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Man and Beast in Chalcolithic Cyprus

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The range of animals exploited during the Cypriot Chalcolithic shows continuity from the preceding Aceramic and Ceramic Neolithic periods. For the most part, caprines and pigs were probably herded, domestic animals, but feral populations also may have been hunted. It is highly unlikely that fallow deer, also of great economic importance in Early Prehistoric Cyprus, were ever domesticated. The anachronistic importance of deer hunting in Cyprus is discussed in its ecological and economic context. Trends inferred from faunal remains are interpreted as representing increasingly intensive exploitation of animals during the Chalcolithic.

INTRODUCTION

The unusual significance of deer as a subsistence resource in the earlier Holocene of Cyprus was noted by Zeuner (1958) and has for several decades attracted considerable comment and speculation. Recent zooarchaeological research (Carter 1989; Croft 1985; 1989; Croft, in press; Davis 1984; Legge 1982; Watson and Stanley Price 1977) has added greatly to our knowledge of human subsistence in Early Prehistoric (E.P.¹; i.e., Neolithic and Chalcolithic) Cyprus and has shown that for 5000 years or so, roughly between 7000 b.c. and 2000 b.c.,² considerable reliance on the exploitation of fallow deer (*Dama mesopotamica*) was a standard, probably invariable, feature of the subsistence economies of village settlements. Heavy reliance on deer seems to have persisted later still in some places (Croft 1988b).

The longevity and obvious importance of the man-deer relationship in Cyprus represents a situation that is unique in the Holocene archaeological record of the Near East; subsistence economies in which deer played a prominent role are otherwise confined to the Pleistocene (Bar Yosef 1981: fig. 11; Edwards 1989: fig. 3).

In addition to deer, only pigs and caprines attained any degree of prominence as a meat source in subsistence economies throughout the E.P. in Cyprus; cattle were entirely absent. This attests a high degree of uniformity in the nature of subsistence within the period, and even into the Chalco-

lithic. Thus, to assess the interaction of man and beast in Chalcolithic Cyprus it is necessary to review the evidence for the origins and development of those heavily deer-oriented economies before the Chalcolithic period.

The larger mammals consumed by the inhabitants of early village settlements in Cyprus, beginning in the Aceramic Neolithic, include sheep, goat, and pig, which were all domesticated animals at the time on the nearby mainland. The Neolithic fauna of Cyprus also includes the fallow deer, which rapidly assumed a level of economic importance unparalleled elsewhere during the Holocene. Although the fallow deer is not generally considered ever to have been domesticated in the past, its importance as a subsistence resource in Cyprus has prompted suggestions, notably by Zeuner (1958: 133) and more recently by Jarman (1982: 166), that it must (in some sense at least) have been a domestic animal. It is argued below, however, that although subjected to controlled exploitation, the fallow deer was a free-living, hunted animal. Among the smaller mammals, which were less likely to have been eaten, dog, fox, and cat are present from the Aceramic Neolithic (Croft 1988a; Davis 1987: 305). This array of unquestionably man-associated animals represents a complete break with the preceding Pleistocene fauna (Boekschoten and Sondaar 1972; Davis 1985: 26). It is conceivable that pig and fallow deer could have colonized by swimming, but that could hardly account for the presence of caprines and the carnivores in

Cyprus. The most probable explanation is that all of those animals were deliberately imported by man (Watson and Stanley Price 1977: 247).

The Ecology of Pre-Chalcolithic Cyprus

Since direct evidence is sparse, consideration of the ecology of early Holocene Cyprus must necessarily rely heavily on extrapolation from evidence obtained from the nearby mainland. In brief, it seems that the northeast Mediterranean region was somewhat moister than it is at present (Bottema and Van Zeist 1981: 130; Van Zeist and Woldring 1980: 120). A period of high precipitation and humidity from 8000 to 6000 b.c. presented most favorable conditions for tree growth (Bottema and Van Zeist 1981: 118; Van Zeist and Bottema 1982: 282). At that time the vegetation of Cyprus would have differed radically from the largely anthropogenic vegetation of today. In place of the degraded communities of the more recent past, Cyprus would have supported a generally less xerophilous vegetation that included a greater number and variety of trees, particularly deciduous species. In the shade of those trees, the annual growth of herbs and grasses would have been more profuse and diverse and the understory vegetation would have remained green for longer into the hot dry season than do the herbs and grasses of the present (Jones *et al.* 1958: 45).

Whether or not the Pleistocene fauna became extinct prior to the first human presence on Cyprus (Simmons 1988), it does seem that it disappeared prior to the animal introductions made by Aceramic Neolithic settlers. It follows, therefore, that the pre-Neolithic vegetation of Cyprus would have developed, for a time at least, in the complete absence of mammalian herbivores. Pygmy hippopotami and elephants would have had little, if any, influence on the vegetation that confronted the Neolithic colonists of Cyprus and their animal imports.

It appears, then, that whether colonization occurred as early as 7500 b.c. (Todd 1987: 184) or as late as ca. 6000 b.c. (Le Brun *et al.* 1987: 283–84), there would have been at least some centuries, and possibly up to two millennia, during which natural woodland vegetation was able to develop in the complete absence of any browsing pressure. Browse-resistant plants would therefore have possessed no competitive advantage, and the vegetation that developed would have been highly palatable to herbivores and liable to damage following their

introduction. That vulnerability is confirmed by pollen evidence from Aceramic Neolithic Khirokitia, which indicates that the local woodland vegetation had already become degraded by an early stage in the life of the settlement (Renault-Miskovsky 1987).

The sparse distribution of Aceramic sites in Cyprus suggests that the human population did not multiply sufficiently during that period for its area of distribution to extend even throughout the lowland zone, let alone into the uplands. However, introduced ungulates, particularly free-living deer, would have colonized the entire habitable range far more rapidly, and it is highly probable that deer at least would have become established islandwide within a few human generations of the initial introduction. If, for the sake of argument, the assumptions are made that there was only one successful liberation of fallow deer in E.P. Cyprus, that it took place about half-way along the north coast in the vicinity of Troulli, and that the rate of dispersion of the deer was 0.8 km per year (Chapman and Chapman 1980: 129), then it is clear that deer could have colonized the entire island in about a century and a half. At the same rate of dispersion, liberation at Cape Andreas at the tip of the Karpas Peninsula, the most easterly point of the island, would have resulted in the most protracted colonization process, but even that would have taken less than three centuries.

