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FROM THE MEDITERRANEAN TO THE ATLANTIC

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*Umberto Albarella, Cleia Detry, Sónia Gabriel, Catarina Ginja,
Ana Elisabete Pires and João Pedro Tereso*

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Traditional sheep and goat husbandry in Cyprus: the effects of scale and its identification in archaeological assemblages

Angelos Hadjikoumis

Khirokitia village, Cyprus, 2013

Herder: ...so, are you a friend of Σίμων (Simon's Hellenised name in Khirokitia village)?

Me: Yes, I've known him for a few years and he is a good colleague of mine.

Herder: I thought so!

Me: What made you think that?

Herder: ...because he also likes talking about sheep and goat, like you!

Zooarchaeological, as any archaeological, interpretation relies on analogical reasoning. In many cases, the analogies employed as interpretative aids derive from ethnographic studies. Zooarchaeology in particular has been heavily reliant on ethnography to inform its interpretative framework, especially on animal husbandry practices. The majority of relevant studies, however, concern specialised pastoralists in large-scale systems. Medium- and small-scale animal husbandry practices, especially in mixed agro-pastoral systems, are less documented ethnographically. The scarcity of such ethnographic analogies is detrimental to zooarchaeological interpretation, as scale is a fundamental characteristic of any animal husbandry system and permeates most of its aspects. This study constitutes an effort to address this gap through an ethnozooarchaeological study of, now extinct, medium-scale traditional caprine husbandry practices in 20th-century Cyprus. Data collected through semi-structured interviews with sheep and goat herders are presented to illustrate how scale shapes important aspects of caprine management. Besides providing information of practical use to zooarchaeologists working in Mediterranean environments, this study also serves as a source of analogy for the detection and interpretation of ancient medium-scale systems.

Keywords: Ethnozooarchaeology, zooarchaeology, Cyprus, Mediterranean, caprine husbandry, archaeological interpretation

Introduction

As is the case for all archaeological interpretations (e.g. Wylie 1982), evidence of pastoral activities in the past is interpreted through analogical reasoning. In this endeavour, the most relevant source of analogy for archaeologists is ethnography. For the zooarchaeologist, an even more apt source is ethnozooarchaeology (*sensu* Albarella 2011), which differentiates from ethnography in that it is purpose-focused on collecting data suitable to address specifically zooarchaeological questions. Despite the abundance of ethnographic studies of zooarchaeological relevance in the literature, there is a bias in favour of large-scale specialised pastoralism (e.g. Digard 1981). The scarcity of ethnographic

analogies for small- and medium-scale animal husbandry practices, currently limits the interpretative framework available to the zooarchaeologist. The archaeological record suggests that large-scale and highly specialised pastoralism was a chronologically later, and generally rarer, occurrence (Halstead 1996) than small-scale and medium-scale animal husbandry. Yet, the available interpretative framework for the latter is less developed and lacks in diversity.

The vast majority of caprine herds in this study can be considered as examples of *medium-scale* husbandry. Referring to caprine husbandry practices as *small-*, *medium-* and *large-scale*, however, is a subjective characterisation

that requires context-specific definition. In the context of this study, animal husbandry is considered *small-scale* when it does not represent the primary source of livelihood for a family (*i.e.* parents and children); *medium-scale* when it is the main source of a family's livelihood; and *large-scale* when it requires the hiring of herders to manage larger numbers of animals multiple times a family's income. An alternative pathway to large-scale operations is the fusion of several medium- or small-scale operations, with the important difference of being collectively owned.

The scarcity of cases of small- and medium-scale animal husbandry systems in the ethnozoarchaeological literature is partly justified by the fact that such practices are nowadays rare, especially in Europe and the Mediterranean. Relevant research, however, has shown that such systems still persist, especially in *circum-Mediterranean* areas, and have significant zooarchaeological potential. For example, recent ethnographic studies on small-/medium-scale free-range pig husbandry in Sardinia and Corsica (Albarella *et al.* 2007; 2011), Greece (Halstead and Isaakidou 2011) and Spain (Hadjikoumis 2012) contribute towards a better understanding of how such practices would be identified in the archaeological record and, at the same time, help interpreting them. Besides pigs, there are also recent examples of traditional caprine management from Greece (Halstead 2014), Cyprus (Hadjikoumis 2017), France (Blaise 2006) and Spain (Seguí 1999). These cases are not exhaustive but show that the study of traditional husbandry practices is feasible, even in modernised Mediterranean Europe. Besides scale, there is also a geographic and environmental bias in the literature, in the form of an unbalanced representation in favour of montane environments with strongly continental climates (*e.g.* Digard 1981).

The aim of this study is to add to a growing corpus of ethnozoarchaeological studies from Europe and the Mediterranean through the provision of useful analogies for the interpretation of medium-scale caprine husbandry. The information generated is of direct relevance to a wide variety of zooarchaeological themes revolving around the management of sheep/goat herds within agropastoral systems in Mediterranean environments. Some of these have already been covered in other publications (Hadjikoumis 2018; 2017; Hadjikoumis *et al.* 2019) and will be referred to here to provide a nuanced picture of the system in question. The focus of the present study is on scale and how it affects important aspects of husbandry, such as herd composition, age-at-death, male:female ratios and mobility. Beyond its benefits to relevant archaeological research, the recording of such practices was urgent as they are extinct or have significantly been altered in the last 40 years.

Methods

The methodology used in the study has been already published elsewhere (Hadjikoumis 2017) and thus is

presented here only briefly. The study was designed to gather information that is relevant to and usable by zooarchaeologists, mainly as an interpretative aid. The data were collected through semi-structured interviews with sheep and goat herders in Cyprus in 2013. The interviews were approached as casual conversations, allowed to expand in unforeseen directions and without the use of a rigid questionnaire. The study geographically covered most of the island (Fig. 5.1) despite the current division, due to the fact that some of the interviewees exercised sheep/goat herding in the north of the island prior to their displacement in 1974. The obvious concentration of caprine herding in lowland areas (>800 m asl) is the combined product of legislation protecting forested mountainous areas and the fact that most caprine (especially sheep) husbandry was traditionally integrated with cereal agriculture. Beyond basic information about the herders, the interviews yielded information on the environmental setting, herd size and composition, mobility, diet, seasonality, and consumption/sale of animal products.

