\delta^{13}C$ and $\delta^{18}O$ Results N= 36; Orange = Ditch Samples, Red = Death Pit Samples, Green = Op. III Samples, and Purple = Quotidian Samples

Pig samples range from $\delta^{13}C$ -13.57‰ to -9.98‰ with a mean value of -11.51 ± 0.79‰ (N=36, 1σ). As with previous samples, a Mann-Whitney-Wilcoxon test was performed to determine whether or not samples derived from feasting and quotidian deposits likely came from different populations. As seen in the other tests for $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ in pigs, and among all tests for the other taxa, animals in all contexts likely came from one population (p=0.54).

Pigs exhibit $\delta^{13}C$ values commensurate with a diet of primarily C3 plants, with a dietary average of 14% C4 plants. This suggests that all animals likely fed off crop refuse and trash at the settlement, and wild flora that are primarily C3 plants. These results accord well with Weber and

Price's study of microbotanical remains in pig calculous from Domuztepe. Sources of $\delta^{13}C$ enrichment from C4 plants are likely weeds such as purslane, which grows in waste areas, and from C4 wetland flora.

Humans and Dog

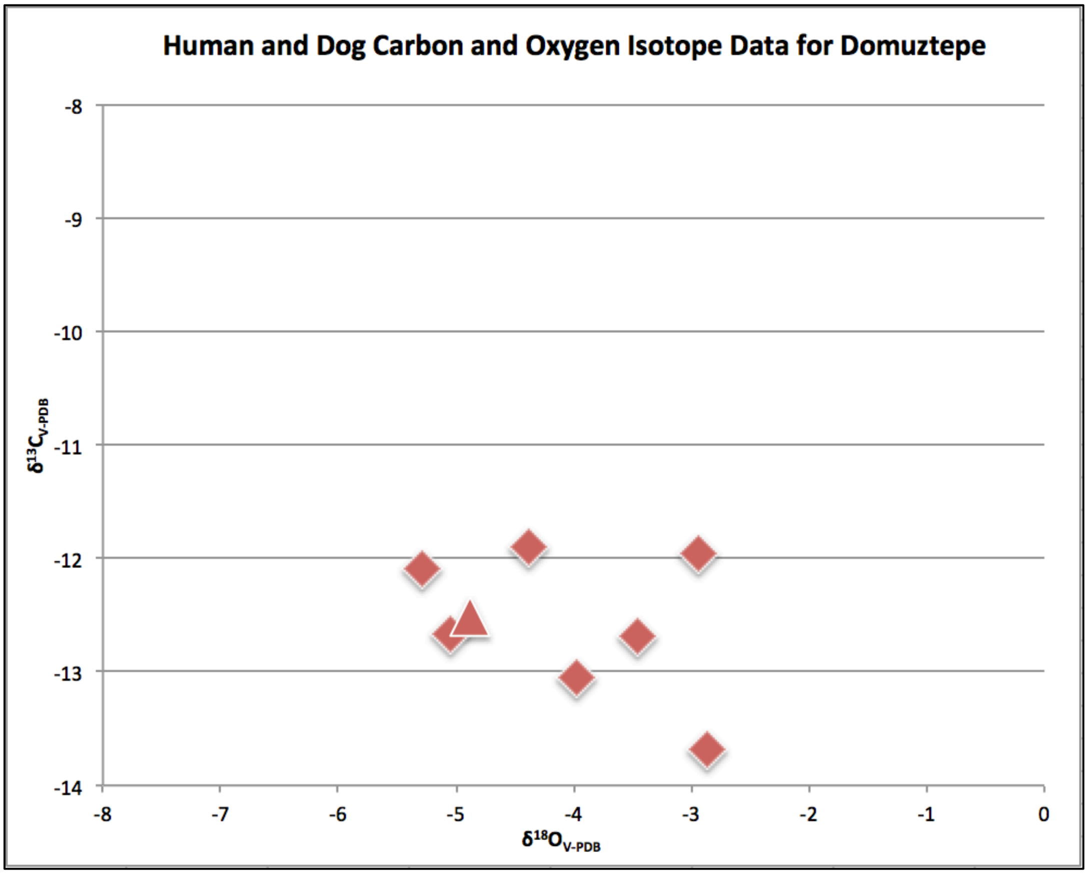


Figure 4.17 Human and Dog $\delta^{13}C$ and $\delta^{18}O$ Results N=8, Diamonds denote human samples, triangle denotes dog sample. All samples come from the Death Pit Feasting Context

Human samples yield a range of $\delta^{13}C$ values from -13.68‰ to -11.90‰ with a mean of -12.58 ± 0.65‰. The singular dog sample yielded a value of -12.51‰. Both humans and dogs exhibit values that are not significantly enriched with respect to $\delta^{13}C$. For humans this is indicative of a diet containing minimal amounts of C4 plants. This is consistent with crop regimes known for this time period from macrobotanical results (Kansa et al. 2009b). While there are wild taxa that are C4 plants that are consumed by humans, such as purslane, which is still eaten in Turkey today, they show up in low proportions in macrobotanical remains, and may reflect animal consumption as well as human consumption.

SUMMARY

In summary, all taxa (livestock, humans and the dog) consumed primarily C3 vegetation. This is consistent with the crops grown near Domuztepe and the majority of wild flora that grow in the area. Cattle, however, exhibit more enriched $\delta^{13}C$ values relative to other taxa. This indicates that cattle consumed more C4 vegetation than other animals.

4.5 Correlating Isotopic Results Among Herded Taxa

In this section I correlate the results from the biogeochemical analyses described in detail above. First I discuss covariation among the different variables, followed by an assessment of what these data indicate about herd-management strategies.

PRINCIPAL COMPONENTS ANALYSIS

Principal Components Analysis (PCA) was used to assess co-variation among the three isotopic values for all the herded taxa (caprines, cattle and pigs) in aggregate. While these types of analyses trace different isotopes, they combine to form the isoscape around Domuztepe and areas exploited by herders who fed people at the site. Further, these three isotopes are incorporated into animals' skeletons through consumption of plants and imbibing water. This statistical analysis is intended to clarify how these three variables relate to one another.

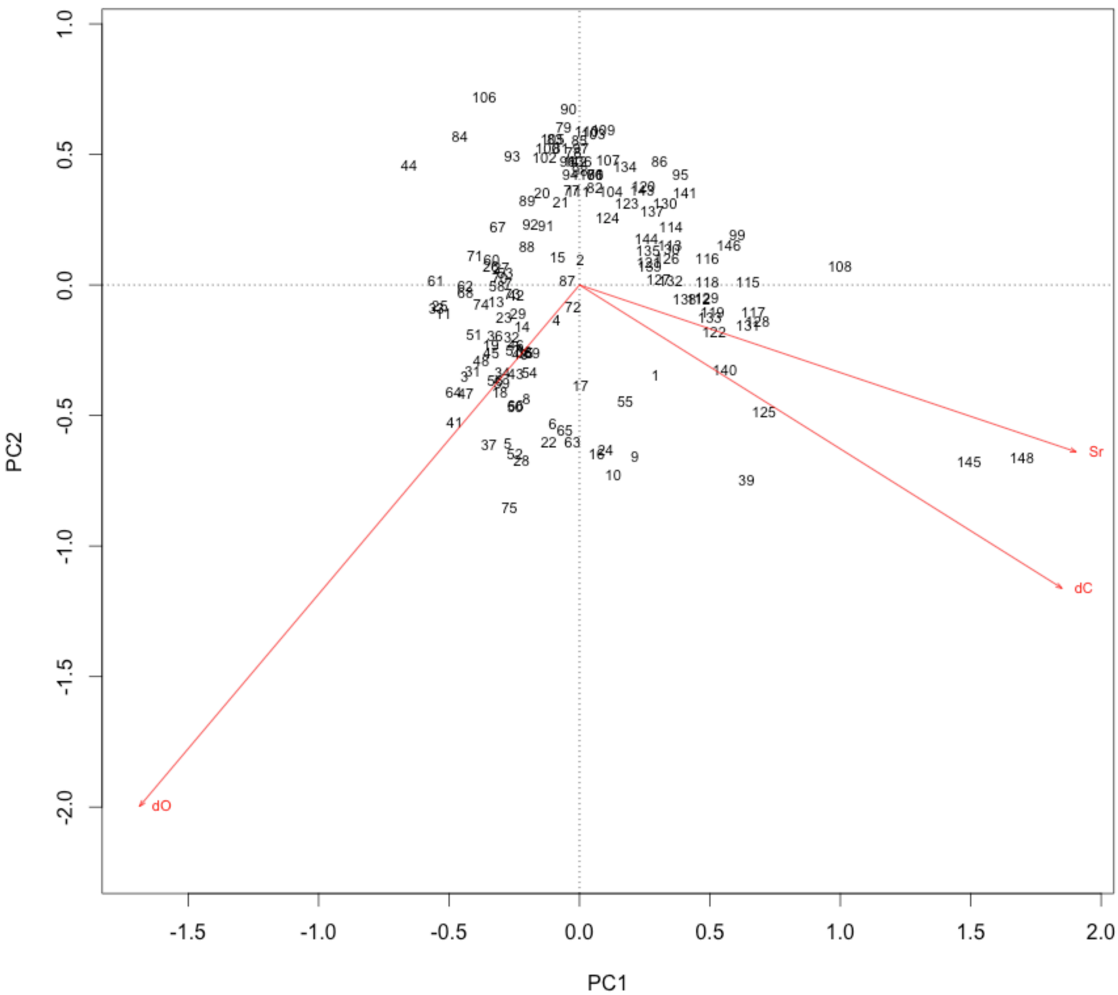


Figure 4.18 PCA comparing $^{87}Sr/^{86}Sr$, $\delta^{18}O$ and $\delta^{13}C$ for Domesticated Taxa

Figure 4.18 shows the relationship between the variables resultant from the PCA analysis. $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ have a weak relationship with one another, while $^{87}Sr/^{86}S$ and $\delta^{13}C$ appear more closely associated. In the following section I discuss each paired variable.

Oxygen and Strontium

$^{87}Sr/^{86}Sr$ and $\delta^{18}O$ are both used as indicators of paleomobility. The results from the herded taxa (caprines, cattle and pigs) echo what the PCA analysis suggested: there is no strong association between $^{87}Sr/^{86}Sr$ values and $\delta\,^{18}O_{vpdb}$ values. This is due to the largely flat nature of the $^{87}Sr/^{86}Sr$ values. The majority of samples fall within a narrow range of strontium values regardless of taxa. All taxa are eating food deriving their strontium from the same geological sources, though cattle exhibit greater variance in $^{87}Sr/^{86}Sr$ than the other taxa, suggesting a larger proportion of the animals were raised non-locally than among other taxa.

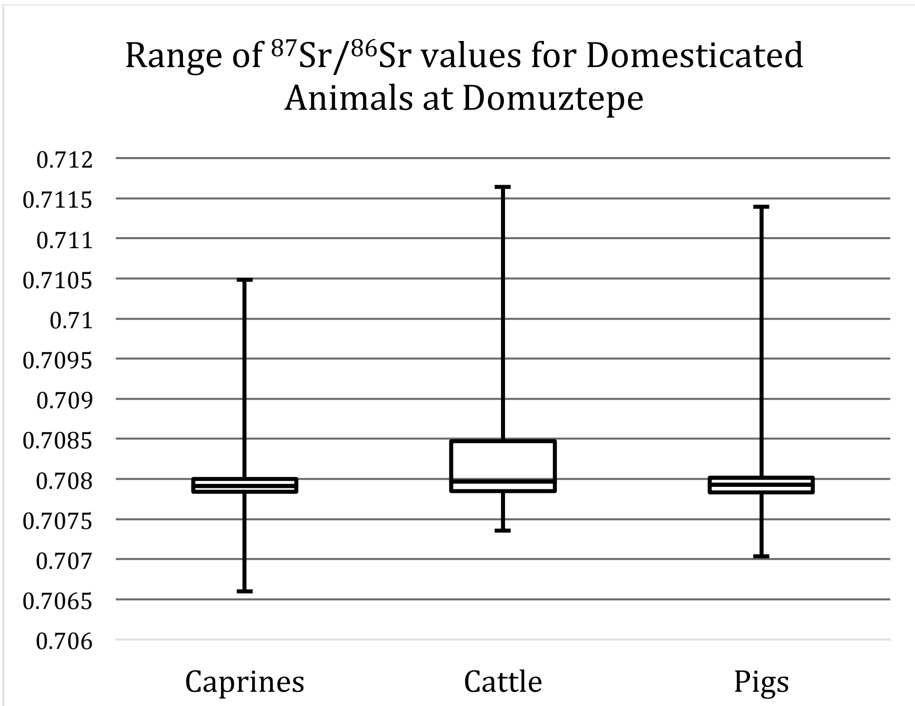


Figure 4.19 Range of $^{87}Sr/^{86}Sr$ values for Domesticated Animals at Domuztepe Includes all samples from all contexts

$^{87}Sr/^{86}Sr$ values for all taxa are similar to those reported by Meiggs (2009:248) for caprines at Pre-Pottery Neolithic B (ca. 9800-6800 BCE) Gritille and reference teeth from wild taxa at Göbekli Tepe, Çayönü, and Titriş Höyük (Meiggs 2009:247), which he attributes to herders grazing their animals on the Eocene-Miocene carbonates of the Arabian Foreland. Gritille is located approximately 130 km to the east and slightly to the north of Domuztepe. Eocene-Miocene carbonates are found to the south and east to the Euphrates toward Abu Hureyra.

$\delta^{18}O$ values, in contrast, show greater variability. While pigs and cattle yield similar values, caprines exhibit both greater variability and more enriched values over all. This indicates that caprines consumed at Domuztepe derived water from a greater variety of sources than the other taxa, and were likely more mobile than other herded taxa. This is further indicated by models that compare species-specific fractionation and expected enamel values for animals consuming only local precipitation; cattle and pigs largely conform to anticipated local enamel values, while caprines differ.

Carbon and Strontium

PCA analysis found the strongest covariability between strontium values and carbon values. $^{87}Sr/^{86}Sr$ and $\delta^{13}C$ are both incorporated into the skeleton through ingestion but function as indicators of different actions. As discussed above, the majority of animals from all taxa exhibit $^{87}Sr/^{86}Sr$ values within a narrow range. $\delta^{13}C$ values for all the three taxa overlap substantially, but cattle exhibit a more enriched signature than caprines or pigs. Overall it appears the majority of all animals largely consumed foodstuffs grown within the same geological region.

Carbon and Oxygen

The clearest differentiation is seen when comparing $\delta^{13}C$ and $\delta^{18}O$. As described above, $\delta^{13}C$ and $\delta^{18}O$ values from archaeological teeth reflect the plant diet and water sources consumed by the animal as part of Domuztepe herders' herding strategies. Domuztepe herders employed specific herding strategies for each of the domesticated taxa they consumed. Cattle and pigs consumed water from similar sources. Caprines, in contrast consumed water from more varied sources. The more enriched $\delta^{18}O$ values for caprines suggest they are accessing water from warmer places and/or lower elevations and latitudes.

Variations in $\delta^{13}C$ demonstrate that different taxa are also consuming different plants. Sheep, goat and pigs had similar diets composed primarily of C3 plant vegetation. Cattle, however, are relatively more enriched in their $\delta^{13}C$ values, suggesting they were consuming relatively larger quantities of C4 plants, although C3 plants still comprise the majority of their diets. $\delta^{13}C$ data are related to $\delta^{18}O$ not only in that water sources feed the plants, but also because many animals receive a significant amount of their water from plants indirectly, rather than from imbibed sources. Therefore differences between $\delta^{13}C$ and $\delta^{18}O$ in these datasets indicate that the animals are eating the same quantities of C3 and C4 plants, but from different sources. This distance between these two variables in the PCA plot above is likely the result of the species-specific differences in $\delta^{13}C$, with cattle as a group furnishing more enriched $\delta^{13}C$ values, and $\delta^{18}O$, where caprines possess more enriched $\delta^{18}O$ values.

4.6 Implications for Halaf Period Herding Practices

These data cannot provide the particular provenance of individual animals, but do suggest broad trends in Domuztepe-affiliated peoples' animal management strategies. The majority of animals from all four taxa was herded in areas around the site and to the southeast, in the area that is broadly dominated by Eocene-Miocene carbonates of the Arabian Foreland. This is indicated by the narrow distribution of $^{87}Sr/^{86}Sr$ values. All samples reflect the average $^{87}Sr/^{86}Sr$ values consumed over the formation of the sampled teeth, and thus short forays into areas with different geological signatures – the basaltic outcrops that dot the region, or the nearby Amanus or Taurus mountains, cannot be identified, as they would be subsumed into the average. Linear sub-sampling might permit identifying such movement (Meiggs 2007). Bulk sampling as employed here does not offer such fine reconstruction, but it did permit a larger sample size (see AII.II). The generally small range of values for $^{87}Sr/^{86}Sr$ suggest that time spent in regions out of the Arabian Foreland were likely quite limited, or at least regular enough to affect the average values the same way among all animals within a taxonomic group and among herd animals more broadly.

While the majority of all animals exhibit values within the same narrow $^{87}Sr/^{86}Sr$ range, there are some clear outliers among all taxa. Cattle exhibit the greatest range of $^{87}Sr/^{86}Sr$ values relative to other herded taxa, and the greatest proportion of outliers. Sheep/Goat and Pigs exhibit relatively narrower ranges, with some outliers on each end of the spectrum. This suggests more cattle enter the herding and, ultimately, consumption system at Domuztepe through some sort of mobility or exchange than other animals. Among all taxa, outliers were no more likely to be recovered from feasting contexts than Quotidian contexts. Halaf period people at Domuztepe consumed animals from the same networks in all social contexts. Indeed, outliers were more frequently identified among quotidian remains. The fact that they show up more frequently among quotidian remains is likely an artifact of the fact the quotidian sample size is larger. Regardless, animals raised outside the local area (defined geologically) are important indicators of interaction with people in other regions. These animals may come to the site accompanying migrants to the Kahramanmaraş Valley, or through exchange as pastoralists or craftspeople move throughout the region.

Given the broad distribution of similar geological formations throughout the Arabian plateau, $\delta^{18}O$ data provide a clearer indicator of animal mobility within the region. Cattle and pigs yield $\delta^{18}O$ values that accord broadly with expected values at the site. They are likely consuming water from open sources around the village, such as the marsh that used to be adjacent to the site. Sheep and goat, in contrast, likely were herded for considerable periods of time in locales to the south of the study region, perhaps to the southeast along the Euphrates moving in some sort of seasonal round. This would account for why the $^{87}Sr/^{86}Sr$ signature is similar to the local signature at Domuztepe, but the $\delta^{18}O$ values differ from expected values at the site. This type of migration correlates with the existing distribution of Halaf material culture, which is discussed in more detail in the next chapter. Domuztepe, located in the well-watered northwestern edge of the Halaf cultural sphere, may have been sufficiently wet for summer pasture during this particularly moist period of the Holocene. This contrasts with modern herding practices that have been recorded ethnographically in the region. Bates (1973), for example, observed that Yoruk groups passing through the region took their animals up into the Taurus Mountains during the summer in search of pasture. Sheep and goats at Domuztepe also exhibit a greater range of $\delta^{18}O$ values than the other taxa suggesting that this herding strategy is a broad trend, rather than a tightly regulated mobility pattern practiced by all herders. This could also be related to sample size.

Results from analysis of $\delta^{13}C$ correlate well with $\delta^{18}O$ data. While these two variables track different isotopes, since animals receive some of their water from the plants they consume, these are related. Each taxonomic group shows distinct patterns of vegetation consumption. Cattle exhibit the most enriched $\delta^{13}C$ values as a group, with many animals consuming significant proportions of C4 plants. Caprines and cattle exhibit approximately the same range of variability in $\delta^{13}C$ values, but caprines are less enriched, corresponding to values consistent with a diet more reliant on C3 plants. Pigs consume primarily C3 plants. They exhibit the smallest range of variability with more than three quarters of the samples consuming less than 20% of their diet in C3 plants.

From these trends I hypothesize Domuztepe caprines were likely herded moving in rounds that extended to the south and east of Domuztepe. Some groups likely ranged significantly further to the south, accounting for the samples exhibiting the most enriched values of $\delta^{18}O$. This would reflect a combination of village-based herding and transhumant pastoralism as defined by Abdi (2003). Depending on their proximity to settlements, sheep and goat likely fed on a combination of grasses and other plants throughout the rangeland and fallowed fields comprised primarily of C3 grasses and weeds (primarily C3, with some C4 taxa), and on crops. Sheep and goats likely fed on a combination of refuse from cereal harvesting, specifically grown fodder, and/or stubble on harvested fields.

Cattle were likely herded near the site and taken to pasture by individual households, which accounts for a great variability in their diets, but similarity in their $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ sources. Cattle consumed water from precipitation stored at the site, and from the adjacent wetland. Today the cattle and caprines are watered at springs near the base of the rocky outcrops (Carter, personal comm.). Cattle were probably grazed on a varying combination of wild flora from rangeland and wetlands near the site and crop refuse, fodder, and fallowed fields depending on the owner. Animals exhibiting higher $\delta^{13}C$ values probably consumed larger proportions of wild flora growing near the marshes or in waste areas, where C4 plants are more common. $\delta^{18}O$, $\delta^{13}C$ and pollen core data all support such a herding strategy. It is unlikely that cattle traveled great distances from the settlement, more likely staying nearby to be used for draught purposes and to be milked. Herders may also have kept animals close to the site as cattle require considerably larger volumes of water than caprines and Domuztepe and its' environs have abundant water sources.

Pigs, like cattle, probably stayed close to the settlement, perhaps consuming water from the adjacent wetlands and precipitation either freely in the marsh or in household sties. This would account for the narrow $\delta^{18}O$ values that accord well with local estimates for enamel values based on local precipitation. Pigs likely fed primarily on refuse at the site. This accords well with the $\delta^{13}C$ values which indicate an almost entirely C3 diet for many of the animals and the results of microbotanical studies which recovered cooked starch grains in dental calculus from pigs (Weber and Price 2015:4). This study also identified grasses and acorn starch granules in dental calculus, which agrees with reconstructions of local habitat from both macrobotanical remains (Kansa et al. 2009b) and pollen cores (Woldring et al., In Prep.). Processed crop remains were recovered on both metrically-identified wild and domesticated animals (Weber and Price 2015). This may indicate that wild stock were drawn to the settlement's abundant food refuse, feeding on trash when available, and/or that wild boar were incorporated into domestic stocks. A third option might be that Domuztepe residents took advantage of the adjacent marshland to raise their pigs in a manner not unlike pannage known from Roman (MacKinnon 2001) and Medieval Europe (Weallans 2013) or New Guinea models of pig rearing. Redding proposed a similar model for PPNA Hallan Çemi (Redding and Rosenberg 1998). This may also explain the anomalous age distribution of pigs identified in Chapter Three, which encompasses a greater range of ages than is often posited for pig rearing in the Near East. Under such a model pigs are herded extensively rather than intensively in household sties.

4.7 People and Dog in the Death Pit

The human samples from the Death Pit are a small subset of the assemblage (one fifth of the MNI). Based on these results it seems that people and at least one dog that were sacrificed, cooked, and perhaps consumed as part of the Death Pit event were from areas with the same geological background as Domuztepe, at least during the period of time that was captured during tooth formation. None of the individuals exhibit $^{87}Sr/^{86}Sr$ values that deviate strongly from the local baseline. Similarly data from $\delta^{18}O$ in enamel seem to correlate well with expected values for people primarily imbibing water from precipitation at Domuztepe.

This picture would be greatly clarified with a broader study encompassing more individuals from the Death Pit. It would also be edifying to sample skeletal elements from the assemblage, as bone remodels over the course of one's lifetime and thus can be used to identify mobility later in life. Unfortunately the extensive butchery of the assemblage would make it likely impossible to unite specific tooth samples with bone samples, unless they come from the skull. Thus such a study could only speak to very broad patterns in mobility, rather than elucidating specific individuals' life histories.

4.8 Conclusions: Halaf Peoples' Consumption Choices and Social Implications of Herding at Domuztepe

These data indicate that people at Domuztepe consumed animals from the same herding networks for feasting events and daily meals. In no case does it appear that animals consumed at feasting events represent a distinct population based on biogeochemical evidence. People at Domuztepe also likely chose humans for consumption from the same area in which they herded their animals. The implications and significance of these choices is considered in Chapter Five.

The biogeochemical data from Domuztepe have important implications for how herding was structured and how it impacted social life among inhabitants. Isotopic data indicate that two of the taxa — cattle and pigs — were herded locally, organized at a household level, or perhaps among households at the site. Inhabitants had to incorporate these animals' herding needs among other labor obligations. These requirements include taking the animals to graze and to consume sufficient amounts of water. Cattle engender the additional demands of milking and processing milk (e.g. either consuming raw milk, or processing it to more storeable dairy products like butter, cheese and yogurt). Cattle may also have assisted in agricultural tasks providing necessary draft labor. Such needs could be met within a household, or by cooperation among households. For example, ethnographic accounts from Tell Toqaan in northwest Syria (Sweet 1960) record that villagers herded cattle collectively by a hired shepherd. Caprines, in contrast, were grazed in collective herds organized among households within the village. These collective herds were organized based on ties among households by kinship and marriage associations. Similar herding systems have been ethnographically identified in western Iran (Kramer 1982; Watson 1979).

The greater variability among $\delta^{18}O$ among caprines, in contrast, suggest that at least some portion of caprines at Domuztepe were herded away from the village for some period of time during the period the animals' enamel formed. I argue that this likely occurred to the south and east of the site, within the western distribution of the Halaf cultural sphere. This would have required periods of time for herders to be away from Domuztepe. Such herding would also require members within a household or among households to schedule this labor among other agropastoral tasks. It would have necessitated cooperation among participants in the agropastoral system. Secondary product production — dairy production and wool production — would also have to be scheduled among labor demands and would likely have taken place at or near the site.

CHAPTER FIVE: MOVING OBJECTS, MOVING ANIMALS, MOVING PEOPLE

5.1 Movement and Interaction in the Halaf Cultural Sphere: Additional Evidence of Cooperation and Interaction at Varying Spatial Scales

Interaction and cooperation in the Halaf cultural sphere took place within and between communities. Understanding the nature of movement and interaction among communities in this period, and how communities interacted with one another is important for differentiating which of the differing interpretations of cooperation and attendant incipient complexity outlined by previous scholarship is most plausible.