It will be clear from the foregoing that the ecological circumstances of the earliest human settlement in Cyprus probably differed very considerably from those on the contemporary mainland, from which Cyprus was colonized, but from which it seems to have remained effectively isolated for the succeeding several millennia.

THE ANIMALS

Deer

The earliest discussion of the origin and status of the fallow deer of Cyprus was that of Zeuner (1958), who thought that they were probably indigenous to the island. Zeuner believed that by the Late Bronze Age the fallow deer was domesticated in Cyprus, and the abundance of deer remains in the Late Bronze Age sanctuary at Myrtou-Pigadhes led him to suggest a religious context for that domestication. He did, however, discuss the alternative view that the fallow deer was not indigenous

and that its presence in the Neolithic period indicates that it must have been imported at an early date. In Zeuner's opinion importation "would imply not only cultural relations, but a certain amount of 'domestication' . . . for religious purposes only or for meat supply also" (Zeuner 1958: 133).

It is now generally accepted that the deer were imported from Syria-Palestine (Chapman and Chapman 1980: 121; Davis 1987: 307; Halstead 1977: 267; Jarman 1982: 66; Karageorghis 1982: 25; Morris 1985: 189; Watson and Stanley Price 1977: 248), although not necessarily as domestic animals. That constitutes one element in the broader argument for an easterly rather than a northerly origin for the Aceramic culture of Cyprus (Stanley Price 1977: 84).

Ducos (1965: 4) was unable to determine whether or not the fallow deer of Cyprus were domesticated, since he lacked sufficient data to produce age frequency curves for the various sites. Such data are now available, but unfortunately they do not answer the question either. Ducos' assumption that mortality patterns that indicate other than random culling indicate that the species involved was domestic (Ducos 1968: xiv) is no longer accepted. The ungulates of Neolithic and Chalcolithic Cyprus appear normally to have been culled in a nonrandom fashion, which does reflect resource management; but resource management is not necessarily synonymous with domestication (Jarman 1982: 51).

Ducos (1965: 4-5) avoided the term "domestication" but suggested that the fallow deer of Cyprus were probably tamed or "semidomestic" at the inception of the Ceramic Neolithic. He bases that claim largely on the great economic importance of deer during the later part of the E.P. as represented by the sites of Sotira-Teppes and Erimi-Pamboula, compared with its lesser importance at Aceramic Neolithic Khirokitia. Since that time various others (e.g., Schwartz 1974: 103) have also suggested that the sheer quantity of deer remains in E.P. Cyprus indicates that deer were domesticated. That interpretation is not necessarily accurate; the abundance of the deer logically suggests only that deer were of considerable economic importance, not that they had to have been domesticated.

As the following section of this article will show, reliance on deer hunting increased subsequent to the Aceramic period in Cyprus, even though the importance of deer at Khirokitia may have been atypically low for the period because of the inadequacy of hunting to support an unusually large population there. Increased reliance on deer may

be explained in terms of ecological and economic factors, and does not require a major change of the sort Ducos (1965) envisaged in the nature of the relationship between man and deer.

Individual fallow deer are easily tamed (Clutton-Brock 1981: 182) and herds of untamed fallow deer are easy to keep in large, enclosed areas such as deer parks (Zeuner 1963: 434). On this basis it has been suggested that their status in Europe in recent centuries amounts to that of a semidomesticated (Ducos 1965: 4), and that view has undoubtedly influenced the interpretation that Jarman (1976: 42-43; 1982: 66) placed upon the Cypriot evidence:

The introduction [to Cyprus] of deer in sufficient numbers to act as a breeding stock for the substantial population for which there is archaeological evidence clearly argues for a high degree of control over the animals and for their sophisticated management. Furthermore, it is surely perverse to suggest that man imported small numbers of sheep and goats, which he herded and husbanded while depending primarily on fallow deer which he also imported, but then released and hunted. It seems overwhelmingly more like[ly] that the deer were the objects of the same measures of husbandry as the other imported herbivores, and that they were herded, behaviorally domestic animals until their decline in economic importance some millennia after their first introduction to the island (Jarman 1982: 66).

Is the suggestion that Neolithic man released and hunted the fallow deer in Cyprus really so perverse? On the contrary, it is arguably perfectly natural that incoming humanity, encountering a landscape devoid of huntable creatures, should wish to stock it with useful free-living animals such as deer. Following an apparent decline in numbers of the species in the Natufian period, the remains of fallow deer, while regularly present, are not generally abundant on Levantine sites during the Holocene (Bar Yosef 1981: fig. 11; Davis 1982; Edwards 1989, fig. 3; Legge 1982: 83). Fallow deer made a relatively small contribution to subsistence, and were clearly a hunted rather than a domestic animal. It follows, then, that it would have been as hunted animals that they were introduced by the early colonists of Cyprus. Moreover, it is hardly likely that those who first liberated the fallow deer into that unbrowsed, and therefore highly palatable, insular environment could have foreseen how what was traditionally a minor resource on the mainland was to become the basis of a highly

successful insular adaptation that would sustain successive human generations over several millennia.

Fallow deer are primarily grazers, but commonly browse trees and shrubs. Neither very open conditions, lacking in cover and shelter, nor densely wooded conditions suit them but they are able to thrive in a wide diversity of habitat types between those two extremes, ranging from fairly open grassland and scrub to moderately dense woodland (Chapman and Chapman 1975: 173–74). The broad ecological tolerance and the adaptability of fallow deer underlie its rapid rise to prominence in the subsistence economies of E.P. Cyprus.