Results

Before examining how different aspects of caprine husbandry are affected by its scale, it is useful to briefly introduce the herders and the context they operated in. Basic information on the herders is published more extensively elsewhere (Hadjikoumis 2017, 127, table 15.1) and is thus only summarised here. Most of the herders were not active in the profession at the time of the interviews, and all were older than 60 years old, except for four younger herders in their 50s. Herders with the longest possible experience were deliberately targeted in order to gain insights into traditional Cypriot caprine husbandry as it was exercised as far back in the 20th century as possible. Fast-paced development over the last 50 years led to the extinction of most traditional agropastoral practices, which highlights both the value and urgency to interview herders with long experience and family tradition.

The decline of traditional caprine husbandry practices can be traced back to the 1970s, primarily due to the displacement of a large part of the Cypriot population as a result of the Turkish military invasion of 1974. Increased pressure on land to satisfy a denser and increasing population, intense economic (mostly tourism-related) development and broader social changes, have contributed to the decline of traditional pastoral practices and family-owned caprine herds in the next three decades. This trend has intensified in the last two decades of further construction and legal harmonisation with the European Union. For these reasons, pre-1974 cases are the focus as they represent examples of traditional caprine husbandry in Cyprus as exercised for most of the 20th century. In order to reflect this reality, the herds managed by the interviewees were divided into 'traditional' (*i.e.* pre-1974)

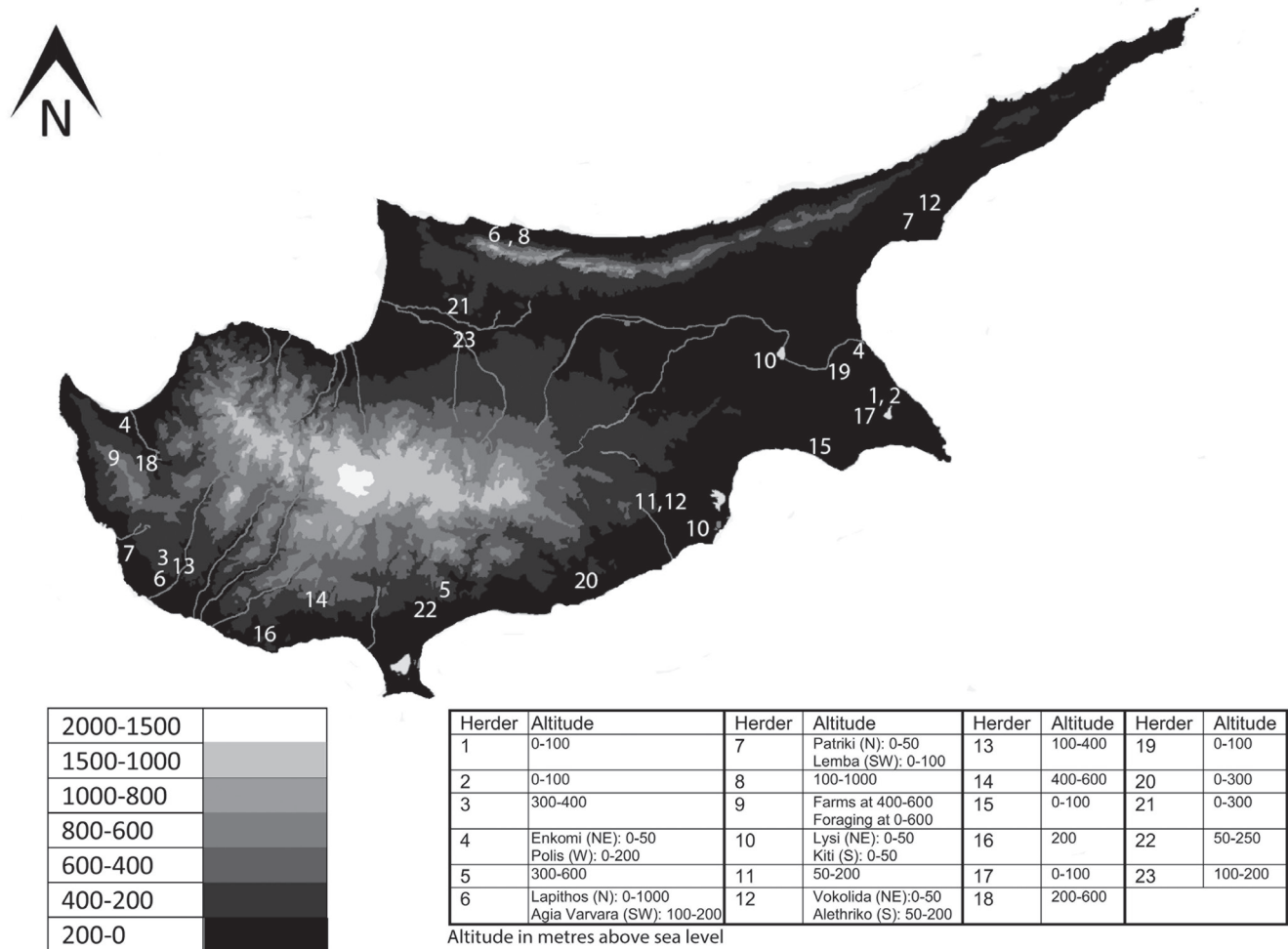


Figure 5.1. Map of Cyprus with the location and altitude of the areas where each herder was active. Numbers 1–23 correspond to the additional information provided for each herder in the inlaid table; for herders displaced by the Turkish invasion of 1974, pre- and post-1974 locations are indicated by the same number (map from: Hadjikoumis 2017, fig. 15.1, 127).

and ‘recent’ (*i.e.* 1974–2013). Naturally, herders were variably affected by the dramatic events of 1974 and subsequent socioeconomic changes, mainly depending on where they lived. For this reason, herders (1, 5, 9 and 17) that remained faithful to their traditional practices and continued managing the same number of animals post-1974, were included in the ‘traditional’ instead of ‘recent’ category in the analyses (Table 5.1).

