Communities, Landscapes, and Interaction in Neolithic Greece

Edited by

Apostolos Sarris, Evita Kalogiropoulou, Tuna Kalayci and Lia Karimali

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Humans, Animals, and the Landscape in Neolithic Koutroulou Magoula, Central Greece: An Approach through Micromorphology and Plant Remains in Dung

Georgia Koromila, Panagiotis Karkanas, Georgia Kotzamani, Kerry Harris, Yannis Hamilakis, and Nina Kyparissi-Apostolika

Abstract

This paper examines evidence on animal diet through the study of dung and its contents in order to discuss animal-related mobility and the use of ecological resources at Neolithic Koutroulou Magoula in central Greece. Micromorphological analysis of intact sediments was employed in order to identify the presence of animal dung in archaeological deposits, thereby providing direct evidence of animal diet. Building on these observations, phytolith and archaeobotanical analyses were used to further investigate plant content of dung-rich deposits. Micromorphology showed that dung was a major contributor to sediment accumulation at the site. It was encountered in trampled (likely penning) deposits, secondary refuse accumulations, and in-situ fuel. It was also found that the dung is extremely rich in phytoliths, including wild-grass- and reed-derived morphotypes and domesticated cereals. Plant macroremains from dung-rich contexts revealed a similarly diverse picture of animal diet, including cereals, weeds, and fruits. It is thereby suggested that a combination of animal foddering and grazing practices were employed by the inhabitants of Koutroulou. The integration of micromorphology with archaeobotanical, zooarchaeological, and other analytical methods, as well as with broader archaeological, on-site and off-site data, provides a more holistic understanding of human and animal relationships with the environment.

Keywords

micromorphology, phytoliths, archaeobotany, animal diet, paleoenvironment

Among the recent proliferation of raw material provenience studies (e.g. Kilikoglou et al. 1996; Milić 2014; Pentedeka 2011; Quinn et al. 2010; Whitbread and Mari 2014) that provide a suitable dataset to discuss regional-scale movement and communication patterns and networks, smaller-scale, settlement-based ways of movement can be overlooked. Village daily life is far from static, however, and one way to approach small-scale, subtle types of mobility is by examining the implications of farming-related tasks. These tasks include the herding of domestic animals: the joint human-animal ways of engaging with the landscape created by this activity comprise a fundamental part of Neolithic lifeways.

Studies of animal-related mobility in Neolithic Greece have primarily focused on questions of seasonal movement and the degree of settlement permanence. Halstead (2005) examined faunal data from sites of different types to conclude that there is no supporting evidence for the hypothesis of transhumance, as faunal assemblages are compatible with year-round presence of domesticates. Valamoti (2007) approached animal-related mobility by analyzing archaeobotanical remains from dung-rich contexts in four sites (tells and flat/extended sites). She proposed that in tell sites, animals were kept within or in proximity to the settlement year round, in contrast to flat sites, where the absence of seeds and fruits in dung suggests summer movement away from the settlement.

Recent studies of the archaeobotanical content of dung-derived deposits at Neolithic sites in Greece reveal the multiplicity of animal feeding options, following in each case spatial, environmental, and socioeconomic contingencies. These options range from an emphasis on grazing of arable land in Final Neolithic–Early Bronze Age Mandalo (Valamoti and Jones 2003) and Final Neolithic Arkadikos (Valamoti 2004), to grazing in different patches of vegetation in the landscape of Late Neolithic Makri, and to some form of herd movement during summer months at Middle Neolithic Apsalos (Valamoti 2006) and Late Neolithic Makriyalos (Valamoti 2004). Vaiglova et al. (2014) also highlight diversity in animal feeding practices at Middle and Late Neolithic Kouphovouno, Peloponnese, based on isotopic dietary signatures of animal bones.

Within this research framework, the present study

proposes a combined approach for the investigation of herbivore diet in order to explore human-animal environmental relationships at Neolithic Koutroulou Magoula in central Greece. This is achieved by the examination of plant content of dung-rich deposits through the integration of micromorphology, phytolith analysis, and archaeobotany, with additional data from the faunal record. This integrated approach aims at providing new ways of exploring human-animal environmental interactions; thus our study has wider methodological implications beyond the specific case study.

