Revisiting Neolithic Caprine Exploitation at Suberde, Turkey

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This paper addresses the nature of sheep and goat exploitation at the Aceramic Neolithic site of Suberde, Turkey. Although previously interpreted as a Neolithic hunters’ village, new demographic and measurement data indicate that the sheep and probably goats at Suberde represent the earliest appearance of managed populations in the Beşêhir region of central Anatolia. Kill-off data indicate that the caprines were carefully selected for slaughter within a narrow age range, while measurement data provide evidence for size diminution, a feature commonly seen in domestic populations. There is no evidence, however, to indicate that caprine management included the intensive culling of young males, a feature which is often considered to be characteristic of herding economies. This divergence from the expectations of various ethnographic models of pastoral management may represent highly localized “experimental” caprine management strategies in the earliest Neolithic settlements of central Anatolia.

Introduction

Forty years ago Dexter Perkins and Patricia Daly published a brief but important report describing animal exploitation at the site of Suberde, a late Aceramic Neolithic settlement in the Beşêhir region of south central Anatolia dating to the mid–late 8th millennium B.C. (Perkins and Daly 1968). Although this now classic paper is often cited for its innovative interpretations of faunal data, particularly with regard to the discussion of skeletal part transport costs and the so-called “schlepp effect” (Perkins and Daly 1968: 104), it also represents an important and early contribution to the study of Neolithic animal exploitation and domestication.

In their study of the faunal remains Perkins and Daly (1968) argued that sheep, goats, cattle, and pigs at Suberde were wild and that the dog was the only domestic animal present at the site. The site was therefore described as “an unusual example” (Bordaz 1969: 60) of a Neolithic hunters’ village. Suberde was thought to represent a community of settled farmers or collectors “who relied for their subsistence in large measure on the hunting of animals” (Bordaz 1969: 60), comparable to Epi-palaeolithic cultures in the Near East such as the Natufian and Mureybian.

As the earliest known Neolithic site in the Beşêhir region, this interpretation of the subsistence economy at Suberde has important implications for understanding the processes by which Neolithic lifeways and technologies spread into central Anatolia and beyond (see Bellwood and Renfrew 2002; Harris 1996; Price and Gebauer 1995).

As more data have accumulated over the four decades since 1968, the interpretation of Suberde as a late Aceramic Neolithic hunters’ village seems increasingly problematic. This is partly due to the fact that neither the excavation itself, nor the work of the specialists involved in the project, have ever been published in detail. In addition, the analytical models (below) that led Perkins and Daly to conclude that Suberde represents a hunters’ village have been seriously questioned (Martin, Russell, and Caruthers 2002; Payne 1972). Finally, recent archaeofaunal studies have resulted in a detailed regional picture of the process of animal domestication, providing a regional context for the Suberde data that was nonexistent when the original study was carried out.

Current research suggests that sheep and goats first came under human control in adjacent regions almost a millennium before Suberde was first occupied (Horwitz et al. 1999; Peters et al. 1999; von den Driesch and Peters 1999; Zeder and Hesse 2000). Moreover, data from the nearby site of Çatalhöyük indicate that domestic sheep and goats were present at that site from the earliest levels (pre-XII–VII), which were roughly contemporaneous with the
occupation at Suberde (Russell and Martin 2005). Thus, to find a sedentary village settlement supported by an economy based on the exploitation of “prodemestic” (Dyson 1953: 662) but wild animals dating to this period and in this geographic location requires some explanation. It is thus essential to reevaluate this assemblage and to test the validity of Perkins and Daly’s interpretation of the nature of caprine exploitation at this important site.

If Suberde does represent a case of Neolithic villagers continuing to hunt taxa that were domesticated by their neighbors, why did hunting continue to play such a central role? If Suberde does not represent a hunters’ village, then what do the fauna indicate about early caprine management strategies in the region? Does the management of caprines in this early period fit with the expectations of model herding strategies in which herders maximize the production of primary, or postmortem, products such as meat?

In an attempt to answer these questions some 2000 specimens of the surviving faunal collection from Suberde were examined. Of these, 359 were diagnostic specimens that could be identified as either sheep or goat. Of these diagnostic specimens 84 were identified as sheep and 23 as goat, while the remainder were identified as one or the other of these morphologically similar taxa. In this study diagnostic specimens were defined as those from which measurements could be taken or which provided age data. These included the proximal and distal ends of long bones (both diaphyseal and epiphyseal portions), the innominate, the atlas and axis, the major tarsals (calcaneus and astragalus), as well as mandibles and mandibular teeth.