Chapters Three and Four focused on Domuztepe residents; agropastoral production and how herding practices were likely structured within the community, and how inhabitants coordinated resource use for large-scale commensal events, which are collective actions. In this chapter I correlate the results of these two studies and the implications these results have for understanding cooperation in agropastoral production and at collective action events.

I then examine data for people in Halaf communities interacting with one another and with communities outside the Halaf cultural sphere. I trace the movement of raw materials and finished craft goods at three geographic scales: the sub-regional (any area that is within restricted parts of the Halaf cultural sphere, usually up to about 300 km), regional (extending the full geographical extent of the Halaf cultural sphere), and supra-regional (involving areas beyond the geographic scope of the Halaf cultural sphere). The distribution of where materials came from, how craft goods were produced and distributed within the region, and the frequency with which people at Halaf sites interacted with one another elucidates how communities cooperated and coordinated different aspects of their economy with one another. Resource procurement and good production would also have to be schedule among other competing labor demands, such as those raised by animal husbandry. Such good production also became a focus of low-level specialization, which necessitate that the craftspeople were able to exchange their goods for other necessities. The archaeological record yields evidence that certain sites produced specific goods —both utilitarian objects and luxury items— that were consumed at other sites. These items show up in greater frequency at Domuztepe and other sites in collective action events, e.g., in deposits that are the result of feasts.

Craft production in ceramics, seals, and other forms of personal adornment also may have created opportunities for individuals and groups to establish inequalities among their contemporaries by exerting control over networks of craft production and distribution. Further, the items may have been used to visually communicate their growing status, as many of the luxury items are associated with personal adornment. Seals demonstrate the connection between the ability to control production and monitoring systems and how individuals broadcasted that control are related. Seals were used to account for goods, such as the products of agropastoral production. Monitoring systems like accounting systems were essential to ensuring continued cooperative behavior. Seals were also finely crafted, often of quality stones and sometimes from rare materials like metals. They were often worn as a form of personal adornment, showing that the wearer had the ability to account for goods and to procure finely crafted items. I end this chapter by considering the implications that such interaction and exchange may have had for incipient social complexity at Domuztepe and other sites in the region.

5.2 Correlating Zooarchaeological results and Isotopic Results at Domuztepe

Zooarchaeological analyses in Chapter Three examined how people varied their animal management strategies in quotidian consumption and for episodic communal feasting events at Domuztepe. Halaf period people at Domuztepe engaged in an animal economy focused on domesticated sheep, goat, cattle and pigs. They raised these animals to produce meat, dairy, and wool. Each of these productive goals required human caregivers to input different kinds of labor, which had to be coordinated with other labor demands, such as farming, craft production, and building construction and maintenance. People at Domuztepe regularly participated in communal feasting events that became more elaborate in terms of volume and the type of animals chosen for consumption as time went on.

Biogeochemical studies in Chapter Four elucidate inhabitants' herding strategies for their stock animals. Halaf period people did not engage in a highly organized herding regime, but rather seem to have raised some taxa as household stock, and participated in some sheep and goat herding at a distance from the site. These decisions were probably made at the household level, or among groups of households working together. Pigs, cattle, and some sheep and goats were kept close to the settlement, likely fulfilling daily requirements for dairy and meat. Sheep and goat were also herded away from the site for at least part of the year. These animals, at the direction of their human caretakers, traveled south and east, perhaps following the Euphrates valley at a distance of, at most, around 200km-250km. We cannot, unfortunately, pinpoint exactly where Halaf period herders moved their animals as part of their herding rounds with these biogeochemical indicators. We can note, however, that this directional movement to the south and east contrasts with modern ethnographies of herders who moved from the plains of Southeastern Turkey into the central Anatolian plateau in their seasonal rounds (Bates 1973). The range of $\delta^{18}O$ values in sheep and goat enamel does not show a pattern indicative of a tightly regulated movement, but this may be due to inter-annual variation in precipitation during the long period of occupation at Domuztepe and the sampling method employed (bulk sampling over the period of tooth formation as opposed to linear sub-sampling). Finally, while $^{87}Sr/^{86}Sr$ values do indicate that the majority of animals were raised in areas with the same geological backdrop as the site, there are a few animals in each taxonomic group that came from different areas, indicating that Halaf period people exchanged animals on a small scale.

When combined, these data make clear that Domuztepe people made the choices of what animals to slaughter in feasting events within the same economic system as their day-to-day subsistence choices. This is evident in that among herd animals there was no clear association between context and isotopic values for $^{87}Sr/^{86}Sr$, $\delta^{18}O$, and $\delta^{13}C$. Non-local animals were no more likely to be consumed in feasts than in daily meals, as indicated by their $^{87}Sr/^{86}Sr$ values. Similarly herding strategies indicated by $\delta^{18}O$ and $\delta^{13}C$ exhibit no clear pattern relative to consumption context, suggesting the animals (and people) consumed at feasts at Domuztepe were not herded or fed differently than those consumed in more quotidian meals. Planning and preparation for these events occurred within the same broader animal management system that fed inhabitants on a daily basis. These feasts were not simple events where inhabitants ate whatever was brought to them by a population with whom they interacted infrequently. Inhabitants made conscious choices to sacrifice animals of great economic and symbolic value. They were aware of the ramifications of these choices — how it would affect what animal products and animal stock would be available to them in the future. Events on the scale of the Death Pit, where a whole herd of prime-age female cattle were slaughtered, would have had a major effect on the organizers' animal stocks and likely would have required long-term planning and coordination to ensure they could grapple with such a loss. Given the moist nature of this period of the Holocene, kill off in anticipation of herd loss from something like drought seems unlikely. Organizers, whether at a community level or a few enterprising individuals or groups, would also have been cognizant of the display such sacrifice would create. If feasts were, as the faunal evidence from the Ditch suggests, an opportunity to redistribute resources (specifically meat) throughout the community, we can see the scale at which such redistribution occurs growing over time (both within the Ditch, and among the feasting assemblages), perhaps indicating more participants cooperating with one another.

5.3 Circulating Material Culture

The macroscale and biogeochemical zooarchaeological studies from Domuztepe reveal that animals, and by extension, at least those people charged with minding them moved within an area that may have extended up to several hundred kilometers to the south and east of the site. This movement matches well with the distribution of Halaf material culture, oriented southward towards the Syrian Euphrates valley as opposed to northward into the Taurus and west-southwest into the Amanus Mountains. But how did pastoral mobility fit within the wider system of movement and interaction in the Late Neolithic Halaf cultural sphere? In this section I look at evidence of sub-regional, regional, and supra-regional movement of goods, and information exchange among people throughout the Halaf cultural region and beyond.

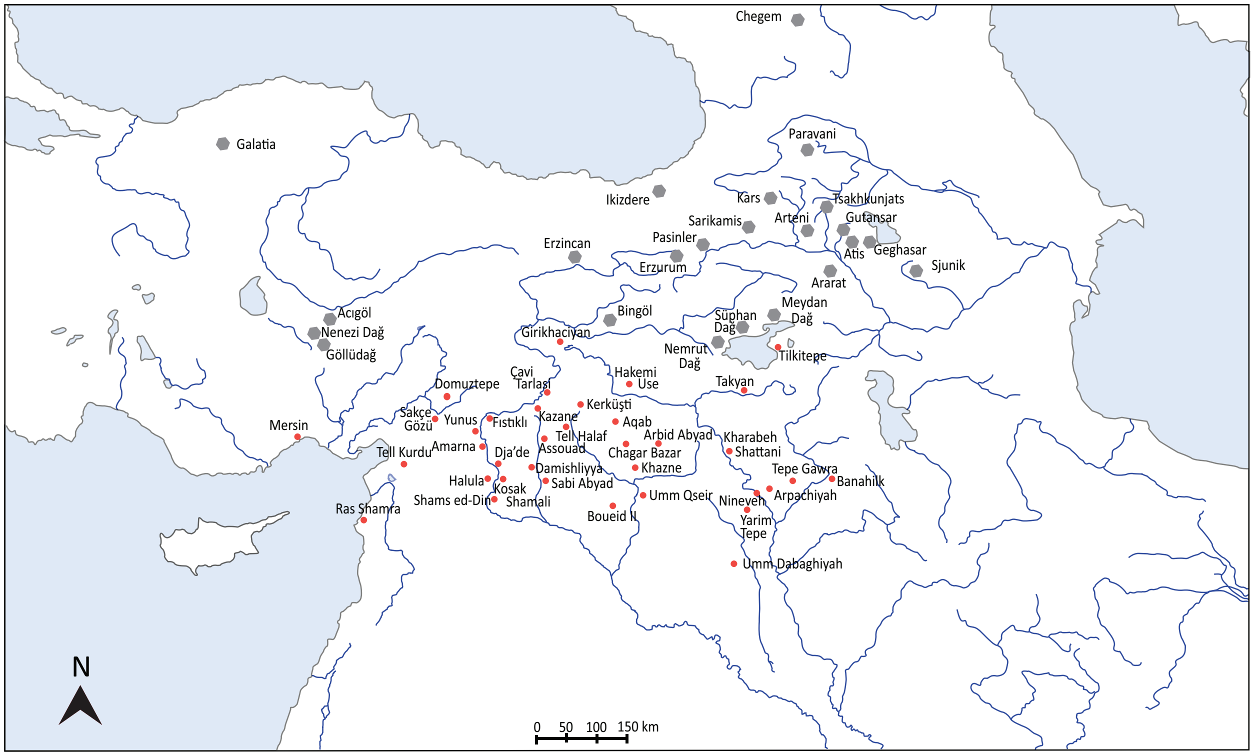


Figure 5.1 Map of Halaf Sites and Obsidian Sources. Sites marked in red, obsidian sources in grey. Map by author, modified from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

OBSIDIAN TRADE

Obsidian furnishes arguably the most robust data source at present for movement and interaction between people residing in Halaf sites and those outside the Halaf heartland area. Obsidian is only found in sources from Central Anatolia, Eastern Anatolia, Armenia and Yemen in the Near East, and thus its presence, proportion and form is indicative of interregional contact and exchange (Healey 2007:171). Obsidian is found at many Pre-Pottery Neolithic and Pottery Neolithic (including Halaf) sites in Mesopotamia and Anatolia, in varying proportions from a few select finished items to the majority of assemblages. In general scholars have noted that Epipaleolithic and Pre-Pottery Neolithic sites east of the Euphrates relied more on Bingöl/Van sources for obsidian, while sites west of the Euphrates primarily used obsidian from Central Anatolian sources (M.-C. Cauvin and Chataigner 1998). Sites in the North Euphrates valley and Levant drew from both sources.

Obsidian shows up in large proportions of lithic assemblages (over 50% and up to 100%) at some Halaf period sites, and in small proportions (less than 25%) or not at all at others. Sites in the eastern Halaf region generally have larger proportions of obsidian relative to other types of lithics than sites in the Northern Euphrates valley and Levant. Residents at sites with larger proportions of obsidian in their lithic assemblages likely had more regular access to obsidian sources or those people who traded these materials; the converse is true for residents at sites with smaller proportions of obsidian (e.g. Tell Sabi Abyad, described in Akkermans 1993: 273).

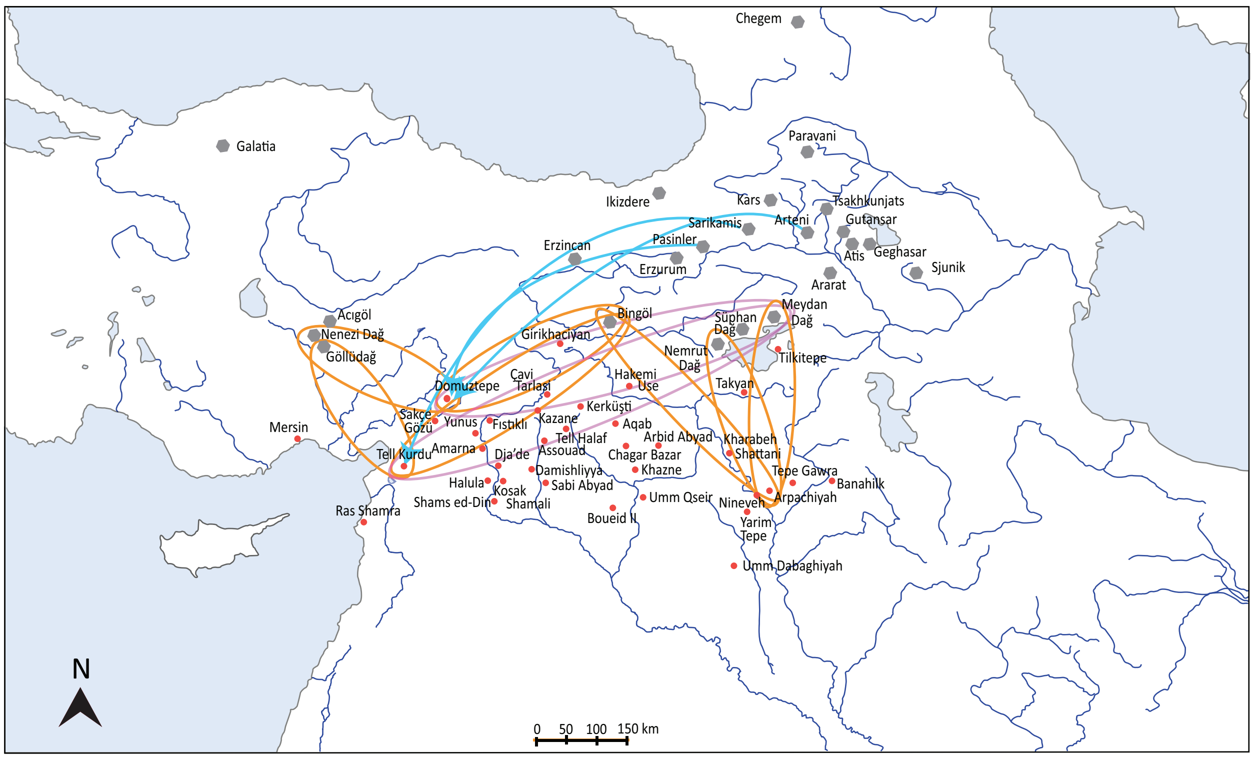


Figure 5.2 Some Examples of Obsidian Exchange Spheres During the Halaf. Results based on Healey 2007. Orange denotes sub-regional exchange. Fuchsia denotes regional exchange. Blue denotes supra-regional exchange. Sites marked in red, obsidian sources in grey. Map by author, modified from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

Site	% Assemblage Obsidian	Sources
Tell Arpachiyah	50+%	Southeastern Anatolia Bingöl Nemrut Dağ Meydan Dağ
Domuztepe	18%	Central Anatolia Göllüdağ-East Nenezi Dağ Southeastern Anatolia Bingöl Nemrut Dağ Meydan Dağ Northeast Anatolia/Armenia Pasinler Arteni Unidentified Source
Tell Kurdu	23%	Central Anatolia Göllüdağ-East Southeastern Anatolia Bingöl Nemrut Dağ Meydan Dağ Northeast Anatolia/Armenia Sarıkamış

Table 5.1 Obsidian Sourcing for Arpachiyah, Domuztepe, and Tell Kurdu. Data from Healey 2007

Archaeologists have completed several studies identifying the provenance and distribution of different types of obsidian at Halaf sites (summarized in Healey 2007: 177-180; see also Bressy et al. 2005; Maeda 2003; Pernicka et al. 1997; Renfrew et al. 1966). Evidence suggests that obsidian came to Halaf sites from sources at distances 200 to 900 km away. Few sites have had large enough samples of obsidian analyzed for their chemical properties to determine their sourcing, but work at Domuztepe, Arpachiyah and Tell Kurdu using both chemical analyses (Bressey 2005) and macroscopic analyses (Campbell and Healey 2013; Healey 2007; Healey and Campbell 2014) do hint at some trends. Healey's study (2007) of obsidian at the three sites indicates that while obsidian constitutes a smaller proportion of the assemblage at Halaf

Domuztepe and Kurdu than Tell Arpachiyah (Table 5.1), more sources are exploited at the two Turkish sites. Healey (2007:175) reports that obsidian at Domuztepe can be traced to sources ranging from 250 to 900 km from the site. Obsidian recovered at Tell Kurdu comes from the same Southeastern Anatolia sources, and more restricted sources in Central Anatolia and Northeast Anatolia. Obsidian from Arpachiyah, where Mallowan and Rose (1935) reported considerably larger amounts of obsidian relative to the other sites, has only been linked to the Southeastern Anatolian sources. As noted before, both Central and Southeast Anatolian sources were exploited in the Pre-Pottery Neolithic, but there is a shift to more consumption of obsidian from eastern sources at Levantine sites during the Halaf period. This is also evident at contemporaneous sites in the Rouj Basin (Maeda 2003). The Halaf period also marks the first time the Meydan Dağ sources were used which, as Healey notes, signifies either that Halaf people were exploring new areas, or people at the source sites were expanding their networks of long-distance contact and exchange (2007:176).

Halaf period people accessed obsidian from a range of sources, but obsidian procurement and/or exchange was not carried out in the same manner at all sites, or from all sources. In addition to identifying obsidian sources used by people at Domuztepe, Tell Kurdu and Arpachiyah, Healey conducted techno-typological studies of these lithics (2007). At Domuztepe and Arpachiyah she found higher proportions of unworked or minimally worked green obsidians, characteristic of peralkaline obsidians from Bingöl and Nemrut Dağ. Grey obsidians, in contrast, showed fewer indications of early reduction stages. Halaf period people acquired grey obsidians from Göllüdağ, Meydan Dağ, and Sarıkamış. Grey obsidians at Arpachiyah were only derived from southeastern sources, while those at Domuztepe came from all three sources. Archaeologists have identified workshops at Göllüdağ-east (Balkan-Altı et al. 1999; Pernicka et al. 1997) where early reduction stages likely occurred. Thus residents at Domuztepe probably received these obsidians in a preliminarily worked form. No cores were recovered at Domuztepe from obsidians with red inclusions (Healey 2007:176) and items from Arteni and Pasinler likely arrived at the site as finished goods. Evidence from other contemporaneous sites indicates that Halaf people at many settlements received obsidian in finished or semi-finished states. For example, no obsidian cores or core preparation materials were recovered at Pottery Neolithic Mezraa-Teleilat (Coşkunsu 2011).

Halaf period people used obsidian to construct all manner of tools and a range of non-utilitarian items, such as personal adornments, mirrors, palettes, and fine vessels. These objects may have functioned as prestige items given their labor-intensive production from non-local materials and the rarity with which they appear relative to other items. Occasionally Halaf period people repaired these objects; this further indicates the perceived value. Personal adornments in the forms of pendants and beads are the most abundant non-utilitarian ground obsidian objects, and are recovered widely, although in varying quantities at many Halaf sites. These items would be prime candidates for manipulation as prestige markers if worn publicly, a visual reminder of the wearer's access to non-local materials and fine craftmaking.

Residents at Domuztepe and Arpachiyah had workshops involved in the production of obsidian beads (Belcher 2011; Healey and Campbell 2014). The possible workshop at Domuztepe is a small area where excavators recovered concentrations of unfinished lithic objects in a partially burnt building in Operation I. Debitage from both flint and obsidian in a range of colors were recovered in this area, as well as bead blanks. Obsidian debitage reflects materials from multiple sources, with a preference for green obsidians from Bingöl/Nemrut Dağ peralkaline flows. All of the beads and bead blanks, however, are composed of grey and grey-brown obsidian. Healey and Campbell (2014) interpret the workshop evidence as indicating residents at Domuztepe carried out bead production at a small scale.

Healey and Campbell (2014) also identified an obsidian workshop in the Burnt House at Arpachiyah, an unusually large structure at the small site located in the eastern part of the Halaf cultural sphere. It was filled with abundant fine ceramics and small finds that appear to have been ritually destroyed (Campbell 2000). This building has variously been interpreted as a potter and stonecutter's workshop (Mallowan and Rose 1935), a chief's house (Flannery and Marcus 2012) or a centralizing institution and redistribution center (Campbell 2000; Campbell and Fletcher 2006). As at Domuztepe, the area contained large concentrations of flint and obsidian tools cores, and debitage, as well as finished obsidian beads including six "lozenge-shaped" beads found with cowrie shells, likely forming a necklace, thirty-six rectangular links, and fragments of a pendant. Healey and Campbell carried out provenance analyses on twenty-two links, and fifty-one obsidian fragments, largely debitage (Campbell and Healey 2013; Healey and Campbell 2014). The majority of the debitage (75%), all of the "lozenge-shaped" beads and thirteen of the rectangular links were made of peralkaline obsidians from Nemrut Dağ. The remaining 25% of the debitage came from calcalkaline sources at Bingöl B and Meydan Dağ (Healey and Campbell 2014: 88). Additionally, two rectangular links have been tied to the Bingöl B calcalkaline source and three to Meydan Dağ sources. Healey and Campbell argue that the higher degree of standardization and more elaborate materials recovered at Arpachiyah are indicative of a more sophisticated workshop producing what may be "some sort of common product… [within] a centralized system of acquisition and dispersal and perhaps expertise, at least in north-eastern Mesopotamia," (2014: 95). This type of coordinated production and dispersal is indicated in the spatial distribution of bead forms at other Halaf sites.

Site	Obsidian Object
Tell Arpachiyah	Rectangular Link Beads Lozenge-shaped Beads
Tell Aqab	Lozenge-shaped Beads
Banahilk	Rectangular Link Beads Lozenge-shaped Beads
Chagar Bazar	Rectangular Link Beads (unique form) Lozenge-shaped Beads
Choga Mami	Lozenge-shaped Beads
Tepe Gawra	Rectangular Link Beads Lozenge-shaped Beads
Kazane	Rectangular Link Beads (possible)
Ras Shamra	Lozenge-shaped Beads
Yarim Tepe II	Lozenge-shaped Beads

Table 5.2 Beads at Halaf sites. Data from Healey 2007; Healey and Campbell 2014

Distributions of non-utilitarian obsidian artifacts show that there were sub-regional variations in obsidian use. Beads (Table 5.3) similar to the rectangular links at Arpachiyah have been recovered at three other sites (Healey and Campbell 2014). Similar beads were also recovered at Chagar Bazar but differ slightly in both form and obsidian source (Healey and Campbell 2014: 93). Oval and "lozenge-shaped" beads similar to those identified in the workshop at Arpachiyah have been found in substantial quantities at eight Halaf sites (Table 5.2). With the exception of Ras Shamra and Kazane, all of these sites are located in northeastern Mesopotamia, suggesting a more restricted area of circulation within the broader Halaf world. These items may have been traded from one or a handful of workshops, or may have been a stylistic type favored within this geographical sub-region. Other types of beads and pendants have been recovered at both eastern and western sites, as have obsidian vessels and axes. Mirrors and tranchet tools are, at present, known only from western sites (Domuztepe and Kabri, Healey and Campbell 2014: 182).

Obsidian data thus elucidate the movement and interaction among Late Neolithic people within the Halaf cultural sphere and without. Late Neolithic people engaged in a robust and likely direct trade in obsidians from sources between approximately 200 and 500km of their settlements. Residents at Halaf sites received unworked or partially worked obsidian nodules from these sources and worked the materials further into desired tools and decorative items. They also engaged in a likely less frequent trade in obsidians from more distant sources up to nearly 1000km away. Evidence suggests this trade was in finished goods, and may not have been direct as there is no indication of object production from these types of obsidians at either Domuztepe or Arpachiyah.

Non-utilitarian goods produced from obsidians reveal sub-regional exchange and interaction. There are identifiable styles in beads and other goods with distinct sub-regional distributions, suggesting, at minimum, more frequent interaction, intellectual exchange, and trade within these regions. These items were intended to be displayed, often as personal adornments, demonstrating the wearer's or the group's ability to access these materials, and may have been manipulated as status symbols. Their distribution throughout the Halaf cultural sphere indicates that this potential was not restricted to a few innovative people here or there.

POTTERY TRADE

Pottery provides another means of identifying exchange among Halaf sites and with communities outside of it. Several types of ceramic data shed light on this, including chemical and petrographic provenance studies, assessments of stylistic similarities and differences among assemblages recovered at Halaf sites, the identification of ceramic production locales and manufacture techniques, the presence of imports within Halaf ceramic assemblages and exports of Halaf ceramics at distant settlements. As described in Chapter Two, Halaf pottery is quite distinctive in its form, fabric and decoration (Nieuwenhuyse 2007). Within the ceramic corpora of various Halaf sites there is clear regional variation in Halaf pottery, as well as in what proportions of sites' assemblages are comprised by plain and painted Halaf wares.