Case Study

Excavations at Koutroulou Magoula were begun in 2001 by the 14th Ephorate of Prehistoric and Classical Antiquities (now the Ephorate of Antiquities of Pthiotida and Evrytania), under the direction of Dr. Nina Kyparissi-Apostolika (Kyparissi-Apostolika 2006). Informally since 2009, and officially since 2010, the site has been investigated as part of the Koutroulou Magoula Archaeology and Archaeological Ethnography Project, which is a collaboration between the Greek Archaeological Service and the University of Southampton under the auspices of the British School at Athens (Hamilakis and Kyparissi-Apostolika 2012; Morgan 2011, 2012, 2013). It is located near the village of Vardali, ca. 2.5 km south of the village of Neo Monastiri, Phthiotida, at the southern edge of the Thessalian Plain (Figure 1), and it comprises a distinct mound that rises 6.6 m above the modern plain surface. The anthropogenic character of the mound is attested by cultural layers excavated down to ca. 2.5 m in depth from the tell's surface; the anthropogenic stratigraphy is expected to continue to the base of the mound and is still under investigation.

The bulk of excavated deposits at Koutroulou are dated, based on AMS radiocarbon dating (see Hamilakis et al., this volume), to the first two centuries of the sixth millennium B.C.; there is also extensive evidence of later Bronze Age and Medieval activity at the top of the mound.

The organization of settlement space was characterized by rectilinear, free-standing buildings with stone wall foundations (Figure 2), as revealed by the excavation and the geophysical surveys. The buildings were constructed in relative proximity to each other; e.g. Buildings 1 and 2 are separated by less than 2 m distance. Open spaces in between buildings are characterized by midden-like, charred, and ashy deposits; spatial features such as fire installations, stake holes, and paved surfaces; and dense accumulation of anthropogenic residues, such as pottery, animal

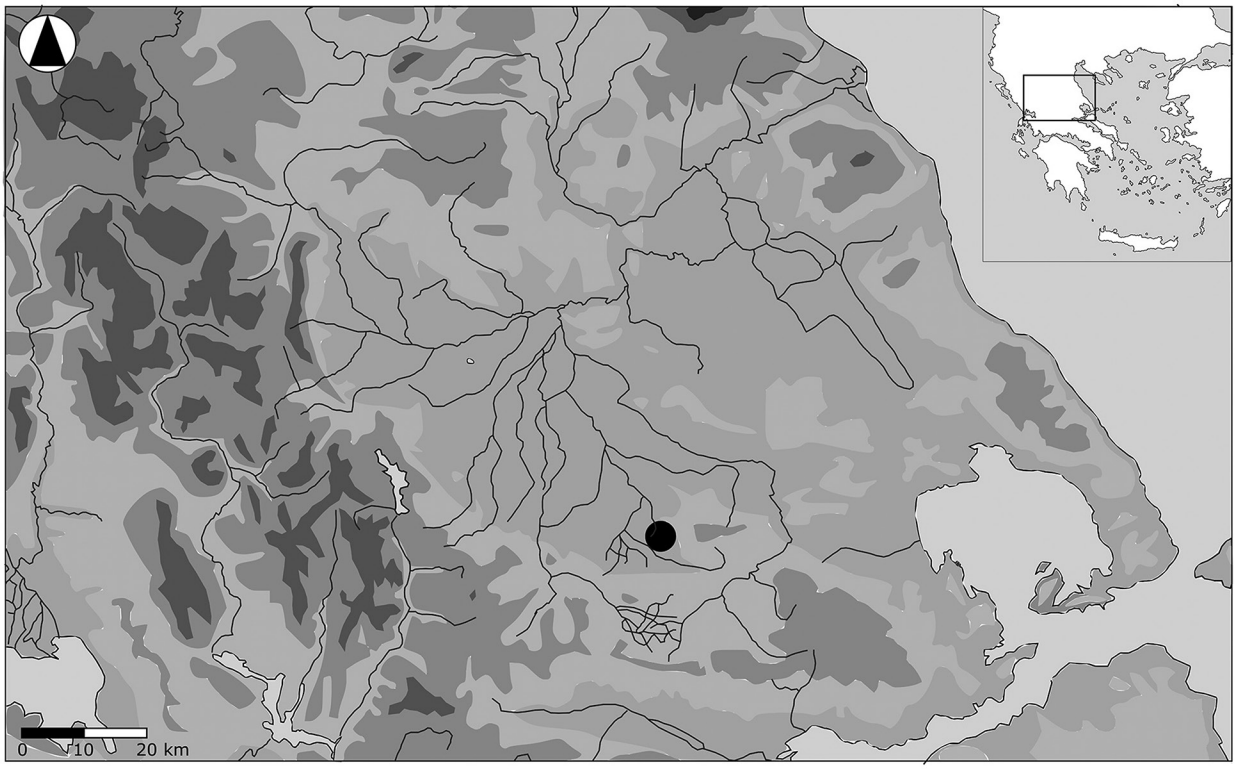

Figure 1. Map showing the modern topographic location of Koutroulou Magoula at the southern edge of the Thessalian Plain.

bones, ground stones, lithics, and clay figurines, all indicating extensive human activity. At the periphery of the site, curvilinear features indicated by the geophysical survey have been preliminarily interpreted as ditches (Hamilakis and Kyparissi-Apostolika 2012; Kyparissi-Apostolika and Hamilakis 2015).