As is typical of early Holocene faunal assemblages in the Near East, the faunal remains from Suberde are highly fragmented and the sample of diagnostic specimens is limited. The recoverable sample of more than 300 diagnostic caprine specimens, however, is comparable in size to those described from many early sites in the Near East (e.g., Davis 1984; Payne 1985; Peters et al. 1999; Vigne, Carrere, and Guilaine 2003; Zeder 2005) and was adequate to test Perkins and Daly’s interpretations of caprine exploitation.

The Site of Suberde

Suberde is located in the smaller of two linked intermontane basins in the Beyşehir-Suğla region of south central Turkey (Bordaz 1969: 43–44) (FIG. 1). The site is situated on a limestone ridge along the NW margin of Lake Suğla (now dry) at an elevation of 1070 m and sits just above the western margin of the Konya Plain.

Suberde was discovered during a survey by Ralph Solecki (1964) and was excavated for two seasons in 1964 and 1965 by Jacques Bordaz as part of the decade-long
Beyşehir-Suğla Project (Bordaz 1965, 1966, 1969, 1973; Bordaz and Alper-Bordaz 1977). Bordaz described four stratigraphic levels at the site. Levels II and III (Bordaz’s “upper” and “lower prehistoric levels”) included the remains of plastered floors and rectilinear mudbrick architecture with storage and bench features, while Level I was a mixed surface layer that contained Roman to Islamic period burials and a small number of Neolithic, Chalcolithic, and Bronze Age sherds. Level IV consisted of sterile sediments.

Six radiocarbon dates from Level III indicated occupation from ca. 7500–6900 cal. b.c. and four new dates derived from bone collagen confirm these results (table 1). This suggests that Suberde was roughly contemporaneous with the last phase of occupation at Aşıklı Höyük, the earliest village settlement in central Anatolia, and the nearby special-purpose site of Musular, as well as with Can Hasan III and the lower levels (pre-XII–VII) at Çatalhöyük (fig. 2) (Cessford 2001; Duru 2002; Eskin and Harmançay 1999; French 1968; Özbaşaran 1999; Payne 1972). Suberde predated the nearby Pottery Neolithic settlement at Erbaa Höyük by several centuries (Bordaz and Alper-Bordaz 1977, 1982).

Table 1. Radiocarbon dates from Suberde. The dates derived from bone collagen are new results and the dates from charcoal are from Bordaz (1969a: 59). All dates were calibrated using the OxCal IntCal 04 curve.

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Material</th>
<th>Strat. level</th>
<th>Radiocarbon years a.p.</th>
<th>Calibrated years a.c.</th>
<th>1 sigma</th>
<th>2 sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS-62229</td>
<td>bone collagen</td>
<td>?</td>
<td>8160 ± 45</td>
<td>7166 ± 72</td>
<td>7308-7060</td>
<td>7246-7066</td>
</tr>
<tr>
<td>OS-62226</td>
<td>bone collagen</td>
<td>?</td>
<td>8120 ± 40</td>
<td>7120 ± 58</td>
<td>7142-7058</td>
<td>7296-7043</td>
</tr>
<tr>
<td>OS-62227</td>
<td>bone collagen</td>
<td>?</td>
<td>8270 ± 40</td>
<td>7314 ± 85</td>
<td>7449-7191</td>
<td>7468-7178</td>
</tr>
<tr>
<td>OS-62370</td>
<td>bone collagen</td>
<td>?</td>
<td>8150 ± 45</td>
<td>7156 ± 70</td>
<td>7180-7065</td>
<td>7308-7056</td>
</tr>
<tr>
<td>P-1385</td>
<td>charcoal</td>
<td>III</td>
<td>7957 ± 88</td>
<td>6865 ± 127</td>
<td>7032-6713</td>
<td>7077-6637</td>
</tr>
<tr>
<td>P-1386</td>
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<td>III</td>
<td>8045 ± 76</td>
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<td>7081-6823</td>
<td>7241-6688</td>
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<td>III</td>
<td>8326 ± 289</td>
<td>7339 ± 377</td>
<td>7679-6837</td>
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<td>7530-7083</td>
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<tr>
<td>I-1867</td>
<td>charcoal</td>
<td>III</td>
<td>8570 ± 140</td>
<td>7668 ± 195</td>
<td>7822-7477</td>
<td>8198-7319</td>
</tr>
</tbody>
</table>

The faunal assemblage from Suberde was recovered through a combination of screening and collection by hand. Although it is said to have originally included more than 300,000 specimens the assemblage was reduced to less than one-tenth of that number as specimens deemed “useless” for analysis at the time (primarily long bone shaft fragments and unidentified fragments) were discarded (Perkins and Daly 1968: 97). The reduced assemblage was then transported to the United States for analysis and storage at Perkins’ home where it remained until his death in 1983. At that time the assemblage was moved to the University of New Hampshire under the care of the late Howard Hecker and then finally to Fordham University where it is currently curated by Allan Gilbert. Only a small part of the already-reduced assemblage remains today and it is clear that post-recovery handling is one of the most significant taphonomic factors to have affected the assemblage.