Herd composition and size

Traditionally, caprine herds tended to consist exclusively or predominantly of sheep or goat (Table 5.1). For the purposes of this study the word ‘predominantly’ assigned to a sheep/goat herd indicates that it consisted 85–100% of either sheep or goat. Moreover, the inclusion of a small number of goats in sheep herds was traditionally a common practice, while the opposite was rare. Sheep herders included goats to enhance the mobility of their herds, while the only goat herder (18) that also owned a small number of

sheep attributed this to his family’s culinary preference for lamb meat. Under traditional practices, the only mixed herd was that of herder 19, consisting of 80 sheep and 30 goats. In recent practices, there were a few more cases of mixed herds (herders 14, 20 and 22), but the interviewees mentioned that their decision was primarily shaped by modern market forces, rather than any practicality relating to animal management.

Beyond composition, herd size is an important parameter of scale in animal husbandry. The numbers provided by the herders refer to reproductively active animals they managed for most of their career. Herders that were displaced or significantly changed their approach to herding in the course of their careers may have contributed information on two or more herds they managed. Pre-1974, the herders managed between 50 and 200 sheep/goat, with the vast majority managing 100–150 animals (Table 5.1). The exception of herder 6 who managed only 25 goats is attributable to the fact that he was engaged in goat herding only to complement

Table 5.1. Herd composition and numbers, divided into 'predominantly sheep', 'predominantly goat' and 'mixed herds'.

<i>Predominantly sheep herds</i>				<i>Predominantly goat herds</i>			
<i>Herder</i>	<i>Practices</i>	<i>Sheep</i>	<i>Goat</i>	<i>Herder</i>	<i>Practices</i>	<i>Sheep</i>	<i>Goat</i>
1	Traditional	150	6	3	Traditional	0	50
2	Traditional	105	3	8	Traditional	0	200
3	Traditional	50	0	9	Traditional	0	160
4	Traditional	140	0	18	Traditional	10	150
5	Traditional	135	0	21	Traditional	0	180
7	Traditional	120	0	6	<i>Traditional</i>	0	25
10	Traditional	120	14	2	Recent	0	105
12	Traditional	100	0	6	Recent	0	100
13	Traditional	75	0	13	Recent	0	265
14	Traditional	70	0	16	Recent	0	200
15	Traditional	115	0		Recent	100	800
17	Traditional	125	0	<i>Mixed herds</i>			
22	Traditional	80	0	<i>Herder</i>	<i>Practices</i>	<i>Sheep</i>	<i>Goat</i>
23	Traditional	135	0	19	Traditional	80	30
4	Recent	245	0	14	Recent	150	65
12	Recent	300	20	20	Recent	200	100
20	Recent	300	2	22	Recent	150	200
23	Recent	400	0				
11	<i>Recent</i>	31	1				

Herds are considered 'mixed' if they contain a minimum of 25% sheep in a goat herd or vice versa. Within each category, traditional practices are presented first, followed by the more recent practices. All herders were occupied full-time in sheep/goat herding with the exception of two part-time herders (6 and 11), indicated in italics.

his main income from agriculture. Moreover, managing a small herd was an unpopular economic strategy, as it required a similar level of commitment as larger herds do, but was insufficient to sustain a family. Herder 10 added that only a few affluent families managed up to 200–300 animals, while poorer families would have to make ends meet with as few as 50–80 animals. A few herders with experience in the 1950s and 1960s mentioned that even smaller herds were viable. Herder 3 for example, was managing about 50 animals in the 1950s and 1960s. Several others with long family tradition also mentioned that in the late 19th/early 20th century families could survive on herds of up to 50 sheep/goat.

Sheep and goat herd sizes did not differ greatly in numbers, but a trend towards larger goat than sheep herds is evident (Table 5.2). Some of the largest caprine herds pre-1974 consisted of 160 (herder 9), 180 (herder 21) and 200 (herder 8) goats, while most sheep herds tended to fall within the 100–150 range. The reason for this is hinted at by the environmental setting of the areas where those larger goat herds were foraging. The aforementioned herders (8, 9 and 21) managed their herds in areas with few or no cultivations. The largest of these goat herds (herder 8) was

Table 5.2. Mean, minimum (Min) and maximum (Max) of 'predominantly sheep' and 'predominantly goat' herds (also see Table 5.1), under traditional and recent practices.

<i>Species</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>
Predominantly sheep, pre-1974 (N=14)	110	50	156
Predominantly goat, pre-1974 (N=5)	150	50	200
Predominantly sheep, post-1974 (N=4)	317	245	400
Predominantly goat, post-1974 (N=5)	314	100	800

foraging in an abrupt high-altitude landscape (100–1000 m asl) far from any cultivations (Fig. 5.1). The same herder also exploited a population of about 1000 feral goats through occasional hunting or capture of animals, but this was not included here as that population was not managed.

After 1974, caprine herds gradually increased in size as traditional husbandry practices were being eroded away (Table 5.2), as it has also been noted for other Mediterranean areas (e.g. Seguí 1999). From 1974 to about the late 1990s, herds tended to fall in the upper end of the 100–200 range, but closer to the present day, there were several examples

of herds with more than 300 animals (herders 12, 16, 20, 22 and 23). An exception to this trend was herder 11, who kept small numbers of animals as he focused on fattening lambs for sale, so as to complement his main income. Commenting on the reasons behind the increase in herd numbers, the herders attributed these changes to mechanisation, cheap immigrant labour, as well as legislative and market pressures. Additional reasons mentioned included the availability of imported animal feed and an increase in available foraging areas due to further abandonment of agricultural land and the countryside in general. Echoing this general trend, several herders mentioned that nowadays, one would have to scale up and manage herds in excess of 500 animals to make a living. This view also illustrates the point that the absolute number of animals necessary to support a family is variable.