The introduction of the fallow deer may have been part of a wider policy of stocking the Cypriot landscape with huntable wild animals. The fox, common on contemporary mainland sites, is also known from the Aceramic period at both Tenta and Khirokitia, and seems to be one such animal, doubtless desirable for its pelt. The presence of a small cat at both of those Cypriot sites may be explained in the same way, unless it was already domesticated at that early date.

In fact, very few deer would have been needed to establish a breeding population (Chapman and Chapman 1975: 185; 1980: 74); as few as a score probably would have been more than adequate. The transportation of such small numbers of animals from the mainland need not have posed a problem to seamen who were, after all, clearly capable of transporting a breeding population of humans (see Clutton-Brock 1981: fig. 18.6). Furthermore, there is no reason why the ability to capture, immobilize, and transport deer should be taken to imply either “a high degree of control over the animals,” in the general sense at least, or their sophisticated management as inferred by Jarman (1982: 66).

The notoriously intractable temperament of the fallow deer (Chapman and Chapman 1975: 156; Dansie 1984: 169; Fletcher 1978: 356; Tomlinson 1988: 93) renders it improbable that they were ever closely controlled in E. P. Cyprus. To this behavioral argument against their having been domesticated may be added the economic argument that the more labor-intensive strategy of carnivorous pastoralism does not provide access to additional products that are not available to the hunter. Furthermore, a herded animal will not normally convert vegetation to meat any more efficiently than a hunted one, and may indeed be less efficient (Ingold 1980: 87). In the absence of large carnivores—and

unless human groups behaved as competing predators—the protection of deer herds by the exercise of close control over them would seem unnecessary.

The deer of Cyprus are unlikely to have utilized terrain above about 1000 m (Chapman and Chapman 1975: 173–74); but land at that elevation is restricted to the core area of the Troodos Massif, so the great majority of the surface area of the island may be considered potential deer range. However, Cyprus is not a large landmass, and the facts that fallow deer do not undertake seasonal mass migrations over considerable distances and that they are easily exploited by sedentary people (Chaplin 1975: 42) indicate that a relationship of the type described by Jarman (1982: 52) as herd following is most unlikely to have existed in the E.P. Cypriot situation. A man–deer relationship of the sort that Jarman categorizes as controlled predation is therefore regarded as having occurred throughout the E.P. period.

Sheep, Goats, and Pigs

Unlike the fallow deer, the other animals that were of primary economic significance in E.P. Cyprus were also important in mainland western Asia. Sheep and goat herding was a regular feature of subsistence economies in the Levant from the mid-eighth millennium b.c. (Bar Yosef 1981: fig. 11; Edwards 1989: fig. 3; Moore 1982: 16) and beyond (Reed 1983: 525–26; Stampfli 1983: 443). It is exemplified at Jericho, where domestic sheep and goat accounted for about half of the 745 bones and teeth of the larger mammals during the PPNB (Clutton-Brock 1979: table 1; 1981: 56, 60). The Jericho pigs, represented by about a third as many items, are considered probably also to have been domestic (Clutton-Brock 1979: 146; 1981: 72). Beyond the Levant, domestic sheep and goats of broadly comparable date are reported from a variety of sites in western Asia, including Jarmo in northeastern Iraq (Reed 1983: 525–26; Stampfli 1983: 443). Domestic pigs are also known from the upper levels of Jarmo, beginning about the mid-seventh millennium b.c. (Stampfli 1983: 443) and from the Balkans, although the latter probably were independently domesticated (Bokonyi 1974: 208).

Thus it is most likely that the caprines and pigs in the earliest village settlements on Cyprus were introduced as domestic stock. The caprines of E.P. Cyprus display no appreciable differences from

their western Asiatic wild ancestors, but there is some evidence that the pigs may have been slightly smaller by the Cypriot Aceramic (Davis 1984: 156, fig. 98).

Even recent, improved forms of those farmyard animals, genetically far more remote from their wild forebears than the early domesticates, possess considerable potential for feralization (Davidson 1989: 61). Thus it is quite possible that free-living populations of those animals became established in Cyprus from an early date and were exploited in some way. Feral goats and pigs are reported to have existed formerly (Storrs and O'Brien 1930: 297), and the existence to this day of the moufflon or *agrino* bears witness to the feralization of primitive domestic sheep on the island (Boekschoten and Sondaar 1972: 333; Groves 1989: 49).

It is possible, therefore, that a typical Neolithic/Chalcolithic faunal assemblage from Cyprus includes the bones not only of hunted deer and herded pigs and caprines, but also of morphologically indistinguishable (or at least closely similar) feral pigs and caprines. This situation poses severe, and presently unsolvable, problems for detailed economic interpretation. Accordingly, the interpretations presented here are based on the working assumption that most, if not all, caprines and pigs were domesticates.

SUBSISTENCE ECONOMY IN PRE-CHALCOLITHIC CYPRUS

Excavations at the Aceramic Neolithic settlements of Kalavassos-Tenta and Khirokitia-Vounoi—6 km apart in the south coastal hinterland—and at Cape Andreas-Kastros, on the tip of the Karpass Peninsula, have furnished evidence for the animal economies of this period (Croft, in press a; Davis 1984; 1987). All three faunal assemblages consist overwhelmingly of deer, pigs, and caprines (mainly sheep in the south central region and goats at Cape Andreas), all of which are abundantly represented. Fox and cats, represented at both Tenta and Khirokitia, may have been exploited for their pelts, although the cat already may have assumed its familiar role of village-dwelling scavenger and exterminator of vermin. Dogs were not reported from these sites but are known from Aceramic Cape Andreas-Kastros (Davis 1987: 305).

The faunal assemblage at Neolithic Dhali-Agridhi was dominated by deer, but caprines and

pigs were also prominent (Carter 1989; Croft 1989; Schwartz 1974). However, since the site possessed components of both the Aceramic and Ceramic Neolithic periods (Lehavy 1989) and the faunal remains could not be chronologically subdivided, they will not be further discussed in the current article.