The results of this study are derived from the measurement and demographic data salvaged from the remaining portion of the faunal assemblage. It seems likely that these types of data were minimally affected by the handling of the assemblage since they are based on larger diagnostic specimens which were the focus of recovery and curation. It is recognized that the state of the assemblage makes a detailed analysis of other features such as taphonomy, skele-
tal part representations, and archaeological context difficult. Due to the lack of detailed contextual information all deposits from Neolithic Levels II and III were treated in the present study as one analytical unit. Although this may mask both intrasite and diachronic variations in animal exploitation, the resulting coarse-grained picture of sheep and goat exploitation at Suberde is an important contribution to understanding regional early Neolithic subsistence strategies.

Zooarchaeological Identification of Hunting and Herding

There are many lines of evidence used by zooarchaeologists to distinguish the remains of hunted versus herded animals (Bökönyi 1969; Ducos 1978; Helmer 1992; Jarman and Wilkinson 1972; Meadow 1989; Perkins 1973; Reed 1959; Uerpmann 1979; Zeder 2006b). The most widely used focus on size decrease and other morphological changes that commonly occur in domesticated populations and on demographic data that indicate the age and sex distribution of the slaughtered animal population.

It is important to emphasize that all methods used to identify hunting and herding strategies are inherently problematic, particularly when they deal with the early stages of domestication (Meadow 1989). This is due, in part, to the fact that there is no single “domestic” mode of production that can be contrasted with a single “hunting” mode of production. Instead there is a wide range of variability in the relationship between humans and their animal prey (Higgs and Jarman 1969; Ingold 1980; Zeder 2006a: 107–108). In addition, the interpretation of zooarchaeological data is rarely straightforward, and most archaeological patterns can be construed as representing multiple exploitation strategies (e.g., Halstead 1998). As a result, re-constructing systems of animal exploitation based on zooarchaeological data is a major challenge.

One of the most widely used methods for studying the origins and spread of herding focuses on the identification of changes in morphology, including size, thought to be linked to the conditions of human management (Boessneck 1985; Meadow 1989; Uerpmann 1978, 1979; Zohary, Tchernov, and Horwitz 1998). These changes have been described in detail elsewhere and include changes in the shape of bovid horns and a decrease in body size (Arbuckle 2005; Davis 1987: 135–140; Meadow 1989). Among morphological changes, size decrease has been the evidence most used by archaeozoologists for identifying the transition from hunting to herding (Ducos 1968; Flannery 1983; Helmer 1992; Köhler-Rollefon 1989; Peters et al. 1999; Uerpmann 1979; von den Driesch and Peters 1999).

Since the observation that domestic animals tend to be smaller than their wild counterparts was first made more than a century ago (Rutimeyer 1862), size decrease, often identified using summaries of the log differences between archaeological populations and a standard animal (using the Logarithm Size Index [LSI] method [Meadow 1999]), has been the preferred line of evidence for identifying early domestic populations (e.g., Peters et al. 1999, although see Zeder 2006b; Zeder and Hesse 2000). Yet there are problems with using this method as the primary means to separate hunted from herded populations. In addition to domestication, many factors can have an impact on body size including hunting pressure, climatic changes, disease load, and nutrition. Moreover, an increase in the proportions of adult female animals in an archaeological assemblage can mimic the size changes associated with domestication especially when multiple measurements are conflated using the LSI method (Zeder 2001).

Finally, researchers have often questioned how quickly morphological changes, including size decrease, appeared in managed populations (Arbuckle 2005; Bökönyi 1976,
Most recently, Melinda Zeder has made the argument that size decrease and other morphological changes are not characteristic of the earliest managed populations but made their appearance centuries after initial domestication (Zeder 2006b; Zeder and Hesse 2000; also see Dyson 1953: 662 and Perkins 1964: 1565 for earlier discussions). Thus, it is argued that the earliest herding economies will be associated with animals with body sizes similar to their local or regional wild counterparts and with little evidence for morphological changes, i.e., the earliest managed populations are expected to be “morphologically wild” (Vigne, Carrere, and Guilaine 2003; Zeder 2001, 2006b).

