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LANDSCAPES OF NOMADISM AND SEDENTISM

Edited by Björn Forsén, Nena Galanidou and Esko Tikkala

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Cover: The Bronze Age site of Goutsoura seen from the south. Photo: Björn Forsén

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Faunal Remains of Goutsoura: The Early Bronze Age Strata

Vivi Deckwirth

Introduction

The corpus of published and unpublished Greek archaeological faunal assemblages is steadily growing, and providing us with valuable information on the development of its faunal history,[1] environments, economy, handicrafts and subsistence patterns, as well as enabling intra- and inter-regional site comparison for gaining a wider perspective on eventual inter-dependencies, differences and changes over time. However, as shown by mapping the sites of analyzed material, they tend to concentrate on the northeastern, eastern and southern parts of mainland Greece together with Crete and several other Aegean islands, revealing that the northwest (Epirus) has gained only little attention, mainly due to limited previous research activity in this region.[2]

In the first two volumes of the Thesprotia Expedition the osteofaunal assemblages from the sites PS 25 (Agios Donatos of Zervochori) and PS 36 (Mavromandilia) in the Kokytos valley were published, adding to our knowledge on the strategies of livelihood and economy in Thesprotia during a time period from the Early Iron Age into Roman times.[3] These results gave us important new information on Epirote subsistence strategies and were in accordance with and complemented complemented previous observations from Kassope[4] (southern Epirus) and ancient literary sources,[5] which describe Epirus from the Archaic Period into the Roman times as an area with an economy based on animal husbandry. However, for Thesprotia we do not yet have information on the early phases of animal husbandry.

This article presents the results of the analysis of the Early Bronze Age (EBA) faunal material from the site Goutsoura (PS 12). The objective was to investigate if animal husbandry was already practiced at the site during this time period, to characterize it, and to evaluate its scale in comparison to the exploitation of wild species. The composition and relative species abundance is investigated, compared and discussed with data from contemporaneous faunal assemblages. Previous Epirote fauna osteological research activity and its implications for Bronze Age subsistence are presented and discussed by Tartaron.[6] The Final Neolithic/EBA site of Doliana, north of Ioannina, provides important

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[1] Including diachronic morphometric intra-species variations. I want to thank Björn Forsén for giving me the interesting opportunity to study the bone material from Goutsoura and Kassiani Lazari of the 32nd Ephorate of Prehistoric and Classical Antiquities, Igoumenitsa, for making it possible and her kind hospitality. I also thank Paul Halstead for providing me with updated data on the Doliana fauna and Eftychia Yannouli for valuable comments on the previous version of this paper.

[2] For compilations of fauna osteological research in Greece, see e.g. Payne 1985a; Trantalidou 1990; Reese 1994; Fillios 2006, 102-113; MacKinnon 2007a; MacKinnon 2007b. For Epirus, see also Tartaron 2004.

[3] Niskanen 2009; Deckwirth 2011.

[4] Friedl 1984.

[5] See e.g. Hernández 2010, 65-80.

[6] Tartaron 2004, 141-142, 179-189.

Fig. 1. The location of Goutsoura and other EBA sites mentioned in the text. 1 = Argissa Magula; 2 = Doliana, 3 = Goutsoura; 4 = Helike; 5 = Kastanas; 6 = Lerna; 7 = Megalo Nisi Galanis; 8 = Pentapolis; 9 = Pevkakia Magula; 10 = Platia Magula Zarkou; 11 = Sitagroi; 12 = Skala Sotiros; 13 = Thermi; 14 = Tiryns.

comparanda results.[7] However, the paucity of published local and regional comparanda is obvious, which gave an impetus to focus also on data available from Thessaly, suggested by the overall resemblance of the EBA Goutsoura pottery to that from the site of Pevkakia Magula.[8] In addition to the faunal material from Pevkakia Magula, results from the Thessalian sites of Platia Magula Zarkou and Argissa Magula are considered (Fig. 1). Besides geographical and ecological divergencies further variations are expected at the level of sample size, methods of collecting, analysis and reporting, indicating the necessity for caution in drawing conclusions.[9]

Goutsoura is located in the Kokytos valley near the modern village of Rachouli, on the lowest eastern slope (ca. 104-116 masl) of the Liminari hill, with an open view towards the plain extending to the Kokytos (nowadays ca. 1.5 km to the east from the site) and further beyond to the Paramythia mountain range in the east.[10] The site shows several periods of activity, with a first settlement dated to the EBA period between ca. 2900-2400 cal. BC, followed by a hiatus, whereafter it was used mainly as a cemetery from the end of the Middle Bronze Age (MBA) to the end of the Late Bronze Age (LBA), i.e., from ca. 2000 to 1100 cal. BC.[11]

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[7] Tartaron 2004, 142; Douzougli and Zachos 2002. Additionally, updated faunal data has been provided by Halstead, pers. comm. Further, see n. 73.

[8] Forsén *et al.* 2011, 81. Additionally, the Corded ware identified at EBA Goutsoura suggests we should include also northern sites (i.e. southern Albanian EBA sites, such as Oricum and sites from the Korçë basin, e.g. Maliq) into our comparanda material, but these are not considered here due to limited availability of faunal results.
The date of the Pevkakia Magula EBA bone assemblage from the excavations in 1967-70 used by Jordan 1975 in his thesis was subsequently revised based on pottery finds to represent a mixed entity of the EBA and MBA (Amberger 1979, 9). The results by Jordan 1975 were excluded from this study.

[9] The possible effects of these variations on the faunal composition of the respective sites are acknowledged, but not further compared or analyzed for this article.

[10] Forsén *et al.* 2011, 79; Forsén, this volume.

[11] For the stratigraphy and dating of the site, see Forsén, this volume. For the human bones, see Niskanen, this volume. There were also identified isolated human bones and fragments thereof in the bags of faunal material provided for this analysis. However, they were omitted from further study and are not considered in any results presented here.

Goutsoura was excavated as three areas (Area 1, Area 2 and Area 3) and several trial trenches. Clean EBA layers were detected in Area 2 (ca. 40 m^2 excavated EBA layers), in Trench A (4.5 m^2) and Trench D (3 m^2).[12] Area 2 lies in the northwest corner of the site next to Trench D, whereas Trench A is located ca. 40 m to the east from Area 2. The majority of the EBA faunal material originates from Area 2, with additional samples deriving from Trenches A and D (Fig. 2).

	n	%
Area 2	3379	95.37
Trench D	113	3.19
Trench A	51	1.44
Total	3543	100

Fig. 2. The absolute and relative distribution of the EBA faunal material.

For studies on subsistence strategies other find categories should also be considered. There are several such at EBA Goutsoura. One of these is represented by spindle whorls and spools indicating some kind of textile production at the site.[13] We do not know if wool or flax was used for this purpose. However, at several EBA sites the increase in size of sheep compared to the Neolithic has been associated with a shift to use a woolly variety of sheep.[14] The recovered sickle elements consisting of blades with silica gloss[15] could have been used for the harvest, but they are also suitable for the collection of plants for winter feed for animals. Additionally, the palynological studies at the lakes of Kalodiki and Ioannina (ca. 15 and 40 km from the Kokytos valley) suggest an increasing human impact, with remains of open ground vegetation and cultivated plants during the EBA.[16] Furthermore, a recovered fishhook[17] implies the supplementation of subsistence by fishing activity, which could have been practiced either at the nearby river or lakes not too far away. Thus, the artefact finds give us some suggestions for subsistence strategies, but the faunal material itself provides the most reliable evidence.

Materials and methods

The faunal material from Goutsoura comprises a total of 6103[18] specimens of bones or teeth and their fragments recovered from Areas 1, 2 and 3 as well as several trial trenches during the excavations at the site in the years 2007-2010. The EBA material consists of 3543 fragments, of which 3379 specimens (95.37%) derive from Area 2, 51 (1.44%) from Trench A and 113 (3.19%) from Trench D (Fig. 2). Neither whole or partial skeletons nor articulated elements were found. The material will be discussed as one sample unit

[12] See Forsén, this volume, Fig. 4 for a map.

[13] Forsén *et al.* 2011, 81-82; Papayoannis, this volume.

[14] See e.g. Argissa Magula (Boessneck 1962, 46-47), Pevkakia Magula (Amberger 1979, 70-71, 148), Platia Magula Zarkou (Becker 1991, 20-21), Sitagroi (Bökönyi 1986, 79-80), Skala Sotiros (Yannouli 1994, 216). A shift in the age profile of sheep is also suggestive of a changed exploitation pattern. However, flax continued to be used for textile production in the LBA as well, as indicated by the Linear B tablets from Knossos and Pylos (Halstead 2001).

[15] Forsén 2011, 7.

[16] Forsén 2011, 8. See also Lelivelt 2011.

[17] See Papayiannis, this volume.