In order to obtain a holistic understanding of Neolithic life at the site, it is important to study its position within the wider landscape. Located at the southern edge of the Trikala alluvial basin at the low rises formed at the junction between the Othrys and Revenia Mountains to its southeast, the settlement was in proximity to both upland and lowland types of environments and resources. According to palynological studies (Bottema 1979, 1982), lowland vegetational zones in Thessaly during the Neolithic were characterized as wet environments, possibly affected by periodic flooding (van Andel and Runnels 1995), with strong arboreal presence at least until ca. 4000 B.C., as well as patches of shorter grassland. Upland forested regions were covered by mixed, oak-dominated woodland. The topographic location of Koutroulou at the ecotone between different geomorphological and environmental zones afforded access to diverse environments and resources of low and high altitude, potentially including woodland, semi-open grasslands, and wetland vegetation within the alluvial plain.

Aims and Methods

This paper aims at examining the ways of movement, access to, interaction with, and use of landscape features at Koutroulou, specifically related to animals, by employing:

1. Micromorphology, in order to identify dung-rich deposits and examine dung in situ to provide evidence on animal diet;
2. Phytolith analysis, in order to quantify and complement micromorphological analysis of plant remains in the composition of animal diet and their environmental implications;
3. Archaeobotanical analysis of dung-rich deposits in order to examine the comparative frequencies of domestic and wild plant (e.g. cereal vs. wild fruit/weeds)