The faunal assemblages from Tenta, Khirokitia, and Cape Andreas are all amenable to chronological subdivision, and fairly distinct trends in animal exploitation may be observed within the Aceramic period. While the animal economies were based on the same three taxa, the diversity attests a high degree of flexibility in economic behavior within the period, no doubt in response to demographic, environmental, and social factors, which varied locally.

At Khirokitia a decrease in the importance of deer and pigs over time is offset by a pronounced increase in the relative abundance of caprine remains; at Cape Andreas exactly the reverse is true (Davis 1987: fig. 21). Trends in animal exploitation at Tenta are less pronounced; as at Khirokitia, reliance on deer decreases over time, but to a far lesser extent, while both caprines and pigs become somewhat more significant.

The implications of those trends in terms of changes in the relative contribution to overall meat supply may be estimated on the basis of counts of identified faunal remains available for both Tenta (Croft, in press) and Khirokitia (Davis 1984: Table 2). Those estimates are explained and presented in Table 1.

Additionally, extrapolation from the graphic representation of Davis' data for Cape Andreas permits the estimate that during Period II the relative contribution of deer, pigs, and caprines to overall meat supply was relatively similar—deer 32 percent, pig 38 percent, and caprines 30 percent. By Period VI, however, the importance of both deer (41 percent) and pig (52 percent) as meat providers had increased significantly, while that of caprines had plummeted to 7 percent.

Assuming that the deer were free-living, hunted animals, and that the caprines and pigs were (at least mostly) domestic, the faunal trends at Khirokitia indicate a pronounced shift in emphasis away from hunting and toward the exploitation of domestic stock; at Tenta the trend is toward a moderate shift in the same direction, while Cape Andreas shows a moderate shift away from husbandry and toward hunting. Nonetheless, all three sites retained

TABLE 1. Remains of Deer, Pigs, and Caprines from
Aceramic Kalavasos-Tenta and Khirokitia-Vounoi

Site/ Period	Deer		Pigs ^a		Caprines		Total
	no.	%	no.	%	no.	%	
Kalavasos-Tenta							
Period 4	206	56.4	83	22.7	76	20.8	365
Meat supply fraction ^b		63.2		30.0		6.9	
Period 3	30	39.0	30	39.0	17	22.1	77
Meat supply fraction		42.7		50.2		7.1	
Period 2	140	42.3	106	32.0	85	25.7	331
Meat supply fraction		48.3		43.0		8.6	
Khirokitia-Vounoi							
Period D		?	51	?	28	?	21
Meat supply fraction		56.6		36.6		6.9	
Level III	110	33.8	68	20.9	147	45.2	325
Meat supply fraction		47.2		34.3		18.5	
Level II	103	22.8	85	18.8	263	58.3	451
Meat supply fraction		36.7		35.7		27.6	
Level I	67	8.5	79	10.1	639	81.4	785
Meat supply fraction		19.3		26.7		54.0	

^aFigures for Tenta are based on identified postcranial fragments that could be confidently attributed to period. The Tenta pig figures exclude metapodia II and V and accessory phalanges, since those elements have no analogues in the deer or caprine skeleton. Furthermore, only half of the pig metapodia III and IV are included since the anatomical analogue of those paired elements in the ruminant skeleton is a single cannon bone. Figures for Khirokitia are based on a selection of skeletal elements and have been taken (or, in the case of Period D, extrapolated) from Davis (1984: 149; 1987: fig. 21).

^bIn estimating contributions to meat supply, if the meat yield of a hypothetical “average caprine,” the smallest animal under consideration, is taken to be a unit, then the yields from the average deer (3.4 units) and pig (4.0 units) may be expressed in terms of this. The case for the use of these particular values has been fully presented elsewhere (Croft 1988a), and it is sufficient to outline here the assumptions that have gone into the calculation of these meat yield factors:

	Deer	Pig	Caprines
Average adult weight (kg)	96	90	34
Edible portion	60%	75%	50%
Edible weight (kg)	57.6	67.5	17.0
Ratio of edible weights	3.4	4.0	1.0

In applying the meat yield factors, each fragment count is multiplied by the appropriate factor, and the product of each calculation is expressed as a percentage of the sum of the products.

a strong hunting (and presumably gathering) component throughout. Such economies generally are associated with low population densities, as may be inferred from the small number of known sites of this Aceramic Neolithic period.

The shift toward greater reliance on domestic stock at Tenta and Khirokitia may be viewed as a shift toward greater labor intensiveness in animal exploitation. Since both settlements outgrew their original boundaries (Le Brun 1981: 464–65; Todd

1987: 29), it is likely that population growth also led to this increased emphasis on food production. However, a greater degree of intensification is apparent at Khirokitia than at Tenta, possibly reflecting the larger size of the former and the differing potential of its environs (Cluzan 1987; Wagstaff 1978).

At the coastal site of Cape Andreas marine resources were important, as evidenced by finds of shells, fish remains, and bone fishhooks. Terrestrial

mammals may have been of lesser importance there than at inland sites like Khirokitia and Tenta. Yet there, too, evidence that deer increased somewhat in economic significance over time suggests a degree of economic deintensification, which may reflect a declining population. Certainly the excavation revealed no particular evidence for settlement expansion.

It seems clear that the Aceramic colonists of Cyprus stocked their newly-occupied, faunally impoverished landscape with a variety of animals, both domestic and wild, which they perceived as useful. In the sense that the perpetrators of such a policy of animal introductions could not have predicted its consequences, it may indeed be apposite to adopt a zoologist's viewpoint that prehistoric man "inadvertently instigated a zoological experiment" (Davis 1984: 148). Even if those prehistoric experimenters could have predicted the success with which the fallow deer would adapt to Cyprus, they could hardly have foreseen that a comparatively minor resource in their former western Asiatic homeland would rapidly become an economic resource of the first importance and would remain so for several millennia.