[18] Bone samples with insufficient field documentation and worked specimens are omitted from the evaluation and not counted into any absolute or relative values presented here. However, the total specimen count of 6103 includes also bones recovered from the topsoil of the site. For the definition of the topsoil, see Forsén, this volume.

without investigation of possible spatial patterning of the identified species or anatomical elements. Bones modified by humans (i.e. worked bones) are not included.[19]

Taphonomy is to be kept in mind when interpreting the species variety and their relative importance. Various factors affect the resulted sample size and consistency. Firstly, the material represents most probably only a sample of the remains of animals or parts of them used and discarded at the site. Morphological and chemical properties of the soil and of the bones themselves affect the preservation of the bones or their fragments.[20] No sieve was used to recover possible small bones of mammals or bones of fish and birds. The use of a sieve has influence on the recovery rate of bone fragments, and can even lead to a shift in species variety and relative abundance, depending on mesh size.[21] However, the results of the soil sample analyses did not include remarks on additional bone fragments of any size.[22] Furthermore, the sample size as such affects the number of identified specimens (NISP) and the minimum number of individuals (MNI), with a decreasing NISP value as the sample size increases and a decreasing MNI as the NISP increases.[23] Thus, the MNI does not equal the original number of individuals present at the site and the NISP and MNI are both strongly dependent on the degree of fragmentation within the assemblage.

All bone fragments were dry cleaned of most sand with a brush, but not weighed because of residual sand and the resulting inaccuracy of the weighing method for analytic purposes. Morphological characteristics and measurements were applied in order to classify each specimen as precisely as possible to taxonomic level, anatomical element and/or part of element, side, age and gender.[24] Attention was paid to the recognition of pathologic alterations or signs of processing. Some of the bone pieces were joined into more recognizable fragments, increasing the overall identifiability and the accuracy for the determination of the MNI. Specimens identified only to the level of mammalian of origin were further categorized into the following size-classes: large-sized mammals include species similar in size to red deer and cattle, medium-sized species similar in size to sheep, canids and pigs, and small-sized, similar in size to such as hare or hedgehog. If these did not apply, the specimen was determined and counted as indeterminate.

Determination of the relative species composition of the material is based on NISP and MNI calculations. Both are widely used in zooarchaeological literature and presented either as raw values or percentages based on them. However, applying them as basis for inter-site comparisons should include caution since methods of recovery, levels of fragmentation and fragment identification, as well as approaches to calculate the NISP

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[19] However, they are presented and discussed by Papayoannis, this volume.

[20] At the site, the soil is mostly light clayish, brown and sandy with variable content of white limestone pebbles of different sizes eroded down from the Liminari hill (Forsén, this volume). For inter- and intra-taxonomix variability of bone density and its implications to taphonomic loss, see e.g. Ioannidou 2003.

[21] See e.g. Payne 1972; Clason and Prummel 1977 or Shaffer and Sanchez 1994. Additionally, for the possible dietary importance of small mammals (Insectivora and Rodentia) and their underrepresentation in the faunal remains of archaeological contexts, see Stahl 1982.

[22] B. Forsén, pers. comm.

[23] See e.g. Grayson 1981.

[24] For age estimation, the status of epiphyseal fusion for post-cranial bones as well as the dental eruption and wear stages were applied according to Silver 1969; Noddle 1974; Andrews 1982; Grant 1982; Grigson 1982; Payne 1985b; Rolett and Chiu 1994; Greenfield and Arnold 2008. Measurements were taken according to von den Driesch 1976. The osteometric results will be presented in a separate forthcoming study.

and MNI values vary. Unfortunately, the methodology used is not always clearly stated in literature. For the present study, the NISP and MNI values were counted as a single analytic unit consisting of all loci identified on the basis of stratigraphy as belonging to the EBA layer.[25] However, combining data from different spatial units decreases significantly the MNI value.[26] For the determination of the MNI value for each species the most abundant bone, its laterality, size, age and gender were taken into consideration when applicable.

The material was analyzed at its place of storage in the village of Gardiki. The taxonomic identification is based on experience, reference material consisting of comprehensive literature[27] and personal photo archives. Some uncertain specimens were measured and photographed for the purpose of consulting reference collections at other locations.[28]

Identified taxa and other results

The nature of the EBA faunal remains suggest that they are waste material from slaughter and food preparation, since they represent, largely, animals of taxa of economic significance (Figs. 3a-3b). The presence of some species may be regarded as intrusive (i.e. not of human impact). At least 13 species were identified (Figs. 3b-3d). The fragmentation degree was high. The majority of the fragments was unburned with only few specimens showing signs of predisposition to heat, becoming grey to white or covered with soot. Some fragments were poorly preserved, with their surfaces eroded, affecting the possibility to take reliable measurements when this otherwise would have been feasible. Puncture-like biting marks were identified on a few fragments suggesting they were disposed by feeding to dogs. The occurrence of epiphyses in the sample is low, reflecting their lesser resistance to taphonomic factors. Preserved whole bones represent teeth or bones from distal extremities with a short and compact structure: mostly phalanges and tarsal bones.

Of the total EBA sample, 28 pieces (0.79%) remained unidentified to animal class, genus, species and anatomical element (Fig. 3a). The majority of specimens were mammalian of origin (98.76%). However, of these were 1533 specimens (43.81%) assignable to the mammalian class only, without any further identification as to genus or species or anatomical position. For further 1644 fragments (46.98%) the determination as mammalian together with an anatomical identification was possible. For a subset of these a further subcategorization as deriving from a large-, middle- or small-sized mammalian was possible, and some allowed even additional identification as belonging to a cloven-hoofed animal (Artiodactyla) or even further to the suborder of ruminants (Ruminantia). The majority of these anatomically identified, but taxonomically further

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[25] For the loci of the EBA layer, see Forsén, this volume, especially Fig. 14.

[26] Casteel 1977, 126.

[27] Including e.g. Boessneck *et al.* 1964; Lemppenau 1964; Bosold 1966; Schmid 1972; Wolsan 1982; Gabler 1985; Payne 1985b; Prummel and Frisch 1986; Prummel 1987; Prummel 1988a; Prummel 1988b; Amorosi 1989; Lister 1996. Further, see Results.

[28] I wish to express my gratitude for the possibility to use the osteological reference collections of the Finnish Museum of Natural History in Helsinki and the Wiener Laboratory of the American School of Classical Studies at Athens.

	Including teeth (NISP)	Including teeth (%)	Excluding teeth (NISP)	Excluding teeth (%)
Mammalia	3499	98.76	3332	98.7
Aves	3	0.08	3	0.09
Reptilia	12	0.34	12	0.35
Amphibia	1	0.03	1	0.03
Pisces	0	0	0	0
Indeterminate	28	0.79	28	0.83
Total	3543	100	3376	100

Fig. 3a. The absolute amounts (NISP) and relative (%) proportions of the animal taxa identified.

	Including teeth (NISP)	Including teeth (%)	Excluding teeth (NISP)	Excluding teeth (%)
Bos	52	12.94	34	13.28
Sus	126	31.34	65	25.4
Ovis	14	3.48	10	3.91
Capra	14	3.48	14	5.47
Ovis/Capra	64	15.92	44	17.19
Capreolus	1	0.25	1	0.4
Canis sp.	8	1.99	7	2.73
Vulpes	4	1	4	1.56
Erinaceus	7	1.74	7	2.73
Lepus	4	1	4	1.56
Ruminantia	9	2.24	4	1.56
Megaruminantia	22	5.47	7	2.73
Mesoruminantia	77	19.15	55	21.48
Total	402	100	256	100

Fig. 3b. The absolute amounts (NISP) and relative (%) proportions of the identified mammalian genera and the suborder of ruminants.

	Including teeth (NISP)	Including teeth (%)	Excluding teeth (NISP)	Excluding teeth (%)	Loose teeth (NISP)	MNI
Bos	52	18.71	34	19.54	18	2
Sus	126	45.32	65	37.36	61	7
Ovis	14	5.04	10	5.75	4	1
Capra	14	5.04	14	8.04	0	2
Ovis/Capra	64	23.02	44	25.29	20	5
Canis sp.	8	2.87	7	4.02	1	1
Total	278	100	174	100	104	18

Fig. 3c. The absolute amounts (NISP) and relative (%) proportions of the identified domestic taxa.

	Including teeth (NISP)	Including teeth (%)	Excluding teeth (NISP)	Excluding teeth (%)	MNI
Capreolus	1	3.12	1	3.12	1
Vulpes	4	12.5	4	12.5	2
Erinaceus	7	21.88	7	21.88	2
Lepus	4	12.5	4	12.5	2
Aves	3	9.38	3	9.38	2
Reptilia	12	37.5	12	37.5	n.a.
Amphibia	1	3.12	1	3.12	1
Total	32	100	32	100	10

Fig. 3d. The absolute amounts (NISP) and relative (%) proportions of the identified wild taxa. N.a. = not analyzed

undifferentiable specimens represent fragments of ribs, long-bone diaphyses, vertebrae and the neurocranium.

Of the analyzed EBA faunal material only 310 fragments (8.75%) could be determined as to genus and/or species (Figs. 3c-3d). Of these, 89.68% are domestic and 10.32% wild (Fig. 8). The identified taxa are described in more detail in the following.