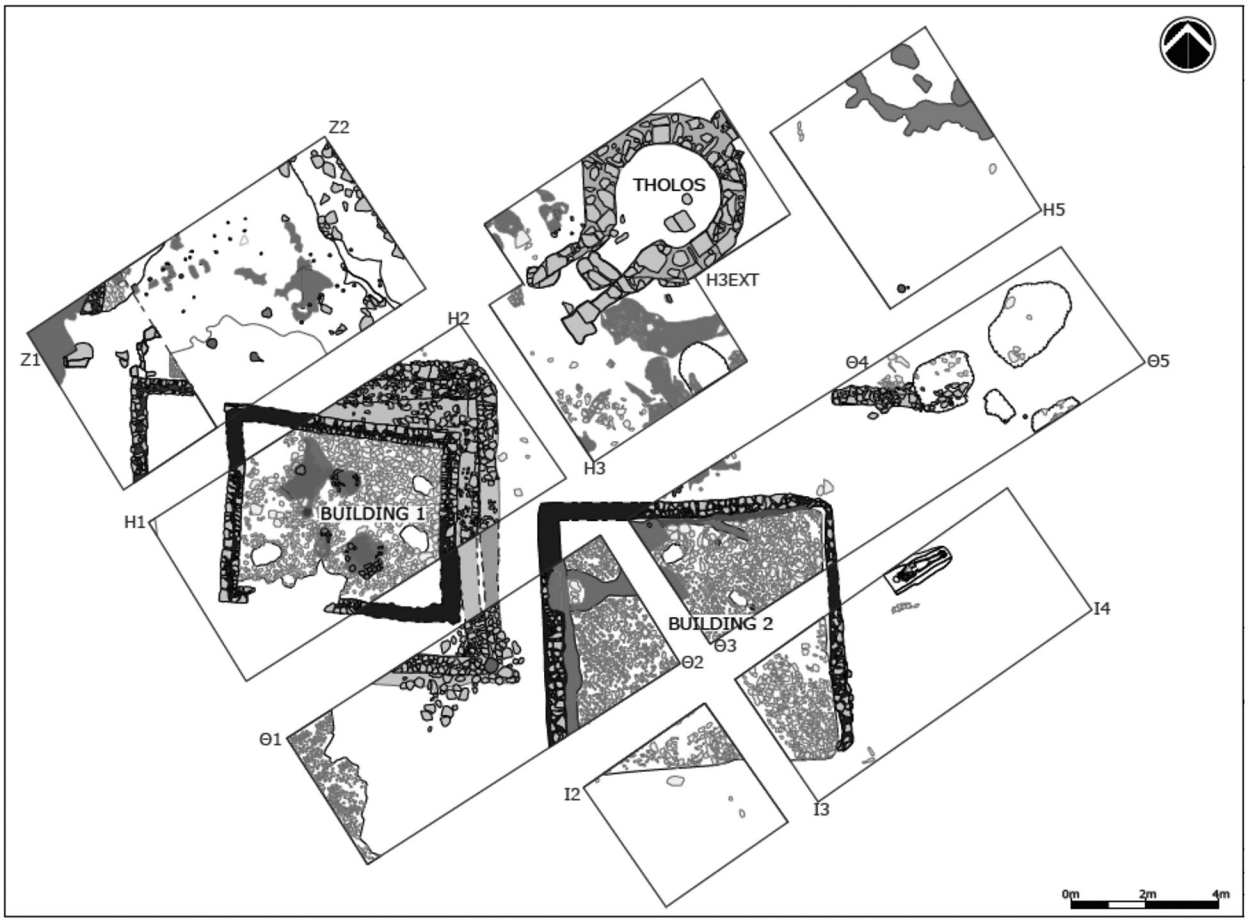

Figure 2. Plan of the main excavated area of Koutroulou Magoula at the end of the 2015 excavation season.

and infer grazing or foddering practices, as well as seasons of consumption;
4. Zooarchaeological analysis to document presence and significance of animal species in the composition of the faunal assemblage.

Subsequent integration of the available evidence aims at composing a comprehensive picture of animal diet, mobility, and interaction with environmental features. Drawing on ethnographic data, an attempt will be made to establish an experiential understanding of possible tasks and the different temporalities involved.

Dung Abundance and Distribution

Evidence of the presence, abundance, spatial and temporal patterns of distribution, depositional pathways, and contextual associations of animal dung is provided by thin-section analysis (Bullock et al. 1985; Courty et al. 1989; Stoops 2003; Stoops et al. 2010), conducted on 35 large-format (5 x 7 cm) and 17 mammoth-sized (14 x 7 cm) thin sections. These were prepared from intact sediment samples collected from diverse contexts at the site, including both internal and external areas.

Indicators used for the identification of dung presence comprise: fecal calcareous spherulites that are formed in the gut of animals (Canti 1999); large amounts of plant tissue and high-abundance levels of phytoliths originating from ingested plant material (Shahack-Gross 2011); organic-rich and phosphatic groundmass (Karkanas and Goldberg 2010); and occasionally preserved microlaminated fabrics (Courty et al. 1991; Macphail et al. 1997; Shahack-Gross 2011).

According to thin section recording, much of the accumulated material at Koutroulou is in fact of dung origin. Dung was observed in several forms that indicate diverse component micro-histories and variable degrees of disaggregation and mixing. First, relatively undisturbed micro-layers, interpreted as trampled penning deposits, were encountered both in open-exterior and roofed-interior areas, more specifically between Buildings 1 and 2, and in the interior space defined by wall features in Trench Z1. Second, aggregates of combined dung indicators were observed as one of the recurring inclusion types in midden-like deposits. Such deposits were identified mainly in the open area to the south of Building 1. Third, spherulites, phytoliths, and small aggregates were observed as randomly dispersed components within homogenized occupational sediments in both open areas examined. Dung-derived remains were also a significant component of in-situ ash residues, indicating that dung was used as fuel, possibly alongside wood. Based on this evidence, it can be argued that dung followed many and diverse paths to final deposition: as in-situ trampled material; as material transported, dispersed, and mixed with other anthropogenic remains; and as fuel, either preserved in situ or as redistributed silica-rich ash.

The significance of animal dung as a major contributor to the total residue accumulation at the site suggests marked animal presence. High concentrations and widespread occurrence indicate that this was a material in abundance, likely produced on-site and subsequently redistributed via diverse pathways and modes of deposition. This hypothesis is further supported by evidence of trampled penning deposits both in close proximity to and within buildings. In addition, use of dung as fuel indicates that it was an available and important material resource for the inhabitants of Koutroulou. The high levels of dung accumulation and use are consistent with animals being kept on site and their mobility being restricted to short distances in proximity to the settlement.

Phytoliths

Phytoliths are inorganic plant remains, formed as silica originating from the groundwater precipitates at the walls of plant cells; thus they are a type of "cast" of plant anatomy, preserved after the organic part has decayed, and resilient under most taphonomic conditions (Piperno 2006).

Micromorphological analysis shows that phytoliths are a significant component of dung remains at Koutroulou, preserved in high concentrations up to 20–30 percent by area. As ingested food remains, phytoliths provide direct evidence for animal diet and its environmental origin(s). Recurring morphotypes within aggregated dung identified in thin section (Figure 3a–b) originate from diverse plant categories, including cereals, reeds, wild grasses, and dicots (trees/shrubs).