A second line of evidence widely used by zooarchaeologists to distinguish hunting from herding focuses on the analysis of demographic data: archaeological indicators of the age and sex composition of a slaughtered population used to infer the method of exploitation. Researchers have long observed that herding practices tend to target young animals, particularly excess males, for slaughter, while hunting tends to target older individuals (Hesse 1982: 403; Hole, Flannery, and Neely 1969; Wright and Miller 1976; Zeder 2001).

As a result, the presence in the archaeological record of relatively high frequencies of immature individuals has often been interpreted as representing human management, or herding, while assemblages dominated by the remains of adult animals are typically interpreted as representing hunting (Chaplin 1969; Coon 1951; Reed 1959; Stampfl 1983; Vigne, Buitenhuys, and Davis 1999; Wright and Miller 1976). By combining measurement and fusion data, Zeder (2001, 2005) recently developed a high-resolution method for analyzing both the age and sex composition of archaeological assemblages. Fusion of the epiphyses of long bones occurs in sheep and goats during known age ranges and in a known order (Noddle 1974; Silver 1970; Zeder 2006c). For example, an unfused distal humerus indicates that the animal was killed sometime before it reached the oldest age at which that skeletal part fuses (ca. 10 months), while a fused distal humerus indicates that the animal was killed sometime after it reached the youngest age (ca. 6 months) at which that skeletal part fuses (Moran and O’Connor 1994). Since caprines exhibit a degree of sexual dimorphism and reach adult body sizes at relatively young ages (ca. one year) (Davis 1996; Zeder 2001), the size of fused and unfused skeletal parts can be used to identify the ages at which males and females were slaughtered (Hesse 1978; Zeder 2001; Zeder and Hesse 2000). This has allowed Zeder (2001, 2005; Zeder and Hesse 2000) to identify differences in the kill-off of males and females, particularly the slaughter of young males, as the defining characteristic of herding strategies and therefore the single best marker for initial management of animals such as sheep and goats.

As with size change, however, there are problems with using demographic evidence to identify animal domestication. Many researchers have expressed reservations about the use of such evidence to distinguish between hunting and herding, arguing that both can produce a wide variety of demographic patterns (Collier and White 1976; Simons and Ilany 1975–1977; Wilkinson 1976; also see Atci and Stutz 2002; Binford and Bertram 1977) and that the method itself is fraught with taphonomic issues (March 1995; Munson 1991, 2000; Watson 1978). Despite these problems associated with interpreting them, demographic data do reflect human decision-making with regard to both the age and sex of the animals chosen for slaughter and that makes them particularly valuable for addressing the early period of animal management before morphological changes became apparent.

Evidence for Hunting at Suberde

Perkins and Daly’s (1968) argument for sheep and goat hunting at Suberde was based on a combination of negative evidence for morphological changes and the interpretation of demographic data. With the exception of one fragment of a frontal bone from a hornless female sheep, no evidence for changes in morphology was noted. Possibly due to a lack of comparable datasets in the region at the time of their study, size diminution was not addressed for the caprines at Suberde.

Given this lack of evidence for morphological change, Perkins and Daly turned to the interpretation of demographic data. Using age at death estimates presumably generated from the state of fusion of long bones (as in Perkins 1964), they compared the frequencies of caprine juveniles (< 15 months old) and adults (> 15 months old) at Suberde to an Iron Age assemblage from Europe and to the proportions of those age groups in a living herd of bighorn sheep (Murie 1944). They argued that the frequency of specimens representing juvenile animals at Suberde (ca. 25%) more closely matched that of the wild herd and was considerably lower than that from the Iron Age site (ca. 45%). Since it was thought that the remains of immature animals were not represented in sufficient quantity to indicate herding, they concluded that the Suberde villagers must have been hunters.

In addition, Perkins and Daly (1968: 102) noted “that no sheep specimens represented animals younger than three months or older than three years.” This very narrow range of age was used to support the interpretation of
hunting since it was argued that “the old animals and the very young animals are precisely the ones that are taken by wild predators” (Perkins and Daly 1968: 102). This suggested to the authors not only that the Suberde villagers were hunters but that they hunted in “cooperative drives, slaughtering whole flocks at a time” (Perkins and Daly 1968: 102).