Cloven-hoofed animals

Cloven-hoofed animals (Artiodactyla) are present with remains of middle- and large-sized ruminants[29] and the genus pig (*Sus*). Not all fragments of the suborder of ruminants (Ruminantia) could be differentiated more accurately to the distinct genus of cattle (*Bos*), sheep (*Ovis*) or goat (*Capra*). However, in order to evaluate the relative importance of the ruminants compared to pig, the category of not further differentiable ruminants (Ruminantia) is included into the analysis and presentation of the results (Fig. 3b). Additionally, of the ruminants, special attention was also given to the identification of possible members of the family of cervids (Cervidae). Interestingly, of these only the genus *Capreolus* was identified.

Ovicaprids

The differentiation of sheep (*Ovis aries* L.) from goat (*Capra hircus* L.) can be difficult from fragmented material. However, there exist several distinctive bone and dental traits which differ morphologically between these species, providing more strength to the identification with increasing number of preserved features on a fragment.[30] The total amount (NISP) of the osteological remains identified as ovicaprid is 92 specimens (Fig. 3b). Of these, undifferentiable sheep or goat (*Ovis/Capra*) count 64 fragments (69.56%) and differentiated sheep and goat 14 specimens (15.22%) each. Altogether, the category of ovicaprids represents 33.09% of the identified domestic fauna (Figs. 3c and 7).

Sheep is identified with cranial (50%) and post-cranial (50%) elements. Of these, only one specimen originates in Trench A (7.14%), whereas 13 specimens (92.86%) were recovered from Area 2. The cranial elements include two fragments of a left caudal mandibula with standing M_3, a fragment of the neurocranium (pars basilaris) and four loose teeth (28.57%). The loose teeth are maxillar and mandibular first (25%), second (50%) and third (25%) molars. The post-cranial fragments represent an arcus with processus spinosus of a thoracic vertebra, a proximal right and left scapula, a right proximal ulna, a right radius diaphysis, a right pelvis and a proximal right femur. The anatomical distribution is suggestive for the processing of whole carcasses at the site (Fig. 4). Interestingly, no horn core fragments were present, which could be suggestive for their collecting for a defined purpose and processing elsewhere. They would have been useful to define the gender of the animals used at the site. Additionally, the preserved right pelvic

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[29] Even though sheep and goat are small ruminants they are here categorized as middle-sized ruminants (Mesoruminantia) based on their size as middle-sized mammalia. Ruminants of the size of cattle or red deer are categorized as large-sized ruminants (Megaruminantia).

[30] See e.g. Boessneck *et al.* 1964; Boessneck 1969; Payne 1985b; Pohlmeyer 1985; Gabler 1985; Prummel and Frisch 1986; Halstead and Collins 2002; Zeder and Lapham 2010; Zeder and Pilaar 2010; Gillis *et al.* 2011. For sexual dimorphism in sheep and goat, see e.g. Boessneck *et al.* 1964; Lemppenau 1964; Prummel and Frisch 1986.

Anatomical region	Head	Vertebral column and thorax	Upper front extremities	Upper hind extremities	Lower extremities	Total	MNI
Proportion of meat	Low	Quite much	Much	Much	Least		
Ovis, incl. teeth, NISP (%)	7 (50)	1 (7.14)	4 (28.57)	2 (14.29)		14 (100)	1
Ovis, excl. teeth, NISP (%)	3 (30)	1 (10)	4 (40)	2 (20)		10 (100)	
Capra, incl. teeth, NISP (%)	5 (35.72)		1 (7.14)	7 (50)	1 (7.14)	14 (100)	2
Capra, excl. teeth, NISP (%)	5 (35.72)		1 (7.14)	7 (50)	1 (7.14)	14 (100)	
Ovis/*Capra*, incl. teeth, NISP (%)	29 (45.31)	2 (3.13)	16 (25)	12 (18.75)	5 (7.81)	64 (100)	5
Ovis/*Capra*, excl. teeth, NISP (%)	9 (20.46)	2 (4.55)	16 (36.36)	12 (27.27)	5 (11.36)	44 (100)	
Sus, incl. teeth, NISP (%)	86 (68.25)	8 (6.35)	16 (12.70)	3 (2.38)	13 (10.32)	126 (100)	7
Sus, excl. teeth, NISP (%)	25 (38.46)	8 (12.3)	16 (24.62)	3 (4.62)	13 (20)	65 (100)	
Bos, incl. teeth, NISP (%)	28 (53.85)	3 (5.77)	5 (9.61)	2 (3.85)	14 (26.92)	52 (100)	2
*B*os, excl. teeth, NISP (%)	10 (29.41)	3 (8.82)	5 (14.71)	2 (5.88)	14 (41.18)	34 (100)	
Capreolus, incl. teeth, NISP (%)					1 (100)	1 (100)	1
Capreolus, excl. teeth, NISP (%)					1 (100)	1 (100)	
Lepus, incl. teeth, NISP (%)			3 (75)		1 (25)	4 (100)	2
Lepus, excl. teeth, NISP (%)			3 (75)		1 (25)	4 (100)	
Vulpes, incl. teeth, NISP (%)	1 (25)		2 (50)	1 (25)		4 (100)	2
Vulpes, excl. teeth, NISP (%)	1 (25)		2 (50)	1 (25)		4 (100)	
Erinaceus, incl. teeth, NISP (%)	1 (14.29)		5 (71.42)	1 (14.29)		7 (100)	2
Erinaceus, excl. teeth, NISP (%)	1 (14.29)		5 (71.42)	1 (14.29)		7 (100)	
Canis sp., incl. teeth, NISP (%)	4 (50)		1 (12.5)		3 (37.5)	8 (100)	1
Canis sp., excluding teeth, NISP (%)	3 (42.86)		1 (14.28)		3 (42.86)	7 (100)	

Fig. 4. The absolute amounts (NISP) and relative (%) proportions of the anatomical elements based on body region for the identified mammalian species at EBA Goutsoura.

fragment represents only a small part of the acetabulum together with a short section of the ischium, and hence does not either allow the distinction of sex. Age estimation is based on dental and epiphyseal fusion data.[31] All elements may derive from a single

[31] Silver 1969; Schmid 1972, table IX; Payne 1973; Grant 1982; Greenfield and Arnold 2008. For goat, see also Noddle 1974.

individual over 3-years-of-age. Thus, the MNI for sheep is one adult (Figs. 3c and 4). The available osteometric data was not suitable for a reliable evaluation of size. Sheep is present in all the faunal comparanda assemblages investigated for this article.[32]

Goat is represented by cranial (35.71%) and post-cranial (64.29%) elements. All derive from Area 2. The cranial elements include the following mandibulae segments: right rostral part with standing P_2, left corpus with standing M_1 and M_2, left corpus with standing dP_2-dP_4 and M_1-M_2, as well as left corpus fragment with standing P_2-P_4. No loose teeth were identifiable as goat. The post-cranial fragments derive from a distal left humerus, a proximal left metacarpus, a proximal left tibia, a distal right tibia and right pelvis. Whole carcass utilization is indicated also for goat (Fig. 4). As with sheep, there were no horn cores of goat either, but the pelvic fragments are suggestive for male. The dental eruption and wear data together with the available epiphyseal fusion data are suggestive for a MNI of two: a young and an adult individual each (Figs. 3c and 4). Goat is identified in all investigated comparanda material.[33]

The further undifferentiable category of sheep or goat (*Ovis/Capra*) consists of a total of 64 specimens. Of these 13 (20.31%) were identified as possibly sheep (*Ovis*?) and 14 (21.88%) as possibly goat (*Capra*?). The remaining 37 (57.81%) fragments were further indistinguishable. The fragments include cranial (45.31%) and post-cranial (54.69%) elements. Of these four (6.25%) originate in Trench A, three (4.69%) in Trench D and 57 (89.06%) in Area 2. Cranial elements include mandibular fragments and loose teeth. The loose teeth originate from both the upper and lower jaws, and represent 31.25% of the identified total count or 68.97% of the identified cranial elements. Post-cranial elements represent all major body parts suggesting the processing of whole carcasses (Fig. 4). As with the categories of sheep and goat, this sample did not include horn core fragments and the identified pelvic fragments allowed no distinction of gender either. Age estimation based on dental eruption and wear as well as epiphyseal fusion suggest the presence of at least one juvenile (under 10-months-of-age; unfused distal humerus epiphysis) and two subadult and two adult individuals (MNI 5) (Figs. 3c and 4).