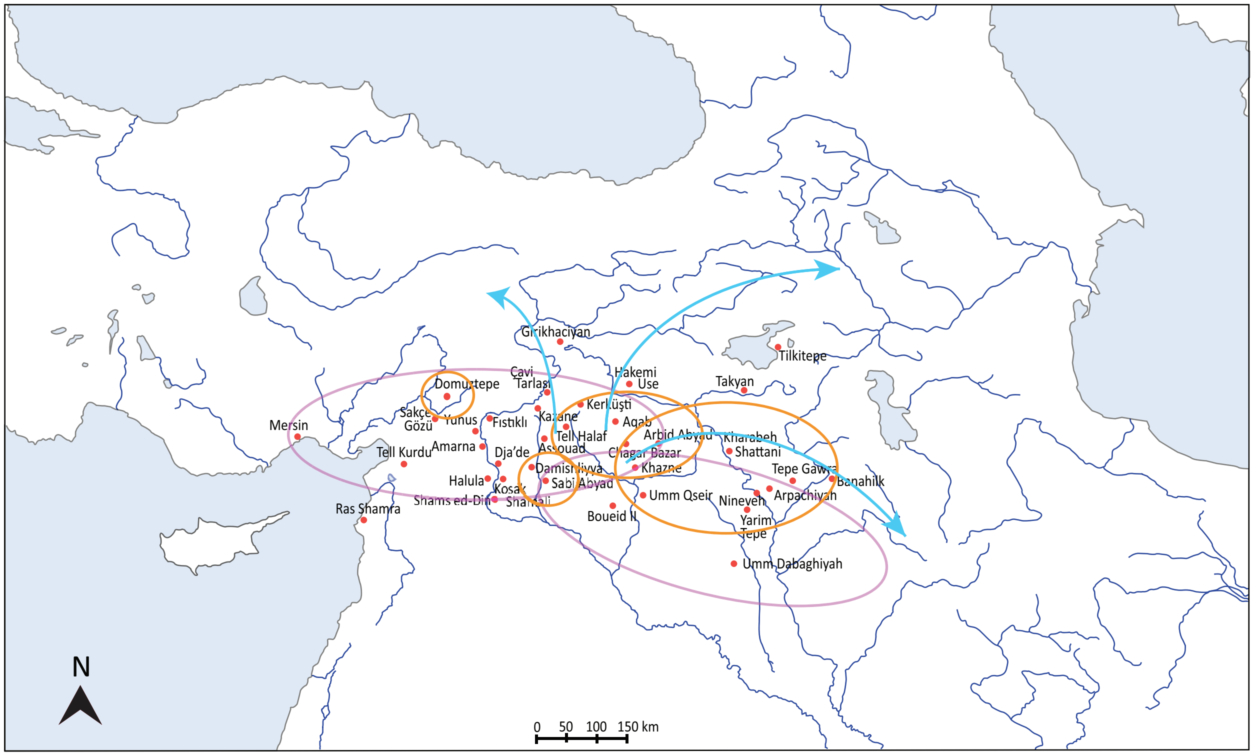


Figure 5.3 Ceramic Exchange Spheres During the Halaf. Orange denotes sub-regional exchange. Fuchsia denotes regional exchange. Blue denotes supra-regional exchange. Map by author, modified from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

Chemical provenance studies using neutron activation analysis (NAA) (Davidson 1981; Davidson and McKerrell 1976; Davidson and McKerrell 1980), x-ray fluorescence (Le Miere and Picon 1987), dispersive x-ray analysis (SEM-EDX) (Spataro and Fletcher 2010), chemical silicate analysis (Gregerová et al. 2013) and petrographic studies (Gregerová et al. 2013; Spataro and Fletcher 2010; van As et al. 1996/97) have demonstrated networks of sub-regional trade in fine Halaf painted wares among Halaf sites. Initial NAA studies evaluating geological samples and pottery from Halaf sites in the Khabur (Davidson 1981; Davidson and McKerrell 1976) and the Mosul region (Davidson and McKerrell 1980) determined that pottery was produced locally at both major Halaf sites (e.g. Chagar Bazar, Tell Halaf, Tell Brak and Arpachiyah) and sites that do not appear to be extraordinary in size or finds (e.g. Tell Aqab). Pottery was traded among these producing sites, and among consumer sites, largely within sub-regions within the Halaf heartland area. Residents at Chagar Bazar were particularly prolific among sites included in these limited studies; results indicate they were the major suppliers of fine painted ware to sites in the Wadi Dara area of the Khabur region. Arpachiyah supplied pottery to nearby Tepe Gawra. While one possible import from Tell Halaf was found at Chagar Bazar, no origin could be identified for non-local ceramics at Tell Halaf. Similarly non-local ceramics were identified at Tell Brak, but they too could not be tied to a clear source location. Forms of non-local pottery at all sites are not restricted to jars, and include shallow open bowls. This implies that, at least in some cases, the object of trade was the ceramic itself rather than the contents of the vessel. Even residents at sites that engaged in local production do appear to have also imported fine wares. These early NAA studies have, however, come under scrutiny due to the small number of trace elements used and the statistical techniques employed (miscalculated Mahalanobis' distances) in them, as well as their small sample sizes (Galbraith and Roaf 2001). They agree with Davidson and McKerrell that the data indicate that different wadi systems have characteristic and differentiated clay types but that the sample was too small to reliably indicate trade; a larger study incorporating both more sherds and a wider range of elements, coupled with more appropriate statistical analyses, are necessary to demonstrate this.

Spataro and Fletcher (2010) combined petrography and chemical characterization to reevaluate Halaf pottery trade. This study analyzed painted fine wares from museum collections from Arpachiyah, Tell Halaf, and Chagar Bazar, as well as a variety of fine wares (painted, unpainted, and various burnished wares) and coarse wares from Domuztepe. Spataro and Fletcher found that Halaf potters used clays from local sources, but looked for similar qualities (micritic clays) and prepared clays in the same manner (levigation) at all sites. Their results echoed the previous studies in that they found some evidence that Chagar Bazar and Arpachiyah participated in the same network of exchange in painted pottery. Ceramics from Tell Halaf and Domuztepe were chemically distinctive. They may have been traded, but no sherds matching those from Domuztepe were recorded in assemblages at Arpachiyah, Tell Halaf or Chagar Bazar. Spataro and Fletcher suggest that this trade might have occurred in more geographically restricted sub-regions of the Halaf zone, which correlates with stylistic similarities in painted ware decorations. Gregerová et al. (2013) found similar results in their provenance study of ceramics from Tell Arbid Abyad.

While ceramic exchange occurred primarily within sub-regions of the Halaf, Spataro and Fletcher found a "common technological formula" used to produce Halaf fine ware pottery, implying some means of knowledge transfer among people within the Halaf world (2010:112). Steinberg and Kamilli's study (1984) of Halaf pigments and pastes on sherds from Arpachiyah, Choga Mami, Tepe Gawra, Abu Maria, and Tell Halaf provides complementary evidence of a shared knowledge of sophisticated ceramic production technology, specifically with respect to the preparation of pigments and firing techniques. They attribute this broad similarity to either itinerant potters or wholesale migration of groups with potters throughout the Halaf cultural zone. The results of their study also correlate with the other provenance studies, as they found possible imports from Tell Arpachiyah in assemblages at Tepe Gawra and Choga Mami alongside locally produced ceramics.

Ceramic exchange is also indicated in the distribution of sites that exhibit evidence of onsite pottery production. Citing preliminary chemical characterizations (Le Mière 1989), and the presence of overfired pottery and wasters in the ceramic assemblage Akkermans argued for onsite ceramic production, "on a considerable scale that can be inferred from the specific technology and knowledge required," (1993: 276) at Tell Sabi Abyad. Such production would need specific facilities and specialists who, Akkermans argues, were likely present only at certain, permanently occupied settlements. He interprets the similarity in production technique but the lack of standardization in form and decoration as indicating that residents engaged in pottery production at Sabi Abyad at a low-level of specialization, possibly seasonal in nature (1993:283-284). Akkermans argues that Sabi Abyad was likely one of the pottery production centers for the Balikh region. Nearby sites with contemporaneous occupations, at Damishliyya and Khirbet esh-Shenef, lack such evidence of production in the form of wasters or overfired pottery or pottery-production tools, as do other sites surveyed in the Balikh valley. This model of a larger, more permanent settlement furnishing nearby smaller sites with pottery is analogous to scenarios posited for the Khabur and Mosul areas from the provenance studies described above. Pottery production facilities, including kilns, have been found a number of Halaf sites (Hansen Streily 2001: 74-75), including Tell Abada, Yarim Tepe II, Tell Arpachiyah, and Tell Hassan.

Such exchange between pottery producing sites and sites that are only consumers is an indicator of cooperation among Halaf communities. Halaf period people in different communities relied on one another to have access to all the materials they needed. In some cases pottery brought to sites with no evidence of production may be the result of seasonal occupations (e.g. Damishliyya), or small communities that are associated with those at nearby larger sites (e.g. Nevruzlu). These communities were dependent on other sites to supply them with ceramics; this was only feasible if they were certain they could access such materials through cooperation with inhabitants at pottery-producing sites.

Finally, ceramic exchange among Halaf sites is attested to in stylistic differences in their ceramic assemblages. Perkins (1949) initially suggested an East-West divide in Halaf styles, but this has been revised by new excavations and more detailed studies. LeBlanc and Watson's cluster analysis study (1973) quantified similarities and differences in design motifs on painted Halaf pottery from seven sites: Tell Arpachiyah, Banahilk, Girikihaciyan, Tell Halaf, Tilkitepe, Tell Turlu and Tell Yunus. The results of their study found that relationships among ceramic assemblages at these sites did not conform simply to an East-West dichotomy. Tell Halaf and Arpachiyah showed the highest coefficients of similarity, which correlates well with existing data that suggest these two sites were major pottery producing centers. Pottery at other sites may have been imported from these centers, or influenced by ceramics produced there and exchanged throughout the region. Banahilk, in contrast, was only stylistically connected to Arpachiyah, to which it is geographically close. Perhaps the residents at Banahilk were consumers of or influenced by pottery circulating from Arpachiyah primarily. While some aspects of LeBlanc and Watson's study's methodology have been critiqued (Spataro and Fletcher 2010), regional styles of Halaf pottery have been identified in studies of particular assemblages (e.g. Campbell 1992; Davidson 1977; Fletcher 2008).

As discussed in Chapter Two, there is also variability in the proportions of ceramic assemblages comprised of classic Halaf pottery relative to other types of pottery, and within the corpus of Halaf pottery of painted to unpainted wares. Campbell reports that at typical Halaf sites about 40% of the assemblage is comprised of Halaf decorated pottery; but about 75% if only rim sherds (where decoration is often restricted to) are considered (Campbell 1992:61). Sites in the western distribution of the Halaf cultural zone continue to use the Dark Face Burnished Wares (DFBW) characteristic of Western Syria and Cilicia (Braidwood et al. 1960) in tandem with pre-Halaf (Tekin 2007) and Halaf ceramics. These ceramics occasionally show up in small quantities at sites in the east such as Sabi Abyad (Akkermans 1993), Kerküşti Höyük (Sarıaltun 2013), Tell Arbid Abyad (Gregerová et al. 2013) and a single sherd recovered at Tell Aqab (Davidson 1981). Similarly the presence of Samarran pottery from Iraq in ceramic assemblages at sites in the North and West of the Halaf heartland demonstrate that ceramic trade at a regional level was not uni-directional. These data attest to at least some exchange interactions in ceramics across the broader Halaf region, a greater geographical distance than indicated by the chemical provenance studies.

Finally, ceramics provide further evidence that people from Halaf sites engaged with people living outside the Halaf heartland. Sites within areas sometimes described as "Halaf Influenced" (a highly variable definition) contain significant quantities of Halaf pottery, but less than those at heartland sites, suggesting regular interaction with Halaf people and even some local imitation. Examples of such sites include Mersin to the west (Garstang 1953; Sagona and Zimansky 2009), Tülintepe, Korucutepe and Çayboyu to the north in the Keban region (reported in Algaze et al. 1994), and Tilkitepe (Korfman 1982, though whether this is a Halaf or Halaf influenced site is unclear) and Yılantaş (Marro 2007) near Lake Van in Anatolia. Similarly sites with some but not exclusive Halaf influence can be found to the east and southeast, such as Choga Mami (Oates 1969) and Tell es-Sawwan (Breniquet 1991). At greater distances Halaf sherds show up in rare instances and small quantities in northern and eastern Anatolia (e.g. at Kuyuluk reported in Burney 1958) and even in the Southern Caucasus, such as at Aratashen in Armenia (Badalyan et al. 2007) and Kültepe in Azerbaijan (Baxşəliyev 1997). Archaeologists have also found Halaf sherds to the east in surveys of the Mahidasht valley in western Iran (Henrickson 1985).

To summarize, chemical provenance studies and stylistic analyses provide strong evidence that Halaf period people engaged in a robust exchange in ceramics within sub-regions of the Halaf distribution of material culture. Frequent sub-regional exchange appears to have occurred within roughly 50km of production sites. Halaf period people also clearly engaged in regional trade within the Halaf heartland at distances spanning up to 600 km. This is demonstrated by the recovery of Syro-Cilician ceramics in sites in the Khabur area (e.g. Gregerová et al. 2013). This distance is similar to the geographic scope identified in some of the obsidian exchange networks. Finally, we can identify some supra-regional long-distance exchange between residents at Halaf sites with people as far away as the Southern Caucasus. While such exchange may have been direct between people at sites on the fringes of the distribution (Mersin, Tilkitepe, Tulintepe, etc.), it seems more likely that the long distance exchange (900km) may have occurred indirectly as part of a broader Late Neolithic exchange network in Anatolia and the greater Near East. Trade among partners separated by this distance is similarly present but comparatively rare to obsidian exchange, as evident in the occasional finished obsidian items from Pasinler, Arteni and Sarıkamış at Domuztepe and Tell Kurdu.

Ceramic data provide significant evidence for cooperation among Halaf communities and potentially evidence for the emergence of inequality during the Halaf period. There is strong evidence for both exchange among Halaf communities and for low-level specialization in ceramic production in some communities and dependence on exchange for ceramics in others. Inhabitants at consumer sites could only flourish if they were able to regularly access the ceramics they needed through established relationships of reciprocity and exchange. Additionally, this system of exchange and low-level specialization offered an opportunity for particular individuals and groups to establish control over ceramic production and use, permitting opportunities for inequalities to develop. This is perhaps most potently expressed in Halaf period peoples' use of fine ceramics in large collective action events like feasts where serving vessels were on display.

SEALS AND SEALING DISTRIBUTION

During the Halaf period people used seals and tokens ubiquitously. This development in accounting technology was a crucial innovation in the Late Neolithic. Seals and sealings are found at many Halaf sites, but the mechanics of how people used them is contested. Duistermaat and Schneider (1998:90-91) lay out the two dominant theories: a) seals were a tool for controlling exchange, where goods arrived at sites sealed or b) seals were a means of controlling storage, where goods were locally sealed and stored. They used x-ray fluorescence to study the provenance of sealings recovered from the Burnt Village at Sabi Abyad (Transitional Halaf period). They found that all sealings were likely composed of clay sources from the Balikh valley, most likely from the site itself, or from clay sources directly adjacent. Goods were evidently sealed and stored locally, rather than exchanged over any considerable distance. They found no clear association between seal design, type of container sealed, find spot within the site and clay source. Thus they concluded that scenario b is more plausible; sealings at Sabi Abyad were used to manage storage locally. They note that, "… although it is clear that exchange of products over long distances did take place at Sabi Abyad, this practice was probably not controlled by an administrative use of sealings," (Duistermaat and Schneider 1998:98). Seals were also produced at least at some Halaf sites. Unfinished seals, tools, and evidence of reduction sequences attest to this at Domuztepe (Belcher 2011; Carter 2010), Arpachiyah (Campbell 2000) and possibly Yarim Tepe II (Merpert and Munchaev 1993b). Inhabitants clearly controlled the production of administrative technologies, not just the goods the technologies were used to track.

Stylistic similarities and differences in glyptic form, motif and material link sites throughout the distribution of Halaf sites (Carter 2010). There are several glyptic studies from pre-Halaf levels at Tell Ain-El-Kerkh (summarized in Duistermaat 2010), transitional Halaf contexts at Sabi Abyad (Akkermans and Duistermaat 1997; Duistermaat 2010) and Halaf seals from Domuztepe (Carter 2010), Arpachiyah and Nineveh, Chagar Bazar, Tepe Gawra and Yarim Tepe (Campbell 2000, Chavart 1994, von Wickede 1990). Carter identifies "minimal overlap" between glyptic recovered at Transitional levels (proto and early Halaf) at Sabi Abyad and Middle and Late Halaf glyptic at Domuztepe (2010: 161). Stronger parallels are apparent with more contemporaneous sites, such as Arpachiyah (TT6 level), forming a common symbolic repertoire and meaning (Ibid: 165). For such commonality to exist Halaf period people must have, at minimum, engaged in some intellectual exchange, if not the exchange of actual seals or sealed goods. A chemical provenance study of sealings from other sites and later contexts would help elucidate this.

Seals not only served an accounting purpose, but also functioned as a form of personal adornment. Three of the four types of seals identified at Domuztepe (Carter 2010), comprising the majority of the forty-four seals recovered in excavations and surface finds, were perforated, suspended on strings and likely worn by their owners. Many bear evidence of polish from string wear. Ancient people re-drilled broken suspension loop holes (Carter 2010: 165) and seals continued to be of use even after they were broken (Campbell 2000:14). Seals were valued objects. Their dual function as both accounting tools and as personal adornment has led scholars to infer that seals were likely associated with particular individuals or institutions (Campbell 2000, Carter 2010). This has also been inferred from the repetition of certain motifs from numerous seals. For example archaeologists infer that sixty-seven stamp seals representing twenty-seven different types are evident among the 189 sealings with seal impressions from Sabi Abyad's Burnt Village (Akkermans and Duistermaat 1996; Duistermaat and Schneider 1998). This suggests sealing practices were widespread within the population at Sabi Abyad as seals were applied locally and, at least in many cases, stored on site. This association between seals and specific individuals, and the capacity individuals had to broadcast their ability to control goods through seals by wearing these administrative tools may have allowed these items to be manipulated as status symbols. This is analogous to the use of obsidian for personal adornment described above.

Overall glyptic data from Halaf sites provide mixed evidence for the circulation of goods within the Halaf cultural area. At present there is only one chemical provenance study of sealings from the Transitional Halaf period (proto-Halaf) on material from Sabi Abyad (Duistermaat and Schneider 1998), which indicates seals and sealings were used for local storage, rather than to control long-distance exchange. A larger data set, particularly from a later site would clarify whether Halaf period people continued to use sealings in the same manner. Regardless of whether or not sealings moved with traded commodities among Halaf sites, there are clear stylistic similarities among glyptic from geographically distant sites, particularly in the Middle and Late Halaf. This demonstrates that a common visual and perhaps symbolic language existed over great geographic distances, implying at least intellectual exchange occurred. This is also evident from ceramic studies; it is likely the two media influenced each other. Finally, Halaf period people universally used seals for personal adornment, which visibly proclaimed the wearer's ability to account for goods.

OTHER CIRCULATING MATERIALS

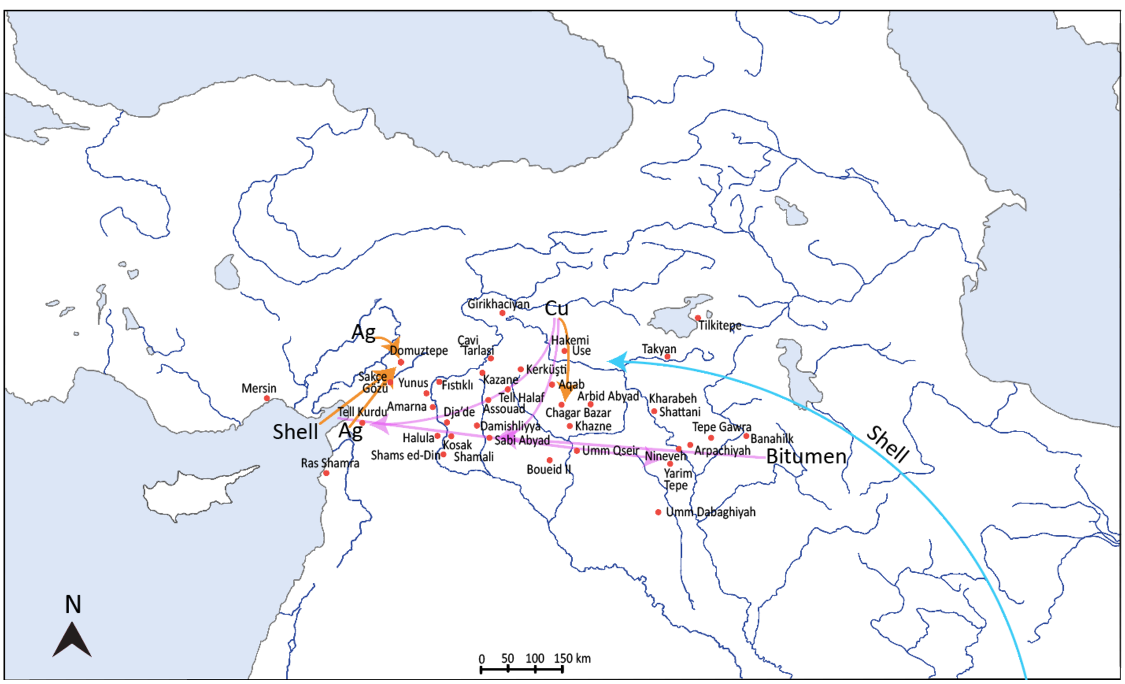


Figure 5.4 Exchange in Some Rare Raw Materials During the Halaf. Orange denotes sub-regional exchange. Fuchsia denotes regional exchange. Blue denotes supra-regional exchange. Map by author, modified from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

Material	Site	Object Typ	Source
Marine Shell (Cassid, Cowrie, Dentalium, *Polinices*)	Arpachiyah (Burnt House)	Cowrie beads (Part of obsidian necklace)	Campbell 2000; Healey and Campbell 2014
	Domuztepe	Cowrie and Dentalium Beads	Campbell and Carter 2006
	Kurban Höyük	Cassid fragments	Reese 1989
	Tell Sabi Abyad	Impressions of Cowrie Beads, Pierced *Polinices* shell	Akkermans and Duistermaat 1996; Cavallo 2000
	Yarim Tepe II	Cowrie Beads	Merpert and Munchaev 1993a: 190
Metals (Copper, Silver Lead)	Arpachiyah	Copper Beads, Unworked Lead	Campbell 2000; Mallowan and Rose 1935
	Chagar Bazar	Copper Beads	Mallowan 1936
	Domuztepe	Silver beads	Campbell and Carter 2006; Lehner et al. In Prep.
	Tell Kurdu	Copper Ore	Ozbal 2006
	Tell Sabi Abyad (Transitional Period Strata)	Copper Ore	Akkermans 1993, 2013; Akkermans and Verhoven 1996
	Sakce Gözü	Copper Fragment	Taylor et al. 1950
	Yarim Tepe I	Unworked Lead	Merpert and Munchaev 1993b
	Yarim Tepe II	Ore, bead, pendant (one of which may have been a seal)	Merpert and Munchaev 1993b
Bitumen	Arpachiyah	Used to haft lithics, sealant	Campbell 2000
	Damishliyya	Used to haft lithics	Akkermans 1993
	Domuztepe	Fragment bearing string/basketry impression	Campbell and Carter 2006
	Kerküşti Höyük	Paint on ceramics	Sarıaltun 2013
	Tell Sabi Abyad	Paint on ceramics, repair stone vessels	Akkermans and Verhoven 1996; Connan et al. 2004:123
	Yarim Tepe II	Used to haft lithics	Merpert and Munchaev 1973

Table 5.3 Other Circulating Materials

People at Halaf sites received various other non-local raw materials by some means of exchange. Marine shells such as cowrie, dentalium and cassids came from either the Mediterranean Sea or the Persian Gulf (Table 5.1). These data together point to exchange in marine products of at least 600 km between the Mediterranean and northern Iraq, and over 2000 km if the *Polinices* shell is found in other Halaf contexts.

Halaf period people also used basalts for grinding cereals and other purposes. At some sites these volcanic rocks came from great distances either via long distance movement or exchanged. Some sites, including Domuztepe, had access to basalt outcrops in their immediate vicinity, but residents at other sites did not. Akkermans estimates that residents at sites in the Balikh Valley, which is approximately 200 km to the Southeast of Domuztepe, had to bring basalt objects over a distance of 100km (Akkermans 1993: 274).

Halaf people also engaged in some limited metallurgy, mainly to produce items of personal adornment (Roberts et al. 2009). Objects made of copper ores are known from Pre-Pottery Neolithic sites preceding the Halaf period in Northern Iraq, Eastern Turkey and the Levant. Small amounts of copper have been recovered at a number of Halaf sites (Table 5.1). Archaeologists found robust evidence of incipient metalworking at 7th and 6th millennium contexts in the Sinjar valley (Merpert and Munchaev 1993b). Generally copper ores were not located far from sources in Southeastern Turkey and northern Iraq, but their presence at sites throughout the Halaf distribution indicate some regional trade, analogous in geographic scale to that identified in obsidian and ceramic trade. Similarly, silver at Domuztepe came from sources relatively near by, perhaps either the Amanus Mountains to the southeast (a traditional source for silver in the area) or Göksun to the northwest.

Finally, Halaf period people used bitumen for practical purposes and for its decorative qualities as pigment on ceramics. Bitumen sources are found in Eastern and Southern Iraq, and one source at Samsat on the Turkish Euphrates. Chemical provenance studies from bitumen paint on ceramics from Transitional levels at Sabi Abyad show that residents used bitumen from sources in Iraq, rather than the nearer sources in southeastern Turkey (Connan et al. 2004).

There is abundant evidence that Halaf period people used bitumen to haft lithics, as a sealant and to repair vessels (Table 5.1).

Overall it is clear that people at Halaf sites engaged in an enduring long distance exchange system for non-local raw materials, some traveling many hundreds of kilometers to their final find spots. This exchange evidently began in the Pre-Pottery Neolithic and continued through the late Halaf and into the succeeding 'Ubaid period. These raw materials are rarely recovered; more frequently objects are found as finished goods, as opposed to unworked raw materials. Metallurgy is an exception to this this. Copper ores have been recovered at several sites, as has unformed lead. Bitumen was also locally worked; there is evidence that bitumen-painted ceramics from Tell Sabi Abyad may have been locally produced (Connan et al. 2004:123).

TRADE WE MAY NOT SEE

From the above discussion it is clear that people at Halaf sites engaged in trade at sub-regional, regional and supra-regional scales, with trade becoming likely less frequent and less direct with increasing geographic scope. But unfortunately we are only able to track the movement of durable goods. We may make some inferences, however, about perishable materials that may have been major foci of Halaf exchange.