The exposure of the pristine vegetation of Cyprus to a variety of exotic herbivores must have resulted in the profound modification of that vegetation, and in consequent broader environmental ramifications, such as soil erosion and increased aridification. It is thus entirely predictable that a series of rapid adjustments should take place early in the postcolonization period within the overall context of a three-way interdependent relationship among man, animals, and environment. Early generations of human colonists would have to find new patterns of cultural behavior that would be both viable and satisfactory in an unfamiliar environment, which was itself undergoing rapid change. Both social behavior and subsistence practice are prone to rapid modification in a community confronted by such a challenge. Furthermore, the social and economic forms encountered among contemporary, perhaps rather isolated, pioneer communities are liable to be unusually diverse, although intercommunal contact may partially mitigate diversity. Social barriers can be as effective as geographical isolation in separating communities from one another (Hughes 1973). Even if the obvious defensive works at Tenta and Khirokitia were not constructed in response to a direct threat of attack by neighboring communities, it is difficult to view them as

other than physical manifestations of an ideology of separateness. It is thus against a backdrop of environmental, demographic, and social instability that the apparently rapid pace of economic change at Tenta, Khirokitia, and Cape Andreas must be viewed and intersite differences in the nature of that change evaluated.

While the economic significance of deer varied both spatially and temporally within the Aceramic Neolithic, deer were always important. The patchy evidence we have from several sites suggests that they were even more so during the Ceramic Neolithic.

In a subsample of the faunal remains recovered from the Ceramic Neolithic settlement of Philia-Drakos Site "A" near Morphou, 252 postcranial fragments included 71 percent deer, 17 percent pig, and 11 percent caprines.³ The high percentage of deer remains supports the thesis that animal economies were unambiguously deer-dominated. The figure of 76 percent quoted by Ducos (1965: 4) for Ceramic Neolithic Sotira-Teppes offers similar support, but his total represents only 19 deer bones.

The Ceramic Neolithic subterranean village of Ayios Epiktitos-Vrysi, on the north coast of Cyprus, produced deer remains only marginally more abundant than those of caprines. The bones of the three main taxa (excluding teeth) included 46 percent deer, 43 percent caprines, and 11 percent pig (Legge 1982: Table 5). That has prompted the suggestion that the subsistence pattern at Vrysi represented a departure from the general pattern for the Ceramic Neolithic and Early Chalcolithic, in which the importance of deer hunting far exceeded that of caprine herding (Peltenburg 1978: 64; 1982a: 99). However, since one deer probably yielded, on average, more than three times as much meat as caprine, the Vrysi bone evidence is consistent with deer hunting having been by far the predominant source of meat.

Man and Beast in Chalcolithic Cyprus

It has been shown above that animal economies in which deer hunting was anachronistically prominent characterize the Cypriot Neolithic. Hunting moved from merely prominent to predominant during the later part of the period—the Ceramic Neolithic. The following section of this article shows that hunting continued to predominate into the early Chalcolithic period, after which it declined somewhat in importance.

Knowledge of the relationship of man and beast in Chalcolithic Cyprus is based primarily on data from the three settlements of Lemba-Lakkous, Kissonerga-Mosphilia, and Kissonerga-Mylouthkia in the Kitma coastal lowlands in the west of the island. Other, lesser, bodies of faunal data are available from Kalavassos-Ayios and Erimi-Pamboula, both in the south coastal hinterland, and these will be discussed first. The range of animals represented and counts of identified mammalian bones are given in Table 2, and an assessment of the relative importance of the main food animals is presented in Table 3.

Because the bone sample from Kalavassos-Ayios (Croft, in press b) was exceptionally fragmentary and very poorly preserved, the sample may be biased in favor of the larger, more durable bones of deer (70 percent) and against those of pigs (9 percent) and caprines (14 percent). However, even if their importance has been inflated, it seems likely that deer were overwhelmingly the most important food animal in the subsistence economy at Ayios.

Little is known of the faunal remains from Erimi-Pamboula, which was excavated in the 1930s. King (1953: 432) observed that deer were common on the site, occurring in all levels of Dikaio's excavations; Ducos (1965: 4) gives the number 164 (71.9 percent) for the deer remains he examined. Another, very small, bone sample acquired from the site more recently also consisted mostly of deer remains (Croft 1981). Three mid-third millennium b.c. radiocarbon dates came from the upper levels of the site (Peltenburg 1982b: 113), but to judge from the 5.5 m depth of the Erimi stratigraphy, the lower levels are probably contemporary with Kalavassos-Ayios and Kissonerga-Mylouthkia, which are dated some centuries earlier. The meager evidence for the animal economy of Erimi, therefore, suggests that it probably was as heavily deer-dependent as the two earlier Chalcolithic sites.

The Ktima Lowlands Chalcolithic sites of Kissonerga-Mylouthkia, Kissonerga-Mosphilia, and Lemba-Lakkous constitute a localized cluster of chronologically overlapping settlements. Excavations on all three sites have yielded faunal remains, providing evidence for the nature of subsistence in three individual settlements and a unique opportunity to examine economic development at the regional level. The outline of economic change in the Ktima Lowlands presented here is a preliminary one, and additional animal bones from both

Mylouthkia and Mosphilia await analysis. It is probable that Mosphilia has already yielded more animal remains than any other archaeological site, of whatever period, in Cyprus—almost 5000 identifiable specimens—and it is estimated that the final count will be two to three times that number.

The following outline presents changes in the regional animal economy, both in terms of the relative abundance of the remains of various animals and in terms of their estimated significance as suppliers of meat. These estimates are based on the bone counts in Table 3, calculated by the method outlined in the notes to Table 1.

The animal economy of Early Chalcolithic Mylouthkia during the first third of the third millennium b.c. was very heavily deer-oriented. At Mylouthkia, as at the other Ktima Lowlands Chalcolithic sites, the caprines consisted overwhelmingly of goats.