Cattle

For cattle (*Bos*), the differentiation from red deer (*Cervus elaphus* L.) and the distinction between the wild (*aurochs, Bos primigenius* Boj.) and domesticated forms (*Bos taurus* L.) may be challenging if the material is poorly preserved. For the differentiation there exist several publications and an indication of origin is given by differences in size and robusticity: red deer bones are more slender with stronger muscle attachment sites than domestic cattle, and aurochs is larger with more prominent muscle attachment sites than red deer or domestic cattle.[34] For undifferentiable specimens the categorization as large-sized ruminant (Megaruminantia) was applied. Aurochs represents only a minor part of

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[32] Boessneck 1962, tables 1 and 6; Amberger 1979, 52, 59, 62-63, 70-71, 148, tables 12, 15; Hinz 1979, 107, tables 21 and 22; Becker 1991, 20-22, fig. 30, tables 2 and 5-6; Douzougli and Zachos 2002, 138; Halstead, pers. comm.

[33] Boessneck 1962, tables 1 and 6; Amberger 1979, 52, 59, 62-63, 70-71, 148, tables 12, 15; Hinz 1979, 107, tables 21 and 22; Becker 1991, 20-22, fig. 30, tables 2 and 5-6; Douzougli and Zachos 2002, 138; Halstead, pers. comm.

[34] Lemppenau 1964; Bosold 1966; Schmid 1972; Bökönyi 1974, 106-107; Bökönyi 1986, 71-72; Prummel 1988b; Lister 1996.

the otherwise highly varying total frequency of identified cattle remains at Greek EBA sites.[35] Both, auroch and domestic cattle have been identified at the comparanda sites of Argissa Magula, Pevkakia Magula and Platia Magoula Zarkou.[36] Cattle is present also at Final Neolithic/EBA Doliana.[37] Especially during the early phases of domestication man possibly continued to capture young aurochs individuals for the purpose of breeding with the result of *transitional forms* as shown by osteometric data.[38] Therefore, the identified bones of aurochs in EBA assemblages with an adult age-at-death suggest either the utilization of individuals hunted and killed at the indicated age-at-death, or individuals captured as young and reared until culling at the indicated age-at-death.[39]

In the faunal material of EBA Goutsoura a total of 52 specimens were identified as *Bos*. That is 18.71% of the identified domestic species. Of these, 11 specimens derive from Trenches A (3.85%; 2/52) and D (17.30%; 9/52) and 41 from Area 2 (78.85%; 41/52). Cranial (53.85%; including loose teeth) and post-cranial (46.15%) elements are present (Fig. 4). Cranial elements include fragments of the left praemaxilla, left and right zygomatic processus, left maxilla with standing M^1-M^3, right rostral mandibula with standing P_2, left mandibula and the hyoid bone. Loose teeth or fragments of them include incisor (44.44%; 8/18), premolar (22.22%; 4/18) and molar (33.33%; 6/18) teeth. The cheek teeth originate from both the upper and lower jaws. Identified post-cranial elements include fragments of ribs, left humerus diaphysis, proximal left radius, proximal right ulna, a right carpi accessorium, metapodial fragments, cranial ramus of the left os pubis, right tibial diaphysis, left astragalus as well as first, second and third phalanges. The anatomical distribution indicates whole carcass processing at the site (Fig. 4). As with the ovicaprid remains, no cattle horn cores were present either. This would strengthen the assumption that horn cores were collected for a defined purpose and processed elsewhere. The horn cores would have been suitable for sexing cattle, as are metapodials and the pelvis too.[40] Unfortunately, the Goutsoura sample contained neither horn cores nor applicable pelvic or metapodial fragments for this purpose. Preserved long bones were fragmentary, allowing only a limited set of osteometric measurements. They indicate the presence of domesticated cattle only and are suggestive for female.[41] Based on the post-cranial elements, partial dentitions and loose teeth the MNI is two, with one subadult and one young adult individual each (Figs. 3c and 4).[42] Furthermore, the Goutsoura material includes five additional fragments identified as large-sized ruminant (Megaruminantia)

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[35] Aurochs is still present also in later bone assemblages, as shown for example in the material of second century BC Messene (Nobis 1994, 302).

[36] Boessneck 1962, 40-42, tables 1, 6, 15, 17; Amberger 1979, 23, 25-32, 48, 141, tables 1, 4-5, 10; Hinz 1979, 107, 111, tables 1, 21 and 22; Becker 1991, 22-25, tables 2, 7.

[37] Douzougli and Zachos 2002, 138; Halstead, pers. comm.

[38] Boessneck 1962, 30-31; Bökönyi 1974, 111-112; Bökönyi 1986, 63, 72.

[39] See e.g. Reichstein 1979, 245; Halstead 1987. Interestingly, at many Greek Bronze Age sites there still are concurrent identifications of wild and domestic forms of cattle and pig (e.g. Payne 1985a, 219). Unlike cattle and pig, sheep and goat had no indigenous ancestors on mainland Greece (e.g. Bökönyi 1973, 166).

[40] See e.g. Armitage and Clutton-Brock 1976; Grigson 1982; Thomas 1988; Berteaux and Guintard 1995; Davis 2000; Sykes and Symmons 2007; Telldahl *et al.* 2012.

[41] Based on comparison with previously published data in Boessneck (1962, 80-85); Amberger (1979, tables 8, 9 and 11); Bökönyi (1986, appendix C table 5.25); von den Driesch and Boessneck (1990, tables 32-33); Becker (1991, table VI) and Yannouli (1994, table 6.18).

[42] Silver 1969, tables A and D; Schmid 1972, table IX; Grigson 1982, appendices 2-4. See also Andrews 1982.

which may originate from cattle (*Bos*?). These comprise metacarpal, mandibular, pelvic as well as first phalanx fragments.

Deer

Greek Bronze Age faunal assemblages have shown the presence of three species of deer: red deer (*Cervus elaphus* L.), fallow deer (*Dama dama* L.) and roe deer (*Capreolus capreolus* L.), with red deer being usually the most numerous. Interestingly, only roe deer was identified at Goutsoura, and even then only by one third phalanx (Fig. 5) from Area 2 (Figs. 3b, 4). It represents 3.12% of the total NISP of wild species and the MNI is one (Figs. 3d and 4). Similar species have been excluded morphologically and metrically.[43] Roe deer has previously been identified at the EBA comparanda sites of Pevkakia Magula, Platia Magula Zarkou and Final Neolithic/EBA Doliana.[44]

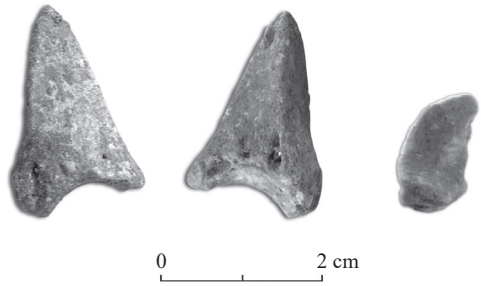

Fig. 5. Third phalanx of a roe deer (*Capreolus capreolus* L.) from Area 2, Square 503/508, Locus 5. Abaxial view (left), axial view (middle) and view of proximal articular face (right).

Pigs

Wild boar (*Sus scrofa ferus* L.*)* is still present in many parts of mainland Greece and a native process of domestication is accepted to have taken place as early as the Pre-Pottery Neolithic in some regions.[45] Interestingly, several Bronze Age faunal reports include concurrent identifications of wild and domesticated (*Sus scrofa domesticus* L.) pig together with *transitional individuals* which fall in-between in the osteometric scattergrams.[46] This suggests a continuation of the process of pig domestication during the Bronze Age. However, the nature of the wild and transitional pigs in these assemblages can be interpreted in different ways. Either the wild pigs represent the remains of individuals hunted, for example, for the purpose of obtaining specific products (e.g. tusks, meat and leather) or they were captured with the intention to be tamed[47] and introduce new genetic material into the existing domesticated pig population, which could be reflected in the presence of the transitional forms. These are mutually not excluding possibilities and the age at death of the wild individual does not necessarily equal the age at the time of capture. The transitional individuals can also be the result of unintentional inter-breeding

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[43] See e.g. Bosold 1966.

[44] Amberger 1979, 133-134, table 1; Reichstein 1979, 243, 246-247; Bökönyi 1986, 92, tables 5.2a-5.2b; Becker 1991, 27-28, table 2; Yannouli 1994, table 4.1; Douzougli and Zachos 2002, 138; Greenfield and Fowler 2005, 27, 96-97; Reese 2013a, 457; Halstead, pers. comm.

[45] E.g. at Sitagroi (Bökönyi 1986, 81). See also Bökönyi 1974, 208.

[46] See e.g. Bökönyi 1986, 81, 83, figs. 5.14-5.17.

[47] See e.g. Bökönyi 1974, 205 and 207.

facilitated by an extensive management system (i.e. free-ranging in the woodland)[48] and the remains of the wild pigs represent those killed to prevent this from happening.