In the years since Perkins and Daly’s analysis, many researchers have found this demographic argument for hunting problematic (e.g., Martin, Russell, and Carruthers 2002; Payne 1972). Although the frequency of juvenile individuals from Suberde parallels that of wild sheep herds, Murie’s (1944) data indicate that most of a typical living wild herd is composed of animals older than three years (also see Caughley 1966; Deevey 1947; Garcia-Gonzales et al. 1992; Hoefs and Bayer 1983; Papageorgiou 1979). Yet these animals were reported to be largely absent at Suberde.

Since sheep and goats segregate into male and female herds for most of the year (Schaller 1977), it is possible that the summer hunting of nursery herds composed of females and their young might result in an over-representation of immature and subadult individuals in the archaeological record, as has been suggested by Hesse (1978) for the earliest level at Ganj Dareh (but see Zeder and Hesse 2000). However, this would not produce the pattern described for Suberde in which mature and senile adults are largely absent. The seasonal hunting of nursery herds would also produce a distinctive absence of adult males; this pattern has not been identified at the site. Instead, the presence of a narrow range of ages suggests that Suberde villagers were not harvesting entire herds, but rather were intentionally selecting animals for slaughter based on age-related criteria (also see Martin, Russell, and Carruthers 2002; Payne 1972).

### Faunal Data from Suberde

#### Species Frequencies

Because Perkins and Daly had access to a much larger sample than is presently available, their descriptions of the composition of the assemblage are reviewed here. In both Levels II and III, the remains of caprines are dominant, comprising ca. 81.5% of the identified faunal remains, with pig, red deer, and cattle present in lower frequencies (Table 2). Eleven other mammalian taxa were identified in small quantities, as well as tortoise, unspecified bird (possibly pelican), freshwater mollusks, and fish (Perkins and Daly 1968: 98). In addition, sheep reportedly outnumbered goats at a ratio of 5.6 : 1.

My reanalysis of the assemblage has also found that sheep outnumber goats, although to a slightly lesser degree, ca. 3.7 : 1. These differences may be the result of variability between researchers in the identification of these morphologically similar taxa, as well as variations in the composition of the samples available for analysis. The results of both studies of the Suberde fauna, however, indicate that sheep is the dominant taxon, a pattern that is typical of Neolithic sites across much of Anatolia (Arbuckle 2006: 13–14; Arbuckle and Ozkaya 2006; Martin, Russell, and Carruthers 2002; Peters et al. 1999; Russell and Martin 2005).

#### Measurement Data

Measurement data are presented both as LSI values and individual measurements of skeletal elements. Using the LSI method, log-transformed measurements are compared with those from standard animals, in this case a modern female *Ovis orientalis* from Iran and the averaged measurements of a modern male and a modern female *Capra aegagrus* from the Taurus mountains in Turkey (following Uerpmann and Uerpmann 1994). Although there are some potential problems with utilizing animals from a different region and time period as the standard (Meadow 1999; Russell and Martin 2005; Zeder 2001), these standard animals are widely used in the literature and are used here in order to aid comparison with previous and future studies.

In Figure 3, LSI values for specimens identified as sheep and sheep/goat from Suberde are compared with those for sheep from Aşıklı Höyük, the lower levels of Çatalköy, and the late Neolithic levels of Körük Höyük. The Suberde results are based on a sample of measurements from 69 different specimens that correspond to those measurements.
presented by Margarethe Uerpmann and Hans-Peter Uerpmann (1994) for the standard animal. Since sheep outnumber goats at Suberde at a ratio of almost 4:1, and the majority of specimens identified as sheep/goat therefore likely represent sheep (also see Arbuckle 2006: 133–134), measurements from specimens identified as sheep/goat are
included with the sheep values in this figure. Although it is possible that one or more of these sheep/goat specimens might represent goats, their addition does not alter the overall shape or range of the LSI distribution but does provide a more robust sample for comparison.

The Suberde sheep are comparable in size to the stan-
dard animal and are clearly larger than the earliest morphologically domestic populations in the region at Çatalhöyük and at Kışık Höyük. They also exhibit similar LSI values to those from Aşikli Höyük, although there are more individuals in the small end of the size range at Suberde, and the median LSI value from Suberde is smaller. The sheep and goat remains from Aşikli Höyük represent large-bodied, morphologically wild populations and provide a baseline for the size of early Holocene wild caprines in the region. The population from Aşikli Höyük is comparable in size to other morphologically wild populations in the Near East dating to the Late Pleistocene such as at Karain B on the Turkish Mediterranean coast (A. L. Atç, personal communication 2006).