Production Goal	Site	Evidence	Source
Textiles	Arpachiyah	Spindle whorls	Campbell 2000
	Tell Arbid Abyad	Spindle whorls	
	Domuztepe	Spindle whorls, Bone points	Carter et al. 2003
	Fıstıklı Höyük	Spindle whorls, possible loom weights, Bone points	Bernbeck et al. 2003
	Kazane	Spindle whorls, Bone points	Bernbeck et al. 1999
	Sabi Abyad	Spindle whorls	1993
	Sakce Gözü	Spindle whorls, Bone points	Taylor et al. 1950
	Yarim Tepe II		
Basketry	Arpachiyah	Matting over burials	Mallowan and Rose 1935: 35
	Domuztepe	Matting impressions, Imagery on "House Pot"	Kansa et al. 2009
	Tepe Gawra	Matting and baskets in burials	Tobler 1950: 121
	Tell Sabi Abyad	Impressions on sealings in storage facilities in Burnt Village	Akkermans and Duistermaat 1996
Storage of Agricultural products	Tell Ain-El-Kerkh	"Communal storage"	Tsuneki 2012:63
	Tell Arbid Abyad (possibly)	Two circular structures	Mateiciucová 2010
	Arpachiyah	Circular pit	Mallowan and Rose 1935
	Domuztepe	Tholoi	Carter et al. 2003
	Fıstıklı Höyük (possibly)	Cell-plan building	Bernbeck et al. 2003
	Tell Kurdu	Small clustered storage structures in Area E, Storage within larger structures in Areas A and B	Ozbal 2006
	Tell Sabi Abyad	Rectilinear, multiroom building (Building II in Burnt Village Strata), Tholoi in later strata	Akkermans 1993; Akkermans and Duistermaat 1996
	Yarim Tepe II	Storage within a round house; Bell-shaped and cylindrical pits	Akkermans 1993; Merpert et al. 1973

Table 5.4 Evidence for Exchange in Perishable Materials

Textiles may have been another circulating good that we cannot identify from extant evidence. Textiles (both plant fiber and woolen textiles) were major traded commodities in historic periods in the Ancient Near East and have even been cited as a possible impetus for the sub-regional exchange that characterized the Late Chalcolithic Uruk Expansion period (McCorriston 1997). By the Early Bronze Age people in Northern Mesopotamia produced large amounts of woolen textiles for exchange (Stein 2004). The antecedents of this system may lie in the Halaf period. We have abundant evidence of textile production at many sites, including spindle whorls and loom weights (Table 5.4). Bone needles and bone points were equally ubiquitous at Halaf settlements, though they likely were not used exclusively for textile production. Thus there is clear evidence for textile production, although whether such production comprised only plant fiber textiles or included wool textiles is contested (Bökönyi 1977; Ryder 1983; Sherratt 1981, 1983). At Domuztepe, Kansa did identify a bias towards older sheep of both sexes in the faunal assemblage associated with quotidian contexts. This is the type of demographic profile that would be anticipated in a pastoral system oriented towards wool production (Kansa et al. 2009b: 911). Halaf period people may have exchanged locally-produced textiles for ceramics, as Akkermans postulates for the small ceramic consumer communities in the Balikh (1993:286). He posits the textiles were produced either by communities farming flax and/or those engaged in wool production such as more pastoral-focused segments of the society

Inhabitants at Halaf sites clearly used basketry and other items made of reed, and these items may have circulated among sites either as goods themselves, or as vessels conveying goods. The ubiquity and significance of basketry is evident in the way Halaf period people mimicked basketry in glyptic motifs (Carter 2010), ceramics (Kansa et al. 2009b; Mallowan and Rose 1935) and other forms of aesthetic expression. At Domuztepe, archaeologists recovered impressions of plastered baskets at the bottom of the Death Pit (Kansa et al. 2009a) (Figure 5.5). Evidence at Domuztepe suggests widespread use of basketry and reed matting, including an image on the

“House Pot” from the Ditch showing a building with a super structure of apparent reed material with images of pots and perhaps baskets in between structures.

Figure 5.5 Example of impression of basketry from the Death Pit at Domuztepe. Photo courtesy of Elizabeth Carter.

The extensive use of wetland resources such as reeds is apparent in earlier periods (e.g. at Çatalhöyük as reported in Atalay and Hastorf 2006), and the frequent situation of Neolithic (not exclusively Halaf) villages near marshes may attest to this; Domuztepe (Gearey et al. 2011; Kansa et al. 2009b), Çatalhöyük (Atalay and Hastorf 2006) and Kamiltepe in Azerbaijan (Helwing et al. 2012; Lyonnet et al. 2012) are all located near wetlands and the resources afforded by these locales were important parts of the local economy.

Agricultural products may have been exchanged among Halaf communities, or brought from one site to another when segments of the population moved with their animals. There is evidence for agricultural storage at a number of sites (Table 5.2). Three specific examples from Halaf period sites show that inhabitants used storage in different ways. The first example comes from the storerooms in building II of Sabi Abyad’s Transitional Halaf Burnt Village, where excavators found large quantities of charred grains (Akkermans and Duistermaat 1996). The excavators suggest these storage facilities may have been used by mobile parts of the population, but note the absence of door sealings. They suggest either staples were "freely accessible" or that the sealed small containers found elsewhere in the Burnt Village sealed tokens that symbolically accounted for claims towards staples rather than sealing actual materials they accounted for (*Ibid*.: 29). Akkermans also suggests that several small tholoi and pits may have served as storage for agricultural products (1993: 227-228).

A second example comes from Tell Kurdu (Ozbal 2006). There excavation exposed different types of storage facilities in different areas of the settlement. In one area (Area E) there were large clusters of small structures (all single-roomed), which excavators interpret as indicative of a situation where "residents of this area shared access to a collective cluster of storerooms, possibly further indicating a corporately organized understanding of property," (*Ibid*.: 175). In other parts of the site (Areas A and B), however, storage facilities were associated with particular structures. Between the two different types of storage facilities, excavators also noted differences in token use. Together Ozbal interprets the evidence as indicative that the concept of ownership and property was just beginning to be established (*Ibid.*:174).

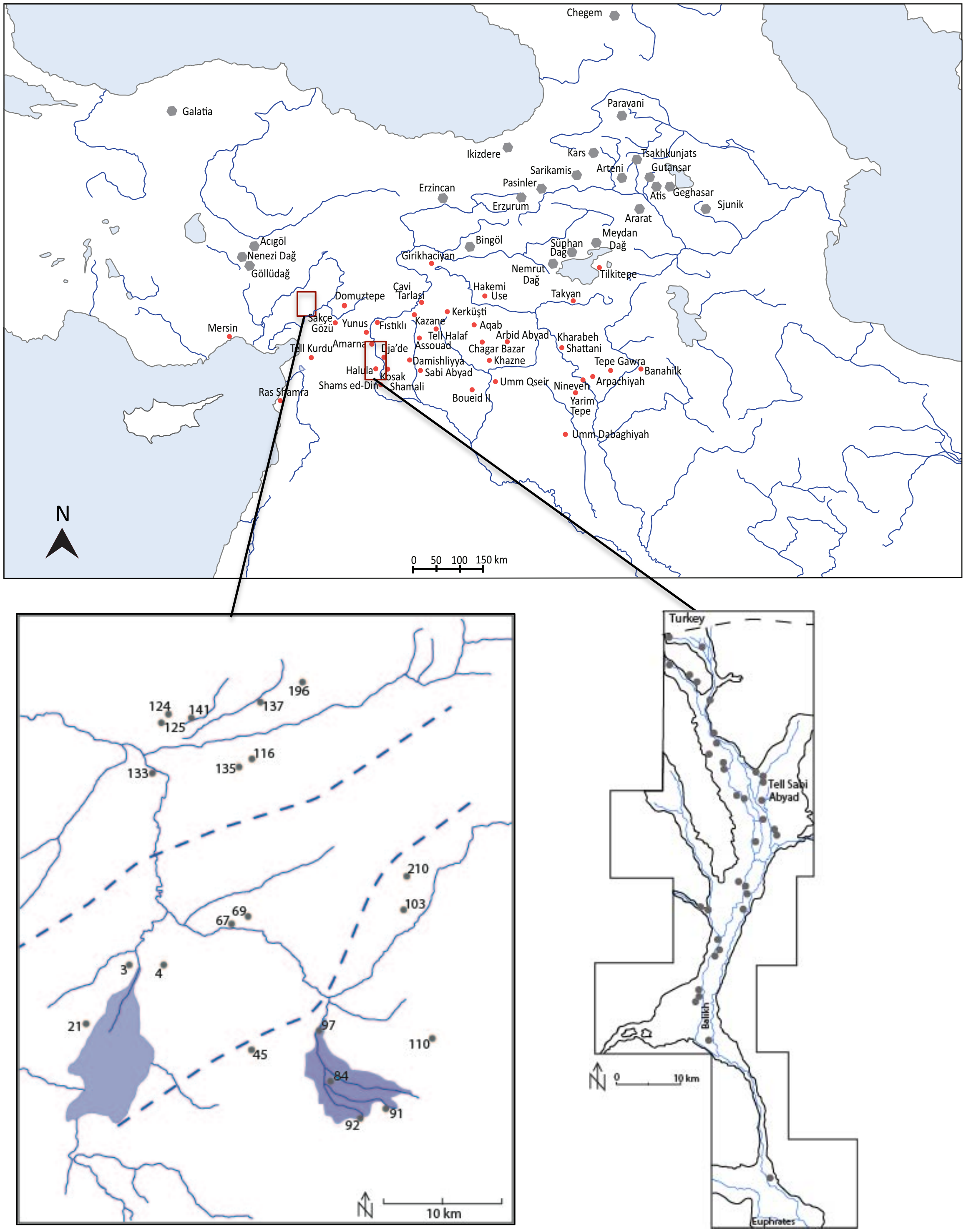
Finally, six tholoi have been identified at Domuztepe that may have served as storage facilities Carter et al. 2003). These structures were lined with lime plaster, perhaps intended to keep pests at bay. Storage facilities alone do not, however, necessarily imply that agricultural products were a circulating commodity. But it is possible that mobile segments of the population relied on ready access to agricultural products produced and stored at more permanent settlements. These stored agricultural products may have sustained not only the herders, but their stock as well.

Livestock may also have been circulating commodities, though biogeochemical evidence from Domuztepe suggests this was relatively rare there. Livestock function as a "walking larder" (Clutton-Brock 1998), a form of food storage that is both portable and regenerative. There is some evidence that livestock was exchanged, either within a population that considers itself one holistic unit (e.g. one population where some of the members engaged in mobile pastoralism) or between groups of pastoralists and residents at Domuztepe and at Sabi Abyad. As described in Chapter Four and earlier in this chapter, caprine husbandry at Domuztepe involved some mobility to more southern locales, either by some segment of the population at the site or a group who regularly interacted with the residents of Domuztepe. Cattle and pig husbandry was focused on the immediate environs at the site. Cavallo noted a similar relationship developing in perhaps Transitional and certainly Early Halaf occupations at Sabi Abyad (2000:114-115). She cites evidence for changing demographic profiles among caprines, as well as the presence of Burnt Village storehouses, which may have been used as localized storage for the nomadic segment of the population. Finally, $^{87}Sr/^{86}Sr$ evidence from Domuztepe did identify a few animals that came to the site from different locations as defined by geology, although these animals were few and far between.

Animals were commodities valued for more than their contribution to Halaf peoples' diets. As herding became an increasingly specialized and intensified activity, animals may have transitioned from valued just for their contribution to subsistence to a form of wealth and a focus of early efforts to mobilize property and the development of inequality (Russell 2012). Ethnographic case studies demonstrate that this is a global anthropological phenomenon (e.g. Lemonnier 1994; Parkes 1987). The development of a more mobile, and more specialized forms of pastoralism and the use of animals in exchange may have allowed stock to transition from deriving their value exclusively from their contribution to subsistence economy to deriving their value also as a form of wealth. The growth of cooperative agropastoral arrangements among Halaf period people may have permitted more profitable herding endeavors, and with that, greater numbers of stock. It also likely increased herders' ability to reap the benefits of secondary productrs. This wealth could be mobilized in commensal politics, at feasts and in exchange within a community.

5.4 Snapshots of Interaction – Evidence at Domuztepe and Sabi Abyad

In the previous sections of this chapter I traced the movement of goods and with them, interaction among areas within the Halaf cultural sphere. Here I look at two case studies where extensive surveys of sub-regions within the Halaf area in conjunction with excavations at major sites in each region permit a more detailed reconstruction of the sub-regional, regional, and supra-regional exchange and movement.



Halaf sites in the Karahmanmaraş Valley Survey Region. Adapted from Eissenstat 2004. Domuztepe is site KM 97.

Halaf sites in the Balikh Valley. Adapted from Akkermans 1993. All phases of the Halaf period are represended. Sabi Abyad is labeled.

Figure 5.6 Comparing Halaf site distributions in the Karahmanmaraş and Balikh Valley

DOMUZTEPE

In Chapter Two I described the distribution of Halaf sites in the Karahmanmaraş Valley. To reiterate, the valley system is divided into four basins, three of which contain communities of settlements composed of one large multi-period Neolithic site, which includes a Halaf occupation, and several smaller Halaf period sites with more temporally restricted occupations. Eissenstat (2004) argued that this pattern of aggregation at longer-occupied sites in tandem with shorter occupations at nearby sites reflects residential mobility that was part of Halaf people's agricultural production strategies, such as accessing prime arable land. As mentioned in Chapter Two, the proximity of marshland to Domuztepe would have restricted the amount of arable land immediately adjacent to the site. Halaf period people in the area may have chose to reside away from the main settlement or moved among settlements for part or all of the year as part of their production system and to alleviate social tensions that can arise in densely populated settlements. Despite residing for all or part of the year away from the larger aggregation sites, these people likely interacted with those residing more permanently at Domuztepe and the other large settlements in the Karahmanmaraş Valley for social, economic, and perhaps political purposes.

Residential mobility patterns inferred from survey data in conjunction with mobility patterns associated with pastoral production gleaned from the biogeochemical studies detailed in Chapter Four thus suggest that Halaf period people associated with Domuztepe moved frequently. They moved within the immediate environs of the site, and in broader rounds to the south as part of their subsistence system. This sub-regional movement is also attested to in local ceramics, which were chemically distinct from other Halaf ceramics from other contemporaneous sites (Spataro and Fletcher 2010). Ceramics at Nevruzlu (KM 69), a site10km north of Domuztepe in the Central Basin, were likely part of this group of Halaf ceramics as well.

Pottery recovered during intensive survey of the site strongly resembles ceramics at Domuztepe along all parameters: fabric, paste, surface treatment, and form (Gürdil 2002:146). The same people may have produced ceramics at both Nevruzlu and Domuztepe.

Mobility on a sub-regional scale was likely a regular part of Halaf period lifeways. The movement of goods detailed above also shows that regional and supra-regional interaction and exchange was also a regular facet of Halaf social and economic life at Domuztepe. Briefly, regional exchange is indicated by the procurement of raw obsidian from two primary sources in central and southeastern Anatolia (Healey 2007). It is also attested to indirectly in stylistic attributes of pottery, glyptic, and other small finds, which indicate participation in a common symbolic language used throughout the Halaf cultural sphere (Carter 2010; Spataro and Fletcher 2010). Supra-regional interaction and exchange is indicated by the presence of raw materials acquired from far outside the Halaf cultural sphere. At Domuztepe these materials include obsidian from eastern Anatolian and Caucasian sources and non-local raw materials such as shell, silver, and bitumen.

SABI ABYAD

British and Dutch teams undertook surveys of the Balikh Valley in the 1970s and1980s. The Dutch surveys were conducted in conjunction with excavations at several sites within the valley system. An overview of settlement during the Halaf period is found in Akkermans's early synthetic publication (1993). Work in the Balikh has continued to the present, making it perhaps the best-understood sub-region of the Halaf cultural sphere.

In the Balikh Valley, Akkermans and colleagues divide the Halaf period into three phases: Balikh IIIB, IIIC, and IIID, which span from c. 6000-5600 cal. BCE. The first phase corresponds to the early Halaf, and is seen as a gradual indigenous development from early Ceramic

Neolithic occupations in the valley. Eleven sites were located in the northern portion of the valley during the IIIB phase, and grouped in three clusters. There is one site that is an exception, which is isolated in another part of the valley. In the IIIC phase there was a considerable increase in the number of settlements (twenty-three). IIIB sites remain occupied and twelve more were newly founded, including some in the southern portion of the valley, which had been unoccupied in the previous millennium. Some sites occupied in the previous period may have contracted or shifted to certain portions of the site, as indicated by excavations at Tell Sabi Abyad. Two sites in close proximity ("a few hundred metres," *Ibid*.: 177) to one another — Mounbatah and Tell as-Sawwan — grew during this phase to 12 ha and 2 ha respectively (*Ibid*.: 179). In tandem these sites likely functioned as the social and economic focus of settlement within the valley. Other sites in this period were small, likely with short periods of occupation. Thus not all IIIC sites were likely contemporaneously occupied; rather occupation shifted among the sites and even within them. Several may have been seasonally occupied camps; excavations at Damishliyya I and Tell Assoud provide evidence of this (*Ibid*.). During the IIID phase, settlement contracted to eight sites scattered across the valley in four groups. Sites within groups were near each other. Mounbatah and Sawwan remained the largest settlement agglomerations, and two other sites, Khadriya and Mefesh, rose in tandem to the southwest in a similar fashion.

Settlement during the Halaf period in the Balikh valley, as in the Kahramanmaraş valley, is thus characterized broadly by a tendency to nucleate in clusters or communities of sites over time. Certain sites had long occupations and perhaps functioned as the focus of social activity. Near these sites were comparatively short-lived, smaller occupations. Some of these sites likely reflect permanent settlements, occupied for a generation or so. Others are more likely seasonally occupied camps, inhabited during specific periods of the year to permit Halaf period people to access particular resources. Not all sites within clusters were likely contemporaneous. These data thus suggest that people moved frequently within the local region, either for particular parts of their year, or for several years at a time. Local interaction was likely frequent, and focused on sites like Mounbatah and Tell as-Sawwan. This frequent interaction and perhaps interdependence of people inhabiting site clusters in the Balikh is also hinted at in the evidence for communally-used (but not clearly communally administered) storage facilities recovered in the Burnt Village at Sabi Abyad (Akkermans and Duistermaat 1996).

Local interaction and exchange within the Balikh valley is also evident in the movement of goods, described in section 5.3. Ceramics were produced at some sites in the Balikh valley (e.g. Sabi Abyad), but not at others (e.g. Damishliyya and Khirbet esh-Shenef). These larger, more permanently occupied sites likely furnished the smaller sites with the ceramics they needed. Regional interaction is attested to in the presence of ceramics from other parts of the Halaf cultural sphere, like DFBW pottery from Cilicia, and in the use of basalts from outcrops at distances roughly 100km from the Balikh but within the Halaf zone. Obsidian at Sabi Abyad and rare raw materials like copper and bitumen came to the site over even greater distances.

COMPARING THE KAHRAMANMARAŞ AND BALIKH VALLEY SYSTEMS

The Kahramanmaraş and Balikh Valley systems during the Halaf period bear great similarities to one another. In both cases valleys were populated with communities of sites. And within each of these communities there was at least one site occupied from previous periods. These sites likely functioned as the focal point of social and economic life in each sub-region. Smaller sites around these focal sites were characterized by shorter occupations, ranging from seasonal encampments to occupations of a generation or so. This suggests frequent residential mobility among populations within the sub-regions, perhaps to take advantage of various resources and areas of arable land within these valley systems.

Artifactual evidence at both Domuztepe and Sabi Abyad, the primary foci of excavation in each valley system, also indicates considerable interaction and exchange among Halaf period people at three geographical scales. Sub-regional movement of people and goods were frequent, regular parts of Halaf peoples' lifeways. Interaction and exchange at the regional level was also frequent, evident in regionally differentiated ceramics found at Sabi Abyad and in raw materials from other areas of the Halaf cultural sphere. It is also attested to indirectly in the shared stylistic and symbolic languages used at sites throughout the region. Supra-regional exchange is evident in a small number of finds at both sites comprised of materials that came from outside the geographical rage of Halaf material culture.

5.5 Conclusions and Implications

This chapter has explored evidence of interaction and movement of people and goods among Neolithic communities within and outside of the Halaf cultural sphere. These interactions take place at three geographic scales. In this section I correlated the different lines of complementary evidence described above and consider the implications of such movement.

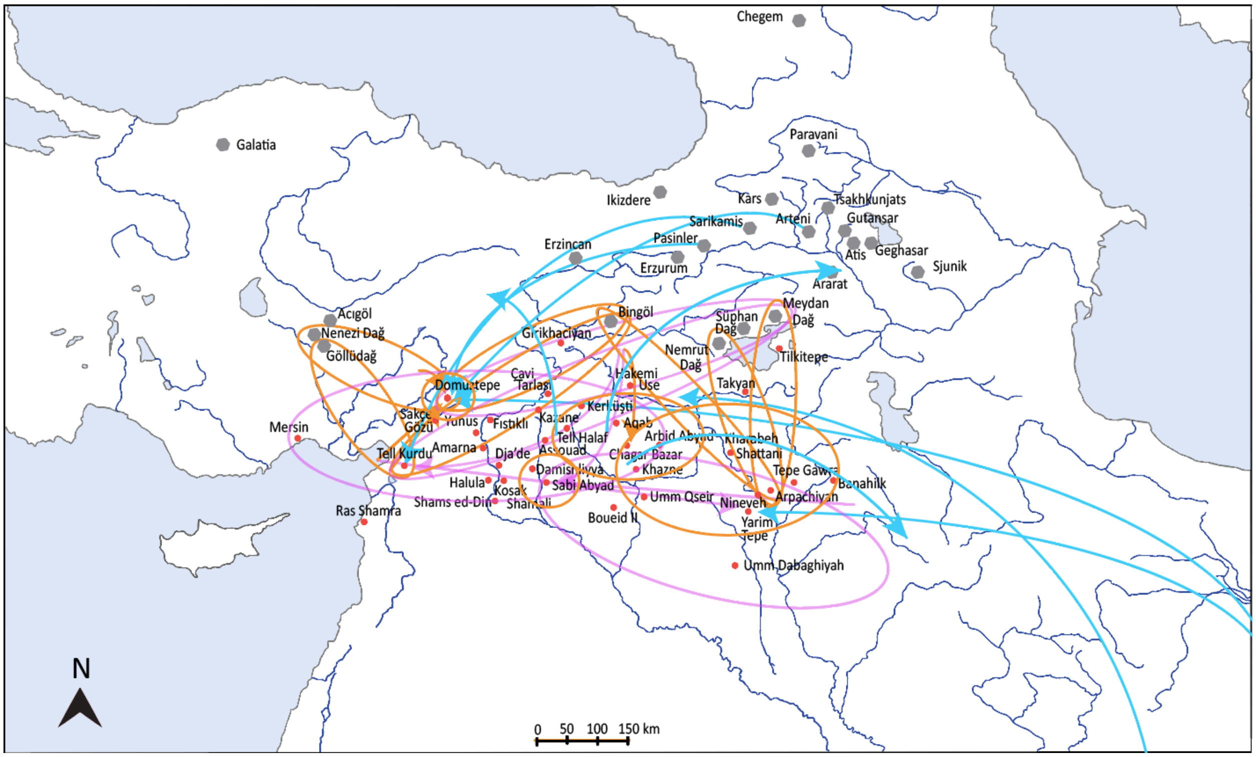


Figure 5.7 Example of sub-regional, regional and supra-regional interaction based on existing provenance studies of obsidian, ceramics, and rare raw materials. Studies have largely been restricted to a few key sites; this map would certainly be much more complicated with more broad studies in provenance of materials from other sites. Orange denotes sub-regional exchange. Fuchsia denotes regional exchange. Blue denotes supra-regional exchange. Map by author, modified from Akkermans and Schwartz 2003, Healey 2007, and Kansa et al. 2009b.

Halaf period people engaged in frequent sub-regional movement and interaction, covering distances up to about 300km. This is clear from a variety of different lines of proxy evidence. Biogeochemical indicators of paleomobility in Domuztepe fauna show that animals moved southward, probably along the Euphrates valley. This orientation towards the south matches the same orientation for the distribution of Halaf material culture; herders circulated regularly within the Halaf cultural sphere, rather than moving northward or westward as modern groups do. Ceramic studies further indicate that Halaf people engaged in robust sub-regional interaction. These sub-regional affinities are also evident in both the presence of sub-regional stylistic trends within Halaf pottery (e.g. Campbell 1992; Davidson 1977; Fletcher 2007; LeBlanc and Watson 1973) and in the frequency with which Halaf people acquired non-Halaf ceramics. Finally, the distribution of copper ores at Tell Kurdu and Sabi Abyad and unworked and minimally worked obsidian suggest that people at Halaf sites engaged in direct interaction and exchange with communities in Central Anatolia and the Lake Van and Bingöl regions. This interaction and exchange covered distances of about 200-300km. Tilkitepe offers the converse evidence: Halaf pottery in proximity to sources of sought-after raw materials. Some have interpreted this site as an outpost of Halaf people intended to access obsidian resources (e.g. Korfman 1982); at minimum Tilkitepe does appear to be a community engaged in frequent exchange with Halaf people, despite its location on the fringes of the Halaf cultural zone. Finally, stylistic differences in the types or artifacts made from these raw materials, particularly obsidian beads and other luxury goods exhibit sub-regional distributions. This further suggests that residents at Halaf sites engaged more frequently with people within distances of up to 300km.

These same materials provide evidence that Halaf people engaged in less frequent interaction at a regional scale (i.e. from the eastern to western extents of the Halaf heartland, a distance of roughly 600km). The presence of non-Halaf ceramics, which are used in tandem with Halaf ceramics at some sites far from their production zones are clear examples of this. A less tangible example is evidence of intellectual exchange among Halaf people at both ends of the distribution. Glyptic evidence suggests a common symbolic language among Halaf communities (Carter 2010). Similarities in ceramic styles and production techniques indicate that communities were in contact with one another, although whether the mechanism is the movement of a small number of itinerant potters or a large movement of people engaged in low-level, occasional, specialized production is unclear.

Finally, there is clear evidence that people at Halaf sites engaged in long-distance supra-regional exchange based on the presence of rare non-locala from distant sources at Halaf sites and Halaf ceramics at sites well outside the Halaf cultural zone. There is little evidence that these rare materials (e.g. shell beads, obsidian blades from sources in northeastern Anatolia and

Armenia) were worked at Halaf sites, suggesting that these items arrived as finished objects and are the product of indirect and infrequent exchange.

The extent and frequency of mobility and interaction among Halaf people clearly shaped their lifeways. The data presented in this chapter shed light on how these networks, and the goods that flowed through them, necessitated coordination among people participating in these systems. Individuals and communities would have had to coordinate within and among themselves to acquire raw materials – sometimes at great distances – craft them into goods – sometimes requiring great sophistication in technique – and redistribute them. This is analogous to the type of cooperation described by Eerkens (2013) in Owens Valley, California.. There was also cooperation among sites in that not all settlements were self-sufficient in producing craft goods; they relied on other settlements to exchange. And enterprising individuals or groups may have also harnessed these networks and goods for their own political purposes.