Altogether, the distinction of the three pig forms may be difficult from fragmentary material. Cranial features such as the size of the lacrymal bone, the length of the lower third molar and the boars tusk are most suitable for the purpose. However, caution should be applied with reliance on post-cranial features and measurements, since several factors (e.g. genetics, gender, nutrition and temperature) may affect the size of an individual leading to overlapping osteometric results of the different genders (female, male, castrated) between wild and domestic animals from different areas and periods of time. For the comparanda sites investigated here, concurrent identifications of wild and domestic pig have been made at EBA Argissa Magula, Pevkakia Magula and Platia Magula Zarkou as well as Final Neolithic/EBA Doliana.[49]

At Goutsoura the genus pig (*Sus*) is represented by 126 specimens, comprising 45.32% of the domestic species NISP. Of these, the majority (97.62%; 123/126) originates in Area 2, with only three (2.38%; 3/126) deriving from Trench D. About half (48.41%) of the positive identifications consist of loose teeth or fragments of them from both (Figs. 3c and 4), the upper and lower jaw, with incisivi being the most abundant (62.30%; 38/61), followed by canini (14.75%; 9/61) and molars (14.75%; 9/61), premolars (4.92%; 3/61) as well as further undifferentiable cheek tooth (3.28%; 2/61). The remaining specimens consist of cranial (38.46%) and post-cranial (61.54%) elements. The cranial elements include fragments from the viscerocranium (os nasale, maxilla, mandibula). The post-cranial fragments represent the spinal column (thoracal vertebrae), front and hind limbs (scapula, humerus, ulna, tibia, calcaneus, metapodia and phalanges) as well as the pelvis. The anatomical distribution indicates the processing of whole carcasses (Fig. 4). Age estimation is based on dental data and epiphyseal fusion.[50] Unfortunately, the preservation status was low with fusion data available only for an unfused distal right humerus (under 1.0-1.5-years-of-age), a fused right acetabulum (over 1-years-of-age), a fused distal right tibia (over 2-years-of-age) and an unfused proximal right calcaneus (under 2.0-2.5-years-of-age). Additionally, a fetal individual is identified by a left proximal ulnar fragment.[51] Therefore, the presence of at least three individuals is indicated by the post-cranial elements: one fetal, one immature-subadult and one adult. However, based on the most frequent post-cranial element (proximal left ulna) there would be four individuals.

Dental data is provided by partial dentitions and loose teeth only. Age estimates based on single teeth and partial dentitions should be regarded with caution, since for example aberrations in the dentition can lead to abnormal dental wear. The partial dentitions include a maxillar fragment with standing I^3, a maxillar fragment with standing P^{2-4}, a maxillar fragment with standing dP^3, a mandibular fragment with standing P_{3-4}, a mandibular fragment with standing M_1, and a mandibular fragment with standing dP_4. The MNI based on partial dentitions would be one immature-subadult, one subadult and one subadult-young adult. The loose teeth provide us with some additional information on the

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[48] See e.g. Bökönyi 1974, 211-212.

[49] Boessneck 1962, 35-37, 47-48, tables 1, 6, 8, 10, 15 and 19; Amberger 1979, 141; Hinz 1979, 24, 27, 64-65, tables 4-5, 11; Becker 1991, 24-25, 28, tables 2, 8, 10; Douzougli and Zachos 2002, 138; Halstead, pers. comm.

[50] Silver 1969, table A; Schmid 1972, table IX; Bull and Payne 1982; Grant 1982; Rolett and Chiu 1994; Wright *et al.* 2014.

[51] Amorosi 1989, 231.

age distribution of this sample. Habermehl describes the root morphology of mandibular first and second incisivi to be age-dependent.[52] In some of the sample specimens the root tip is preserved and enables us to estimate the age of these individuals. It is possible to identify individuals of the estimated age of 2-3 years, 7-9 years and over 10 years, one adult individual each category. The sample contains also one M_2 germ indicating the presence of a subadult individual. Unfortunately, the fragmentary status of the recovered male mandibular canini does not allow the usage of the Brandt-formula for the calculation and estimation of age.[53] Their remaining length varies from 20 mm to 48 mm. Their original length is difficult to assess from broken material. The measurements are not indicative for the absence of wild boar. The lack of adequate third molars makes the situation even more intriguing, but unfortunate. Measurements of post-cranial elements are scarce due to their preservation status. Based on published metrical values,[54] the above named fused distal tibia fragment indicates the presence of domesticated pig.

Thus, the fragmentary state of the recovered material allows no definite exclusion of the usage of the wild form of pig at the site. The available tibial measurement derives from an adult domestic pig. The preserved canini fragments are inconclusive in regard to the differentiation of wild from domesticated individuals. However, they indicate the presence of at least one adult male. The available data suggests a total MNI of 7, comprising one foetus, one immature-subadult, one subadult, one young adult and three mature adults. Furthermore, there are 13 additional fragments identified as possibly pig (*Sus*?) of origin. They comprise neurocranial, maxillar, dental, scapular, radial and ulnar and pelvic specimens.

Canids

The category of canids (Canidae) includes domestic dog (*Canis familiaris* L.), wolf (*Canis lupus* L.) and red fox (*Vulpes vulpes* L.). The distinction is based on morphology and osteometry. However, dog may be difficult to discern from wolf if the material is fragmentary and the specimens lack suitable features. Thus, remains of dog and red fox are frequently identified at EBA sites, but wolf is more seldom with previous positive identifications at e.g. Lerna, Pevkakia Magula and Sitagroi.[55] This scarce occurrence of wolf is not directly indicative of its rarity during EBA in Greece, but rather explained by its underrepresentation in the zooarcheological samples due to lack of affirmed positive distinction from domestic dog and its lesser likelihood to end-up in the faunal sample of a site. It has been suggested from cutting marks on osteological remains, that dog was also consumed for food in Greece before it attained a special status as human companion during the LBA as indicated by their remains in human burials.[56]

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[52] Habermehl 1985, 105.

[53] As presented by Habermehl 1985, 103.

[54] See e.g. Bökönyi 1986, table 5.28 (Measurements for tibia) in appendix C; Becker 1991, table VII (Tibia); Greenfield and Fowler 2005, appendix 4C.15 Tibia.

[55] Amberger 1979, table 1; Bökönyi 1986, tables 5.2a-5.2b; Reese 2013b, 300-301. For further prehistoric identifications of non-domestic canids see Yannouli 2003.

[56] Day 1984. Day also notes that the custom of burying dogs with humans was practiced already during the EBA and MBA on Cyprus as well as by the LBA among the Hittites.

In the fragmentary Goutsoura material differentiation of domestic dog from wolf posed a problem. Based on morphology none of the fragments can definitely be identified as domestic dog or wolf, but based on size dog is represented at least by two fragments of a left maxilla with standing M^1-M^2 and tooth sockets for P^1-P^4.[57] However, there are six further specimens determined as *Canis sp*. (i.e. domestic dog or wolf) (Fig. 3b). These include a rostral fragment of the right mandibula of a young adult (as indicated by tooth sockets), one lower left caninus fragment, one proximal left ulnar fragment, one right calcaneus, one fused distal metapodial fragment as well as one fused first phalanx (Figs. 3c and 4). All specimens can derive from one individual only. Thus, the canid remains include most probably at least one young adult (MNI 1) domestic dog as indicated by the permanent dentition and its osteometry. All specimens except one (left lower caninus; Trench D) derive from Area 2. Of the used comparanda sites, domestic dog remains have been reported from Argissa Magula, Pevkakia Magula, Platia Magula Zarkou and Doliana.[58] Of these, cutting marks have been reported on the remains from Pevkakia Magula.[59]

Red fox is present only in the material from Area 2, consisting of four fragments representing 12.5% of the identified wild species and one possible specimen (Figs. 3b and 3d). The remains comprise one fragment of the caudal left maxilla with permanent, but not worn, P^3 and P^4, one proximal diaphysis fragment of the right femur with unfused and missing epiphysis and two diaphyseal fragments of a right radius (Fig. 4). The proximal femur fuses prior dental change.[60] For the radius fragments no age estimate is possible. The possible fox specimen is a fragment of the left pelvis. The fox remains represent at least two individuals (MNI 2): one young adult and one juvenile. Of the investigated comparanda sites fox has been previously identified at Platia Magula Zarkou and Pevkakia Magula.[61]

Additionally, there exist two dental fragments and one fragment of a short-bone diaphysis which were determinable as Canidae (i.e. red fox, domestic dog or wolf) of origin. None of the described Goutsoura canid specimen shows any cut marks, and hence, there is no indication of their possible use for food despite their occurrence amongst other food debris.

Other mammalia

The hedgehog (*Erinaceus europaeus* L.) is counted by seven specimens and one possible fragment. It represents 21.88% of the identified wild species (Figs. 3b-3c). All derive from Area 2. The best preserved specimens are a left femur of a young individual as indicated by the caput in fusion and missing unfused distal epiphysis (Fig. 6) and two distal fragments of right humeri. One of these humeri has a fused epiphysis. However,

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[57] In wolves, the P^4 is longer than the combined length of M^1 and M^2 (Bökönyi 1974, 314). Unfortunately, in this specific specimen the P^4 is missing, but its approximate length, as indicated by the tooth socket, is equal or less than the total length of M^1+M^2.

[58] Boessneck 1962, 49, tables 1, 6, 8; Hinz 1979, 48-56, table 1; Becker 1991, 25, table 2; Douzougli and Zachos 2002, 138; Halstead, pers. comm.