Somewhat later, during Period 1 at Lemba, which represents the earlier phase of the Middle Chalcolithic at that site, the animal economy appears almost identical to that deduced for Early Chalcolithic Mylouthkia. Although those figures well may have been influenced to some extent by preservational bias, it seems apparent that deer were food animals of considerable importance in both instances. The consistency of the two sets of results prompts the suggestion that they characterize a pattern of faunal exploitation during the earliest centuries of substantive human settlement in the Ktima Lowlands. The heavy predominance of deer among faunal remains from Kalavassos-Ayios and Erimi-Pamboula (above) suggests that such a pattern was also current in other regions of Cyprus.

By the later phase of the Middle Chalcolithic at Lemba (Period 2) deer had declined somewhat in significance relative to the importance of other food animals. The continuation of those trends, at least for deer and pigs, is evidenced by the figures for Lemba, Period 3 (Late Chalcolithic). Indeed the decline in the importance of deer as a food source was even sharper between Periods 2 and 3 than between Periods 1 and 2, as was the concomitant increase in the importance of pigs.

Analysis of faunal remains from the ongoing excavations at Mosphilia is still in progress, but preliminary indications for the Middle to Late Chalcolithic are similar to the situation at Lemba. The patterns for the Late Chalcolithic period at the

TABLE 2. Identified Mammalian Bone Fragments from Chalcolithic Cyprus

		<i>Deer</i>	<i>Pig</i>	<i>Caprine</i>	<i>Dog</i>	<i>Fox</i>	<i>Cat</i>	<i>Cetacean</i>	<i>Total</i>
Kalavassos-	no.	611	81	125	43	11			871
Ayious	%	70.1	9.3	14.4	4.9	1.3			
Kissonerga-	no.	831	390	222	10	74	3		1530
Mylouthkia	%	54.3	25.5	14.5	0.7	4.8	0.2		
Erimi-	no.	184	+	+			+		256 ^a
Pamboula	%	71.9							
Lemba-	no.	546	437	295	3	27	1		1309 ^b
Lakkous	%	41.7	33.4	22.5	0.2	2.1	0.1		
Kissonerga-	no.	1777	2080	859	6	82	6	1	4811 ^c
Mosphilia	%	36.9	43.2	17.9	0.1	1.7	0.1	–	

^aBased on Croft 1981; Ducos 1965; King 1953. Information for the other sites is drawn entirely from examination of the material. + = taxon present but in unknown proportions.

^bTotal excludes two fragments of cattle bone and one fragment of equid bone, both from unreliable contexts.

^cTotal excludes 15 fragments of cattle bone, all from unreliable contexts.

TABLE 3. Relative Importance of Deer, Pig, and Caprines from Chalcolithic Cyprus^a

Site/ Period	Deer		Pigs ^a		Caprines		Total
	no.	%	no.	%	no.	%	
Early Chalcolithic							
Kalavassos-Ayious	545	78.1	48	6.9	105	15.0	698
Meat supply fraction		86.2		8.9		4.9	
Kissonerga-Mylouthkia	723	63.7	211.5	18.6	200	17.6	1134.5
Meat supply fraction		70.2		24.1		5.7	
Early-Middle Chalcolithic							
Lemba-Lakkous Period 1	47	63.9	12.5	17.0	14	19.0	73.5
Meat supply fraction		71.4		22.3		6.3	
Middle Chalcolithic							
Lemba-Lakkous, Period 2	99	47.6	42	20.2	67	32.3	208
Meat supply fraction		58.9		29.4		11.7	
Kissonerga-Mosphilia, Period 3	97	51.3	65	34.4	27	14.3	189
Meat supply fraction		53.5		42.2		4.4	
Late Chalcolithic							
Kissonerga-Mosphilia, Period 4	1272	44.4	1063	37.1	528	18.4	2863
Meat supply fraction		47.5		46.7		5.8	
Lemba-Lakkous, Period 3	127	35.9	129	36.4	98	27.7	354
Meat supply fraction		41.3		49.1		9.4	

^aBased on numbers of identified postcranial fragments. The way in which the pig bones have been counted and the way in which the fraction of meat supply has been estimated are explained in the footnotes to Table 1.

TABLE 4. A Comparison of the Age Stages at Which Deer, Pigs, and Caprines Were Killed at the Chalcolithic Sites of the Ktima Lowlands^a

	Deer				Pig				Caprines			
	I	J	S	A ^b	I	J	S	A	I	J	S	A
Mylouthkia	11	1	17	71	29	2	20	49	4	8	20	68
Lemba, Periods 2–3	5	20	28	47	61	0	23	16	6	29	6	59
Mosphilia	7	25	8	60	33	23	27	17	14	19	9	58

^aPercents, based on epiphyseal fusion data
^bI = Infant J = Juvenile S = Subadult A = Adult

two sites are very similar and the Middle Chalcolithic patterns accord reasonably well.

The conclusions to be drawn from the foregoing attempt at a diachronic view of the regional animal economy of the Ktima Lowlands during the third millennium b.c. are that a marked decline occurred in the importance of deer for meat, while the importance of pigs increased twofold. By the end of the millennium as represented by Period 3 at Lemba, pigs became the major meat producers; the same appears to have been the case in Period 4 at Mosphilia. Assuming that deer were hunted animals and that at least the great majority of other creatures were domesticates, it would seem that herding, particularly of pigs, gradually increased in importance as hunting declined through the third millennium b.c.

As with the Aceramic Neolithic settlements of Kalavassos-Tenta and Khirokitia in the south coastal hinterland, the shift toward greater reliance on domestic stock during the Chalcolithic of the Ktima Lowlands suggests a shift toward greater labor-intensiveness in animal exploitation. The fact that both Tenta and Khirokitia demonstrably outgrew their early boundaries constitutes good evidence for population expansion, and thus provides a motive for the investment of greater effort in subsistence. That population expansion occurred in western Cyprus during the third millennium b.c. may be adduced from ceramic evidence. More than 30 Chalcolithic sites have been located in the Ktima Lowlands-Paphos Plateau region as a whole (Baird 1984; 1985; 1987; Hadjisavvas 1977; Peltenburg 1979: 72–79; Sheen 1981) but only three—Mosphilia, Mylouthkia, and Miliou—have yielded the

Glossy Burnished pottery characteristic of the Early Chalcolithic (Peltenburg 1983: 11; 1989: 195).