Herd size constraints

In 1935, during the colonial period in Cyprus (1878–1960), the maximum number of animals managed by a shepherd was restricted by law to 80 (Harris 2007). Some herders mentioned that in the summer months the law was relaxed and 120 animals were allowed per herder, but the author is yet to encounter documented evidence of this aspect in the legislation. It is possible that the herders were referring to local variations and circumstances. Most importantly, however, the herders confirmed that the legislation did not pose serious constraints, as it could be circumvented by obtaining multiple licences within a network of family and friends.

The most important restriction to herd size was labour requirements. In the absence of mechanisation, most herders could manage at most a few dozen animals, especially when focused on labour-intensive dairying activities. The exact number of animals each herder could manage depended on the availability of additional labour input from the family (usually young boys for herding and spouses for milking/dairying). Another major constraint in herd numbers was the density of cultivation in the foraging area and the consequent responsibility of the herders to avoid damaging the crops. In densely cultivated areas, herders had to be particularly vigilant to avoid conflicts with farmers. This rationale is also reflected in a practice followed by sheep herders in areas with extensive cereal cultivations that involved the fusion of two herds (*i.e.* reaching 200–300 sheep) after summer harvest and prior to autumn sowing, as the need for close supervision of animals was relaxed. The presence of cultivations also heavily affected decisions on whether to manage sheep or goats, with sheep being preferred in cereal-/cash crop-cultivated areas and goats in areas of wild vegetation or a patchwork of wild and cultivated vegetation. The traditional pattern of land use was characterised, for most of the agricultural year, by 100–150 strong sheep herds managed in areas of cereal cultivation (central plain and coastal lowlands) and 100–200 strong goat herds managed in the foothills of the two main mountain ranges (Fig. 5.1), away from densely cultivated areas.

Age-at-death and male:female ratios

Age-at-death data obtained through the interviews were the focus of a different paper (Hadjikoumis 2017) and, hence, findings are only briefly summarised here, focusing on their relevance to the scale of herding. The interviewees mentioned species (*i.e.* sheep or goat) and economic strategies (*i.e.* focus on milk and/or meat), rather than scales of operation, as the most important factors determining age-at-death. Nevertheless, the trend towards an increase in herd size in the last few decades was accompanied by a significant increase in the average age-at-death of lambs and kids (Hadjikoumis 2017, tables 15.2, 130). The herders attributed this, almost exclusively, to technological advances, adoption of modern husbandry knowledge and, most importantly, market forces favouring heavier lambs/kids. The opposite trend was observed in adult sheep and goat, both males and females (Hadjikoumis 2017, tables 15.3–4, 131–32). In this case, besides recent technological and economic developments, several herders attributed this trend also to an increase in the scale of operations in the last 10–20 years. The rationale behind the younger age-at-death among grown-up animals in larger herds is that there is more scope for faster replacement of animals once their productivity starts dropping in terms of milk and reproduction. Put simply, the herders claimed that the larger the herd, the more feasible it is to approach optimisation in productivity, especially when combined with modern technical knowledge and means for its implementation in more recent practices. Another notable concomitant change with the increase in herd numbers is the weakening of emotional bonds between herder and animal. In several cases, traditional herders mentioned that they kept specific animals even to senile age (>15 years) merely due to affection. To sum up, the age-at-death information from traditional Cypriot caprine husbandry shows a tendency towards younger age-at-death among adults, associated with an increase in herd numbers.

Male:female ratios do not exhibit a strong directionality in their fluctuations (Table 5.3). Overall, traditional caprine herding in Cyprus favoured male:female ratios of 1:23–1:40 for sheep and 1:20–1:45 for goat, with the mean at 1:30 and 1:28 respectively. A few herders commented that at the beginning of their careers they started with herds consisting of 10–20 females and a male (*e.g.* herder 15: 17 ewes and 1 ram), thus suggesting that small herds require proportionately more males than medium and large herds. It is important, however, to note that this is not necessarily the case if communal access to male animals for reproduction is practiced or provided as a service in exchange for goods (Xioutas 2001).

Moreover, a few herders hinted at the need for more males in goat than sheep herds with the rationale that female goats exhibit a more restricted ovulation period compared to ewes. More males are therefore required to achieve conception within one ovulation cycle. The fact that such a

Table 5.3. Male: female ratios among adult animals, provided by the interviewed sheep/goat herders. The size of the herd for which information was provided is indicated in parenthesis.

Herder	Male: female ratio
1	Sheep 1:37 (150)
2	Sheep/goat 1:26 (105)
3	Sheep/goat 1:25 (50)
4	Sheep 1:35 (140)
5	Sheep 1:23 (135)
6	Goat 1:20 (100)
7	Sheep 1:33 (120)
8	Goat 1:23 (200)
9	Goat 1:25 (160)
10	Sheep 1:40 (120)
11	Sheep 1:25 (31)
12	Sheep 1:28 (100)
13	Sheep 1:30 (75)
14	Sheep 1:30 (70) Goat 1:22 (65)
15	Sheep 1:35 (115)
16	Sheep/goat 1:28 (100/200)
17	N/A
18	Goat 1:30 (150)
19	Sheep 1:23 (80) Goat 1:30 (30)
20	Sheep 1:25
21	Goat 1:45 (180)
22	Sheep 1:27 (80)
23	Sheep 1:33 (135)
Mean	Sheep 1:30 (112) Goat: 1:28 (119)

trend is only very slightly reflected in the information they provided (Table 5.3) might be attributed to two factors. The firstly could be the lack of motivation (and/or knowledge) in traditional caprine husbandry to focus on a short birth season (Hadjikoumis *et al.* 2019). Secondly, in their accounts of male:female ratios, herders only considered subadult/adult bucks without including younger bucks (usually >1 year) used in reproduction and for promoting the ‘male effect’ (*e.g.* Murata *et al.* 2014). In fact, there is a strong belief among traditional Cypriot herders that in bucks, semen quality deteriorates with age, while in rams it improves or at least does not deteriorate (Xioutas 2001, 15).