[59] Hinz 1979, 56. No signs of cutting were identified at Platia Magula Zarkou (Becker 1991, 25).

[60] Habermehl 1985, 112-116.

[61] Boessneck 1962, table 1; Hinz 1979, 71-73, table 13; Becker 1991, 28-29, table 11.

without both epiphyses it is difficult to determine the accurate age category. The remaining specimens consist of a left ulna corpus, a right proximal ulna, a corpus of radius and a caudal right mandibular fragment (Fig. 4). The MNI would therefore be two (Fig. 3d). The uncertain identification could be an additional corpus fragment of radius. Hedgehog has previously been identified at such EBA sites as Sitagroi, Skala Sotiros and Lerna, but not in the corresponding layers of the comparanda sites.[62] The Lerna example has shown cut marks indicating human processing. Several authors suggest that in the majority of cases the species should be regarded as intrusive (i.e. not by human impact) to the faunal assemblages.[63]

Fig. 6. Left femur of a hedgehog (*Erinaceus europaeus* L.) from Area 2, Square 501/507, Locus 6. Distal epiphysis unfused and missing. Cranial view (left) and caudal view (right).

The brown hare (*Lepus europaeus* Pall.) is present with four fragments, thus representing 12.50% of the identified wild fauna (Fig. 3b). All originate in Area 2. Bones of the front extremities are in majority, with one distal right humerus and two left ulnar fragments. Additionally, a fused distal metacarpal or -tarsal bone is present (Fig. 4). The MNI would therefore be two (Figs. 3d and 4). Data on age estimation in the brown hare based on skeletal elements is scarce. The distal epiphysis of the humerus fuses prior the proximal one,[64] therefore the individual indicated by the fused distal humerus can be subadult or adult. Hare is regularly identified in Greek archaeological wild faunal assemblages, including the investigated comparanda of Pevkakia Magula and Platia Magula Zarkou as well as Doliana.[65]

Birds and fish

The bones of birds (*Aves*) and fish (*Pisces*) are less likely to preserve and be recovered in archaeological assemblages, due to their smaller size and fragility. The used recovery methodology at Goutsoura is biased against smaller remains since no sieving was applied. This may explain why no remains of fish were found in the bone assemblage of the site (Fig. 3a). However, the find of a fishhook strongly suggests that the diet was supplemented at least occasionally by fish. Fish remains have been identified at the EBA comparanda site of Pevkakia Magula.[66]

Bird remains are also underrepresented. In the material only two fourth phalanges of predatory birds and one fragment of a long-bone diaphysis were identified as bird. All

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[62] Bökönyi 1986, 94-95, tables 5.2a -5.2b; Yannouli 1994, 159; Reese 2013a, 460; Reese 2013b, 300-301.
[63] See e.g. Bökönyi 1986, 95; von den Driesch and Boessneck 1990, 112.
[64] Habermehl 1985, 107-110.
[65] Boessneck 1962, table 1; Hinz 1979, 82-84, table 16; Becker 1991, 29; Douzougli and Zachos 2002, 138; Halstead, pers comm. In some publications *Lepus capensis* Linnaeus 1758 is used.
[66] Boessneck 1962, table 1; Amberger 1979, 142, table 1; Hinz 1979, 99-103.

derive from Area 2 and they represent 9.38% of the identified wild species (Figs. 3a and 3d). The recovered phalanges from Goutsoura are of different size and morphologically distinct, indicating the presence of at least two individuals (MNI 2). The morphological traits suggest the presence of tawny owl (*Strix aluco* L.) and white-tailed sea eagle (*Haliaeetus albicilla* L.). Otherwise, birds are quite frequently represented in EBA faunal remains, reflecting both, the local environment (i.e. species variety) and human dietary and/or handicraft preferences (i.e. species suitable for food/artefact manufacture).[67]

Reptilia and amphibia

The total NISP of reptile and amphibian specimens is 13 (Fig. 3a), consisting of tortoises and/or turtles, as well as frog or toad. The order Testudines (i.e. tortoises or turtles) is represented by 12 fragments (37.5%) of the identified wild species. A whole skeleton or articulated elements would indicate the intrusive character of a winter hibernating individual. The identified specimens are fragments of the carapace and plastron only. They wear no signs of human processing. They derive from Trench A (two plastron fragments) and Area 2 (carapace and plastron fragments). Identification to species was not possible due to fragmentation and lack of adequate comparative material. However, Hermann's tortoise (*Testudo hermanni* Gmel.) has been identified at contemporary layers in Pevkakia Magula and Platia Magula Zarkou, and Caspian turtle (*Mauremys caspica* Gmel.) at Argissa Magula and Platia Magula Zarkou.[68] The European pond turtle (*Emys orbicularis* L.) is present at Magula Pevkakia and Platia Magula Zarkou.[69] Other possible taxons are the Greek tortoise (*Testudo graeca* L.) and the marginated tortoise (*Testudo marginata* Schoepf), the latter of which is present at least at Tiryns.[70]

The material from EBA Goutsoura includes also one fragment of the left ilium of a frog/toad from Area 2 (Fig. 3d), thus representing 3.13% of identified wild species. Frog/toad is also identified by Gejvall in EBA Lerna (Lerna III-IV), but remained unpublished, as well as at Thermi with some bones of the extremities.[71] The Goutsoura specimen does not show any cut marks and an intrusive origin (i.e. non-human) is not excluded.

Pathologies

No pathologies were identified. This may be the result of the overall state of fragmentation of the bone sample, residual soil attaching to the bones with obscuring minor changes, or be suggestive of a healthy population of domestic animals and the exploitation of healthy

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[67] See e.g. Lerna (Reese 2013a, 460; Reese 2013b, 301-302), Pevkakia Magula (Amberger 1979, 142, table 1; Hinz 1979, 88-94), Platia Magula Zarkou (Becker 1991, 30-31, table 14), Sitagroi (Bökönyi 1986, tables 5.2a-5.2b), Tiryns (von den Driesch and Boessneck 1990, 114-116, table 13). No bird remains were identified at Argissa Magula (Boessneck 1962, table 1).

[68] Boessneck 1962, 7, tables 1 and 6; Hinz 1979, 95-96, table 19; Becker 1991, 31, table 15. It should be noted, that identification of *Clemmys caspica* at Argissa Magula is based on *most probable possibility* and not by indentification *per se*, as already stated by Boessneck 1962, 37.

[69] Hinz 1979, 95-96, table 19; Becker 1991, 31. The site listing in this chapter is not exhaustive.

[70] von den Driesch and Boessneck 1990, 116-117, table 14.

[71] Lamb 1936, 216; Reese 2013a, 460; Reese 2013b, 301.

wild specimens. Animals with clinical signs of disease and/or traumata could have been deposited outside the settlement, since they would not have been used or used only partly for food purpose. In these cases the altered parts would not be present in the sample collected during excavation.

Discussion

A subsistence strongly based on domesticated animals (89.68%) is identified at EBA Goutsoura, with pig and ovicaprids the most abundant, followed by cattle and dog (Figs. 3b-3c and 7). Wild fauna represent with 10.32% only a minor part of the identified species, indicating a supplementary function in the economy and include both, dietary suitable and fur-bearing species (Figs. 3b, 3d and 8). Of birds and fish, only bird remains were identified, but a fishhook is suggestive for the exploitation also of aquatic resources at least occasionally. An intrusive character of the reptilian and amphibian individuals as well as the hedgehog remains cannot be excluded.

The nature of the practiced animal-based subsistence, and the pattern of animal husbandry in particular, is identified through the relative species frequency as well as age and sex distribution of the identified animal individuals. Increasing sample size raises the accuracy of conclusions. At EBA Goutsoura the state of preservation of the sample posed limitations for the evaluation of the named characteristics. Considering the relative importance of the identified domestic species, their position varies according to whether loose teeth are included into the calculations or not (Fig. 3c). If these are included, pig is the most important with 45.32% of all identified domestic species followed by ovicaprids with 33.09% and cattle with 18.71%. If the loose teeth are excluded from the calculations, ovicaprids represent the majority (39.08%), with pig close-by (37.36%) and cattle remaining on third place (19.54%).[72] Despite the fact that teeth are more resistant to degradation than bone, faunal reports rarely discuss the effect of loose teeth on the relative distribution of species if NISP is used as basis for calculations and interpretations.

Inter-site comparison is usually based on NISP of the total count of identified specimens of a species. Unfortunately, early reports represent mostly only a list of species identified in the sample with occasional remarks on their frequencies or relative abundance. The inter-site comparison of the relative importance of the respective species here is based on the available NISPs for Argissa Magula, Pevkakia Magula and Platia Magula Zarkou, but on Minimum Number of Anatomical Units for Doliana which poses some limitations for direct comparison and evaluation (Figs. 7 and 8). According to these, the inhabitants of all comparanda sites (i.e. Argissa Magula, Pevkakia Magula, Platia Magula Zarkou and Doliana) relied on a subsistence based on animal husbandry with a supplementation by wild fauna (Fig. 8). All major domesticates (i.e. pig, ovicaprids and cattle) are present at each, but in varying frequencies, suggesting three exploitation patterns of domestic animals during the EBA based on the identified main species with emphasis on either pig, ovicaprids or cattle (Fig. 7).