In order to complement the contextual—but only quasi-quantitative—information that can be gained by thin-section analysis (see also Matthews 2010:101), phytoliths were extracted from sediment subsamples collected along with the micromorphological blocks and separately counted in order to quantify individual morphotypes. The 21 analyzed subsamples were selected based on abundance of phytolith-rich herbivore dung, as attested by micromorphology. It is, therefore, argued that most of the extracted phytolith material is of dung origin, and thereby indicative of animal diet. Below, specific phytolith categories are examined according to their significance for identification

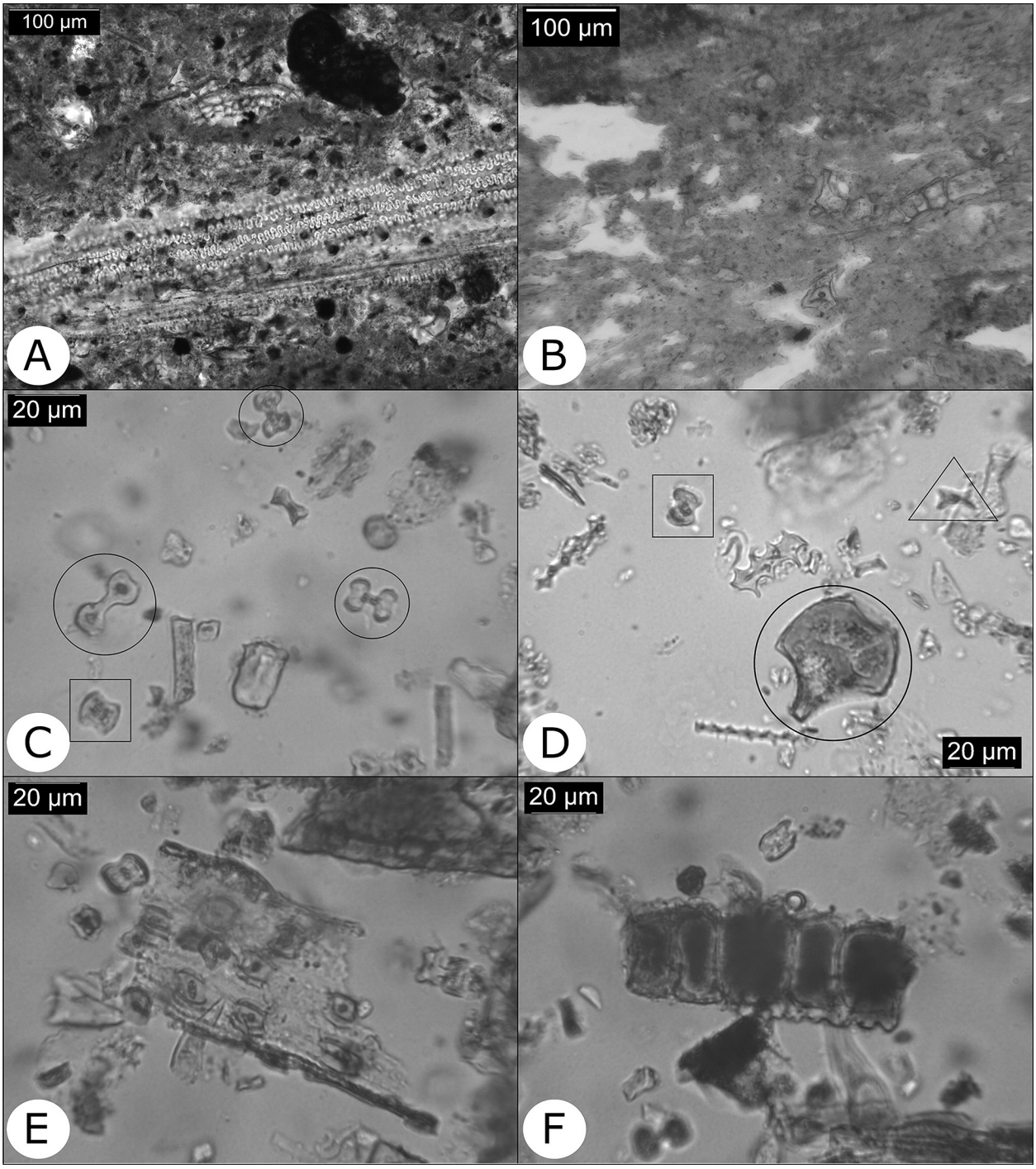

Figure 3. Photomicrographs of phytoliths from dung-rich contexts at Koutroulou, identified in thin section and in associated extracted samples: (a) cereal inflorescence phytolith in dung-rich ash; (b) stacked and keystone bulliform phytoliths in dung; (c) extracted short-cell phytoliths with paleoenvironmental significance: saddle (in square), bilobes (in circle); (d) extracted short-cell phytoliths with paleoenvironmental significance: saddle (in square), rondel (in triangle), keystone bulliform (in circle); (e) multicelled phytolith with squat saddles (chloridoid); (f) stacked bulliform cells (reed).

of plant taxa and plant parts (see Piperno 2006) and their implications regarding animal diet.