Mobility

The type of mobility documented by the interviewed herders is of particular relevance to zooarchaeologists studying faunal assemblages from insular or coastal Mediterranean

environments, especially contexts where animal husbandry is geared towards generic milk-meat exploitation, tightly knitted with agriculture. All interviewed herders commented on the mobility of their herds but also provided additional useful information on other related activities, such as sheep washing in the sea. Their herds foraged in lands owned by their or adjacent communities and involved a moderate level of mobility with distances of 3–12 km covered (Table 5.4), without any form of transhumance exercised. This level of mobility involved daily round trips from the herd’s base to different foraging areas. Moreover, there was little difference between sheep and goat herds in the distances covered. Traditional caprine husbandry in 20th-century Cyprus was defined by this level of mobility but, in the more distant past, longer distance mobility was also an option. One of the herders mentioned that when he was a child, his family travelled 30 km on foot with their goats and sheep to stay for 3–4 months with relatives, taking advantage of access to stubble and agricultural waste after cereal harvest. It is plausible, thus, that in prehistoric (*e.g.* Neolithic) small communities for example, family ties such as those mentioned by the herder may have been activated seasonally to improve labour distribution and productivity in both farming and pastoral tasks.

Another aspect of traditional Cypriot husbandry related to mobility was the now-extinct practice of washing sheep, mainly in the sea but also in freshwater pools wherever an accessible coast was unavailable or too far (Table 5.4). Washing at sea was almost ubiquitously practised by sheep herders when distances from the sea were no more than 10–11 km; otherwise they opted for freshwater pools, natural and artificial. As for the reasons cited for this practice, the herders listed a series of beneficial effects for their animals such as the healing of wounds (especially after shearing) due to the disinfectant quality of salt, the elimination of parasites, and even the overall well-being of the animals. Goat herds were usually not subjected to this practice but, in cases of mixed herds, they were also driven with the sheep in the sea. Besides contributing to the health of caprine herds, such locations in the landscape played the additional role of meeting points that enabled herders to exchange/sell animals, strike other deals of economic nature and exchange information about the landscape and other communities.

Another mobility-related, and also now-extinct, practice in traditional Cypriot caprine husbandry was nocturnal grazing, mainly of sheep, from May through the summer, especially in the more arid eastern Cyprus. After the harvest of cereals, sheep and goat herds were allowed to feed on agricultural waste, stubble and fallen seed. During this period, usually two herders combined herds and took turns in sleeping outdoors to tend the animals. Consequently, mobility increased in the summer and was reduced in winter, also due to weather conditions. Moreover, between years, herders changed their itineraries in accordance to

Table 5.4. Information on the mobility (foraging range) of caprine herds managed traditionally, combined with distance from and interaction with the sea.

Herder	Composition	Foraging range	Distance from sea & interaction
1	Mainly sheep	4–5 km	2–3 km, sheep washed every 15 days in late spring and summer
2	Mainly sheep	6 km	2 km, sheep (and goat) washed every 20–30 days in summer
3	Sheep & goat	6–7 km	8–9 km, no interaction
4	Sheep	5 km	4–5 km, sheep washed
5	Sheep	Usually 3–4, occasionally up to 11–12 km	12 km, sheep washed a few times each summer
6	Goat	Little mobility (small-scale)	3 km. Most herders, although not him, washed sheep/goat in summer
7	Sheep	5 km	2 km, sheep were washed once a week in the sea after shearing (late March–early April)
8	Goat	Mostly free-range goats	N/A
9	Goat	2–3 km	Goats forage near the sea
10	Mainly sheep	4–5 km	25 km, no interaction (sheep washed in water pools for irrigation)
11	Sheep	<2 km	8–9 km, no interaction
12	Sheep	3–4 km	1 km, regularly washed sheep after shearing (April–August)
13	Sheep & goat	7 km	10–11 km, no interaction (sheep washed in nearby stream)
14	Sheep & goat	5 km	17 km, no interaction (washed sheep in pools of water or streams)
15	Sheep	3–4 km	2–3 km, sheep washed in sea every 8–10 days, June–October
16	Sheep & goat	Sheep 1 km, goat 2–3 km	4–5 km, sheep (not goat) washed in the past after shearing
17	Sheep	3–5 km	3 km, sheep washed in summer
18	Mainly goat	4–5 km	16–20 km, no interaction generally in the area (mainly goat herds)
19	Sheep & goat	5 km	10–11 km, sheep and goat washed in sea monthly (May–September)
20	Mainly sheep	3 km	3–4 km, sheep washed twice a year
21	Goat	3 km	20 km, no interaction
22	Sheep	usually 4–5 km, rarely 7 km	7 km, sheep washed twice a year (June–July)
23	Sheep	1.5 km	25–30 km, no interaction. Sheep washed in natural/artificial pools (summer)

community-wide agreements designating agricultural and pastoral use of the land. Most herders also owned land and cultivated crops such as cereals and pulses for their animals to feed on.

Discussion

The different aspects of traditional Cypriot caprine husbandry, presented here and elsewhere (Hadjikoumis 2017; 2018; Hadjikoumis *et al.* 2019), compose the picture of a pastoral system well-integrated with agriculture and adapted to a semi-arid Mediterranean insular environment. Though unique in its specific aspects, this system's overall form is almost identical to the one defined by Halstead (1996, 23) as 'sedentary pastoralism'. Agropastoral systems involving medium-scale caprine husbandry can vary widely in terms of their agricultural and pastoral components, as well as management techniques and economic strategies. There are, however, commonalities stemming from the practicalities of caprine husbandry on the medium scale,

which can serve as valuable analogies in archaeological contexts. As a norm, however, the remains of individual herds are not deposited separately and hence, are not amenable to study in the same way as in ethnoarchaeology. Nevertheless, the scale of ancient pastoral systems often leaves recognisable patterns in different categories of data, which helps zooarchaeologists identify it through analogy to herds documented ethnoarchaeologically.