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[72] The importance of ruminants in the Goutsoura subsistence, whether domesticated or wild, is additionally reflected in the NISP of the further undifferentiable categories of Ruminantia, Megaruminantia and Mesoruminantia as shown in Fig. 3b.

Of the investigated faunal assemblages, Goutsoura is the only one with pig dominating over ovicaprids followed by cattle. At Pevkakia Magula and Platia Magula Zarkou ovicaprids dominate, whereas cattle at Argissa Magula and Doliana.[73] However, if we consider also other EBA faunal assemblages, there is similarity of the Goutsoura material to the relative domesticate frequencies at e.g. Helike (Achaea) and Pentapolis (Macedonia), with the difference that Helike has additionally an identification of horse/equid (Fig. 7).[74] Thus, it seems appropriate to include these sites into the discussion. Data on the age distribution of pig at Goutsoura, Helike and Pentapolis is available with suggesting local rearing and consuming, and additionally a possible provisioning of other sites as put forward at least for Helike and Pentapolis.[75] The usage of pig as primary meat source implies for the presence of ovicaprids and cattle a possibility for emphasis on their secondary products, but with continuation of their primary products exploitation as suggested by young individuals in the assemblages. Younger individuals may also have been purposefully culled as part of the herd strategy in order to prevent or minimize a possible shortage of feed during the winter season.

Ovicaprids represent at Goutsoura the second most important domestic species with an equal amount of identified specimens (NISP) of sheep and goat, but with goat remains more abundant than sheep if MNI values are compared (Figs. 3c and 7). Of sheep, the remains of an adult individual were identified, and of goat those from one young and one adult individual each. The further undifferentiable ovicaprid remains consisted of five additional individuals comprising also the age categories of juvenile and subadult. The presence of these younger individuals indicates the exploitation of ovicaprids for primary products alongside secondary use. If considering secondary products, goat produces more milk than sheep and the wool of sheep is of better quality, thus explaining the presence of both species. The presence of adult animals is suggestive for the exploitation of secondary products such as wool and milk[76] additionally to their use for the maintenance of the population by local breeding. Local breeding and consumption is also indicated by the presence of younger age categories. The birth of offspring is the prerequisite for producing milk. Ovicaprids at Helike comprise all age categories with adult individuals in majority, reflecting the situation at Goutsoura.[77] At Pentapolis sheep are more abundant than goats and the age distribution with rare adults and missing individuals under 12-months-of-age is suggestive for a primary use for meat production only.[78]

Cattle are represented at Goutsoura by at least a subadult and a young adult, suggesting their use for primary products. At Pentapolis the major culling occurred before

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[73] The Doliani faunal data given by Douzougli and Zachos 2002, 138, are not correct. The correct and more updated approximate percentages of MinAU are for cattle (*Bos taurus*) 38.8% instead of ca. 8%, for sheep (*Ovis aries*) 19.5% instead of ca. 33%, for goat (*Capra hircus*) 1.8% instead of ca. 3%, for sheep/goat (*Ovis/Capra*) 14.8% instead of none, for domestic pig (*Sus domesticus*) 12.0%, for dog (*Canis familiaris*) 3.9% instead of ca. 4%, for cat (*Felis sylvestris*) 0.2%, for hare (*Lepus europaeus*) 0.2%, for wild boar (*Sus scrofa*) 0.4%, for bear (*Ursus arctos*) 0.2%, for red deer (*Cervus elaphus*) 7.8% instead of ca. 8%, and for roe deer (*Capreolus capreolus*) 0.6% instead of ca. 1% (Halstead, pers. comm.).

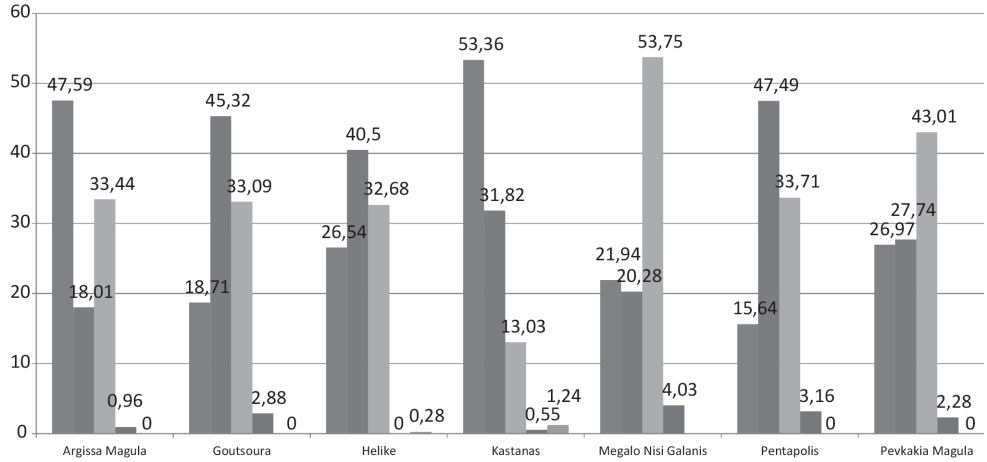
[74] Fillios 2006, 122, appendix table 1.

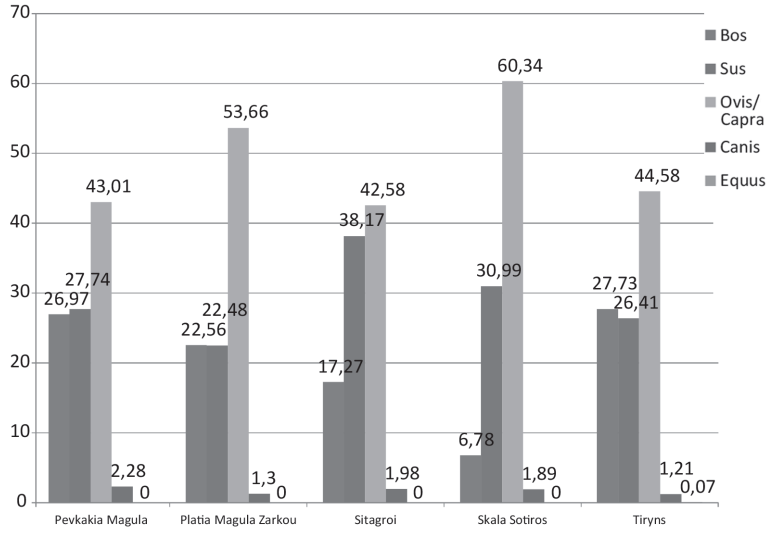
[75] Yannouli 1994, 206-207, 333; Fillios 2006, 130-132.

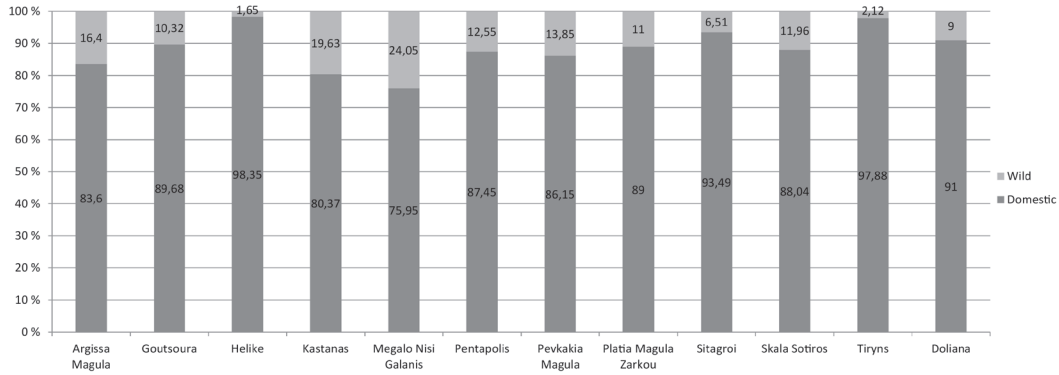
[76] The secondary product category "milk" includes also products made of milk, such as cheese, which would allow a longer storage time and easier transport.

[77] Fillios 2006, appendix table 10.

[78] Yannouli 1994, 187.