LSI values for goats from Suberde show a pattern very similar to that for sheep (FIG. 4). Suberde goats are comparable in size to the large-bodied, morphologically wild population from Aşikli Höyük and are considerably larger than the small-bodied, morphologically domestic populations at Çatalhöyük and at Kışık Höyük.

In Figure 5, LSI values for specimens identified as sheep and sheep/goat are presented for both fused and unfused skeletal parts. Due to small sample sizes, comparable data are not presented for goats. One of the problems with using the LSI method is that differences in body proportions between the standard animals and the archaeological population (i.e., nonallometric scaling) can potentially skew results. The data presented in Figure 5 indicate no major discrepancies between the standard sheep, a modern ewe from Iran, and the Suberde population, with most LSI values ranging between -0.02 and 0.08 on the LSI scale. The only exception is the length of the astragalus, which is proportionately slightly shorter in the Suberde population (see Meadow 1999). Measurements from several skeletal

Figure 5. LSI values for individual skeletal measurements (after von den Driesch 1976) for fused and unfused specimens identified as sheep and sheep/goat. Filled circles represent fused specimens while open circles represent unfused specimens. State of fusion is not applicable for astragalus and proximal metapodials. GL1 = greatest length of the lateral half, Bp = breadth of the proximal end, GLP = greatest length of the processus articularis, BT = breadth of the trochlea, Bd = breadth of the distal end, Dd = depth of the distal end, GB = greatest breadth.
parts fall into two groups, which likely represent sexual dimorphism (Davis 1996), and each of these groups includes both fused and unfused specimens.

The sizes of fused and unfused specimens are compared in greater detail in Figure 6 in order to test for evidence that kill-off was focused on a specific demographic group (e.g., young males, old females, etc.). Figure 6 is limited to data from later fusing skeletal parts (i.e., proximal phalanx 1 and 2, distal metapodials, calcaneus, distal radius) since it is in these skeletal parts that the size difference between males and females is most likely to be visible, even in young unfused specimens (Zeder 2001).

If young males were slaughtered we would expect unfused specimens, primarily representing large-bodied males, to cluster at the larger end of the range while fused specimens, primarily representing smaller females, would cluster at the smaller end of the range. If slaughter was undertaken without regard to sex, then we would expect fused and unfused specimens to be similar in size. Finally, if older males were targeted for slaughter, as is often the case in hunting strategies, we would expect fused specimens to cluster at the larger end of the range with unfused specimens exhibiting a wide range of values.

Figures 6A and 6B indicate that the median value for unfused specimens is slightly smaller than that for fused specimens but provide no evidence for the preferential culling of any specific demographic group (e.g., young males, old females, etc.). A Mann-Whiney U-test indicates that the fused and unfused samples are not significantly different (U = 339.5, p = 0.067). Instead both males and females were slaughtered at both younger and older ages.

The size of the Suberde caprines was also addressed through the analysis of measurements of the astragalus, the most abundant element in the assemblage. Since measurements of length, breadth, and depth of the astragalus all exhibit similar patterns only those results for astragalus length are discussed here. In Figures 7 and 8, measurements of astragalus length for sheep and goats from Suberde are compared with those from Aşıklı Höyük, Çatalhöyük, and Late Neolithic Koşk Höyük (Levels II–V).

Astragalus measurements indicate that the Suberde sheep are intermediate in size between the large-bodied population at Aşıklı Höyük and the small-bodied popula-
and at Köşk Höyük, although some are also well within that range. Although less clear, the results for goats appear to parallel those for sheep, indicating that the Suberde caprines as a whole can be characterized as intermediate in size, somewhat smaller than the morphologically wild populations, but larger than the early morphologically domestic populations in the region.

**Survivorship**

Survivorship data at Suberde are derived from tooth eruption and wear and the state of fusion of the epiphyses of long bones (Figs. 9, 10). In the absence of complete mandibles, survivorship data from tooth eruption and wear for combined sheep and goats were generated (following Payne 1973) from loose mandibular teeth, specifically the deciduous fourth premolar (dp/4) and the third molar (Fig. 9). Since the dp/4 is typically shed around the same time that the third molar erupts (Payne 1973), using these two teeth reduces the risk of double counting loose teeth from a single individual.

Figure 9 indicates that the majority of caprines at Suberde were slaughtered between the ages of one and three years with a clear peak around two years of age. A few caprines were slaughtered in their first year and also as mature adults.