Herd size and composition

One of the defining elements of traditional caprine husbandry in 20th-century Cyprus was a herd size composed of 50 to 200 animals, in predominantly (or exclusively) sheep or goat herds (Table 5.1). The factors that affected the reported herd sizes are relevant to zooarchaeological interpretation. The herd sizes documented (Table 5.1) were deemed adequate by the herders to cover most of their family needs. The exact size of a herd that adequately supports a family, however, can vary significantly depending on economic context, as well as variability between families and the concept of

family in different periods. While 100–120 sheep/goat were sufficient to make a living in 20th-century Cyprus, this was not necessarily the case in earlier periods. The trend within the 20th century in Cyprus was towards smaller herds in the first half of the century, with herds as small as 50–60 animals adequately supporting families of five children or more (Given 2000; Xioutas 2001, 113). Similar information has also been documented in Greece (Halstead 2014, 293; 1998, 213) and Spain (Seguí 1999, 69–70). Extrapolation of herd sizes from 20th-century Cyprus to ancient periods requires caution due to several unknowns on the economies and family/social structures involved, but it is more reasonable to assume that medium-scale caprine husbandry in the past would have involved numbers towards the lower end of the range reported by Cypriot herders.

Besides family needs, herd sizes were also heavily affected by the herder's responsibility to protect plant cultivations, at least in agricultural contexts such as those present in 20th-century Cyprus (wheat/barley, viticulture, and arboriculture). Some of these agricultural options were not available in prehistory, but it can be safely assumed that ancient herders would have also had to protect cultivations from their animals. All herders interviewed in this study made it abundantly clear that density of cultivations in their herd's forage area dictated how many animals they could control without causing damage. The trend for larger average herd size in goat (Table 5.1), compared to sheep herds, is partly attributable to the fact that goats traditionally were led to forage in areas of wild vegetation, further away from cultivations. In archaeological contexts, the integration of other lines of evidence (especially archaeobotanical, field systems and land use evidence), can help in approximating the level of care required by caprine herders to avoid agricultural damage.

Several herders highlighted the importance of good herding dogs in facilitating animal control, while others mentioned the use of a few goats to push sheep herds away from cultivations faster. The identification of the remains of these animals in zooarchaeological assemblages in contexts of predominantly sheep-based agropastoral economies may be pointing towards their use in controlling sheep herds and averting agricultural damage. Moreover, plant cultivation by the herders so that their animals can feed on directly before ripening, constituted yet another measure to divert pressure from cultivations destined for human consumption. Consequently, cases where unripe seeds and other elements of plants (*e.g.* legume pods or cereal ears) are identified in ancient animal dung, could be also interpreted in terms of land ownership by herders, besides as solely the result of agricultural damage. The distinction between these two scenarios is particularly difficult but archaeological interpretations are only further enriched by the consideration of both, as well as providing the incentive

for refined archaeobotanical analyses that could potentially render them separately identifiable.

Age-at-death and sex ratios

The zooarchaeological potential of the age-at-death data collected in this study has been more extensively discussed elsewhere (Hadjikoumis 2017), although the focus was on management rather than scale. While economic strategy is the dominant factor in deciding the age-at-death of lambs and kids, scale affects the age-at-death of older animals. Even medium-scale systems such as those described here are prone to maintaining most reproductive animals beyond their optimal age range. Indeed, in traditional Cypriot caprine husbandry it was common to keep female sheep and goat in declining productivity beyond 10 years and even much older. This is attributable to the more restricted capacity for herd replacement and even the stronger emotional bonds, both emanating from the relatively restricted herd size of medium-scale husbandry. On the other hand, large-scale transhumant pastoralists such as the Baxtyari, free from such constraints, can afford to replace ewes at 6–10 and does at 7–8 years (*e.g.* Digard 1981, 36), and similar ages are reported from large communal sheep herds in Turkey (Payne 1973, 301). It is, therefore, conceivable that herders involved in medium- or small-scale caprine husbandry in the past were also prone to keeping animals well beyond their productively optimal age. In 20th-century Cyprus at least, maintaining female caprines beyond their most productive age range occurred under a strategy primarily aiming at milk and tender meat production, rather than wool.

Scale had a smaller effect on male:female ratios. Beyond the direct interpretative value of the 1:28–30 average ratio (Table 5.3) for medium-scale caprine herds, a few herders suggested that larger herds require fewer males. This approach is supported by ethnographic information on large-scale caprine herders such as the Baxtyari of Iran involving ratios of 1:30–50 for sheep and goat (Digard 1981, 36) and 1:50–60 ratio reported for a large communal sheep herd at Aşvan in Turkey (Payne 1973, 301). This ratio is, however, dependent on a variety of other factors, such as the seasonality of birth and knowledge of animal reproduction. Overall, it constitutes an important trend to be taken into account in zooarchaeological interpretations, especially involving the integration of sex ratios with age-at-death in determining scale (*i.e.* higher male:female ratio combined with younger age-at-death among adults in large-scale vs lower ratios combined with older age-at-death in medium-/small-scale husbandry). Such combinations of multiple lines of evidence can also potentially help in telling apart deliberate economic strategy from the effects of scale (*e.g.* keeping caprines to old age due to lack of capacity for earlier replacement rather than a focus on wool production).

Mobility

Mobility for most caprine herds in 20th-century Cyprus was a short distance affair, involving daily round-trips to distances of 3–12 km, with distances of around 5 km being the norm for most of the year (Table 5.4). Among other factors, the level of mobility is affected by scale, with large-scale pastoralism being characterised by long-distance mobility (Digard 1981; Halstead 1996, 22) and small-scale caprine husbandry being almost stationary. It can be logically assumed that scale had similar effects in ancient husbandry systems as well, due to the practicalities involved in each scale of operations. Leading a small herd to forage farther away than the outskirts of a village would represent a bad investment of an experienced herder's time, resources and skill. This is also illustrated by the traditional practice of delegating the herding of small numbers of caprines (especially goats) to young members of a family. At the other end of the scale, the logistical complexity and scope for agricultural devastation associated with moving caprine herds on the large scale, dictates that such movements are well-organised in advance and the herds involved are kept at safe distance from growing cultivations. The level of mobility of caprine herds in Cyprus (Table 5.4) falls between the two approaches laid out above, and is characteristic of medium-scale caprine husbandry integrated in an agropastoral system.