One focus of cooperative effort among people at Halaf sites was agropastoral production at a household, village, and sub-regional level. There is clear evidence at many sites for the production and storage of surplus agricultural products. These products were certainly consumed locally, and there is some evidence that they may have also been exchanged with more mobile segments of the population in return for their increased labor investment in pastoral production. This is indicated by the presence of large communal storage facilities at Sabi Abyad, where contemporaneous zooarchaeological data suggest a developing focus on offsite caprine husbandry. Biogeochemical indicators at Domuztepe also indicate that animals were kept away from the site for at least part of the year. Their caregivers may have chosen to engage in a more specialized focus on pastoral production as long as they were ensured access to other agricultural products.

There is also clear evidence of feasting at several Halaf sites and at sites in the greater Neolithic Near East. As was noted before, feasts are collective actions. Chapters Two and Three of this dissertation describe the evidence for feasting at Domuztepe. These were important and archaeologically-recoverable instances of collective action among participants. Residents at the site clearly participated in these events regularly, and the scale of these communal gatherings grew over time. Nieuwenhuyse (2008) notes that during the Transitional and Early Halaf periods at Sabi Abyad there is a marked increase in vessels for serving and consuming food and, especially, for consuming drink. He posits that feasting events might have served as an opportunity for rival groups to compete with one another and to "manipulate relations of debt and cement alliances with partners from other groups," (*Ibid*.: 699). In other words, these were forums for political activity, both for cohesion and for the establishment of differential power relationships. This could happen simultaneously with feasts bringing people together; cooperation and competition often exist in tandem. Collective actions were the product of cooperation, and while people may have come together to produce them, they did not necessarily all benefit equally. Feasting, he notes, was not an innovation of this period, but "we observe in the ceramics… a transformation in the *role* of feasting, its nature and scale, and above all, notions on how such events ought to be dressed up," (*Ibid*., emphasis in the original). This same change in scale is evident at Domuztepe.

Feasting may have functioned in a similar manner at Neolithic sites outside the Halaf heartland area. As mentioned previously, Garstang describes a context at Mersin (Level XIX) that may have been analogous to the Death Pit at Domuztepe (1953:111). Another example comes from farther afield in Neolithic Azerbaijan. Kamiltepe, a large 6th millennium BCE site in southern Azerbaijan, offers a case study to explore these types of social processes. During the Late Neolithic, Kamiltepe was a large site in a landscape dotted with smaller, more ephemeral occupations (Helwing and Aliyev 2012; Ricci et al. 2012). The Neolithic inhabitants built a massive sub-circular mudbrick platform at the site, elevating it above the landscape and perhaps offering a landmark for the mobile population where rituals, including feasting, may have occurred. Large-scale commensal events are indicated in the recovery of considerable quantities of animal bones, rich botanical evidence, and ceramics from ash layers at the site (Aliyev and Helwing 2009; Helwing and Aliyev 2012; Lyonnet et al. 2012; Ricci et al. 2012). Feasts at the site thus exhibit similar hallmarks to those at Domuztepe, with an elevated feasting stage and large-scale consumption. Dispersed mobile and settled populations in the Mil Steppe could have used these opportunities to reaffirm their sense of community in an area where they did not interact face-to-face regularly, and to redistribute different agropastoral products. Such face-to-face interaction promotes cooperative behavior among people.

There are also indications of incipient, low-level craft specialization in wealth items at Halaf sites. This is certainly not the type of fully-developed, attached craft specialization (e.g. Arnold and Munns 1994; Earle 1987) that has been identified in the late Chalcolithic Near East, but the sophisticated production of certain types of goods and the regularity of the corpus may indicate some specialized producers in the mix. Specialization is one form cooperation can take (see Stanish 2009). Scholars have identified craft specialization as a precipitant and perpetuator of social inequality in case studies from many different cultural contexts (e.g. Arnold 1987, Brumfiel and Earle 1987). Incipient craft specialization is hinted at in Halaf communities in the sophisticated Halaf ceramic fine ware technology, which has led some to identify either low-level specialized production (Akkermans 1993) or itinerant potters (Steinberg and Kamilli 1984). At Domuztepe there are hints that residents engaged in craft specialization for wealth objects, such as fine Halaf ceramics (Spataro and Fletcher 2010), obsidian luxury goods like beads and mirrors (Belcher 2011; Healey and Campbell 2014), and sophisticated carved stone vessels (Campbell, B.

2013) and glyptic (Carter 2010). Ambitious actors in Halaf communities may have used these wealth items for displays of status. Halaf period people may have used fine ceramics (e.g. Nieuwenhuyse 2008, 2009) and stone vessels (Campbell, B. 2013) to signify and elevate their status in large commensal events. They may have worn beads made from obsidian, shell, metals, and non-local semi-precious stones to project their power of acquiring these materials. Halaf period people clearly wore seals (Carter 2010; Chavart 1994), which not only showed their access to fine craft goods made of carefully selected materials, but also their ability to account for property. Despite these hints at display and the ability of Halaf people to mobilize these goods for their own elevation within their communities, Halaf mortuary evidence suggests that, at least in burial, differentiation was neither a priority nor the norm. As described in Chapter Two, Halaf mortuary traditions are highly variable in many respects, but generally grave goods are relatively modest: ceramics and the occasional ornaments. Akkermans identifies age as the only determinant of the wealth of grave goods individuals received (1989; 2010).

Taken together these data paint a picture of communities with many of the ingredients anthropologists have identified as precipitants of incipient political complexity: agricultural production capable of creating surpluses and budding economic specialization in staple food production, developing accounting practices suggesting an increasing need to coordinate decision-making and account for property, craft specialization in fine goods and sophisticated networks facilitating their production and exchange, and evidence of the use of luxury goods in display. These ingredients result from increasing cooperation in labor and coordination in resource acquisition and craft production among inhabitants at Halaf sites and between communities within the Halaf cultural sphere. There is also abundant evidence for large scale communal ritual activity, which would allow communities to redistribute the fruits of these increasingly complex economic systems and provide the necessary forum for ambitious actors to experiment with mobilizing foodways and wealth items to elevate their status within their communities, if only for a fleeting period. Thus while evidence is ambiguous for the presence of any full-fledged political complexity in the Halaf period, there is innovation and experimentation taking place. And by the ‘Ubaid period, these experiments have begun to succeed.

CHAPTER SIX: CONCLUSIONS

6.1 Summary of results and what they tell us about cooperation and emergent political complexity during the Halaf

In this dissertation I have argued that by paying explicit attention to the scale of cooperation among people, we can identify changes in their relationships with one another, and their transformation to different forms of social organization. I argued that one way to look at cooperation and its bearing on emergent social complexity is to look at agropastoral production in day-to-day consumption and at instances of collective action visible feasting events. I tracked the change in scale of these events through comparisons in the choices that participants made with regards to what animals to slaughter in earlier Ditch deposits and with the later Death Pit and Op. III assemblages. At later events participants chose animals that were more costly in resource inputs, potential to produce secondary products and in their impact on herd security. Participants in these events chose animals from the same herding system which nourished them daily. At these later events social concerns rather than economic ones prevailed in their choices.

Data discussed in this dissertation provide strong evidence for cooperation among people at several scales: among members within households and households with one at other at Domuztepe and other sites, and at a sub-regional level within the Halaf cultural sphere. There is evidence of regional, and, more rarely, supra-regional interaction, but weak evidence of persistent cooperation among people at the supra-regional geographic scale.

Evidence from Domuztepe shows strong indications of cooperation within the community. This cooperation is evident in animal management practices. Different households made individual decisions with regards to how to herd stock, particularly cattle, pigs, and some caprines kept close to the site. But there are indications that Half residents engaged in herding practices for caprines encompassing greater geographic range and likely necessitating that some portion of the population be away from the site to care for these animals for some period of the year. This type of pastoral specialization, even if only temporary, would require an explicitly different type of cooperation. It is unclear, however, if this type of cooperation exceeded the household scale of organization. Evidence from large communal feasting events at Domuztepe offers clear indications of cooperation exceeding the household level. These events drew animals from the same herds as quotidian food consumption. Faunal refuse, ceramic data and food preparation facilities indicate these events were communal and comprised a large number of participants.

Artifactual data provide strong evidence for sub-regional exchange and cooperation among Halaf communities within sub-regions of the Halaf cultural sphere. This is evident in the acquisition, production and exchange of certain raw materials and and finished goods. Not all communities produced all craft products; within sub-regions some communities relied on other communities to produce craft products, such as fine Halaf ceramics and obsidian tools and objects (e.g. vessels and beads). Such artifactual evidence also indicates that Halaf period people were constructing luxury items such as personal adornment in a variety of rare materials, including seals which were worn and doubled as administrative tools, and fine artifacts like stone and obsidian vessels and mirrors.

Interaction was less frequent at the regional level and even less frequent at the supra-regional level, making it clear that while there may be blips of complexity here and there within the Halaf cultural sphere, no one individual or group could unite large areas under one regional polity. Communities specialized in craft production at sub-regional scales primarily. The great variability in subsistence, mortuary and ritual practices found at different Halaf sites further support this interpretation. No particular lifeway was common throughout the whole Halaf sphere. Iconographic and stylistic similarities across the Halaf cultural sphere, however, show that while communities across the region were not likely explicitly working with one another, they were in contact, and employed a shared symbolic language. Glyptic evidence provides the most robust indication of this (Carter 2010).

This leaves us with the question posed in Chapters one and two: given these data, which interpretation of Halaf sociopolitical complexity seems most plausible? No proposed model fits these data completely. I reject models at both ends of spectrum, the fully egalitarian model (Akkermans 1993; Akkermans and Schwartz 2003), and those that envision chiefdoms dominating the Halaf social landscape (Flannery and Marcus 2012; Watson 1982; Watson and LeBlanc 1990). I think elements of Frangipane's model (2007, 2012) fit most appropriately, as she envisions that Halaf people were distributed over various resource patches as part of a broader cooperative system. But I disagree that this system was wholly egalitarian, or that the distribution of sites is solely the result of community fission to maintain egalitarian relationships. In some cases, this was likely true, but in others, what might be interpreted as fission may actually reflect economic specialization, with different communities specifically targeting different resources, with the goal of cooperation. Yoffee's application of the idea of an "interaction sphere" (1993) is an appropriate way to characterize the Halaf cultural sphere, though I disagree that this took place among fully-formed chiefdoms. Rather, as I have argued, I think the Halaf Period is a transitional one for social organization, where different individuals and communities are experimenting with different forms of cooperation and sociopolitical organization. In some cases, these experimentations may have permitted inequalities to develop and leaders to emerge, although their power may have been fleeting. This is the period of the *inception* of incipient complexity.

6.2 How does this fit in to the broader trajectory of Ancient Near Eastern political complexity?

In the succeeding 'Ubaid period (ca. 5500-4100 BCE in Southern Mesopotamia, late 5th millennium in Northern Mesopotamia) and the related Susa A (Susa I) there are clear indications of incipient politically complex societies. Stein (In Press) has argued that 'Ubaid communities in Southern and Northern Mesopotamia and Susa A communities developed distinct forms of sociopolitical complexity along different trajectories. Leaders in these three geographical sub-areas employed different strategies for gaining support from followers and mobilizing surpluses. In Southern Mesopotamia leaders chiefly employed corporate-type strategies (sensu Blanton et al. 1996, Feinman 1995) to instigate and coalesce support from community members (Stein In Press:4). These leaders used ritual institutions and ideologies to control agricultural surpluses created by irrigation agriculture. This close association with ritual and communal institutions permitted leaders to influence people beyond their immediate kinship network, permitting them to reach a larger population and reap the benefits of economies of scale. He perceives this type of "ritual-based authority" as one that was "grounded in consensus and shared ideology, rather than coercion," (*Ibid*.: 8). This type of strategy would have set the stage for the rise of the temple-based economy seen in historic periods of Ancient Mesopotamia, which begins during the 'Ubaid Period.

The 'Ubaid period in Northern Mesopotamia replaced local Halaf material culture gradually in the late 5th millennium BCE. This transition is evident at many sites, including Domuztepe (Campbell and Fletcher 2006). Stein argues that, in contrast to 'Ubaid communities in Southern Mesopotamia, leaders at 'Ubaid communities in the North employed more network-based (sensu Blanton et al. 1996) strategies to consolidate their control within their polities. Citing evidence primarily from his work at Tell Zeidan, Stein highlights evidence of "economic intensification and specialization, prestige goods, administrative artifacts, and large scale public architecture," (Stein In Press: 8) as well as the growth of long-distance exchange. These factors allowed people in Northern Mesopotamia to establish:

> a set of loosely organized small polities whose aspiring leaders combined both staple and wealth finance to mobilize surpluses from the production of subsistence goods and specialized crafts, while forging long distance exchange connections to procure non-local raw materials for prestige goods. (*Ibid*.:10).

Unlike 'Ubaid communities in Southern Mesopotamia, ritual institutions in Northern Ubaid sites were not used as the primary forum for mobilizing surpluses or wealth items. Rather, Stein argues, power coalesced in leaders who could mobilize their economic power, and display it through feasts, the construction of large houses, and rich burial burials. Such power would be based primarily on kinship networks. Such a different orientation in leadership may have given way to the palace-based economy that developed in Bronze Age Northern Mesopotamia, which is often juxtaposed to the temple-based economy of contemporaneous Southern Mesopotamia (Stein 2004).

Differences in the form of power identified by Stein in contemporaneous 'Ubaid communities that share many cultural traits likely stem from what possible kinds and pathways to power already existed in these sub-regions. What should be immediately clear from this description of 'Ubaid Northern Mesopotamian polities are the similarities they bear to Halaf communities in the preceding period. Several of the attributes Stein identifies as hallmarks of leadership in Northern Mesopotamian 'Ubaid polities are the fully formed version of what Halaf people began to experiment with. In this dissertation I have shown evidence of incipient specialization in agropastoral production, and in craft production at Domuztepe and other Halaf sites. I have also demonstrated the growth of long-distance exchange in prestige goods, and the widespread use of administrative tools. Public architecture is present from the early Neolithic, and evident in the Halaf period in the construction of the Red Terrace at Domuztepe and the platform and communal storage facility at Sabi Abyad. These pathways to amassing political power and altering social relationships were already something that people were familiar with in Northern Mesopotamia by the ʻUbaid period, when they could be fully harnessed.

Two features from Stein's description that appear in the Late Chalcolithic 2 period in Northern Mesopotamia are missing across the Halaf cultural sphere: evidence of stratification in residences and in burial (*Ibid*.:11). While some have interpreted the Burnt House at Arpachiyah as a chief's house (Flannery and Marcus 2012), this interpretation is not widely accepted. Similarly, Halaf burials often contain modest grave goods (usually ceramics and the occasional personal adornments), which are variously interpreted as expressing an egalitarian ethos with some differentiation by age (Akkermans and Schwartz 2003) or reflecting status differentiation (Flannery and Marcus 2012). I propose that Halaf sites lack these two clear indicators of rank differences among residents because during this period people were only beginning to develop inequality; inequality had not become fully ensconced in Halaf social life. In fact, the ambiguity of the data is perhaps an indicator of this type of experimentation. Thus while individuals may have be able to emerge as leaders for given periods of time, or accumulate agropastoral resources or wealth, it was not part of their social repertoire to express these differences in such permanent displays.

This comparison between periods also demonstrates why focusing on increasing scalar cooperation is important for understanding emergent political complexity. Many of these indicators are only clearly observable in the archaeological record when inequality and leadership are fully formed institutions. Focusing on changing scales of cooperation among people requires scholars to correlate multiple lines of proxy evidence, some of which will show clearer indications of shifting scales of cooperation, and some which may be ambiguous. But identifying these flickers in shifts in sociopolitical cooperation and organization is essential for understanding how these clearly visible forms of incipient complexity come to be.

6.3 Future Work

This dissertation has shed light on one small part of the greater picture of emergent political complexity in the Late Neolithic Halaf Near East. Much more work is necessary for understanding sociopolitical organization and change during this period.

More work at Domuztepe will further nuance the interpretations set forth in this dissertation. Specifically, expanding the biogeochemical study of domesticated taxa would elucidate herding practices more clearly and permit greater diachronic distinction. This would require that material currently unavailable for analysis in Turkey become accessible for these studies. More work on the humans in the Death Pit would also be illuminating, and may be possible in the near future. Additionally, a more comprehensive study of heavy fraction would permit us to better understand residents' exploitation of wild fauna, particularly birds and fish in the marshes near the site. Finally, more excavations, particularly those focusing on earlier ceramic Neolithic layers at Domuztepe would be helpful to understand the nuances of diachronic differences in animal management strategies at the site. These layers were initially exposed during the 2011 season under the direction of Stuart Campbell, Alexandria Fletcher and Mücella Erdalkıran. A Turkish team under the direction of Halil Tekin plans further excavations.

Additional excavation and publication of sites like Domuztepe are essential to further our understanding the Halaf period. In order to know whether the behaviors I have identified at Domuztepe are ordinary or extraordinary in any definitive sense we need to know whether they are present at other sites, both big and small. Only a handful of contemporaneous sites have been systematically excavated with broad horizontal exposure; fewer still have been thoroughly published. These data are essential for contextualizing the results from Domuztepe, and for understanding regional trends in sociopolitical transformation.

APPENDIX I: ZOOARCHAOLOGICAL STUDY METHODS

AI.1 Recovery of Faunal Remains

Faunal assemblages were recovered through hand collection and whole earth samples of selected rich context, which were wet-sieved and the resultant heavy fraction saved. The assemblages described here are primarily only the hand-picked portion of the assemblages, which introduces a size-related bias to the results. For this reason I have chosen to primarily focus on mammalian fauna, as we do not yet have a comprehensive sense of what ichtyofaunal and avifauna at Domuztepe looks like.

At present only a small amount of microfauna from heavy fraction have been analyzed; Kansa completed an unpublished study of microfauna from Domuztepe in 2003. These came from quotidian contexts, and it was from this assemblage that microfauna from the isotope study were selected (see Appendix II). The majority of the microfauna, including those from the Ditch context are held at the Kahramanmaraş Arkeoloji Müzesi. Without a comparative collection or the ability to bring it to a collection in Turkey or a foreign institution, I felt that it was not feasible to do an adequate job in the time it was possible to spend in at the museum.

AI.2 Identification and Faunal Resources

Data gathering is, in some sense, a subjective endeavor. What elements a zooarchaeologist can and is willing to identify to particular taxonomic specificity will vary by training, experiences, and resources for comparison (i.e. comparative specimens and images). Thus, it is important to identify what resources were available during analysis.

I received training on zooarchaeological analysis as an undergraduate at the University of Pennsylvania where I had access to the comparative collections then held as part of the Museum Applied Science Center for Archaeology. I received additional training at UCLA under Dr.

Thomas Wake, with additional mentorship during this time from Dr. Sarah Whitcher Kansa. In addition to my work on collections from Syria and Turkey I have worked on collections from Azerbaijan and Tunisia, which contain a similar range of animals. Together these experiences have prepared me to undertake this dissertation research, and made me familiar with all the principle animals identified here and with the variation that can exist among them with respect to size, sex, age and pathology.

Faunal identification of the Ditch took place in three stages. Sarah Whitcher Kansa analyzed approximately one quarter of the assemblage during the 2006 and 2008 seasons at Domuztepe. I am responsible for the analysis of three quarters of the assemblage. This analysis occurred in several stages. I analyzed a portion of the Ditch assemblage in Fall 2010-Winter 2011 as my Masters paper. While at UCLA I had access to the full collections of the Cotsen Institute of Archaeology Zooarchaeology Lab under the direction of Dr. Thomas Wake. Comparative collections at the Cotsen include several specimens of all major domesticates. I completed the bulk of the analysis of the Ditch assemblage in the Kahramanmaraş Arkeoloji Müzesi during summer fieldwork in 2011 and 2012, and three months from October 2012 through December 2012. While at the museum I had access to comparative specimens of one young male sheep and one young male goat, graciously acquired by Dr. Carter from the local stockyards and prepared for this purpose. I also had access to a comparative collection compiled by Sarah Whitcher Kansa that contained a range of caprine, pig, cattle, and a few deer specimens (red deer).

For all stages of my analyses I had access to a range of drawings and images. Among them are Helmer and Rocheteau (1994), Hillson (2005), Pales (1971), Prummel (1988), Schmid (1972), Walker (1985). I also used 3-D faunal collections from the Max Planck Institute for Evolutionary Anthropology, particularly their gazelle, horse (representative of equidae) and beaver specimens, and several images of fallow deer provided by Richard Redding.

Sheep and goat pose a particular issue in assemblages given their very similar morphology. Only certain parts of elements can be differentiated among the genera. Scholars have produced several different studies showing which aspects of elements are most reliable for differentiation. Sarah Whitcher Kansa and I chose specific elements we felt most reliable in this population to permit identification of specific species. These elements, specific attributes and relevant situations are listed below in Table AI.1.

Element	Attribute(s)	Citation(s)
Cranium	1. Horn cores 2. Suture between frontale and parietale 3. Suture between parietale and occipitale	Boessneck 1969; Prummel and Frisch 1986
Atlas	1. Dorsal aspect	Boessneck 1969
Axis	1. Spinous process	Boessneck 1969
Scapula	1. Distal end, shape of glenoid fossa, processus coracoideus, and margo cervicalis	Boessneck 1969; Prummel and Frisch 1986;
Humerus	1. Distal end, all aspects	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Radius	1. Proximal end and shaft	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Ulna	1. Proximal end, articular surface	Boessneck 1969; Prummel and Frisch 1986
Metacarpal	1. Distal end 2. Overall squatness	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Femur	1. Proximal end, shape of caput femora	Boessneck 1969; Prummel and Frisch 1986
Tibia	1. Distal end	Prummel and Frisch 1986; Zeder and Lapham 2010
Metatarsal	1. Distal end 2. Overall squatness 3. Anterior aspect	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Calcaneus	1. Distal end	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Astragalus	1. All aspects	Boessneck 1969; Prummel and Frisch 1986; Zeder and Lapham 2010
Phalanx 1	1. Proximal end 2. Posterior surface 3. Distal end	Boessneck 1969; Zeder and Lapham 2010
Phalanx 2	1. Distal end 2. Posterior surface	Boessneck 1969; Zeder and Lapham 2010
Phalanx 3	1. Distal aspect 2. Processus extensorius	Boessneck 1969

Table AI.1 Elements and attributes used to differentiate sheep and goat

I noted in the comments section in my data collection if I felt I could differentiate genera on aspects of elements not included in this list (e.g. we agreed not to use the distal radius since Kansa had chosen not to distinguish this element following Buckley et al. 2010's study showing discrepencies in visual identifications and ZooMS identifications, but often I would record it in the notes section). We specifically chose not to identify teeth to species among caprines. This is because there is considerable debate among scholars about which morphological attributes can be reliably used to differentiate genera (Halstead and Collins 2002; Zeder and Pilaar 2010). In our populations we found that many mandibles were ambiguous, with some teeth showing some genera's characteristics, while other teeth displaying the other genera. Further, these criteria do not work well for very young or very old animals. Thus using mandibles differentiated by genera to construct species-specific demographic profiles would be incomplete, omitting animals on both ends of the age spectrum. This is particularly problematic in certain assemblages at Domuztepe where sheep were kept to older ages for wool production.

Domesticated fauna was differentiated from wild fauna of the same species (pigs) or genera (cattle, sheep and goats) based on the size distribution of their elements. Size reduction is a trait that comes with the domestication of animals (Arbuckle and Makarewicz 2009; Grigson 1989). In order to identify this among specimens from Domuztepe a log size index was generated using standard measurements (lengths and breadths see AI.4 for explanation) to create a size distribution of the population. Cattle and pigs were compared against standard animals (for cattle the Mesolithic female auroch following Grigson 1989; for pigs the Southeast Anatolian female boar reported in Hongo and Meadow 1998). No standard animal was used for caprines; rather I used the distribution of the population to identified specimens that were outliers based on their size.

Fauna was identified to the most precise taxonomic category possible. If a specimen is too fragmentary to be identified with great specificity it is defined by size and class (e.g. large mammal). Generally the term "large" refers to animals the size of cattle, equids and red deer, "medium" to animals the size of sheep, goat, gazelle, roe and fallow deer, and dogs, and "small" to animals the size of hares, and smaller microfauna. During our interanalyst variation study (see below) we determined that Kansa is more likely to use the category "medium/large" for animals that are approximately the size of pigs than I am; I am more apt to put those specimens in the "medium" category. This did not have an impact on the analyses used here, but it would if one were to look at body part distribution over at a broader scale, rather than just at specific species (see section AI.9 below).

Certain elements we agreed could not be securely identified beyond size and class. Rib fragments, and vertebrae except for the atlas, axis and well-preserved sacrums were only identified to size and class. This is a normal practice among zooarchaeologists trained in U.S. institutions. But their size class distinction does indicate what animals they most likely came from.

AI.3 Data Recording

Kansa developed an Excel sheet to record data, which she has used at Domuztepe and other sites. I used this same form to ensure the comparability of our results. These forms record a variety of contextual information including operation, date excavated, date analyzed, and unique bone specimen number. Each specimen is described by the following attributes: NISP, taxon, bone, part of bone, percent preserved, side, whether the proximal and/or distal ends are present, any age or sex related characteristics, pathology, cut marks, gnaw marks, whether the bone is broken and if that breakage is ancient or modern, and whether the bone is modified by burning or working, or if it articulates with other specimens. There are additional fields for recording comments and measurements.

AI.4 Measurements

All specimens were measured using a pair of dial or digital calipers that can measure to the nearest 0.1mm. Measurements were taken following von den Driech (1976), with some additional measurements following Whitcher (2000). Table AI.2 lists the specific measurements taken for each element. Abbreviations refer the orientation of the measurement (e.g. GL refers to greatest length, Bp refers to breadth of proximal end).