Survivorship based on fusion of the long bones is presented in Figure 10 in the form of a survivorship curve, showing the percentages of caprines from a theoretical cohort surviving past the youngest age at which fusion occurs in four skeletal parts. The four skeletal parts used in this figure are the most abundant in the assemblage and represent a cross-section of survivorship from three months of age to three years. In order to increase sample size, specimens identified as sheep and sheep/goat (but not goat) are pooled together in Figure 10. Sample sizes do not permit goat survivorship to be addressed.

Survivorship data for the Suberde sheep indicate that kill-off is overwhelmingly concentrated in the first three years with ca. 75% of sheep surviving past their first year, 50% past two years, and only 8% surviving past 36 months, the approximate age of fusion of the distal radius. This is in general agreement with Perkins and Daly’s (1968: 102) statement that “no sheep specimens represented animals younger than three months or older than three years.” This convergence of results with those of the original study, in which Perkins and Daly had access to the complete assemblage, is positive evidence that the surviving sample of the assemblage provides an adequate source of data for reconstructing sheep and goat exploitation at the site.

In Figure 10, survivorship data for Suberde sheep are
further compared with those for caprines from the Upper Palaeolithic site of Yafteh Cave (Hole, Flannery, and Neely 1969), sheep and goats from Ganj Dareh (Hesse 1978; Zeder and Hesse 2000), and caprines from Köşk Höyük (Arbuckle 2006). The caprines from Yafteh Cave and the sheep from Ganj Dareh are thought to represent wild hunted populations and exhibit high survivorship values with ca. 67% of caprines surviving past 3 years of age, while the Ganj Dareh goats and Köşk Höyük caprines are thought to represent domestic herded populations and exhibit very low survivorship (< 25%) past 3 years of age. Survivorship data for the Suberde sheep are similar to those for the Ganj Dareh goats and Köşk Höyük caprines, which suggests, contrary to Perkins and Daly’s interpretation, that the demographic pattern at Suberde falls well within the range of variation of herding practices.

The similarity between sheep survivorship data at Suberde and those from sites where herding was practiced is not definitive proof that the sheep at Suberde were themselves herded. It has been shown that both hunting and herding practices can produce a wide variety of survivorship curves (Simmons and Ilany 1975–1977; Wilkinson 1976) and, in fact, a pattern of kill-off of caprines in their first three years has also been identified at sites such as Halan Çemi, Körtik Tepe, and Çafes, which are interpreted as representing hunting economies (Arbuckle and Özkaya 2006; Helmer 1988; Redding 2005). In addition, survivorship data for morphologically domestic caprines from the earliest levels (pre-XII) at Çatalhöyük indicate a considerably older kill-off than for the Ganj Dareh goats, Köşk Höyük caprines, or Suberde sheep (Russell and Martin 2005: 73). Thus, although sheep were consistently chosen for slaughter within a narrow age range at Suberde, the survivorship data alone do not clarify the nature of the exploitation system and whether it took the form of traditional herding or a less intensive strategy more akin to wildlife management (e.g., Hecker 1982; Ingold 1974).

**Discussion and Conclusions**

The faunal data generated from this reexamination of the Suberde assemblage suggest a complex picture for the earliest system of Neolithic animal exploitation in the Beştepe region of central Anatolia. Measurement data based on the coarse-grained LSI method suggest that the sheep and goat populations there were similar in size to morphologically wild populations in the region. More detailed investigation of astragalus measurements, however, indicates that the Suberde sheep were significantly smaller than the morphologically wild populations at other sites in the region, while at the same time they were larger than the morphologically domestic populations on the Konya Plain and in Cappadocia (i.e., at Çatalhöyük and at Köşk Höyük). Thus it seems that the sheep, and possibly the goats, at Suberde are characterized by a mild expression of size diminution, a feature widely seen as indicating a managed and domestic population (Peters et al. 1999; Uerpmann 1978, 1979).

On a regional scale it is tempting to see the smaller size at Suberde as a transitional stage linking the large morphologically wild caprines at Aşıklı Höyük with the small domesticates at Çatalhöyük and Köşk Höyük. The morphologically domestic caprines in the lowest levels at Çatalhöyük (pre-XII–VII), however, were contemporaries of those much larger animals at nearby Suberde. This discrepancy in size between neighboring populations can be addressed by examining the causes of morphological changes such as size diminution in the first place.