The examined phytolith assemblages are grass-dominated, although dicots generally produce much lower numbers of phytoliths than grasses (Tsartsidou 2009; Tsartsidou et al. 2007) and, therefore, can be under-represented.

Further paleoenvironmental information is provided by the presence and abundance of short-cell phytoliths of grass origin. In the examined samples from Koutroulou, there is co-occurrence of phytoliths associated with plants of different environmental preferences, i.e. rondels, saddles, bilobes, and bulliform types (Table 1 and Figure 3c–f). Correlations between these phytolith categories suggest overall covariance, apart from rondels, which do not correlate at all with any of the other short-cell types. As rondels are produced by both wild grasses and domesticated cereals, their independent variance can be interpreted as due to different and/or multiple sources of input. Spatial and contextual comparisons indicate higher concentrations of saddles, bilobates, and bulliforms in the dung-rich ash context in Trench H3.

The occurrence of multi-celled husk phytoliths that can be diagnostic of cereals indicates admixture of domesticated cereals and wild grasses, with no clear context associations. Species-level identification of wheat and barley husk articulated phytoliths (after Rosen 1992), where possible, indicates higher concentrations of wheat-like phytoliths in midden-like deposits; barley-like cases mostly concentrate in charred dung and a penning unit.

Abundance of inflorescence phytolith types was also used to assess assemblage composition and seasonality (Rosen 2005). The general co-occurrence of leaf/stem and inflorescence-derived phytolith types is consistent with whole plants being consumed. The low fluctuation in their ratio between successive laminated deposits does not support the hypothesis of seasonal rotation in their deposition. Storage of collected grain and fodder, however, might have masked potential seasonal signatures.

To summarize, phytolith analysis indicates that diverse plant categories contributed to animal diet at Koutroulou. Wild grass resources identified in the dung suggest an origin from wet and dry environments that could include fallow fields. Phytoliths of pooid grasses, which include cereals, seem to originate from different types of input; this is consistent with a combined origin from foddering and grazing practices. The abundance fluctuations of phytolith morphotypes from different grass taxa indicate variability in sample composition, with increased presence of wild species recorded in dung fuel in Trench H3. Although seasonal variation was likely a key factor affecting variable dietary choices, potential seasonal signatures were not preserved between successive fine stratigraphic layers.

Plant Macroremains

Systematic soil sampling across the whole excavated space of Koutroulou Magoula resulted in the retrieval of a relatively rich archaeobotanical assemblage that represents all types of contexts, and thus may provide useful insights into multiple aspects of the contribution of plants to the socioeconomic life of the Middle Neolithic settlement. Further evidence on animal feeding patterns and, by extension, on the ways the exploitation of plant environment and its products may have been integrated with animal husbandry practices (Charles 1998), was pursued

Table 1. Plant Taxa Identified at Koutroulou and Their Habitat Preferences, as Inferred by the Presence of Characteristic Phytolith Types.

Grass Sub-Family	Characteristic Phytolith Morphotypes	Paleoenvironmental Significance
Pooidae	Rondels, crenates	Tall grasses of cool and moist environments, including Near Eastern cereals
Chloridoidae	Saddles	Short and drought-adapted grasses, including certain weed species
Arundidoidae	(Tall) saddles, bilobes, keystone and stacked bulliforms, many stomata	Reeds, wet/marshy environments

Note: After Jenkins and Rosen (2007), Ollendorf et al. (1988), Piperno (2006), and Shillito (2011).

through the study of seed, fruit, and other plant part macroremains (i.e. chaff) preserved in dung deposits at the site. In this vein, the botanical content of 26 soil samples, deriving from contexts for which micromorphology attested the presence of animal dung, was examined in order to supplement respective data gathered through phytolith analysis. Most of the samples come from open spaces between and around Buildings 1 and 2 (Trenches Θ1, Θ2, H3, and Θ3ext), while one sample corresponds to the interior space defined by wall features in Trench Z1. The bulk of plant remains encountered in the samples has been preserved through carbonization, but mineralized remains are also present.