Element	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12
Atlas	GB	GL	H	BFcr	BFcd	GB						
Axis	SBV	BFcr	BFcd									
Scapula	SLC	GLP	LG	BG	HS	DHA	Ld	Hn*				
Humerus	GL	SD	Bt	Bd	Bp	Dp	Hd*	SHd*				
Radius	GL	PL	SD	DD	Bp	BFp	Bd	BFd				
Ulna	GL	SDO	DPA	LO	BPC							
Innominate	LA	LAR	Sh*	Sb*	Lds*	Dssh*	Hi*	Bi*				
Sacrum	GB	BFcr										
Femur	GL	GLC	Bp	DC	Bd	SD						
Tibia	GL	Bp	Bd	Dd	SD							
Carpal/Tarsal	GB											
Astragalus	GLl	GLm	Bd /BFd	Dl	Dm	GLl						
Calcaneus	GL	GB	Btu*									
Metapodia	GL	SD	DD	Bp	Dp	Bd	Dlv*	Blc*	Dlt*	Dmv*	Bmc*	Dmt*
Phalanx 1	Glpe	Bp	Dp	SD	BFp	Bd	BFd					
Phalanx 2	GL	Bp	BFp	Bd	SD							
Phalanx 3	HP	Ld	GL	DLS	MBS	HP						

Table AI.2 Key to Measurements. Reprinted with permission from Whitcher 2000. Measurements from von den Driesch 1976 unless noted with *. Measurements with * are defined in Whitcher 2000 Appendix B.

AI.5 Interanalyst Variation Study

The interpretations I make in this dissertation rely on comparisons between my analyses of faunal material and those of Sarah Whitcher Kansa. As discussed above, while data acquisition for archaeobiological data is subjective, based on training, experience, resources, and even the conditions in which identification takes place.

In order to be confident we conducted a comparative study to see where our analyses might differ. We independently analyzed a subset of the Op. III assemblage composed of 466 bones (including small fragments) that had not previously been analyzed. This analysis took place at UCLA using the references cited above and with the comparative collections held in the

Cotsen Institute of Archaeology's Zooarchaeology Laboratory. Both of us analyzed the material in the Cotsen Institute of Archaeology's Anatolia lab to ensure similar light conditions, which can affect the observers' ability to identify small features.

Taxon	Observer A	Observer B
Size Class Only		
Small mammal	1	0
Small/Medium mammal	7	1
Medium mammal	54	39
Medium/Large Mammal	3	19
Large mammal	44	37
Indeterminate	41	42
Ungulata		
Medium Ungulate	1	4
Artiodactyla		
Bovid	8	9
Small Bovid/Cervidae	0	0
Medium Bovid/Cervidae	2	5
M/L Bovid/Cervidae	1	0
L Bovid/Cervidae	5	1
Bos taurus	58	57
Ovis/Capra/Gazella	1	0
Ovis aries/Capra hircus	122	112
Ovis aries	31	25
Capra hircus	13	16
Capra aegagrus	1	1
Cervus elaphus	0	1
Sus scrofa domesticus	61	83
Perissodactyla		
Equus sp.	0	1
Carnivora		
Canis sp.	1	2
Total	**455**	**455**

Table AI.3 Results from Interanalyst Variation Study

A specimen-by-specicemn comparison shows greater discrepencies than is demonstrated in the aggregate result. Overall Observer A and Observer B differed on 139 specimen identifications. In 124 cases, accounting for 89% of the discrepencies and 27% of the entire assemblage, the difference was to the level of specificity used to describe the specimen (e.g. Observer A identified a specimen as *Ovis aries* while Observer B identified it to the less specific taxonomic category as *Ovis/Capra*) or the type of size class to assign the specimen to. Observer A is more of a "lumper," using primarily Small Mammal, Medium Mammal, and Large Mammal for size classes, rather than the Medium/Large Mammal category. Observer B uses this for animals that are roughly "pig-sized" so a body part distribution including these elements would need to control for this difference. No comparisons based on size class data were used in this dissertation, so this had no meaningful affect on the interpretations put forth here.

Differences in species assignment only occurred in 15 instances, accounting for 11% of the discrpencies, and approximately 3% of the overall assemblage. In 7 instances where Observer B identified a specimen as pig (*Sus scrofa domesticus*), Observer A identified it as *Ovis aries/Capra hircus*. These were largely fragmentary portions of longbones. The remaining differently identified specimen was identified by Observer A as a cattle (*Bos taurus*) sesmoid and by Observer B as a pig patella. This accounts for about half the differently identified specimens. The remaining discrepencies were in relatively rare taxa (Observer B identified red deer, an equid, and a canid where Observer A did not) and in couple instances of disagreement in determining among caprine genera.

Overall I do not think interanalyst variation had a significant impact on the datasets compared in this dissertation. Despite there being specimen-by-specimen discrepencies between Observer A and Observer B, overall the resultant proportions of each taxon or size class were similar. Further, even though Observer A and Observer B made slightly different choices about which elements to consider as one unit (e.g. an articulating radius and ulna would be input into the data collection spread sheet but only counted once), both observers ended up with the same total NISP. The assemblages compared in this dissertation are large, and as sample size increases, I would expect the effect of these discrepencies to further more diluted. Should any analyses be undertaken using data only categorized to size class (e.g. a body part distribution of axial elements, which were only identified to size class), the researcher would need to mitigate these discrepencies.

AI.6 Quantification

The main quantification used in this study is NISP — Number of Identified Specimens. This presents a count for all specimens that can be used to estimate relative frequency of taxa. NISP is widely used in faunal reports, but the measure may be biased by taphonomy, analytical procedure, and the types of animals in the assemblage under study. Reitz and Wing (2007:202-205) provide a good summary of the attendant issues. Despite these limitations it remains the most useful measure of abundance for this study. When comparing assemblages at Domuztepe, I only compared NISP for specimens that had been identified to family or better, with the exception of avifauna and ichtyofauna, which are reported to class. The Ditch fauna is also reported including specimens only identified to size and class. In order to reduce the probability of double counting specimens from the same animal where possible, when two bones articulate (e.g. an epiphysis and diaphysis or an ulna and a radius) they were only recorded once.

I also report the MNI — minimum number of individuals — Kansa found in the Death Pit Assemblage (Kansa et al. 2009b). This metric estimates the "smallest number of individuals that is necessary to account for all the skeletal elements (specimens of a particular species," (Reitz and Wing 2008:205) within a specific assemblage. This was used for this context as it was a sealed, discrete deposition.

Finallly, I do use a third quantification measure: Minimum Number of Elements. This quanification describes the smallest number of possible individual elements in this assemblage. The method of calculation is described below in AI.8 Body Part Representation.

A1.7 Demographic Profiles

Demographic profiles were constructed based on indicators of age and sex of animals identified in individual specimens in aggregate. Age profiles are constructed based on two main indicators: epiphyseal fusion and tooth wear.

When animals are young their bones are in separate pieces that fuse over time. The shaft of the bone is the diaphysis, and the ends are the epiphyses. These elements fuse over time, and the rate at which this occurs varies among taxa. Observations in modern animals are used to define the age at which specific elements fuse in specific taxa. Among archaeological assemblages for each specimen where the point of fusion is visible it is categorized as fused, unfused or fused with epiphyseal line still visible. Then the proportion of each element that occurs fused or unfused is added up, thus showing what percentage animals in each age class survived to that age or later.

The age at death of animals can also be determined from looking at their teeth. Two different aspects of animal teeth speak to this: the presence of deciduous and/or permanent teeth and the wear on their teeth. Deciduous teeth are the first dentition that emerge and are replaced with permanent, adult teeth. As animals eat they wear down the enamel on their teeth for both types of dentition. Scholars have observed these wear rates in mandibles and published schemas for categorizing them. In some cases these wear stages have been tied to specific ages for animals; in others it is simply relative. For all mandibles and maxilla and individual teeth I recorded the type of tooth. For teeth either in mandibles, or individual lower teeth I recorded the wear and how it corresponds to the appropriate defined wear charts (described below). For maxillas and individual upper teeth I described the wear, as none of the existing studies include maxillary teeth.

Sex profiles are constructed based on morphological features of specific elements and on the size distribution of certain elements that are strongly sexually dimorphic. Depending on the taxon, innominates, horn cores, and canines can be used to determine whether or not they came from male or female animals. However, there may be some introduced bias in that in some elements juvenile animals may be misidentified as one sex or the other, such as the innominate in caprines. Size distribution of elements that exhibit size differences between the sexes can be used to corroborate sex profiles based on morphological distinctions.

Below describes the particular criteria and relevant citations used for the four taxa with sample sizes large enough to permit constructing demographic profiles in the Ditch. For the other three contexts I used the demographic profiles reported by Kansa in Kansa et al. (2009a,b) and Kansa and Campbell (2008).

SHEEP AND GOAT

Age data based on epiphyseal fusion were constructed in a manner adapted and modified from Reitz and Wing (2007:72 and 193-197). The classes are defined based on age of fusion for sheep reported by Schmid (1972) and Silver (1969) and for goats by Noodle (1974). Tooth wear was recorded using the categories identified in Payne (1973). Only mandibles were used rather than individual loose teeth to construct age profiles, but wear on all individual teeth were recorded.

Sex profiles for caprines were constructed based on morphological features of the innominate described in Boessneck (1969) and Prummel and Frisch (1986). Neither Kansa nor I used the morphological criteria in Boessneck (1969) to differentiate among genera as they were rarely preserved and we did not feel we could reliably use them in this collection. Since the innominate data describe caprine sex distributions in aggregate (i.e. lumping both species together) I used the size distribution of phalanges and metapodai to better understand trends in sex distributions among goats and sheep specifically as these elements can reliably be identified to species and exhibit size differences based on sex (Zeder 2001).

PIGS

Age data based on epiphyseal fusion were constructed based on age of fusion data reported in Schmid (1972) and Silver (1969). Tooth wear was recorded following Grant (1982). As Grant only records relative wear, rather than tying wear stages to a particular age, I relied on epiphyseal fusion data to construct age classes. Sex distributions in pigs were constructed on the basis of the morphology of canines. These distinctions are illustrated in Hillson (1986) and Mayer and Brisbin (1988).

CATTLE

Age classes based on epiphyseal fusion were constructed using the age of fusion reported in Schmid (1972) and Silver (1969). Tooth wear was recorded using the descriptors in Grant (1982). Sex distributions in cattle were constructed based on innominates following Grigson (1982a). Horn core sexing criteria were also recorded following Grigson (1982b) but as most horn cores were too fragmentary to permit distinction, the sample size was too small to be used.

A1.8 Body Part Representation

Body part representation was calculated for each individual element that was identified to sub-family or better by picking one distinct part of the element (e.g. the proximal end) and counting the number of times it was recorded for the element on each side. The resultant number is the Minimum Number of Elements (MNE). For caprines this was constructed in aggregate, as not all elements were equally distinguishable among genera. Kansa followed the same procedure while recording the Death Pit and Op. III assemblages, and these were reported in Campbell et al. (2014:43-44). Additional Op III data were added following the interanalyst variation study.

A1.9 Anthropogenic Processing

Kansa and I both recorded evidence of processing through ancient butchery and cooking practices. We recorded burning on bones by describing the location and color of the burning, which is indicative of the heat the bone was exposed to. We also recorded the presence and, where possible, type of cut mark (sawed, sliced). Breakage that occurred in antiquity was also recorded, which may be indicative of ancient peoples' butchery practices and marrow extraction.

A1.10 Taphonomy

A range of taphonomic markers were recorded. These included whether or not bones were broken during excavation, or in antiquity, evidence of trampling and weathering, and indications of gnawing and digestion by rodents and carnivores. After data acquisition density-mediated attrition was also considered following Lyman (1994) and Ioannidou (2003).

A1.11 Statistical Analyses

I used a Test of Equal or Given Proportions to determine whether or not differences in the proportion of each taxon in each assemblage. Afterwards a post-hoc pairwise comparison was performed using a Holm adjustment for multiple comparisons. This reduces the likelihood of committing a Type I error, wherein the null hypothesis is erroneously rejected. All procedures related to running these tests are described in the R States Package 3.4.0 (R Core Team and contributors worldwide 2016). Wild fauna were aggregated as one category as the number of each individual species was so low that to use individual counts was likely to introduce errors.

APPENDIX II: BIOGEOCHEMICAL STUDY METHODS

AII.1 Sample Selection

Samples for isotope analysis described in chapter four were drawn from faunal assemblages from Domuztepe located in the United States and in the United Kingdom. It was not possible to draw samples from faunal collections held in Turkey, where the bulk of Domuztepe samples are stored.

In each available lot (the most specific delineation of an excavation unit at Domuztepe) teeth were selected for each taxon. In a given lot the most frequent tooth type was identified, and then sampled with preference given to frequency, and teeth that formed at older ages. For example, in a lot with four left sheep/goat lower third molars and two right sheep/goat lower first molars the four left lower third molars were selected. This ensured the maximum possible sample size. The goal of selecting teeth that form later was to alleviate any possible enrichment in $\delta^{18}O$ values due to the consumption of mothers' milk prior to weaning (Wright and Schwarcz 1998).

The Death Pit was excavated as several different lots, but the assemblage was treated as one large lot, which seems more appropriate given the interpretation of the whole feature once excavated. Only one lot was available for sampling from Op III (Lot 1081).

Each sample was given two distinct numbers: a sample number and a laboratory number. The sample number follows the form DOMUZ-Lot Number-Teeth within Lot.
For example, Sample DOMUZ-1081-02 refers to the second tooth analyzed fom Domuztepe (DT) Lot 1081. Each sample also received an Arizona State University (ASU) Archaeological Chemistry Laboratory (ACL) number, which is the numbered specimen within the corpus brought into the ACL. These two numbers were used in tandem to safeguard against any mislabeling.

AII.2 Sample Preparation (enamel)

Tooth samples were taken from the full length of the tooth crown, thus creating an averaged sample for the full duration of enamel formation. All samples were photographed and recorded. Then tooth samples were mechanically cleaned of accretions using a diamond-tipped drill bit in a Dremel Mini-Mite drill, and then samples were taken with a clean drill bit. This followed standard procedures in the Archaeological Chemistry Laboratory at ASU (see Knudson et al. 2012:483; Knudson and Price 2007).

AII.3 Sample Preparation for Analysis of Radiogenic Strontium.

Samples were prepared for radiogenic strontium isotope analysis under the direction of Drs. Kelly J. Knudson and Gwyneth Gordon and following standard procedures employed in the ASU Archaeological Chemistry Laboratory and the ASU W.M. Keck Foundation Laboratory for Environmental Biogeochemistry. These procedures are delineated in Knudson et al. (2014:409; 2016:595).

AII.4 Sample Preparation for Analysis of $\delta^{18}O$ and $\delta^{13}C$

Samples for $\delta^{18}O$ and $\delta^{13}C$ were prepared following standard procedures at the ASU Archaeological Chemistry Laboratory and analyzed at the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University. The full procedures are described in Knudson (2009) and Knudson et al. (2014).

AII.5 Assessment of Diagenesis

A sub-sample of the total sampled fauna from each taxa and context were analyzed to look at elemental concentrations. These are measures of diagenesis (Price et al.1992). Trace element concentration samples were prepared under the direction of Drs. Kelly J. Knudson and Gwyneth Gordon. I followed standard procedures used in the ACL, and described in Knudson and Price (2007:31. See also Knudson et al. 2014:413). Samples were then analyzed on the Thermo-Finnigan quadrupole inductively coupled plasma mass spectrometer Q-ICP-MS in the W. M. Keck Foundation Laboratory for Environmental Biogeochemistry.

Table AII.I Shows the results of these analyses. All faunal samples fall within acceptable ranges that do not indicate significant diagenic alteration. Human samples show lower ranges of Ca/P values. Based on these data I assume that other samples of the same skeletal material (enamel) and from the same depositional contexts are also acceptable, and the values of resultant analyses are not the result of diagenic alteration.

ACL and Sample Number	Taxon	Tooth	Context	Ca/P	U/Ca
ACL-5602 DOMUZ-3680-01	Ovis/Capra	P3	Ditch	2.2	1.07487E-05
ACL-5606 DOMUZ-2528-01	Ovis/Capra	P4	Quotidian	2.1	1.46748E-06
ACL-5610 DOMUZ-3954-01	Ovis/Capra	P4	Ditch	2.1	2.23129E-06
ACL-5615 DOMUZ-2527-01	Ovis/Capra	P4	Quotidian	2.2	3.68134E-06
ACL-5618 DOMUZ-2400-01	Ovis/Capra	M3	Quotidian	2.2	6.17166E-07
ACL-5627 DOMUZ-2464-01	Ovis/Capra	M2	Quotidian	2.2	4.30883E-06
ACL-5632 DOMUZ-3890-01	Ovis/Capra	P3	Ditch	2.1	3.11602E-06
ACL-5633 DOMUZ-2468-01	Ovis/Capra	P4	Quotidian	2.2	3.73392E-06
ACL-5641 DOMUZ-1081-05	Ovis/Capra	P4	Op III	2.2	2.13973E-06
ACL-5643 DOMUZ-0799-02	Ovis/Capra	M3	Quotidian	2.1	4.16343E-07
ACL-5652 DOMUZ-0704-03	Ovis/Capra	M3	Quotidian	2.2	8.08747E-07
ACL-5657 DOMUZ-0869-01	Ovis/Capra	M3	Quotidian	2.1	6.81966E-06
ACL-5661 DOMUZ-2711-01	Ovis/Capra	M3	Quotidian	2.1	1.4379E-06
ACL-5662 DOMUZ-2659-01	Ovis/Capra	M3	Death Pit	2.1	4.91602E-07
ACL-5669 DOMUZ-2512-02	Ovis/Capra	P4	Quotidian	2.2	2.53955E-06
ACL-5684 DOMUZ-2585-02	*Sus scrofa*	M3	Quotidian	2.1	6.86865E-07
ACL-5691 DOMUZ-3891-01	*Sus scrofa*	M2	Ditch	2.1	3.35456E-06
ACL-5692 DOMUZ-2017-03	*Sus scrofa*	M3	Quotidian	2.1	4.32519E-06
ACL-5695-DOMUZ-4020-03	*Sus scrofa*	P3	Ditch	2.1	6.9029E-07
ACL-5698 DOMUZ-2649-01	*Sus scrofa*	M3	Death Pit	2.1	1.29413E-07
ACL-5701 DOMUZ-2012-02	*Sus scrofa*	P2	Quotidian	2.2	3.86607E-05
ACL5702 DOMUZ-2021-02	*Sus scrofa*	M1	Quotidian	2.1	4.03763E-06
ACL-5704 DOMUZ-1533-01	*Sus scrofa*	P3	Quotidian	2.1	3.09652E-06
ACL-5705 DOMUZ-1081-06	*Sus scrofa*	M1	Op III	2.1	4.69778E-06
ACL-5714 DOMUZ-2528-03	*Bos taurus*	M1/2	Quotidian	2.1	1.29159E-06
ACL-5720 DOMUZ-2760-02	*Bos taurus*	M1/2	Quotidian	2.1	1.45526E-06
ACL-5722 DOMUZ-1716-01	*Bos taurus*	M1/2	Quotidian	2.1	3.94432E-07
ACL-5732 DOMUZ-2008-01	*Bos taurus*	P3	Quotidian	2.1	3.93481E-07
ACL-5735 DOMUZ-2774-01	*Bos taurus*	P3	Quotidian	2.1	3.2666E-07
ACL-5739 DOMUZ-1081-10	*Bos taurus*	P3	Op III	2.1	5.37135E-07
ACL-5741 DOMUZ-3940-01	*Bos taurus*	M3	Ditch	2.1	2.97614E-07
ACL-5742 DOMUZ-1704-01	Ovis/Capra	M3	Death Pit	2.1	6.12003E-07
ACL-5744 DOMUZ-2656-01	*Bos taurus*	M3	Death Pit	2.1	4.14772E-07
ACL-5754 DOMUZ-2650-01	*Canis familiaris*	P2	Death Pit	2.1	9.26282E-07
ACL-5759 DOMUZ-0848-01	*Bos taurus*	M1/2	Quotidian	2.1	5.8466E-07
ACL-6703 DOMUZ-2616-01	*Homo sapiens*	M3	Death Pit	1.7	2.52295E-07
ACL-6704 DOMUZ-1939-03	*Homo sapiens*	M2	Death Pit	1.7	6.15784E-07
ACL-6705 DOMUZ-1936-01	*Homo sapiens*	M2	Death Pit	1.7	3.71447E-08
ACL-6706 DOMUZ-1719-01	*Homo sapiens*	M1	Death Pit	1.7	4.77913E-07
ACL-6707 DOMUZ-1719-02	*Homo sapiens*	M2	Death Pit	1.7	5.11581E-07
ACL-6708 DOMUZ-1939-04	*Homo sapiens*	P2	Death Pit	1.7	1.00337E-07
ACL-6709 DOMUZ-2645-01	*Homo sapiens*	M3	Death Pit	1.8	1.57839E-07

Table AII.1 Results of Elemental Concentration Analyses

AII.6 Statistical Analyses

Samples from all contexts were compared with one another using a Mann-Whitney-Wilcoxon Test in R. This tests determines whether or not data samples come from distinct populations without assuming they are normally distributed. Procedures for this test are described in the R Package 3.4.0 (R Core Team and contributors worldwide 2016).

APPENDIX III: ISOTOPE DATA

AIII.1 Results from Strontium Analyses

ACL and Sample Number	Taxon	Tooth	Context	$^{87}Sr/^{86}Sr$
'ACL-5602 DOMUZ-3680-01'	Ovis/Capra	P3	Ditch	0.70799
'ACL-5603 DOMUZ-3680-02'	Ovis/Capra	P3	Ditch	0.70798
'ACL-5604 DOMUZ-3680-03'	Ovis/Capra	P3	Ditch	0.70784
'ACL-5605 DOMUZ-3680-04'	Ovis/Capra	P3	Ditch	0.70784
'ACL-5610 DOMUZ-3954-01'	Ovis/Capra	P4	Ditch	0.70792
'ACL-5611 DOMUZ-3929-01'	Ovis/Capra	M3	Ditch	0.70782
'ACL-5612 DOMUZ-3926-01'	Ovis/Capra	M3	Ditch	0.70802
'ACL-5613 DOMUZ-4020-01'	Ovis/Capra	P4	Ditch	0.70794
'ACL-5614 DOMUZ-4020-02'	Ovis/Capra	P4	Ditch	0.70789
'ACL-5619 DOMUZ-3852-01'	Ovis/Capra	P4	Ditch	0.70799
'ACL-5630 DOMUZ-3899-01'	Ovis/Capra	M3	Ditch	0.70762
'ACL-5631 DOMUZ-3889-01'	Ovis/Capra	P4	Ditch	0.70792
'ACL-5632 DOMUZ-3890-01'	Ovis/Capra	P3	Ditch	0.70767
'ACL-5616 DOMUZ-2542-01'	Ovis/Capra	M3	Death Pit	0.70805
'ACL-5617 DOMUZ-2542-02'	Ovis/Capra	M3	Death Pit	0.70805
ACL-5622 DOMUZ-2557-01'	Ovis/Capra	M3	Death Pit	0.70811
'ACL-5625 DOMUZ-2611-01'	Ovis/Capra	M3	Death Pit	0.70816
'ACL-5649 DOMUZ-3390-01'	Ovis/Capra	M3	Death Pit	0.70804
'ACL-5655 DOMUZ-1931-01'	Ovis/Capra	M3	Death Pit	0.70804
'ACL-5662 DOMUZ-2659-01'	Ovis/Capra	M3	Death Pit	0.70819
'ACL-5742 DOMUZ-1704-01'	Ovis/Capra	M3	Death Pit	0.70786
'ACL-5637 DOMUZ-1081-01'	Ovis/Capra	P4	Op III	0.70791
'ACL-5638 DOMUZ-1081-02'	Ovis/Capra	P4	Op III	0.70802
'ACL-5639 DOMUZ-1081-03'	Ovis/Capra	P4	Op III	0.70789
'ACL-5640 DOMUZ-1081-04'	Ovis/Capra	P4	Op III	0.70789
'ACL-5641 DOMUZ-1081-05'	Ovis/Capra	P4	Op III	0.70793
'ACL-5606 DOMUZ-2528-01'	Ovis/Capra	P4	Quotidian	0.70784
'ACL-5607 DOMUZ-2528-02'	Ovis/Capra	P4	Quotidian	0.70789
'ACL-5608 DOMUZ-2465-01'	Ovis/Capra	M3	Quotidian	0.70792
'ACL-5609 DOMUZ-2465-02'	Ovis/Capra	M3	Quotidian	0.70868
'ACL-5615 DOMUZ-2527-01'	Ovis/Capra	P4	Quotidian	0.70789
'ACL-5618 DOMUZ-2400-01'	Ovis/Capra	M3	Quotidian	0.7079
'ACL-5620 DOMUZ-2417-01'	Ovis/Capra	M2	Quotidian	0.70724
'ACL-5621 DOMUZ-2522-01'	Ovis/Capra	M3	Quotidian	0.70771
'ACL-5623 DOMUZ-2453-01'	Ovis/Capra	M3	Quotidian	0.70788
'ACL-5624 DOMUZ-2453-02'	Ovis/Capra	M3	Quotidian	0.70796
'ACL-5626 DOMUZ-2418-01'	Ovis/Capra	M1/2	Quotidian	0.70776
'ACL-5627 DOMUZ-2464-01'	Ovis/Capra	M2	Quotidian	0.70845
'ACL-5628 DOMUZ-2464-02'	Ovis/Capra	M2	Quotidian	0.71048
'ACL-5629 DOMUZ-2464-03'	Ovis/Capra	M2	Quotidian	0.70796
'ACL-5633 DOMUZ-2468-01'	Ovis/Capra	P4	Quotidian	0.70806
'ACL-5634 DOMUZ-2500-01'	Ovis/Capra	P4	Quotidian	0.70769
'ACL-5635 DOMUZ-2421-01'	Ovis/Capra	P4	Quotidian	0.70776
'ACL-5636 DOMUZ-2419-01'	Ovis/Capra	P4	Quotidian	0.70660
'ACL-5642 DOMUZ-0799-01'	Ovis/Capra	M3	Quotidian	0.70792
'ACL-5643 DOMUZ-0799-02'	Ovis/Capra	M3	Quotidian	0.70790
'ACL-5644 DOMUZ-0799-03'	Ovis/Capra	M3	Quotidian	0.70797