Economic intensification, inferred from the shift toward greater reliance on herding and reduced reliance on hunting, is also suggested by a second line of evidence. Data regarding the stage of life at which the animals were culled during the E.P. in the Ktima Lowlands, presented in Table 4, suggest that both deer and pig were, on average, culled at a younger age in the later third millennium b.c. than previously.

Although the growth rate of the fallow deer is in constant decline from the outset, it is still rapid until the third year of life. By the fourth year, it has become rather slow, and it is very slow (males) or possibly nonexistent (females) thereafter. Therefore, the younger the average age of a deer population the more productive (of biomass) it will be. Efficient exploitation would probably focus on culling in the juvenile stage, when the deer attain a substantial portion (possibly some 50 to 70 percent) of adult body weight (see also the work of Koike and Ohtaishi [1987] on deer hunting in Jomon, Japan).

The study of the animal remains from the Chalcolithic settlements of the Ktima Lowlands has demonstrated that deer persisted as an important resource for the entire third millennium b.c. Moreover, faunal evidence from Maa-Palaeokastro (Croft 1988b), a late second millennium b.c. settlement on the northern margin of the lowlands, shows that deer retained a high degree of economic significance for another thousand years in the locality. The longevity of the man–deer relationship in the area certainly suggests a conservationist policy

toward deer exploitation, but that may not tell the whole story. Although uncontrolled, indiscriminate hunting may lead to the extinction of an animal population, that is not invariably the case. If the animals exist over a wide area, so that pockets of habitat exist that are inaccessible to hunters, the animals may continue to flourish (Bailey *et al.* 1983: 77).

In the Ktima Lowlands, age-biased mortality patterns established from deer remains from a range of Chalcolithic settlements and phases represent selective (nonrandom) culling, and seem to reflect the various stages of an evolving system of game management. Increasing intensification of deer hunting has been inferred from the apparent trend toward younger culling. However, since at least some of the deer culled may have been replaced by immigration from beyond the hunted area, one cannot infer that the longevity of the man-deer relationship in the region was entirely attributable to an effective conservationist approach to deer exploitation.

Ceramic evidence points to an increase in the human population of the Ktima Lowlands-Paphos Plateau region during the Chalcolithic period. It seems probable that the population density in the region may have been sufficiently low during the Early Chalcolithic that unhunted areas existed. As settlement density increased over time, however, such pockets of unhunted deer would have become reduced and eventually would have disappeared. Hunters would have gained smaller returns from the prevailing hunting strategy, which would have provided an incentive to modify that strategy for greater efficiency of exploitation. It is proposed that the changes in deer culling policy that have been inferred between the Early Chalcolithic (Mylouthkia) and later stages in the third millennium b.c. represent just such an improvement in the productive efficiency of deer exploitation.

It is clear from the prominence of deer in the Maa-Palaeokastro faunal sample that even as late as the later second millennium b.c., deer had not been hunted to extinction in the Ktima Lowlands area. However, it is probable that as the human population expanded during the third millennium b.c. and deer were exploited more fully, the importance of hunting to the subsistence economy gradually lessened. Whether there would have been an absolute decline in the deer population as a result of hunting remains a moot point, although that is

certainly possible. The size of the deer population would have declined with respect to that of the human population as the latter increased; however many deer there were, the number of deer per hunter undoubtedly would have declined over time. A reduction in the availability of what was traditionally the main meat animal must certainly have underlain the modifications in the mode of exploitation of deer.

The culling of pigs prior to subadulthood increased over time (Table 4), and an intensification in pig exploitation may therefore be indicated. In fact, it is exceptionally difficult to interpret this trend with any degree of confidence due to the possible presence of morphologically indistinguishable hunted, free-living pigs as well as domestic stock.

The attitudes of the people of Mylouthkia to the culling of both feral and domestic pigs, if both were exploited, may well have diverged considerably. Evidence from Mylouthkia for crop agriculture (Colledge 1980; 1981) suggests that the feral pigs would have been unwelcome visitors in fields or gardens. Although a useful source of meat, these destructive animals might have been viewed largely as pests to be exterminated on sight, irrespective of age or sex. It seems likely that the population of feral pigs around such early sites as Mylouthkia in time became depleted. As feral pig became scarcer, the mortality pattern that may be inferred from the pig remains should increasingly represent culling of domestic pigs alone. Taken as a whole, the pig culling pattern at Mylouthkia might represent some combination of two separate strategies applied to domestic and feral populations, while that at Lemba (Periods 2, 3) and Mosphilia may more purely reflect the former. Thus the increased emphasis on the slaughter of very young pigs may have run hand in hand with increasing reliance on husbanded rather than feral pigs.

A reduction over time in the availability of deer and feral caprines may also have had repercussions for the conduct and importance of pig keeping. Concurrently with those trends during the third millennium b.c. in the Ktima Lowlands, pig meat increased in overall importance in human diet. At Mylouthkia and the earliest period of occupation at Lemba, pig is estimated to have accounted for about one-quarter of meat consumed, while in the latest period at Lemba and at Mosphilia during Period 4, the figure approaches one-half.

Examination of the detailed morphology of the caprine skeletal remains from the Ktima Lowlands sites indicates that the vast majority of caprines present in the third millennium b.c. were goats. On the basis of a wide range of elements believed identifiable to the genus level, sheep appear to represent only 4 percent of the caprine material at Mylouthkia; and although slightly more common later at Lemba (9 percent) and Mosphilia (12 percent), they still were only a small percent of caprines.

With apparently only one exception, goat horncores from E.P. Cypriot sites are of the robust "scimitar" type, displaying no hint of the helical twist characteristic of the more developed varieties of domestic goat (Zeuner 1955; Clutton-Brock 1981: 61). They tend to have the lozenge- or almond-shaped cross-section generally associated with an early stage of domestication rather than the quadrangular section typical of the western Asiatic wild goat (*Capra aeqagrus*) (Bokonyi 1973: 173–74; Hole, Flannery, and Neely 1969: 271–72, fig. 115; Reed 1960: 130). The one exception, a specimen from Mosphilia, shows a slight degree of twisting, but it probably is not of great significance (Ducos and Helmer 1981: 523).