The archaeobotanical material of the samples (coarse and fine flot sections) is rather abundant, with more than 50 identifiable and quantifiable items counted. A large part of the finds is fragmented, allowing for only relative recording of their presence. All samples exhibit mixed composition, containing in most cases cereal grains and chaff (einkorn, emmer, and barley) as the major components, followed in quantitative order by wild/weed seeds, fruit seeds (namely, fig and cornelian cherry), and occasionally few legume remains (lentil and common pea). The group of wild/weed seeds comprises both annual and perennial taxa that thrive in different ecological niches, ranging from arable land and fallow fields to different types of grassland and wetter/aquatic environments. Table 2 summarizes the main wild/weed species spotted in the archaeobotanical samples of this study according to principal habitat preferences and life cycle. No major differences in the samples' composition in relation to spatial attributes are traceable, although small variations in the relative proportions of chaff, grain, wild/weed seeds, and fruits are observed.

The recurrent pattern of admixture in the Koutroulou Magoula dung-associated samples, with crop processing by-products (cereal glume bases) coexisting with wild seeds of different potential origin, is most probably suggestive of animal feeding practices that involved both cereal chaff or straw foddering, as well as grazing of the stubble and fallow fields of the community, with parallel exploitation of further ecological niches in proximity to the settlement (meadow, grassland, ruderal, dry, and wet habitats). Thus, macrobotanical data from dung-derived deposits of the site is in accordance with the picture obtained through phytolith evidence, which implied that the combination of on-site keeping/foddering of animals with small-scale mobility of the herds and grazing of nearby open habitats was the preferred animal husbandry practice at Koutroulou. Plant taxa representation in the archaeobotanical samples points toward the existence of a variety of micro-ecosystems in the surrounding landscape (fallow fields, grassland and meadow pastures, wet/marshy environments), providing seasonal diversity in animal diet throughout the year.

Integration with Faunal Data

Analysis of the animal bone material is still only in the primary assessment stage; however, a total of 22,375 animal bone fragments have been noted so far from excavation years 2001–2011. Of this material, 32 percent are identifiable to species, which may increase during the detailed recording process.

At this stage, no attempt has been made to distinguish between sheep and goat; however, as a combined category, "sheep/goat" are by far the most frequently occurring species (73 percent). Other species recorded are cattle (14 percent), pigs (12 percent) and dogs (1 percent), as well as a number of fragments of both bone and antler from red deer (N = 8) and roe deer (N = 7). Hare and tortoise bones are also noted as present.

The high frequency of sheep/goat and cattle species in the animal bone assemblage is consistent with the observation that the phytolith assemblages are grass-dominated, with the lowland grassland perhaps being used for cattle, and sheep and goat herded on the upland grazing area. The tree and shrub phytoliths might be linked with the presence of goats and pigs in the assemblage; the former being browsers, and the latter perhaps herded in woodland areas. Alternatively, shrubs and trees could have been collected in the surrounding environments and brought to the site to be consumed by animals as fodder.

The presence of roe deer and red deer in the faunal assemblage, both of which prefer woodland habitats (or open upland, in the case of the latter), indicate that these environments were also encountered.

At this stage, it is not possible to comment on seasonality of occupation based on the animal bone evidence.

The taphonomic condition of the animal bone material suggests variation in fragmentation patterns across the site, with some areas (e.g. the external area to the east of Building 2) containing intensively fragmented bone material (e.g. bone fragments or splinters). This fragmentation may have been caused by animal trampling, for example, in the penning areas.

There is also evidence of bone material having been burnt to a high temperature, turning it completely black. These bones do not appear to have been burnt in situ in the context from which they were recovered,

Table 2. Summary of Major Habitat Preferences and Life Cycle of the Main Wild/Weed Seeds Considered in the Study.

	Weed (Arable/Ruderal)	Weed/Grassland	Dry Places/Grassland	Damp Places/Meadows	Wet Environments	Small-Seeded Legumes
Species	*Bilderdykia convolvulus* (A)[a]	*Bromus* sp. (P)	*Anthemis* sp. (I)	*Ranunculus* sp. (I)	*Scirpus* sp. (P)	*Medicago* sp. (I)
	Chenopodium album (A)	*Cynodon dactylon* (P)	Compositae (I)			Leguminosae small (I)
	Eragrostis minor (A)	Gramineae (I)	*Echium vulgare* (P)			
	Galium/Asperula sp. (A)	Labiatae (I)	*Erodium* sp. (I)			
	Lithospermum arvensis (A)	*Phalaris* sp. (I)	*Stipa* sp. (P)			
	Lolium temulentum (A)	*Polycnemum majus/arvense* (A)				
	Lolium sp. (A)	*Verbena officinalis* (P)				
	Malva sp. (I)					
	Portulaca oleracea (A)					
	Rubiaceae (A)					
	Rumex sp. (I)					

Note: Main sources of ecological information: Gennadios (2005[1914]), Polunin (1969, 1980), and Tutin et al. (1964–1980).
[a] A = annual, P = perennial, and I = indeterminate.

but rather may represent the redeposition of burnt bone material, perhaps also related to middening practices.