'ACL-5645 DOMUZ-0799-04'	Ovis/Capra	M3	Quotidian	0.70800
'ACL-5646 DOMUZ-0813-01'	Ovis/Capra	P4	Quotidian	0.70793
'ACL-5647DOMUZ1815-01'	Ovis/Capra	M3	Quotidian	0.70781
'ACL-5648 DOMUZ-1815-02'	Ovis/Capra	M3	Quotidian	0.70804
'ACL-5650 DOMUZ-0704-01'	Ovis/Capra	M3	Quotidian	0.70795
'ACL-5651 DOMUZ-0704-02'	Ovis/Capra	M3	Quotidian	0.70798
'ACL-5652 DOMUZ-0704-03'	Ovis/Capra	M3	Quotidian	0.70781
'ACL-5653 DOMUZ-0848-01'	Ovis/Capra	M3	Quotidian	0.70966
ACL-5654 DOMUZ-0848-02'	Ovis/Capra	M3	Quotidian	0.70808
'ACL-5656 DOMUZ-1809-01'	Ovis/Capra	M3	Quotidian	0.70793
'ACL-5657 DOMUZ0869-01'	Ovis/Capra	M3	Quotidian	0.70790
'ACL-5658 DOMUZ-2580-01'	Ovis/Capra	M1/2	Quotidian	0.70822
'ACL-5659 DOMUZ-2580-02'	Ovis/Capra	P4	Quotidian	0.70800
'ACL-5660 DOMUZ-2711-01'	Ovis/Capra	P4	Quotidian	0.70718
'ACL-5661 DOMUZ-2659-01'	Ovis/Capra	M3	Quotidian	0.70759
'ACL-5663 DOMUZ-2709-01'	Ovis/Capra	M3	Quotidian	0.70800
'ACL-5664 DOMUZ-2016-01'	Ovis/Capra	M3	Quotidian	0.7079
'ACL-5665 DOMUZ-2760-01'	Ovis/Capra	P4	Quotidian	0.70785
'ACL-5666 DOMUZ-2017-01'	Ovis/Capra	M1/2	Quotidian	0.70791
'ACL-5667 DOMUZ-2017-02'	Ovis/Capra	P4	Quotidian	0.70780
'ACL-5668 DOMUZ-2512-01'	Ovis/Capra	P4	Quotidian	0.70741
'ACL-5669 DOMUZ-2512-02'	Ovis/Capra	P4	Quotidian	0.70789
'ACL-5670 DOMUZ-2484-01'	Ovis/Capra	P4	Quotidian	0.70773
'ACL-5671 DOMUZ-1798-01'	Ovis/Capra	P4	Quotidian	0.70735
'ACL-5672 DOMUZ-1023-01'	Ovis/Capra	M2	Quotidian	0.70894
'ACL-5673 DOMUZ-2021-01'	Ovis/Capra	M2	Quotidian	0.70784
'ACL-5674 DOMUZ-2012-01'	Ovis/Capra	P4	Quotidian	0.70800
'ACL-5675 DOMUZ-2723-01'	Ovis/Capra	M3	Quotidian	0.70782

Table AIII.1 Caprine $^{87}Sr/^{86}Sr$ results N = 75, σ=0.00047

ACL and Sample Number	Taxon	Tooth	Context	$^{87}Sr/^{86}Sr$
'ACL-5729 DOMUZ-3680-07'	*Bos taurus*	P4	Ditch	0.70807
'ACL-5741 DOMUZ-3940-01'	*Bos taurus*	M3	Ditch	0.70781
'ACL-5743 DOMUZ-1931-02'	*Bos taurus*	M3	Death Pit	0.70787
'ACL-5744 DOMUZ-2656-01'	*Bos taurus*	M3	Death Pit	0.70832
'ACL-5745 DOMUZ-2542-03'	*Bos taurus*	M3	Death Pit	0.70911
'ACL-5738 DOMUZ-1081-09'	*Bos taurus*	P3	Op III	0.70872
'ACL-5739 DOMUZ-1081-10'	*Bos taurus*	P3	Op III	0.70797
'ACL-5740 DOMUZ-1081-11'	*Bos taurus*	P3	Op III	0.70870
'ACL-5712 DOMUZ-2465-04'	*Bos taurus*	M3	Quotidian	0.70781
'ACL-5713 DOMUZ-0799-06'	*Bos taurus*	M1/2	Quotidian	0.70802
'ACL-5714 DOMUZ-2528-03'	*Bos taurus*	M1/2	Quotidian	0.70790
'ACL-5715 DOMUZ-2017-04'	*Bos taurus*	M1/2	Quotidian	0.70785
'ACL-5716 DOMUZ-2512-03'	*Bos taurus*	M1/2	Quotidian	0.70784
'ACL-5717 DOMUZ-0869-03'	*Bos taurus*	premolar frag	Quotidian	0.70954
'ACL-5718 DOMUZ-1533-02'	*Bos taurus*	M1/2	Quotidian	0.70801
'ACL-5719 DOMUZ-2468-03'	*Bos taurus*	M3	Quotidian	0.70823
'ACL-5720 DOMUZ-2460-02'	*Bos taurus*	M1/2	Quotidian	0.70895
'ACL-5721 DOMUZ-0824-01'	*Bos taurus*	M3	Quotidian	0.70802
'ACL-5722 DOMUZ-1716-01'	*Bos taurus*	M1/2	Quotidian	0.70787
'ACL-5723 DOMUZ-2730-01'	*Bos taurus*	P4	Quotidian	0.70797
'ACL-5724 DOMUZ-2453-04'	*Bos taurus*	M2	Quotidian	0.70783
'ACL-5725 DOMUZ-2522-03'	*Bos taurus*	P4	Quotidian	0.70805
'ACL-5726 DOMUZ-2464-05'	*Bos taurus*	M3	Quotidian	0.70779
'ACL-5727 DOMUZ-2464-06'	*Bos taurus*	M3	Quotidian	0.70792
'ACL-5728 DOMUZ-2737-01'	*Bos taurus*	M1/2	Quotidian	0.70789
'ACL-5730 DOMUZ-2019-01'	*Bos taurus*	M2	Quotidian	0.70794
'ACL-5731 DOMUZ-2012-03'	*Bos taurus*	M1/2	Quotidian	0.70795
'ACL-5732 DOMUZ-2008-01'	*Bos taurus*	P3	Quotidian	0.70785
'ACL-5733 DOMUZ-2527-02'	*Bos taurus*	M1/2	Quotidian	0.70869
'ACL-5734 DOMUZ-2772-01'	*Bos taurus*	M1/2	Quotidian	0.70823
'ACL-5735 DOMUZ-2774-01'	*Bos taurus*	P3	Quotidian	0.70736
'ACL-5736 DOMUZ-2573-01'	*Bos taurus*	M1/2	Quotidian	0.70847
'ACL-5737 DOMUZ-2723-02'	*Bos taurus*	P4	Quotidian	0.70784
'ACL-5746 DOMUZ-1019-01'	*Bos taurus*	M3	Quotidian	0.71081
'ACL-5747 DOMUZ-1037-01'	*Bos taurus*	M1/2	Quotidian	0.70910
'ACL-5758 DOMUZ-0704-05'	*Bos taurus*	M1/2	Quotidian	0.70773
'ACL-5759 DOMUZ-0848-04'	*Bos taurus*	M1/2	Quotidian	0.71164

Table AIII.2 Cattle $^{87}Sr/^{86}Sr$ results N= 37; σ=0.00085

ACL and Sample Number	Taxon	Tooth	Context	$^{87}Sr/^{86}Sr$
ACL-5683 DOMUZ-3889-02'	*Sus scrofa*	M3	Ditch	0.70803
'ACL-5691 DOMUZ-3891-01'	*Sus scrofa*	M2	Ditch	0.70791
'ACL-5695 DOMUZ-4020-03'	*Sus scrofa*	P3	Ditch	0.70793
'ACL-5696 DOMUZ-3680-05'	*Sus scrofa*	M2	Ditch	0.70769
'ACL-5697 DOMUZ-3680-06'	*Sus scrofa*	M2	Ditch	0.70793
'ACL-5710 DOMUZ-3890-02'	*Sus scrofa*	P2	Ditch	0.70800
'ACL-5685 DOMUZ-1939-01'	*Sus scrofa*	M3	Death Pit	0.70796
'ACL-5698 DOMUZ-2649-01'	*Sus scrofa*	M3	Death Pit	0.70817
'ACL-5705 DOMUZ-1081-06'	*Sus scrofa*	M1	Op III Feast	0.70704
'ACL-5706-DOMUZ-1081-07'	*Sus scrofa*	M2	Op III Feast	0.70783
'ACL-5707 DOMUZ-1081-08'	*Sus scrofa*	M2	Op III Feast	0.70823
'ACL-5676 DOMUZ-2013-01'	*Sus scrofa*	M2	Quotidian	0.70788
ACL-5677DOMUZ2709-02'	*Sus scrofa*	M2	Quotidian	0.70797
'ACL-5678 DOMUZ-0848-03'	*Sus scrofa*	M2	Quotidian	0.70797
'ACL-5679 DOMUZ-1815-03'	*Sus scrofa*	M2	Quotidian	0.70776
'ACL-5680 DOMUZ-0799-05'	*Sus scrofa*	M2	Quotidian	0.70794
'ACL-5681 DOMUZ-1809-02'	*Sus scrofa*	M2	Quotidian	0.70794
'ACL-5682 DOMUZ-2744-01'	*Sus scrofa*	M2	Quotidian	0.70756
'ACL-5684 DOMUZ-2585-02'	*Sus scrofa*	M3	Quotidian	0.70771
'ACL-5686 DOMUZ-0813-02'	*Sus scrofa*	M3	Quotidian	0.70911
'ACL-5687 DOMUZ-0869-02'	*Sus scrofa*	M3	Quotidian	0.70791
'ACL-5688 DOMUZ-2016-02'	*Sus scrofa*	M3	Quotidian	0.70810
'ACL-5689 DOMUZ-2586-01'	*Sus scrofa*	M2	Quotidian	0.70789
ACL-5690 DOMUZ-2453-03'	*Sus scrofa*	P4	Quotidian	0.70989
'ACL-5692 DOMUZ-2017-03'	*Sus scrofa*	M3	Quotidian	0.70793
'ACL-5693 DOMUZ-2770-01'	*Sus scrofa*	M3	Quotidian	0.70801
'ACL-5694 DOMUZ-2014-01'	*Sus scrofa*	M2	Quotidian	0.70790
'ACL-5699 DOMUZ-2400-02'	*Sus scrofa*	M3	Quotidian	0.70788
'ACL-5700 DOMUZ-2465-03'	*Sus scrofa*	M3	Quotidian	0.70789
'ACL-5701 DOMUZ-2012-02'	*Sus scrofa*	P2	Quotidian	0.70783
'ACL-5702 DOMUZ-2012-02'	*Sus scrofa*	M1	Quotidian	0.70750
'ACL-5703 DOMUZ-2468-02'	*Sus scrofa*	M3	Quotidian	0.70784
'ACL-5704 DOMUZ-1533-01'	*Sus scrofa*	P3	Quotidian	0.71139
'ACL-5708 DOMUZ-0704-04'	*Sus scrofa*	M3	Quotidian	0.70781
'ACL-5709 DOMUZ-2464-04'	*Sus scrofa*	P3	Quotidian	0.70803
'ACL-5711 DOMUZ-2522-02'	*Sus scrofa*	M3	Quotidian	0.70819

Table AIII.3 Pig $^{87}Sr/^{86}Sr$ Results N=36; σ=0.0007189

ACL and Sample Number	Taxon	Tooth	Context	$^{87}Sr/^{86}Sr$
'ACL-6703 DOMUZ-2616-01'	*Homo sapiens*	M3	Death Pit	0.70822
'ACL-6704 DOMUZ-1939-03'	*Homo sapiens*	M2	Death Pit	0.70828
'ACL-6705 DOMUZ-1936-01'	*Homo sapiens*	M2	Death Pit	0.70800
'ACL-6706 DOMUZ-1719-01'	*Homo sapiens*	M1	Death Pit	0.70786
'ACL-6707 DOMUZ-1719-02'	*Homo sapiens*	M2	Death Pit	0.70797
'ACL-6708 DOMUZ-1939-04'	*Homo sapiens*	P2	Death Pit	0.70805
'ACL-6709 DOMUZ-2645-01'	*Homo sapiens*	M3	Death Pit	0.70791
'ACL-5754 DOMUZ-2650-01'	*Canis familiaris*	P2	Death Pit	0.70831

Table AIII.4 Human and Dog $^{87}Sr/^{86}Sr$ Results N=8; σ=0.00017

AIII.2 Results from Oxygen Analyses

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{18}O_{VPDB}$ (‰)	^{18}O sd	$\delta^{18}O_{VSMOW}$ (‰)
'ACL-5602 DOMUZ-3680-01'	Ovis/Capra	P3	Ditch	-0.84	0.12	30.04
'ACL-5603 DOMUZ-3680-02'	Ovis/Capra	P3	Ditch	-1.83	0.19	29.01
'ACL-5604 DOMUZ-3680-03'	Ovis/Capra	P3	Ditch	5.12	0.15	36.23
'ACL-5605 DOMUZ-3680-04'	Ovis/Capra	P3	Ditch	0.55	0.24	31.48
'ACL-5610 DOMUZ-3954-01'	Ovis/Capra	P4	Ditch	5.8	0.19	36.94
'ACL-5611 DOMUZ-3929-01'	Ovis/Capra	M3	Ditch	3.66	0.17	34.71
'ACL-5612 DOMUZ-3926-01'	Ovis/Capra	M3	Ditch	1.2	0.23	32.16
'ACL-5613 DOMUZ-4020-01'	Ovis/Capra	P4	Ditch	3.92	0.20	34.98
'ACL-5614 DOMUZ-4020-02'	Ovis/Capra	P4	Ditch	2.08	0.21	33.07
'ACL-5619 DOMUZ-3852-01'	Ovis/Capra	P4	Ditch	3.44	0.24	34.48
'ACL-5630 DOMUZ-3899-01'	Ovis/Capra	M3	Ditch	3.68	0.14	34.73
'ACL-5631 DOMUZ-3889-01'	Ovis/Capra	P4	Ditch	3.56	0.17	34.61
'ACL-5632 DOMUZ-3890-01'	Ovis/Capra	P3	Ditch	1.73	0.08	32.71
'ACL-5616 DOMUZ-2542-01'	Ovis/Capra	M3	Death Pit	2.03	0.24	33.02
'ACL-5617 DOMUZ-2542-02'	Ovis/Capra	M3	Death Pit	-1.1	0.19	29.77
ACL-5622 DOMUZ-2557-01'	Ovis/Capra	M3	Death Pit	3.47	0.15	34.52
'ACL-5625 DOMUZ-2611-01'	Ovis/Capra	M3	Death Pit	2.04	0.17	33.03
'ACL-5649 DOMUZ-3390-01'	Ovis/Capra	M3	Death Pit	4.68	0.19	35.77
'ACL-5655 DOMUZ-1931-01'	Ovis/Capra	M3	Death Pit	3.57	0.16	34.62
'ACL-5662 DOMUZ-2659-01'	Ovis/Capra	M3	Death Pit	-2.33	0.13	28.49
'ACL-5742 DOMUZ-1704-01'	Ovis/Capra	M3	Death Pit	-3.05	0.15	27.74
'ACL-5637 DOMUZ-1081-01'	Ovis/Capra	P4	Op III	4.43	0.14	35.51
'ACL-5638 DOMUZ-1081-02'	Ovis/Capra	P4	Op III	2.33	0.23	33.33
'ACL-5639 DOMUZ-1081-03'	Ovis/Capra	P4	Op III	2.83	0.14	33.85
'ACL-5640 DOMUZ-1081-04'	Ovis/Capra	P4	Op III	3.88	0.17	34.94
'ACL-5641 DOMUZ-1081-05'	Ovis/Capra	P4	Op III	1.13	0.10	32.08
'ACL-5606 DOMUZ-2528-01'	Ovis/Capra	P4	Quotidian	0.75	0.15	31.69
'ACL-5607 DOMUZ-2528-02'	Ovis/Capra	P4	Quotidian	5.8	0.14	36.94
'ACL-5608 DOMUZ-2465-01'	Ovis/Capra	M3	Quotidian	1.64	0.22	32.61
'ACL-5609 DOMUZ-2465-02'	Ovis/Capra	M3	Quotidian	-4.24	0.13	26.50
'ACL-5615 DOMUZ-2527-01'	Ovis/Capra	P4	Quotidian	4.74	0.20	35.84
'ACL-5618 DOMUZ-2400-01'	Ovis/Capra	M3	Quotidian	2.53	0.11	33.54
'ACL-5620 DOMUZ-2417-01'	Ovis/Capra	M2	Quotidian	3.31	0.11	34.35
'ACL-5621 DOMUZ-2522-01'	Ovis/Capra	M3	Quotidian	3.62	0.12	34.67
'ACL-5623 DOMUZ-2453-01'	Ovis/Capra	M3	Quotidian	2.53	0.10	33.54
'ACL-5624 DOMUZ-2453-02'	Ovis/Capra	M3	Quotidian	3.06	0.16	34.09
'ACL-5626 DOMUZ-2418-01'	Ovis/Capra	M1/2	Quotidian	6.23	0.19	37.38
'ACL-5627 DOMUZ-2464-01'	Ovis/Capra	M2	Quotidian	3.18	0.15	34.21
'ACL-5628 DOMUZ-2464-02'	Ovis/Capra	M2	Quotidian	2.15	0.12	33.14
'ACL-5629 DOMUZ-2464-03'	Ovis/Capra	M2	Quotidian	2.82	0.14	33.84
'ACL-5633 DOMUZ-2468-01'	Ovis/Capra	P4	Quotidian	7	0.13	38.18

'ACL-5634 DOMUZ-2500-01'	Ovis/Capra	P4	Quotidian	0.92	0.10	31.87
'ACL-5635 DOMUZ-2421-01'	Ovis/Capra	P4	Quotidian	3.32	0.17	34.36
'ACL-5636 DOMUZ-2419-01'	Ovis/Capra	P4	Quotidian	-0.71	0.15	30.17
'ACL-5642 DOMUZ-0799-01'	Ovis/Capra	M3	Quotidian	3.65	0.14	34.70
'ACL-5643 DOMUZ-0799-02'	Ovis/Capra	M3	Quotidian	2.61	0.14	33.62
'ACL-5644 DOMUZ-0799-03'	Ovis/Capra	M3	Quotidian	5.71	0.15	36.84
'ACL-5645 DOMUZ-0799-04'	Ovis/Capra	M3	Quotidian	4.28	0.10	35.36
'ACL-5646 DOMUZ-0813-01'	Ovis/Capra	P4	Quotidian	2.51	0.10	33.52
'ACL-5647DOMUZ-1815-01'	Ovis/Capra	M3	Quotidian	4.35	0.15	35.43
'ACL-5648 DOMUZ-1815-02'	Ovis/Capra	M3	Quotidian	3.78	0.11	34.84
'ACL-5650 DOMUZ-0704-01'	Ovis/Capra	M3	Quotidian	5.9	0.44	37.04
'ACL-5651 DOMUZ-0704-02'	Ovis/Capra	M3	Quotidian	0.93	0.20	31.88
'ACL-5652 DOMUZ-0704-03'	Ovis/Capra	M3	Quotidian	2.89	0.16	33.91
'ACL-5653 DOMUZ-0848-01'	Ovis/Capra	M3	Quotidian	2.79	0.07	33.81
'ACL-5654 DOMUZ-0848-02'	Ovis/Capra	M3	Quotidian	4.5	0.18	35.59
'ACL-5656 DOMUZ-1809-01'	Ovis/Capra	M3	Quotidian	2.87	0.11	33.89
'ACL-5657 DOMUZ0869-01'	Ovis/Capra	M3	Quotidian	1.5	0.12	32.47
'ACL-5658 DOMUZ-2580-01'	Ovis/Capra	M1/2	Quotidian	4.55	0.17	35.64
'ACL-5659 DOMUZ-2580-02'	Ovis/Capra	P4	Quotidian	1.01	0.25	31.96
'ACL-5660 DOMUZ-2711-01'	Ovis/Capra	P4	Quotidian	2.46	0.15	33.47
'ACL-5661 DOMUZ-2659-01'	Ovis/Capra	M3	Quotidian	2.15	0.19	33.14
'ACL-5663 DOMUZ-2709-01'	Ovis/Capra	M3	Quotidian	3.78	0.09	34.84
'ACL-5664 DOMUZ-2016-01'	Ovis/Capra	M3	Quotidian	5.96	0.18	37.10
'ACL-5665 DOMUZ-2760-01'	Ovis/Capra	P4	Quotidian	3.51	0.14	34.56
'ACL-5666 DOMUZ-2017-01'	Ovis/Capra	M1/2	Quotidian	4.4	0.17	35.48
'ACL-5667 DOMUZ-2017-02'	Ovis/Capra	P4	Quotidian	-0.38	0.13	30.52
'ACL-5668 DOMUZ-2512-01'	Ovis/Capra	P4	Quotidian	2.14	0.15	33.13
'ACL-5669 DOMUZ-2512-02'	Ovis/Capra	P4	Quotidian	2.33	0.07	33.33
'ACL-5670 DOMUZ-2484-01'	Ovis/Capra	P4	Quotidian	0.99	0.12	31.94
'ACL-5671 DOMUZ-1798-01'	Ovis/Capra	P4	Quotidian	0.67	0.18	31.61
'ACL-5672 DOMUZ-1023-01'	Ovis/Capra	M2	Quotidian	0.84	0.15	31.78
'ACL-5673 DOMUZ-2021-01'	Ovis/Capra	M2	Quotidian	1.18	0.14	32.14
'ACL-5674 DOMUZ-2012-01'	Ovis/Capra	P4	Quotidian	2.63	0.07	33.64
'ACL-5675 DOMUZ-2723-01'	Ovis/Capra	M3	Quotidian	7.51	0.12	38.71

Table AIII.5 Caprine $\delta^{18}O$ Results N=77; μ= 2.65 ‰ σ=2.22‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{18}O_{VPDB}$ (‰)	^{18}O sd	$\delta^{18}O_{VSMOW}$ (‰)
'ACL-5729 DOMUZ-3680-07'	*Bos taurus*	P4	Ditch	-4.32	0.11	26.42
'ACL-5741 DOMUZ-3940-01'	*Bos taurus*	M3	Ditch	-5.28	0.10	25.42
'ACL-5743 DOMUZ-1931-02'	*Bos taurus*	M3	Death Pit	-5.81	0.15	24.87
'ACL-5744 DOMUZ-2656-01'	*Bos taurus*	M3	Death Pit	-6.11	0.13	24.56
'ACL-5745 DOMUZ-2542-03'	*Bos taurus*	M3	Death Pit	-4.63	0.10	26.10
'ACL-5738 DOMUZ-1081-09'	*Bos taurus*	P3	Op III	-4.95	0.10	25.77
'ACL-5739 DOMUZ-1081-10'	*Bos taurus*	P3	Op III	-5.23	0.09	25.48
'ACL-5740 DOMUZ-1081-11'	*Bos taurus*	P3	Op III	-3.66	0.19	27.11
'ACL-5712 DOMUZ-2465-04'	*Bos taurus*	M3	Quotidian	-6.17	0.14	24.50
'ACL-5713 DOMUZ-0799-06'	*Bos taurus*	M1/2	Quotidian	-3.89	0.15	26.87
'ACL-5714 DOMUZ-2528-03'	*Bos taurus*	M1/2	Quotidian	-4.04	0.11	26.71
'ACL-5715 DOMUZ-2017-04'	*Bos taurus*	M1/2	Quotidian	-5.12	0.18	25.59
'ACL-5716 DOMUZ-2512-03'	*Bos taurus*	M1/2	Quotidian	-4.08	0.07	26.67
'ACL-5717 DOMUZ-0869-03'	*Bos taurus*	premolar	Quotidian	-1.43	0.17	29.42
'ACL-5718 DOMUZ-1533-02'	*Bos taurus*	M1/2	Quotidian	-4.6	0.11	26.13
'ACL-5719 DOMUZ-2468-03'	*Bos taurus*	M3	Quotidian	-3.47	0.11	27.30
'ACL-5720 DOMUZ-2460-02'	*Bos taurus*	M1/2	Quotidian	-4.57	0.14	26.16
'ACL-5721 DOMUZ-0824-01'	*Bos taurus*	M3	Quotidian	-4.7	0.12	26.03
'ACL-5722 DOMUZ-1716-01'	*Bos taurus*	M1/2	Quotidian	-6.3	0.27	24.36
'ACL-5723 DOMUZ-2730-01'	*Bos taurus*	P4	Quotidian	-5.22	0.13	25.49
'ACL-5724 DOMUZ-2453-04'	*Bos taurus*	M2	Quotidian	-4.26	0.12	26.48
'ACL-5725 DOMUZ-2522-03'	*Bos taurus*	P4	Quotidian	-4.17	0.20	26.58
'ACL-5726 DOMUZ-2464-05'	*Bos taurus*	M3	Quotidian	-6.19	0.15	24.48
'ACL-5727 DOMUZ-2464-06'	*Bos taurus*	M3	Quotidian	-4.31	0.16	26.43
'ACL-5728 DOMUZ-2737-01'	*Bos taurus*	M1/2	Quotidian	-4.81	0.37	25.91
'ACL-5730 DOMUZ-2019-01'	*Bos taurus*	M2	Quotidian	-5.56	0.15	25.13
'ACL-5731 DOMUZ-2012-03'	*Bos taurus*	M1/2	Quotidian	-4.01	0.25	26.74
'ACL-5732 DOMUZ-2008-01'	*Bos taurus*	P3	Quotidian	-3.98	0.11	26.77
'ACL-5733 DOMUZ-2527-02'	*Bos taurus*	M1/2	Quotidian	-2.41	0.14	28.41
'ACL-5734 DOMUZ-2772-01'	*Bos taurus*	M1/2	Quotidian	-6.84	0.10	23.80
'ACL-5735 DOMUZ-2774-01'	*Bos taurus*	P3	Quotidian	-5.27	0.15	25.43
'ACL-5736 DOMUZ-2573-01'	*Bos taurus*	M1/2	Quotidian	-5.28	0.09	25.42
'ACL-5737 DOMUZ-2723-02'	*Bos taurus*	P4	Quotidian	-4.72	0.18	26.01
'ACL-5746 DOMUZ-1019-01'	*Bos taurus*	M3	Quotidian	-5.07	0.10	25.64
'ACL-5747 DOMUZ-1037-01'	*Bos taurus*	M1/2	Quotidian	-5.69	0.15	25.00
'ACL-5759 DOMUZ-0848-04'	*Bos taurus*	M1/2	Quotidian	-5.91	0.16	24.77

