PAPERS AND MONOGRAPHS OF THE FINNISH INSTITUTE AT ATHENS VOL. XV

THESPROTIA EXPEDITION I
TOWARDS A REGIONAL HISTORY

edited
by Björn Forsén

HELSINKI 2009

ISSN 1237-2684
ISBN 978-952-67211-0-1

Printed in Finland by Ekenäs Tryckeri.

Cover: The Early Hellenistic fortress Agios Donatos of Zervochori seen from the south.
Photo: Esko Tikkala.

Layout: Vesa Vahtikari

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A Shift in Animal Species Used for Food from the Early Iron Age to the Roman Period

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Introduction

Studies of animal bones and pollen samples have played an increasingly important role in archaeological research during the last few decades. These analyses are essential for environmental reconstructions, as well as for reconstructing subsistence systems and economies of people behind the archaeological remains.[1] In this article, osteological finds recovered in trial excavations conducted during the summer of 2006 by the Thesprotia Expedition in the Kokytos valley are analysed to gain information on temporal changes in subsistence system and economy between the Late Iron Age and the Hellenistic / Roman period. Bones analysed are from two sites – PS 36 and PS 25, focusing on the relative abundance of animal species from these two sites. Differences in relative frequencies generally reflect shifts in food economy and may even allow the reconstruction of the way of life (e.g., nomadic pastoral, transhumance, settled agriculturalism, etc.).

PS 36 is dated from 1100 until 400/350 BC, but most of the finds belong to the ninth and eighth centuries BC, and thus to the Early Iron Age. This site is located at Mavromandilia on the valley bottom close to the Kokytos river. It is thought that the subsistence economy of the Early Iron Age people of this region was a form of transhumance, in which animals were herded in the mountains in the summer and in the lowland plains in the winter.[2] Local Epirotic and Albanian wares, as well as Corinthian imports, are represented among pottery recovered from this site.[3]

PS 25 is a small fortified hill settlement, located on the lower slopes of the Paramythia mountain range. Its walls date to the late fourth or early third century BC, the Early Hellenistic period.[4] However, it was also used after the Roman conquest of Thesprotia in 167 BC and especially in the first century AD as indicated e.g. by rich finds of *terra sigillata* pottery.[5] It is impossible to say for certain which bones date to the Hellenistic period and which bones to the Early Roman period. However, because most finds from the layers excavated in Trench A (the tower) were of Early Roman date,[6] I have assumed that bones from Trench A are predominantly from the Early Roman period. Most of the finds from Trench B (small gate) were in a layer of eroded soil originating from the settlement above and containing a mixture of Hellenistic and Early Roman finds. Thus at least a part of the bones recovered from Trench B are presumably Hellenistic in date.[7]

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[1] Davis 1987, 61-74.
[2] See e.g. Sakellariou 1997, 38-42, 54-58.
[3] For PS 36 and its finds see J. Forsén, this volume.
[4] For the walls see Suha, this volume.
[5] For the *terra sigillata* see Ikäheimo, this volume. For PS 25 in general see Forsén and Tikkala 2006.
[6] This goes for the parts of Trench A that were excavated in 2006. In 2007 the work in Trench A continued, whereby a purely Early Hellenistic layer was found below the Early Roman floor level. However, osteological finds from 2007 are not included for discussion in this article.
[7] B. Forsén, personal communication.

	Including teeth		Excluding teeth	
Site	PS 36	PS 25	PS 36	PS 25
Bos	60 (70.6%)	22 (20.8%)	44 (77.2%)	21 (25.6%)
Ovis	20 (23.5%)	66 (62.3%)	10 (17.5%)	48 (58.5%)
Sus	2 (2.4%)	10 (9.4%)	1 (1.8%)	5 (6.1%)
Equus	2 (2.4%)	--	1 (1.8%)	--
Cervus	--	2 (1.9%)	--	2 (2.4%)
Birds	1 (1.2%)	5 (4.7%)	1 (1.8%)	5 (6.1%)
Fishes	--	1 (0.9%)	--	1 (1.2%)
Total	85 (100%)	106 (100%)	57 (100%)	82 (100%)

Fig 1. The absolute and relative proportions of species or species groups used for food from PS 36 and PS 25. Relative proportions are in parentheses after absolute numbers.

Species and their relative abundance

There are considerable differences, as regards absolute numbers and relative proportions of animal species used for food, between PS 36 and PS 25. Depending on whether teeth are included or excluded, cattle bones represent 70.6-77.2% and ovicaprid bones 17.5-23.5% of all species used for food at PS 36. These proportions are almost reversed at PS 25, where cattle bones represent 20.8-25.6% and ovicaprid bones 58.5-62.3% of all species (Fig. 1).

Within PS 25, there are some differences in relative abundance of cattle, ovicaprids and pigs, depending on whether bones are recovered from Trench A (presumably the Roman period) or from Trench B (presumably mixture of the Hellenistic and Roman finds). Although ovicaprid bones outnumber cattle and pig bones in both sub-samples, cattle were relatively better represented among bones recovered from Trench B (cattle N = 11; ovicaprid N = 17; pigs N = 2) than from Trench A (cattle N = 11; ovicaprid N = 49; pigs N = 8).

The considerable differences in relative abundance of cattle and ovicaprid bones between PS 36 and PS 25 are hardly results of sampling, because sample sizes of positively identified bones are adequate for both sites. Hence this shift in the cattle / ovicaprid proportion probably reflects a change in the local subsistence economy between the Early Iron Age and the Hellenistic / Roman period. Whether the observed difference within PS 25 is real or a result of random sampling is less clear due to smaller sample size.