Discussion

The examined dataset provides evidence that is compatible with continuous animal presence near the settlement. Such evidence comprises probable penning deposits within the settlement, abundance and widespread redistribution of dung in on-site accumulated sediments, and its use as fuel, suggesting that dung was a significant and available resource for the community of Koutroulou. Furthermore, long periods of absence (e.g. during the summer months), proposed for certain Neolithic sites (Valamoti 2007), are not supported in this case due to the consistent presence of fruits, seeds, and inflorescence grass and cereal parts in animal diet. Thus, continuous coexistence between humans and animals at the site is implied.

Data on animal diet, obtained through the study of plant remains in dung, indicate diverse ecological input that originated at least partly from grazing outside the limits of the inhabited settlement area. This suggests mobility, likely in the form of small-scale herding, involving routine short-distance travelling that may have varied according to the needs and preferences of different species. Throughout the year, such mobility would have depended on the seasonal cycles of farming and livestock rearing, demonstrating at the same time the close connection between plant and animal lives. Undertaking herding-related tasks and associated roles within the community could have had social and experiential implications. As suggested by ethnographic studies (e.g. Abdi 2003), it is plausible that such tasks were performed by young household members who were not required for other agricultural, more labor-intensive activities. For these individuals or groups, herding could have been one of multiple pathways to familiarization with the world beyond the settlement—a means of knowledge acquisition through well-trodden paths connecting places, in a context where animals and humans could have had interchanging roles and relationships of leader and follower (Ingold and Vergunst 2008). In other words, it is stressed here how the shared realities between humans, animals, and the landscape shaped knowledge and meaning, and how humans and other animals co-produced the material constitution of Koutroulou Magoula.

This obtained familiarity with and knowledge of the landscape would have played an essential part in developing and sustaining the diverse animal-feeding strategies adopted by the inhabitants of Koutroulou. The demonstrated diverse composition of animal diet suggests a range of origins and vegetation habitats: grazing in upland dry grasslands, fallow fields, wet environments near streams, and/or the floodplain lowlands, as well as the consumption of stored grain fodder. The combined use of diverse ecological niches, which are possibly dependent on seasonal availability, highlights an understanding of the environmental potential and a flexibility and diversity in human and animal livelihoods.

On a broader scale, the evidence presented here is consistent with the pattern of intensive, small-scale, mixed farming proposed for Neolithic Greece and Southeastern Europe (e.g. Bogaard 2005, 2012; Halstead 2011, 2014; Valamoti 2007). This pattern includes rotational, intensive garden-scale cultivation of cereals and pulses and intensive manuring (Bogaard 2012; Vaiglova et al. 2014). Indeed, year-round animal presence in Koutroulou is consistent with small-scale husbandry integrated with agricultural practices. The use of dung as fuel indicates a knowledge and appreciation of its properties. Such knowledge is compatible with other potential uses, e.g. as manure. Finally, the demonstrated flexible and varied approach to animal feeding is in agreement with the suggested broader diversity of Neolithic farming regimes.

This study also demonstrates that, if we are to understand Neolithic worlds, we will have to practice a multi-species archaeology rather than a purely anthropocentric one (see Armstrong Oma 2010, 2013; Brittain and Overton 2013; Hamilakis and Overton 2013; O'Connor 1997; Overton and Hamilakis 2013). Animals were cohabitants of the elaborate Neolithic buildings and, with the deposition of their dung, contributed significantly to the creation of the Neolithic mound. They were thus co-producers of the materiality of Koutroulou Magoula and co-shapers of the Neolithic world of this site.

Conclusions and Suggestions for Future Work

Integrated evidence from micromorphology, phytoliths, plant macroremains, and animal bones at Neolithic Koutroulou Magoula suggests a flexibility in animal dietary choices, with the combination of foddering and grazing practices in the form of small-scale mobility of herds at proximal distances. Engagement with and use of diverse micro-environments is indicative of a profound knowledge of the landscape and available resources. The diversity of animal feeding practices at Koutroulou Magoula provides supporting evidence for an intensive, mixed farming mode of Neolithic life, and the data overall point to a world

in which humans, other animals, and plants were all active participants.

The dataset discussed here is far from complete, with the potential for integration with more data categories, including macro-charcoal and other environmental proxies, to reconstruct a more complete picture of vegetation and paleoenvironment, as well as isotope signatures of animal bones to provide complementary evidence on diet and human-animal interaction.

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