The most general attributes of the system such as the geographic and environmental context (*i.e.* large Mediterranean island with semi-arid climate in this case) act as the backdrop for this type of mobility, and thus require consideration before applying information to archaeological data. The low frequency of climatic extremes, the dependence on water wells with strict access rights in some areas, the relatively small scale of the insular environment and the integration of the pastoral and agricultural land-uses, all contributed to the evolution of moderate levels of mobility associated with medium-scale husbandry in Cyprus and possibly similar archaeological contexts. As far as the animal species managed are concerned (sheep, goat, or mixed), it is intriguing that all herders noted that goats can forage faster and farther than sheep, but this difference is not reflected in the distances covered by their herds (Table 5.4). This discrepancy suggests that this level of mobility does not positively 'select' goat herds for their advantages cited by the herders. Nevertheless, the practice of including a few goats in predominantly sheep herds (Table 5.1), in this specific context, was based on the logic that they are leading sheep away from cultivations faster, thus reducing the risk of agricultural damage. Although it does not affect mobility *per se*, it provides yet another factor contributing positively to the integration of caprine husbandry and agriculture.

Other factors exerting an effect on mobility levels, as well as relating to scale, include the practices of combining

two herds (mainly sheep) over the summer months and washing animals. The former practice had the purpose of alleviating pastoral labour requirements to allow much needed rest or diversion of labour to other activities (cheese making, processing of agricultural harvest, etc.). Moreover, it illustrates once more the effect that the need to protect growing crops had on the scale of caprine husbandry, as well as its intra-annual adaptations in response to constraints (*i.e.* plant growing phase) and opportunities (stubble and fallen seed after cereal harvest). The latter practice, of washing sheep mainly in the sea, is rather unrelated to scale as it can be potentially adopted by all scales of husbandry, but it does provide an incentive to herders for covering longer distances. Its documentation in the ethnographic record (*e.g.* Ryder 1984; Santillo Frizell 2004), however, is also relevant to archaeology. The often centuries-long use of the same locations for washing animals led to modifications, potentially identifiable in the archaeological record, such as the constructed steps or ramps and the levelling of rock surfaces from animal trampling. On the interpretative level, this practice (more detail in Hadjikoumis 2018) also provides an additional mechanism for the transmission of cultural information and carrying out economic transactions.

The approximation of distances involved, the exact landscapes exploited and the identification of finer details on mobility-related practices in the archaeological record, require the application of multiple lines of evidence. Some of the most promising proxies in studying mobility in the past include the identification of relevant structures (*e.g.* field systems with 'corridors' to allow safe animal access, modified washing spots, etc.), archaeobotanical data addressing questions on foraging environments and animal diet, as well as the taxonomic and 'demographic' composition of the herds. Concerning the fusion of herds after harvest and prior to sowing (*i.e.* summer), any category of data (taxonomic, age-at-death, stable isotopes, etc.) that could help detect a seasonal absence of herds from the settlement would constitute potential evidence for this practice.

Concluding remarks on scale: archaeological opportunities and challenges

Through its study of traditional animal husbandry practices, ethnoarchaeology contributes plausible management variants. These enrich zooarchaeology interpretative framework and promote the development of analytical tools to detect them in the archaeological record. This study contributes new ethnozoarchaeological data on caprine husbandry, relevant to zooarchaeological analysis and interpretation. The husbandry system presented in this study and elsewhere (Hadjikoumis 2017; 2018; 2019), constitutes a valuable source of analogies for medium-scale

pastoralism integrated with agriculture. Such systems are nowadays practically extinct in Cyprus, but are of high relevance to the archaeology of coastal south-west Asia and *circum-Mediterranean* areas due to geographic and environmental affinities. Evidently, good practice in the use of ethnographic analogies dictates that any important technological, economic and cultural differences are also considered in interpreting the past.

Besides being useful as ethnographic analogies, the presented information also focuses on the effect of scale on caprine husbandry and addresses the scarcity of medium-scale systems in the ethnographic literature. Herd size is an attribute of direct relevance to scale and this study provides data that help determine and compare scale in ancient caprine husbandry systems. In the traditional agropastoral systems of 20th-century Cyprus, the threshold between small- and medium-scale caprine husbandry was around 50 animals, while that between medium- and large-scale around 200 animals. This tripartite scheme is somewhat arbitrary as the exact numbers can fluctuate based on a multitude of factors but it largely also holds true in other Mediterranean areas (*e.g.* Halstead 1996; Seguí 1999). Assigning individual herd numbers in the past is extremely difficult due to the amalgamation of animal remains, deposited over long periods of time. It is, however, both feasible and productive to determine scale in the past through its effect on other attributes of a given system. As this study has shown, such attributes include primarily zooarchaeological lines of evidence (age-at-death, sex ratios and mobility), although the importance of their integration with other lines of evidence (archaeobotany, land-use, stable isotopes, etc.) cannot be overstated.

Mortality within the first year, in both sheep and goat, was primarily affected by economic strategy (*i.e.* focus on milk and meat). Among reproductive animals, however, mortality was shaped by the medium-scale system's limited capacity for replacement of animals in decreasing productivity. Another contributing factor was the stronger emotional bond developed between herder and sheep/goat in medium-scale husbandry, resulting in maintaining reproductive animals beyond their optimal age. Zooarchaeologists frequently interpret high survivorship of caprines to advanced age (>10 years) as evidence for wool/hair exploitation (Payne 1973). The Cypriot case illustrates how scale can affect mortality to such a degree as to 'imitate' wool exploitation. Although difficult, it is feasible to distinguish scale from economic strategy through differences in mortality. Lower mortality in the first year combined with higher degree of uniformity in age-at-death among adults is expected in wool-focused systems (Payne 1973). Traditional medium-scale systems in Cyprus, on the other hand, were geared towards mixed milk and meat production, resulting in higher first year mortality (mostly 0–6 months) and high diversity in age-at-death among adults.

Scale has a smaller effect on male:female ratios compared to age-at-death. Sex ratios, however, provide further opportunities to separate economic strategies. Ethnographic literature, as well as the interviewed herders, suggest male:female ratios of 1:50 for large-scale sheep/goat husbandry and 1:30 for medium-scale husbandry. Such ratios are rarely documented in zooarchaeological studies, but the trend is based on practical and economic rationales that are worth considering in archaeological interpretations. Moreover, the widespread practice in Cyprus of slaughtering bucks at significantly younger ages than rams, although not informative on scale, could have also been practised in the past and can be identified zooarchaeologically through analyses combining biometric and age-at-death data.