Figs.7 (above) and 8 (below). Relative frequencies of domestic species at EBA Goutsoura and comparanda sites presented as percentages. Calculations based on available NISP and for Doliana on MinAU. Values for Doliana are approximate. Fauna of Megalo Nisi Galanis represents material from the Late Neolithic and EBA, and that of Doliana from the Final Neolithic and EBA. For Platia Magula Zarkou shellfish are not included into the calculations of wild species in Fig. 8.

the age of 3.5-4.0 years and for a modest amount only there after. None were identified to be under 1-1.5-years-of-age.[79] For Helike a small amount was slaughtered at 1-2-years-of-age, with the majority being culled at over 2-years-of-age.[80]

Thus, for Goutsoura, Helike and Pentapolis a self-contained animal production economy based on pig is indicated with additional exploitation of domestic ruminants for both primary and secondary products. Furthermore, the results suggest, at least for Helike and Pentapolis, a possible provision of other sites with primary products of pig.[81] For Goutsoura we noted an absence of ovicaprid and cattle horn cores despite the presence of other cranial elements in the assemblage. However, these cranial elements did not include any fragments of the horn-bearing region of the skull which makes the evaluation for possible hornless forms of these species impossible. The absence of horn cores may also be due to the sample size or a purposeful collecting for manufacturing artefacts somewhere else, either at the site or outside it. Halstead and Fillios note that this kind of mixed composition of livestock provides additionally to the broad product variety a buffer to minimize the risks of adverse natural forces.[82] This kind of risk increases with production specialization based on one or a maximum of two species of livestock only. Halstead and Fillios also note that a husbandry pattern based on mixed livestock is consistent with a small-scale settlement and farming, since the species vary in their management requirements which would be difficult to realize on a larger scale.[83] This is confirmed by a broad age profile and wide range of skeletal elements of the animals in the given bone assemblages.[84]

The second exploitation pattern of domestic stock as suggested by comparison of available NISPs shows a dominance of ovicaprids followed by pig and cattle or cattle and pig, respectively. This pattern is recognized at Pevkakia Magula (ovicaprids > pig > cattle) and Platia Magula Zarkou (ovicaprids > cattle > pig). The age profiles at the sites are suggestive for a mixed use of the ruminants for both primary and secondary products with minor site specific variation. Pig is, again, exploited for its primary products (i.e. meat and fat) with adult individuals present indicating local breeding.[85] At Pevkakia Magula sheep are more abundant than goat, with the age profile emphasizing secondary production, but possibly with an importance in milk, since females dominate the assemblage.[86] However, female sheep are suitable for both milk and wool production.[87] Secondary product exploitation is reflected also in the age profile of the Pevkakia Magula cattle, with more numerous mature than immature animals.[88] The amounts and age profiles of pig at Pevkakia Magula also suggest its exploitation for meat as supplementation for the otherwise primary exploitation of secondary products of the small ruminants and cattle.[89]

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[79] Yannouli 1994, 197-198.
[80] Fillios 2006, 133, appendix table 10.
[81] Yannouli 1994, 333; Fillios 2006, 130-131.
[82] Halstead 1993 and 1996, 24; Fillios 2006, 181.
[83] Halstead 1993 and 1996, 24; Fillios 2006, 181.
[84] Fillios 2006, 181.
[85] Hinz 1979, 25-26; Becker 1991, 24-25.
[86] Amberger 1979, 52, 59, 63, tables 12 and 17; Hinz 1979, 112.
[87] Amberger 1979, 63.
[88] Amberger 1979, 23, tables 5-6; Hinz 1979, 111.
[89] Hinz 1979, 24-27, 112-113, tables 5 and 7.

A similar relative distribution of the domestic species to Pevkakia Magula is shown in the material of, for example, EBA Sitagroi and Skala Sotiros.[90] At the site of Platia Magula Zarkou cattle follow ovicaprids in importance prior to pig. Sheep are more abundant than goat at the site, but both show broad age profiles indicating primary and secondary exploitation with an emphasis on secondary products.[91] This is also the case for cattle, the versatile usage of which should be noted when interpreting the meaning of its importance compared to pig.[92] Pig is again used for primary products.[93] The exploitation pattern of domestic species shown at Platia Magula Zarkou is reflected in the faunal material of, for example, EBA Tiryns and LN/EBA Megalo Nisi Galanis.[94]

At Argissa Magula and Doliana a third exploitation pattern of domestic species is identified, with a dominance of cattle followed by ovicaprids and pig.[95] At Argissa Magula the age profile for cattle shows a dominance of adults over infantile, juvenile and subadult individuals, hence indicating their exploitation for both primary and secondary products with emphasis on the latter.[96] The same is shown and indicated for ovicaprids, together with a dominance of sheep over goat.[97] Pig follows as third in relative importance and their age profile shows again their use for primary production and maintenance of a local breeding population.[98] At Doliana the age profile for cattle and sheep are suggestive for their primary use for meat production with a possible secondary use.[99] Sheep remains are more abundant than those of goat.[100] A slightly different exploitation pattern, with pig following cattle prior ovicaprids, is identified at, for example, EBA Kastanas.[101]

The here presented exploitation patterning is based on available data which are not always directly comparable and should therefore be considered with a caveat. The comparison here is based on NISP and Minimum Number of Anatomical Unit values which should be considered when making interpretations. As known, the NISP value is strongly affected by sample size, grade of fragmentation and used excavation methodology, but also associated with the amount of identified species and therefore also the species variety identified at a site.[102] This is reflected especially in the wild fauna composition of the comparanda assemblages and the species variety identified from the different excavation areas at Goutsoura, with the most abundant being that of Area 2, which also has the highest amount of recovered fragments.

At Goutsoura the applied excavation methodology without sieving is biased against small mammalian bone elements and is undoubtedly reflected also in the underrepresentation of bird and fish remains. However, the scarcity of these may also be

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[90] Bökönyi 1986; Yannouli 1994.
[91] Becker 1991, 20-22, tables 2 and 4.
[92] Becker 1991, 22-24, table 7.
[93] Becker 1991, 24-25, table 8.
[94] von den Driesch and Boessneck 1990; Greenfield and Fowler 2005.
[95] Boessneck 1962. For the updated data on the Doliana fauna, see n. 73. For Argissa Magula NISP values are available and for Doliana percentages based on Minimal Number of Anatomical Units.
[96] Boessneck 1962, table 17.
[97] Boessneck 1962, 42, tables 1, 6 and 18.
[98] Boessneck 1962, table 19.
[99] Douzougli and Zachos 2002, 143; Tartaron 2004, 142.
[100] See n. 73.
[101] Reichstein 1979, 250, table 1.
[102] See e.g. Grayson 1981.

the result of local taphonomical factors since the remains of both taxa are less resistant to natural destructive forces than mammalian bones. This could also be the reason for low numbers of very young mammalia, since their bones are not yet fully ossified and prone to lesser preservance. Both, bird and fish are frequently identified at other EBA sites in varying amounts, depending on the local environmental setting and viscinity to aquatic resources. Despite the missing osteological remains, the exploitation of fish at Goutsoura is strongly suggested by the find of a bronze fishhook. The three identified bird bones at Goutsoura represent 0.08% of the total NISP and 9.38% of the identified wild species. The faunal remains of Platia Magula Zarkou did not contain any fish remains, but several water bound bird species have been identified and represent 0.22% of the total NISP of the site.[103] At Pevkakia Magula fish comprise 0.45% and bird 0.19% of the total NISP, and at Pentapolis 1.55% and 0.06%, respectively.[104]

Altogether, the wild fauna of a given site does not only represent species hunted for supplementing subsistence (i.e. for food or other products), but also those killed to protect the livestock. They also reflect the local environment and allow us to draw conclusions on it based on known habitat preferences of the given species. In the case of Goutsoura the tawny owl lives near open mixed and deciduous forests, which are also suitable for the roe deer and red fox, as well for the brown hare and hedgehog if situated close to areas of open vegetation such as fields, pastures or meadows. The white-tailed sea eagle may well follow major rivers from the coast to the inland and visit lakes.

Concluding thoughts

With the faunal analysis of EBA Goutsoura we have presented the earliest evidence so far of animal husbandry in the Kokytos valley and Thesprotia. The results are suggestive for a livestock-based economy utilizing all major domestic species (i.e. pig and ovicaprids, followed by cattle) in a self-contained production manner with a supplementation by wild species. Since zooarchaeological data from other EBA excavations in the region are currently not available it is difficult to place the observed pattern of animal husbandry in a relevant and useful regional framework. However, the results of Goutsoura show a similar pattern of livestock exploitation to Helike (Achaea) and Pentapolis (Macedonia), and confirm the role of animal husbandry in subsistence during the EBA also for this region in northwestern Greece.

Animal husbandry seems to be already established at EBA Goutsoura. Therefore, it would be intriguing to investigate more properly the origin of the domestic species identified at the site and the route by which they arrived. Important questions in this respect would be if animal husbandry developed in the region autochtonous from local wild boar and aurochs populations, by influence or through importation of primary stock from somewhere else (as it would be the case for sheep and goat anyway). However, such a study would need a comprehensive analysis of Neolithic and Bronze Age archaeological remains, including the find contexts and molecular genetic analysis of the bones. Several possible routes are already postulated by the data on pottery from EBA Goutsoura.[105]

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[103] Becker 1991, 30-31, table 2.
[104] Amberger 1979, 142, table 1; Yannouli 1994, appendix D, table D1. See also Hinz 1979, 88-94, 99-103.
[105] Forsén *et al.* 2011, 81.

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