A study of deer and caprine skeletal remains (Croft 1988a) suggests that sexual size dimorphism is in general more pronounced among the caprines of E.P. Cyprus than among the deer, permitting a variety of caprine skeletal elements to be sexed with a high degree of confidence. That study concluded that a pronounced sexual imbalance existed among the fused caprine bones from Tenta; roughly nine of ten represented females for both sheep and goats. Such an imbalance would be expected only if the Tenta caprines were husbanded animals exploited primarily or solely for meat; the great majority of males would have been superfluous for herd maintenance and therefore would have been slaughtered at a young age.

The relatively slight preponderance of females over males at the three Chalcolithic sites of the Ktima Lowlands (as seen in the fused skeletal elements) presents a radically different picture. Numbers of males per female are 0.79 at Mylouthkia, 0.73 at Lemba, and 0.95 at Mosphilia, clearly denoting a different system of caprine exploitation than at Tenta. Such a large proportion of male caprines would be inefficient for either meat or milk production, and while a balanced sex ratio is characteristic of wool production (Payne 1973:

figs. 1–3), the heavy predominance of goats in the Ktima Lowlands caprine population invalidates that interpretation.

It thus appears that productive efficiency was not the sole guiding principle behind the exploitation of goats in the Ktima Lowlands during the third millennium b.c. In all three bone samples discussed here, a far larger proportion of males appears to have been allowed to survive into adulthood than would be expected if the animals were being herded for meat. Three plausible explanations may be suggested, but the available evidence does not permit us to evaluate the relative merit of each.

The first is that the Chalcolithic goat-herders of the Ktima Lowlands indulged an "expensive" dietary preference for the flesh of well-grown male goats.

A second explanation suggests that although uneconomic in terms purely of meat production, the maintenance of a large proportion of well-grown males was perceived as desirable. It is conceivable that mature male goats, with their massive, graceful, backward-sweeping horns advertised the wealth and status of their owner. Alternatively, those impressive animals may have symbolized certain social values or aspirations, possibly connected with fertility. Even today, horns remain a powerful symbol in rural Cyprus to ward off the evil eye (*to mati*), particularly from animal pens, and also to characterize the *keratas* or cuckold (see Morris *et al.* 1979: 120–46).

Finally, perhaps the assumption that the goats of the Ktima Lowlands consisted overwhelmingly of domestic stock is erroneous; the age-sex patterning within the caprine sample to a large extent may instead represent predation on feral herds. In support of this suggestion, the 41–47 percent representation of males among the sexable fused elements of caprines from the three Ktima Lowland sites compares far more closely with their 37–53 percent representation among hunted deer from six E.P. sites (Croft 1988a: Table 3.4) than it does with the ten percent figure for the representation of males among domestic caprines from Tenta.

The mortality patterns presented in Table 4 suggest that caprines, like deer and pig, may have been culled younger as time went on. Certainly, while preadult culling at the two later sites tended to occur mostly prior to the end of the juvenile stage, it seems to have been concentrated during the succeeding (subadult) stage at Mylouthkia. Thus, even

if a similar proportion of caprines survived to adulthood on the later sites, the average age at death seems still to have decreased.

CONCLUSIONS

The anachronistic importance of deer is the most conspicuous aspect of the subsistence economies of village settlements during the Neolithic and Chalcolithic periods of Cyprus. Indeed, it has sometimes been suggested that the importance of deer was such that they must have been domesticated. It is argued here, however, that for man to have herded deer would have involved greater effort than hunting without yielding additional returns and it is consequently concluded that the deer would have been a free-living, hunted animal throughout the period under discussion (roughly 7000–2000 b.c.).

The extent to which animal economies were oriented toward deer hunting reached a peak during the Ceramic Neolithic, and a very high level of dependence upon deer endured through the earlier part of the Chalcolithic. Subsequent decline in overall economic significance of deer hunting during the Middle and Late Chalcolithic in the Ktima Lowlands may have been due to the decreasing capacity of the hunting strategy to support an expanding human population. It is apparent that the trend was accompanied by an increase in the relative importance of pigs. Pig herding probably ex-

panded, although the possibility should not be overlooked that some of the pig remains from those Chalcolithic settlements represent hunted feral animals. Concurrently with the changes in the relative contributions of deer and pig to subsistence, there may also have been a shift toward younger culling, indicating intensification in their exploitation. Despite the steady decline in their contribution to subsistence during the Chalcolithic, even by the end of that period deer hunting was still providing almost a half of all meat consumed.

Caprines, mostly goats in the Ktima Lowlands, were never major sources of meat, but are represented at a fairly constant, if low, level throughout the Chalcolithic. The balanced representation of the sexes among mature bones would indicate a grossly inefficient mode of exploitation if maximization of the meat yield had been the primary objective. This suggests either that other considerations were uppermost in the herdsman's mind, or that the caprines were (at least mainly) hunted animals, although an equal sex ratio would not seem to represent a particularly efficient pattern of hunting either. Even so, the mortality patterns of the Ktima Lowlands caprines hint that they, like the deer and pig, may have been culled younger over time. That would accord with the proposed general trend towards an increasingly intensive exploitation of beast by man in Chalcolithic Cyprus.

NOTES

¹Following Stanley Price (1979: xi), the term Early Prehistoric (E.P.) is used here as a more concise way of indicating that portion of Cypriot prehistory that encompasses what are conventionally referred to as the Aceramic (Early) and Ceramic (Late) Neolithic and the Chalcolithic periods.

²b.c. (lower case) is used throughout to denote radiocarbon years before Christ, while B.C. indicates calendar years.

³I examined some of the faunal remains from Philia-Drakos "A" with the kind permission of A. J. Legge, to whom the material had been given for study.

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