The level of mobility associated with medium-scale caprine husbandry in 20th-century Cyprus involved distances of 3–12 km. This type of mobility was adapted to other aspects of a system operating on the medium-scale. The general economic and environmental context, the agricultural landscapes, the numbers of animals and herd composition, herd age/sex composition, and a multitude of other management practices (*e.g.* seasonal herd fusion, sheep washing, etc.) can all serve as proxies of medium-scale caprine husbandry characterised by moderate mobility. Consequently, a holistic approach is required to tackle issues of scale in ancient animal husbandry. Such an approach should combine zooarchaeological with archaeobotanical, as well as geochemical, land-use and architectural evidence.

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References

- Albarella, U. (2011) Ethnozoarchaeology and the power of analogy. In Albarella and Trentacoste (eds) 2011, 1–3.
- Albarella, U. and Trentacoste, A. (eds) (2011) *Ethnozoarchaeology*:

- The Present and Past of Human-Animal Relationships*, Oxford and Oakville, Oxbow Books.
- Albarella, U., Manconi, F. and Trentacoste, A. (2011) A week on the plateau: pig husbandry, mobility and resource exploitation in central Sardinia. In U. Albarella and A. Trentacoste (eds) 2011, 143–159.
- Albarella, U., Manconi, F., Vigne, J.-D. and Rowley-Conwy, P. (2007) The ethnoarchaeology of traditional pig husbandry in Sardinia and Corsica. In U. Albarella, K. Dobney, A. Ervynck and P. Rowley-Conwy (eds) *Pigs and Humans. 10,000 Years of Interactions*, 285–307. Oxford, Oxford University Press.
- Blaise, E. (2006) Référentiel actuel de brebis « Préalpes du Sud (Digne, Alpes-de-Haute-Provence, France): pratiques d'élevage et âges dentaires. *Anthropozoologica* 41(2), 191–214.
- Digard, J.-P. (1981) *Techniques des nomads Baxtyâri*. Cambridge/Paris, Cambridge University Press/Editions de la Maison des sciences de l'homme.
- Elliott, S., Bendrey, R., Whitlam, J., Rauf Aziz, K. and Evans, J. (2015) Preliminary ethnoarchaeological research on modern animal husbandry in Bestansur, Iraqi Kurdistan: Integrating animal, plant and environmental data. *Environmental Archaeology* 20(3), 283–292.
- Given, M. (2000) Agriculture, settlement and landscape in Ottoman Cyprus. *Levant* 32, 209–230.
- Hadjikoumis, A. (2012) Traditional pig herding practices in southwest Iberia: Questions of scale and zooarchaeological implications. *Journal of Anthropological Archaeology* 31, 353–364.
- Hadjikoumis, A. (2017) Age-at-death in Cypriot traditional sheep and goat husbandry: implications for zooarchaeology. In P. Rowley-Conwy, P. Halstead and D. Serjeantson (eds) *Economic Zooarchaeology: Studies in Hunting, Herding and Early Agriculture*, 126–134. Oxford, Oxbow Books.
- Hadjikoumis, A. (2018) Ethnoarchaeology as a means of improving integration: an ethnozooarchaeological study from Cyprus and its contribution to the integration of zooarchaeology with archaeobotany and other lines of archaeological evidence. In E. Piskin, A. Marciniak and M. Bartkowiak (eds) *Environmental Archaeology: Current Theoretical and Methodological Approaches*, 181–198. Cham, Springer.
- Hadjikoumis, A., Vigne, J.-D., Simmons, A., Guilaine, J., Fiorillo, D. and Balasse, M. (2019) Autumn/winter births in traditional and Pre-Pottery Neolithic caprine husbandry in Cyprus: evidence from ethnography and stable isotopes. *Journal of Anthropological Archaeology* 53, 102–111.
- Halstead, P. (1996) Pastoralism or household herding? Problems of scale and specialization in early Greek animal husbandry. *World Archaeology* 28 (Zooarchaeology: New Approaches and Theory), 20–42.
- Halstead, P. (2014) *Two Oxen Ahead: Pre-mechanised Farming in the Mediterranean*. Oxford, Wiley Blackwell.
- Halstead, P. and Isaakidou, V. (2011) A pig fed by hand is worth two in the bush: ethnoarchaeology of pig husbandry in Greece and its archaeological implications In U. Albarella and A. Trentacoste (eds) 2011, 160–174.
- Harris, S.E. (2007) *Colonial Forestry and Environmental History: British Policies in Cyprus, 1878–1960*. Unpublished PhD thesis, University of Texas, Austin.
- Murata, K., Tamogami, S., Itou, M., Ohkubo, Y., Wakabayashi, Y., Watanabe, H., Okamura, H., Takeuchi, Y. and Mori, Y. (2014) Identification of an olfactory signal molecule that activates the central regulator of reproduction in goats. *Current Biology* 24(6), 681–686.
- Payne, S. (1973) Kill-off patterns in sheep and goats: the mandibles from Aşvan Kale. *Anatolian Studies* 23, 281–303.
- Ryder, M.L. (1983) *Sheep and Man*. London, Duckworth.
- Santillo Frizell, B. (2004) Curing the flock. The use of healing waters in Roman pastoral economy. In B. Santillo Frizell (ed.) *PECUS. Man and Animal in Antiquity. Proceedings of the Conference at the Swedish Institute in Rome, September 9–12, 2002*, 80–93. Rome, The Swedish Institute in Rome.
- Seguí, J.R. (1999) *Traditional Pastoralism in the Fageca and Famorca Villages (Mediterranean Spain): An Ethnoarchaeological Approach*. Unpublished PhD thesis, University of Leicester.
- Wylie, A. (1982) An analogy by any other name is just as analogical. *Journal of Anthropological Archaeology* 1(4), 382–401.
- Xioutas, P. (2001) *Kupriaki laografia ton zoon* (Animals and the Cyprus Folklore). Nicosia, Kentro Epistimonikon Erevnon (Centre for Scientific Studies).