Researchers have argued that size diminution and other characteristics of the “domestication syndrome”—that suite of traits characteristic of a wide range of domesticates (Hemmer 1990)—are the result of a combination of reproductive isolation from wild populations and exposure to, and breeding within, an intensely anthropogenic environment (Arbuckle 2005; Davis 1987: 135–140; Price 1998; Zohary, Tchernov, and Horwitz 1998). One can argue that the sheep and goats at Çatalhöyük, located on the Konya Plain outside of the range of wild caprines, were subject to both of these conditions while those at Suberde, located within the wild habitat of both species, were not. In addition to the possibility of regular interbreeding between wild and managed sheep, it is also possible that management strategies at the small site of Suberde did not in-
volve intensive exposure to an anthropogenic environment as they did at the larger village of Çatalhöyük. Although it is tempting to attribute the lack of remains of perinatal sheep at Suberde to their vulnerability to taphonomic factors (Munson 2000; Vigne and Helmer 2007: 17), the lack of these remains may suggest that caprines were not present within the settlement, at least during the birthing season, as they were at Çatalhöyük (Russell and Martin 2005: 73–74).

Survivorship data suggest that the culling of sheep at Suberde was highly selective with regard to age but not sex. This pattern fits neither the most common models for hunting, in which older, mature individuals in their prime are slaughtered (Hole, Flannery, and Neely 1969; Stiner 1990; Wright and Miller 1976), nor those for herding in which young males are culled (Zeder and Hesse 2000). It seems clear that caprines were under some form of human control at Suberde, but until more specific and precise data regarding aspects of caprine exploitation such as seasonality, mobility, and foddering (e.g., Makarewicz and Tuross 2006) are examined, the exact form that management took will remain difficult to address.

That there is no evidence for the intensive culling of young males, a pattern thought by some to be the best marker of a herding economy (Zeder and Hesse 2000), is interesting and raises questions concerning both how herds were managed at Suberde as well as the universal validity of that model when applied to the early Neolithic in Anatolia. Although there are other potential explanations for the lack of evidence for young male kill-off (e.g., seasonal movements of herds away from the site), it is possible that herds at Suberde were subject to a management strategy that did not involve the focused slaughter of young males and which does not conform to models of herd management based on ethnographic analogy. It may be that in the earliest Neolithic communities in the region, the set of circumstances unique to initial colonization by villagers resulted in the development of a management system that has no modern analog.

Caprine exploitation at Suberde, therefore, may repre-
sent one example of a variety of “experimental” exploitation systems present in early sedentary sites in Anatolia (e.g., Hallan Çemi, Körtik Tepe, Cafer) in which caprines were selected with regard to age but which do not seem to exhibit evidence for “typical management” including young male kill-off.

Although not described here in detail, caprine exploitation at Aşılık Höyük, the earliest excavated Neolithic village in central Anatolia, may also fit into this “experimental” category. Caprine exploitation at Aşılık Höyük, representing a form of management referred to as “proto-domestication,” included selective culling of morphologically wild animals between the ages of 2–4 years as well as a relatively large number of neonatal individuals (Buitenhuis 1997). Although caprine exploitation at both Suberde and Aşılık Höyük exhibits selective slaughter of juvenile and young adult animals, management practices at Suberde resulted in size diminution, whereas there is no evidence for any morphological changes through the more than 400 year sequence at Aşılık Höyük (Buitenhuis, personal communication 2005). This suggests that these two sites were characterized by different management strategies and, with the addition of a third distinct system documented in the early levels at Catalhöyük, supports the idea that central Anatolia was characterized by a mosaic of different management strategies in the Neolithic, each unique to its own geographic and sociocultural context.

The lack of evidence for young male kill-off and the lack of fit with the usual models of pastoral management may suggest that early Neolithic herd management at Suberde was fundamentally dissimilar to the practices of herders at sites such as Ganj Dareh and at later sites in the region such as Kösök Höyük, which do conform to these models (Arbuckle 2006). As a consensus emerges regarding the high level of variation in early Neolithic subsistence economies (Mithen et al. 2000; Redding 2005; Rosenberg 1999; Weiss, Kislev, and Hartmann 2006), it may be that Suberde can be seen as representing an example of an early Neolithic experiment in caprine exploitation that was replaced by more intensive husbandry systems in the region in the Pottery Neolithic. Thus, although Perkins and Daly’s interpretation of Suberde as a Neolithic hunters’ village is no longer supported, the site continues to provide valuable insights not only into the emergence of pastoralism in the Bessèhir region of central Anatolia, but also concerning the complex nature of the spread of agro-pastoral lifeways throughout SW Asia and beyond.

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