Table AIII.6 Cattle δ^{18}O Results N=36; σ=1.09‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{18}O_{VPDB}$ (‰)	^{18}O sd	$\delta^{18}O_{VSMOW}$ (‰)
'ACL-5683 DOMUZ-3889-02'	*Sus scrofa*	M3	Ditch	-4.75	0.15	25.97
'ACL-5691 DOMUZ-3891-01'	*Sus scrofa*	M2	Ditch	-3.67	0.15	27.10
'ACL-5695 DOMUZ-4020-03'	*Sus scrofa*	P3	Ditch	-4.82	0.15	25.90
'ACL-5696 DOMUZ-3680-05'	*Sus scrofa*	M2	Ditch	-5.5	0.10	25.19
'ACL-5697 DOMUZ-3680-06'	*Sus scrofa*	M2	Ditch	-4.85	0.09	25.87
'ACL-5710 DOMUZ-3890-02'	*Sus scrofa*	P2	Ditch	-4.46	0.12	26.28
'ACL-5685 DOMUZ-1939-01'	*Sus scrofa*	M3	Death Pit	-4.42	0.20	26.32
'ACL-5698 DOMUZ-2649-01'	*Sus scrofa*	M3	Death Pit	-4.33	0.19	26.41
'ACL-5705 DOMUZ-1081-06'	*Sus scrofa*	M1	Op III	-2.67	0.11	28.14
'ACL-5706 DOMUZ-1081-07'	*Sus scrofa*	M2	Op III	-5.46	0.10	25.24
'ACL-5707 DOMUZ-1081-08'	*Sus scrofa*	M2	Op III	-6.93	0.13	23.71
'ACL-5676 DOMUZ-2013-01'	*Sus scrofa*	M2	Quotidian	-0.91	0.17	29.96
'ACL-5677 DOMUZ2709-02'	*Sus scrofa*	M2	Quotidian	-0.54	0.10	30.35
'ACL-5678 DOMUZ-0848-03'	*Sus scrofa*	M2	Quotidian	-1.89	0.04	28.95
'ACL-5679 DOMUZ-1815-03'	*Sus scrofa*	M2	Quotidian	-6.12	0.12	24.55
'ACL-5680 DOMUZ-0799-05'	*Sus scrofa*	M2	Quotidian	-1.8	0.15	29.04
'ACL-5681 DOMUZ-1809-02'	*Sus scrofa*	M2	Quotidian	-1.34	0.13	29.52
'ACL-5682 DOMUZ-2744-01'	*Sus scrofa*	M2	Quotidian	-3.2	0.10	27.58
'ACL-5684 DOMUZ-2585-02'	*Sus scrofa*	M3	Quotidian	-4.31	0.18	26.43
'ACL-5686 DOMUZ-0813-02'	*Sus scrofa*	M3	Quotidian	-6.25	0.09	24.42
'ACL-5687 DOMUZ-0869-02'	*Sus scrofa*	M3	Quotidian	-4.38	0.20	26.36
'ACL-5688 DOMUZ-2016-02'	*Sus scrofa*	M3	Quotidian	-4.98	0.32	25.74
'ACL-5689 DOMUZ-2586-01'	*Sus scrofa*	M2	Quotidian	-4.55	0.12	26.18
'ACL-5690 DOMUZ-2453-03'	*Sus scrofa*	P4	Quotidian	-5.41	0.15	25.29
'ACL-5692 DOMUZ-2017-03'	*Sus scrofa*	M3	Quotidian	-4.11	0.18	26.64
'ACL-5693 DOMUZ-2770-01'	*Sus scrofa*	M3	Quotidian	-4.63	0.13	26.10
'ACL-5694 DOMUZ-2014-01'	*Sus scrofa*	M2	Quotidian	-3.77	0.06	26.99
'ACL-5699 DOMUZ-2400-02'	*Sus scrofa*	M3	Quotidian	-6.03	0.18	24.64
'ACL-5700 DOMUZ-2465-03'	*Sus scrofa*	M3	Quotidian	-4.9	0.37	25.82
'ACL-5701 DOMUZ-2012-02'	*Sus scrofa*	P2	Quotidian	-4.65	0.19	26.08
'ACL-5702 DOMUZ-2012-02'	*Sus scrofa*	M1	Quotidian	-4.1	0.12	26.65
'ACL-5703 DOMUZ-2468-02'	*Sus scrofa*	M3	Quotidian	-5.8	0.14	24.88
'ACL-5704 DOMUZ-1533-01'	*Sus scrofa*	P3	Quotidian	-6.04	0.15	24.63
'ACL-5708 DOMUZ-0704-04'	*Sus scrofa*	M3	Quotidian	-6.56	0.12	24.09
'ACL-5709 DOMUZ-2464-04'	*Sus scrofa*	P3	Quotidian	-5.74	0.16	24.95
'ACL-5711 DOMUZ-2522-02'	*Sus scrofa*	M3	Quotidian	-3.52	0.17	27.25

Table AIII.7 Pig $\delta^{18}O$ Results N=36; σ=1.58‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{18}O_{VPDB}$ (‰)	^{18}O sd	$\delta^{18}O_{VSMOW}$ (‰)
'ACL-6703 DOMUZ-2616-01'	*Homo sapiens*	M3	Death Pit	-3.98	0.21	26.81
'ACL-6704 DOMUZ-1939-03'	*Homo sapiens*	M2	Death Pit	-5.29	0.19	25.46
'ACL-6705 DOMUZ-1936-01'	*Homo sapiens*	M2	Death Pit	-2.94	0.11	27.88
'ACL-6706 DOMUZ-1719-01'	*Homo sapiens*	M1	Death Pit	-2.87	0.36	27.95
'ACL-6707 DOMUZ-1719-02'	*Homo sapiens*	M2	Death Pit	-3.46	0.18	27.34
'ACL-6708 DOMUZ-1939-04'	*Homo sapiens*	P2	Death Pit	-5.04	0.05	25.71
'ACL-6709 DOMUZ-2645-01'	*Homo sapiens*	M3	Death Pit	-4.39	0.17	26.38
'ACL-5754 DOMUZ-2650-01'	*Canis familiaris*	P2	Death Pit	-4.88	0.06	25.88

Table AIII.8 Human and Dog $\delta^{18}O$ Results N=8

AIII.III Results from Carbon Analyses

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{13}C_{VPDB}$	$^{13}C\_sd$	Est. %C4
'ACL-5602 DOMUZ-3680-01'	Ovis/Capra	P3	Ditch	-6.76	0.08	42.7
'ACL-5603 DOMUZ-3680-02'	Ovis/Capra	P3	Ditch	-10.18	0.11	17.5
'ACL-5604 DOMUZ-3680-03'	Ovis/Capra	P3	Ditch	-11.35	0.12	9.0
'ACL-5605 DOMUZ-3680-04'	Ovis/Capra	P3	Ditch	-9.66	0.16	21.4
'ACL-5610 DOMUZ-3954-01'	Ovis/Capra	P4	Ditch	-9.56	0.20	22.1
'ACL-5611 DOMUZ-3929-01'	Ovis/Capra	M3	Ditch	-8.38	0.13	30.8
'ACL-5612 DOMUZ-3926-01'	Ovis/Capra	M3	Ditch	-11.85	0.26	5.3
'ACL-5613 DOMUZ-4020-01'	Ovis/Capra	P4	Ditch	-9.69	0.21	21.1
'ACL-5614 DOMUZ-4020-02'	Ovis/Capra	P4	Ditch	-5.99	0.13	48.3
'ACL-5619 DOMUZ-3852-01'	Ovis/Capra	P4	Ditch	-6.57	0.12	44.0
'ACL-5630 DOMUZ-3899-01'	Ovis/Capra	M3	Ditch	-12.16	0.14	3.0
'ACL-5631 DOMUZ-3889-01'	Ovis/Capra	P4	Ditch	-12.35	0.15	1.6
'ACL-5632 DOMUZ-3890-01'	Ovis/Capra	P3	Ditch	-11.04	0.12	11.2
'ACL-5616 DOMUZ-2542-01'	Ovis/Capra	M3	Death Pit	-11.03	0.16	11.3
'ACL-5617 DOMUZ-2542-02'	Ovis/Capra	M3	Death Pit	-10.98	0.20	11.7
'ACL-5622 DOMUZ-2557-01'	Ovis/Capra	M3	Death Pit	-7.59	0.16	36.6
'ACL-5625 DOMUZ-2611-01'	Ovis/Capra	M3	Death Pit	-9.02	0.17	26.1
'ACL-5649 DOMUZ-3390-01'	Ovis/Capra	M3	Death Pit	-10.73	0.08	13.5
'ACL-5655 DOMUZ-1931-01'	Ovis/Capra	M3	Death Pit	-11.58	0.12	7.3
'ACL-5662 DOMUZ-2659-01'	Ovis/Capra	M3	Death Pit	-12.57	0.14	0.0
'ACL-5742 DOMUZ-1704-01'	Ovis/Capra	M3	Death Pit	-11.13	0.15	10.6
'ACL-5637 DOMUZ-1081-01'	Ovis/Capra	P4	Op III	-8.48	0.12	30.0
'ACL-5638 DOMUZ-1081-02'	Ovis/Capra	P4	Op III	-11.53	0.17	7.6
'ACL-5639 DOMUZ-1081-03'	Ovis/Capra	P4	Op III	-6.84	0.14	42.1
'ACL-5640 DOMUZ-1081-04'	Ovis/Capra	P4	Op III	-13.03	0.16	-3.4
'ACL-5641 DOMUZ-1081-05'	Ovis/Capra	P4	Op III	-12.31	0.12	1.9
'ACL-5606 DOMUZ-2528-01'	Ovis/Capra	P4	Quotidian	-11.78	0.13	5.8
'ACL-5607 DOMUZ-2528-02'	Ovis/Capra	P4	Quotidian	-8.91	0.14	26.9
'ACL-5608 DOMUZ-2465-01'	Ovis/Capra	M3	Quotidian	-10.97	0.18	11.7
'ACL-5609 DOMUZ-2465-02'	Ovis/Capra	M3	Quotidian	-9.70	0.16	21.1
'ACL-5615 DOMUZ-2527-01'	Ovis/Capra	P4	Quotidian	-11.33	0.14	9.1
'ACL-5618 DOMUZ-2400-01'	Ovis/Capra	M3	Quotidian	-10.77	0.14	13.2
'ACL-5620 DOMUZ-2417-01'	Ovis/Capra	M2	Quotidian	-11.43	0.13	8.4
'ACL-5621 DOMUZ-2522-01'	Ovis/Capra	M3	Quotidian	-10.08	0.13	18.3
'ACL-5623 DOMUZ-2453-01'	Ovis/Capra	M3	Quotidian	-10.16	0.11	17.7
'ACL-5624 DOMUZ-2453-02'	Ovis/Capra	M3	Quotidian	-11.39	0.17	8.7
'ACL-5626 DOMUZ-2418-01'	Ovis/Capra	M1/2	Quotidian	-9.63	0.18	21.6
'ACL-5627 DOMUZ-2464-01'	Ovis/Capra	M2	Quotidian	-11.67	0.08	6.6
'ACL-5628 DOMUZ-2464-02'	Ovis/Capra	M2	Quotidian	-9.39	0.16	23.3
'ACL-5629 DOMUZ-2464-03'	Ovis/Capra	M2	Quotidian	-10.48	0.07	15.3
'ACL-5633 DOMUZ-2468-01'	Ovis/Capra	P4	Quotidian	-11.59	0.15	7.2
'ACL-5634 DOMUZ-2500-01'	Ovis/Capra	P4	Quotidian	-10.65	0.14	14.1
'ACL-5635 DOMUZ-2421-01'	Ovis/Capra	P4	Quotidian	-9.83	0.14	20.1
'ACL-5636 DOMUZ-2419-01'	Ovis/Capra	P4	Quotidian	-12.34	0.11	1.7
'ACL-5642 DOMUZ-0799-01'	Ovis/Capra	M3	Quotidian	-11.16	0.08	10.4

'ACL-5643 DOMUZ-0799-02'	Ovis/Capra	M3	Quotidian	-10.57	0.13	14.7
'ACL-5644 DOMUZ-0799-03'	Ovis/Capra	M3	Quotidian	-11.43	0.18	8.4
'ACL-5645 DOMUZ-0799-04'	Ovis/Capra	M3	Quotidian	-11.53	0.08	7.6
'ACL-5646 DOMUZ-0813-01'	Ovis/Capra	P4	Quotidian	-12.37	0.14	1.5
'ACL-5647DOMUZ1815-01'	Ovis/Capra	M3	Quotidian	-9.56	0.14	22.1
'ACL-5648 DOMUZ-1815-02'	Ovis/Capra	M3	Quotidian	-12.16	0.16	3.0
'ACL-5650 DOMUZ-0704-01'	Ovis/Capra	M3	Quotidian	-9.31	0.14	23.9
'ACL-5651 DOMUZ-0704-02'	Ovis/Capra	M3	Quotidian	-11.97	0.19	4.4
'ACL-5652 DOMUZ-0704-03'	Ovis/Capra	M3	Quotidian	-9.62	0.12	21.7
'ACL-5653 DOMUZ-0848-01'	Ovis/Capra	M3	Quotidian	-11.47	0.19	8.1
ACL-5654 DOMUZ-0848-02'	Ovis/Capra	M3	Quotidian	-11.11	0.05	10.7
'ACL-5656 DOMUZ-1809-01'	Ovis/Capra	M3	Quotidian	-10.64	0.15	14.2
'ACL-5657 DOMUZ0869-01'	Ovis/Capra	M3	Quotidian	-11.81	0.12	5.6
'ACL-5658 DOMUZ-2580-01'	Ovis/Capra	M1/2	Quotidian	-11.26	0.19	9.6
'ACL-5659 DOMUZ-2580-02'	Ovis/Capra	P4	Quotidian	-12.54	0.09	0.2
'ACL-5660 DOMUZ-2711-01'	Ovis/Capra	P4	Quotidian	-11.65	0.14	6.8
'ACL-5661 DOMUZ-2659-01'	Ovis/Capra	M3	Quotidian	-11.85	0.18	5.3
'ACL-5663 DOMUZ-2709-01'	Ovis/Capra	M3	Quotidian	-8.08	0.18	33.0
'ACL-5664 DOMUZ-2016-01'	Ovis/Capra	M3	Quotidian	-11.59	0.07	7.2
'ACL-5665 DOMUZ-2760-01'	Ovis/Capra	P4	Quotidian	-8.05	0.09	33.2
'ACL-5666 DOMUZ-2017-01'	Ovis/Capra	M1/2	Quotidian	-9.82	0.12	20.2
'ACL-5667 DOMUZ-2017-02'	Ovis/Capra	P4	Quotidian	-12.29	0.15	2.1
'ACL-5668 DOMUZ-2512-01'	Ovis/Capra	P4	Quotidian	-11.30	0.11	9.3
'ACL-5669 DOMUZ-2512-02'	Ovis/Capra	P4	Quotidian	-10.01	0.09	18.8
'ACL-5670 DOMUZ-2484-01'	Ovis/Capra	P4	Quotidian	-11.40	0.17	8.6
'ACL-5671 DOMUZ-1798-01'	Ovis/Capra	P4	Quotidian	-11.38	0.17	8.7
'ACL-5672 DOMUZ-1023-01'	Ovis/Capra	M2	Quotidian	-12.22	0.16	2.6
'ACL-5673 DOMUZ-2021-01'	Ovis/Capra	M2	Quotidian	-11.16	0.10	10.4
'ACL-5674 DOMUZ-2012-01'	Ovis/Capra	P4	Quotidian	-12.25	0.11	2.4
'ACL-5675 DOMUZ-2723-01'	Ovis/Capra	M3	Quotidian	-8.43	0.11	30.4

Table AIII.9 Caprine $\delta^{13}C$ Results N=77; σ=1.56‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{13}C_{VPDB}$	13C_sd	Est. %C4
'ACL-5729 DOMUZ-3680-07'	*Bos taurus*	P4	Ditch	-6.79	0.14	42.4
'ACL-5741 DOMUZ-3940-01'	*Bos taurus*	M3	Ditch	-7.59	0.10	36.6
'ACL-5743 DOMUZ-1931-02'	*Bos taurus*	M3	Death Pit	-7.94	0.15	34.0
'ACL-5744 DOMUZ-2656-01'	*Bos taurus*	M3	Death Pit	-6.35	0.21	45.7
'ACL-5745 DOMUZ-2542-03'	*Bos taurus*	M3	Death Pit	-9.77	0.16	20.6
'ACL-5738 DOMUZ-1081-09'	*Bos taurus*	P3	Op III	-6.87	0.16	41.8
'ACL-5739 DOMUZ-1081-10'	*Bos taurus*	P3	Op III	-6.54	0.28	44.3
'ACL-5740 DOMUZ-1081-11'	*Bos taurus*	P3	Op III	-7.87	0.18	34.5
'ACL-5712 DOMUZ-2465-04'	*Bos taurus*	M3	Quotidian	-9.03	0.13	26.0
'ACL-5713 DOMUZ-0799-06'	*Bos taurus*	M1/2	Quotidian	-8.47	0.12	30.1
'ACL-5714 DOMUZ-2528-03'	*Bos taurus*	M1/2	Quotidian	-5.52	0.17	51.8
'ACL-5715 DOMUZ-2017-04'	*Bos taurus*	M1/2	Quotidian	-9.36	0.14	23.6
'ACL-5716 DOMUZ-2512-03'	*Bos taurus*	M1/2	Quotidian	-9.64	0.08	21.5
'ACL-5717 DOMUZ-0869-03'	*Bos taurus*	premolar	Quotidian	-7.39	0.19	38.0
'ACL-5718 DOMUZ-1533-02'	*Bos taurus*	M1/2	Quotidian	-7.98	0.12	33.7
'ACL-5719 DOMUZ-2468-03'	*Bos taurus*	M3	Quotidian	-8.51	0.14	29.8
'ACL-5720 DOMUZ-2460-02'	*Bos taurus*	M1/2	Quotidian	-7.21	0.18	39.3
'ACL-5721 DOMUZ-0824-01'	*Bos taurus*	M3	Quotidian	-6.47	0.10	44.8
'ACL-5722 DOMUZ-1716-01'	*Bos taurus*	M1/2	Quotidian	-8.39	0.20	30.7
'ACL-5723 DOMUZ-2730-01'	*Bos taurus*	P4	Quotidian	-4.91	0.07	56.2
'ACL-5724 DOMUZ-2453-04'	*Bos taurus*	M2	Quotidian	-7.16	0.15	39.7
'ACL-5725 DOMUZ-2522-03'	*Bos taurus*	P4	Quotidian	-6.21	0.09	46.7
'ACL-5726 DOMUZ-2464-05'	*Bos taurus*	M3	Quotidian	-9.70	0.12	21.1
'ACL-5727 DOMUZ-2464-06'	*Bos taurus*	M3	Quotidian	-8.36	0.16	30.9
'ACL-5728 DOMUZ-2737-01'	*Bos taurus*	M1/2	Quotidian	-11.21	0.15	10.0
'ACL-5730 DOMUZ-2019-01'	*Bos taurus*	M2	Quotidian	-8.80	0.12	27.7
'ACL-5731 DOMUZ-2012-03'	*Bos taurus*	M1/2	Quotidian	-6.85	0.20	42.0
'ACL-5732 DOMUZ-2008-01'	*Bos taurus*	P3	Quotidian	-7.93	0.14	34.1
'ACL-5733 DOMUZ-2527-02'	*Bos taurus*	M1/2	Quotidian	-6.79	0.11	42.4
'ACL-5734 DOMUZ-2772-01'	*Bos taurus*	M1/2	Quotidian	-8.94	0.15	26.6
'ACL-5735 DOMUZ-2774-01'	*Bos taurus*	P3	Quotidian	-9.99	0.15	18.9
'ACL-5736 DOMUZ-2573-01'	*Bos taurus*	M1/2	Quotidian	-10.70	0.11	13.7
'ACL-5737 DOMUZ-2723-02'	*Bos taurus*	P4	Quotidian	-8.36	0.17	30.9
'ACL-5746 DOMUZ-1019-01'	*Bos taurus*	M3	Quotidian	-4.64	0.15	58.2
'ACL-5747 DOMUZ-1037-01'	*Bos taurus*	M1/2	Quotidian	-9.34	0.17	23.7
'ACL-5759 DOMUZ-0848-04'	*Bos taurus*	M1/2	Quotidian	-5.41	0.10	52.6

Table AIII.10 Cattle $\delta^{13}C$ Results N=36; σ=1.59‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{13}C_{VPDB}$	13C_sd	Est. %C4
'ACL-5683 DOMUZ-3889-02'	*Sus scrofa*	M3	Ditch	-11.01	0.21	17.3
'ACL-5691 DOMUZ-3891-01'	*Sus scrofa*	M2	Ditch	-11.11	0.19	16.6
'ACL-5695 DOMUZ-4020-03'	*Sus scrofa*	P3	Ditch	-11.61	0.14	12.9
'ACL-5696 DOMUZ-3680-05'	*Sus scrofa*	M2	Ditch	-11.57	0.08	13.2
'ACL-5697 DOMUZ-3680-06'	*Sus scrofa*	M2	Ditch	-10.75	0.14	19.2
'ACL-5710 DOMUZ-3890-02'	*Sus scrofa*	P2	Ditch	-12.18	0.14	8.7
'ACL-5685 DOMUZ-1939-01'	*Sus scrofa*	M3	Death Pit	-10.67	0.17	19.8
'ACL-5698 DOMUZ-2649-01'	*Sus scrofa*	M3	Death Pit	-12.87	0.16	3.7
'ACL-5705 DOMUZ-1081-06'	*Sus scrofa*	M1	Op III Feast	-12.50	0.22	6.4
'ACL-5706 DOMUZ-1081-07'	*Sus scrofa*	M2	Op III Feast	-11.35	0.18	14.8
'ACL-5707 DOMUZ-1081-08'	*Sus scrofa*	M2	Op III Feast	-9.99	0.11	24.8
'ACL-5676 DOMUZ-2013-01'	*Sus scrofa*	M2	Quotidian	-9.98	0.11	24.9
'ACL-5677 DOMUZ2709-02'	*Sus scrofa*	M2	Quotidian	-11.72	0.10	12.1
'ACL-5678 DOMUZ-0848-03'	*Sus scrofa*	M2	Quotidian	-12.30	0.10	7.9
'ACL-5679 DOMUZ-1815-03'	*Sus scrofa*	M2	Quotidian	-11.85	0.05	11.2
'ACL-5680 DOMUZ-0799-05'	*Sus scrofa*	M2	Quotidian	-11.42	0.15	14.3
'ACL-5681 DOMUZ-1809-02'	*Sus scrofa*	M2	Quotidian	-11.84	0.32	11.2
'ACL-5682 DOMUZ-2744-01'	*Sus scrofa*	M2	Quotidian	-12.22	0.16	8.4
'ACL-5684 DOMUZ-2585-02'	*Sus scrofa*	M3	Quotidian	-10.84	0.08	18.6
'ACL-5686 DOMUZ-0813-02'	*Sus scrofa*	M3	Quotidian	-11.54	0.07	13.4
'ACL-5687 DOMUZ-0869-02'	*Sus scrofa*	M3	Quotidian	-11.58	0.27	13.1
'ACL-5688 DOMUZ-2016-02'	*Sus scrofa*	M3	Quotidian	-11.90	0.14	10.8
'ACL-5689 DOMUZ-2586-01'	*Sus scrofa*	M2	Quotidian	-11.10	0.12	16.7
ACL-5690 DOMUZ-2453-03'	*Sus scrofa*	P4	Quotidian	-11.28	0.16	15.3
'ACL-5692 DOMUZ-2017-03'	*Sus scrofa*	M3	Quotidian	-12.34	0.15	7.6
'ACL-5693 DOMUZ-2770-01'	*Sus scrofa*	M3	Quotidian	-11.06	0.12	17.0
'ACL-5694 DOMUZ-2014-01'	*Sus scrofa*	M2	Quotidian	-12.22	0.09	8.4
'ACL-5699 DOMUZ-2400-02'	*Sus scrofa*	M3	Quotidian	-11.19	0.17	16.0
'ACL-5700 DOMUZ-2465-03'	*Sus scrofa*	M3	Quotidian	-10.02	0.30	24.6
'ACL-5701 DOMUZ-2012-02'	*Sus scrofa*	P2	Quotidian	-12.07	0.18	9.5
'ACL-5702 DOMUZ-2012-02'	*Sus scrofa*	M1	Quotidian	-13.57	0.16	-1.5
'ACL-5703 DOMUZ-2468-02'	*Sus scrofa*	M3	Quotidian	-10.37	0.13	22.0
'ACL-5704 DOMUZ-1533-01'	*Sus scrofa*	P3	Quotidian	-12.02	0.11	9.9
'ACL-5708 DOMUZ-0704-04'	*Sus scrofa*	M3	Quotidian	-10.81	0.10	18.8
'ACL-5709 DOMUZ-2464-04'	*Sus scrofa*	P3	Quotidian	-11.79	0.12	11.6
'ACL-5711 DOMUZ-2522-02'	*Sus scrofa*	M3	Quotidian	-11.65	0.21	12.6

Table AIII.11 Pig $\delta^{13}C$ Results N=36, σ=0.79‰

ACL and Sample Number	Taxon	Tooth	Context	$\delta^{13}C_{VPDB}$	13C_sd
'ACL-6703 DOMUZ-2616-01'	*Homo sapien*	M3	Death Pit	-13.05	0.12
'ACL-6704 DOMUZ-1939-03'	*Homo sapien*	M2	Death Pit	-12.09	0.10
'ACL-6705 DOMUZ-1936-01'	*Homo sapien*	M2	Death Pit	-11.96	0.06
'ACL-6706 DOMUZ-1719-01'	*Homo sapien*	M1	Death Pit	-13.68	0.11
'ACL-6707 DOMUZ-1719-02'	*Homo sapien*	M2	Death Pit	-12.69	0.10
'ACL-6708 DOMUZ-1939-04'	*Homo sapien*	P4	Death Pit	-12.67	0.09
'ACL-6709 DOMUZ-2645-01'	*Homo sapien*	M3	Death Pit	-11.90	0.13
'ACL-5754 DOMUZ-2650-01'	*Canis familiaris*	P2	Death Pit	-12.51	0.15

Table AIII.12 Human and Dog $\delta^{13}C$ Results N=8

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