There are also differences in species diversity between these two sites, PS 25 exhibiting more diversity than PS 36. PS 25 provided a considerably higher percentage of pig bones than PS 36 (6.1-9.4% vs. 1.8-2.4%). PS 36 did not provide any osteological evidence of the utilization of fish, but there is a vertebra of a rather large fish (vertebral length 12 mm) from Trench A of PS 25. Small quantities of shells were also recovered in both trenches of PS 25.[8] It should be kept in mind, however, that bird bones and fish bones are very likely to be underrepresented at both sites due to their lower rate of preservation in comparison to mammalian bones.

[8] So far the shells have only been preliminarily inspected by David S. Reese. Most common according to him (pers. comm. October 2007) are examples of *Cerastoderma glaucum* (cockle), different *murex* species (both *trunculus* and *brandaris*) as well as *Helix* sp. (land snail).

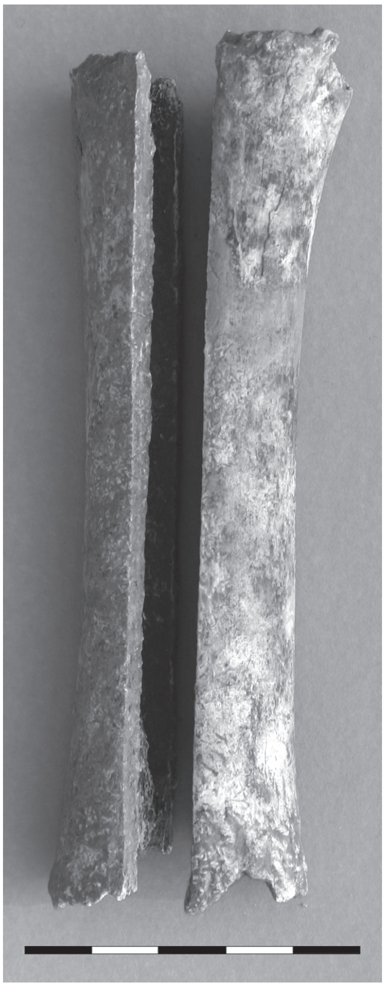

Fig. 2. A metacarpal of a cow split in half from PS 36.

PS 25 provided evidence of a domestic dog (*Canis familiaris*). There was one maxillary fragment that included a canine and an incisor of a rather small dog. This specimen was found in Trench B. The only animal that was present at PS 36 but not at PS 25 was horse (a metacarpal and a tooth).

At both sites, there is no evidence that bone assemblages are biased toward certain body parts. Instead, cranial fragments and teeth, as well as parts of all major regions of the postcranial anatomy, are present for both *Bos* and *Ovis / Capra*. This rather complete anatomical coverage indicates that animals were butchered close enough to where bones are found.

Completely fused and unfused epiphyses indicate that animal bones represent both mature and young animals. However, the nature of this bone material makes it very difficult to provide accurate estimations of average ages at which cattle and ovicaprids were killed.

Butchering marks

There are butchering marks on many bones. Many of the bone shafts are split, presumably for bone marrow extraction (Fig. 2). There are also cut marks at proximal and distal ends, probably resulting from cutting tendons during the process of meat extraction (Fig. 3).

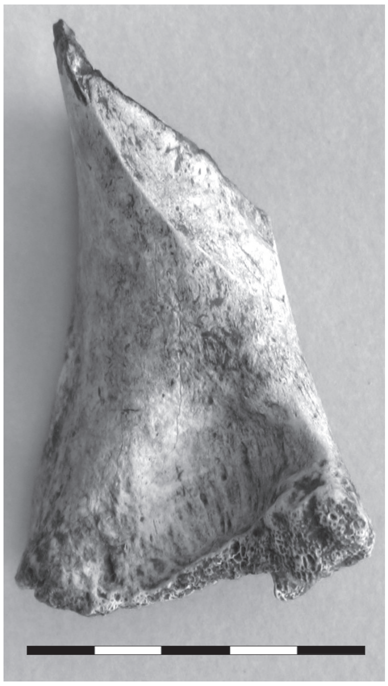

Fig. 3. A distal humerus of a small cow from PS 36. The shaft as well as the distal epiphysis has been cut during butchering.

At least in the case of cattle, animals were apparently almost invariably slaughtered when adult. This was the case also in Kastanas, Macedonia, during prehistoric and early historic times.[9]

Cattle

It is possible to estimate body size of animals from their skeletal dimensions. Genus *Bos* is characterized by a high level of sexual dimorphism. Bulls are generally much heavier than cows of the same population. There is little overlap between bulls and cows in breadth dimensions

[9] Becker 1986, 294.

	Bone	M-L breadth (mm)	Percentage difference (males)	Percentage difference (females)
PS 36	Distal metacarpal	56	-10.69	+1.54
	Proximal metacarpal	48	-21.18	+5.96
	Metacarpal (distal end measured)	53.5	-14.67	-2.90
	Metacarpal midshaft	25.5	-26.62	-11.92
	Metatarsal midshaft	28.5	-3.72	+8.57
P2 25	Metacarpal midshaft	31.5	-9.35	+8.81
	Distal metacarpal	63	+0.48	+14.23

Fig. 4. Breadth dimensions of cattle metapodia from PS 36 and PS 25. Percentage differences are computed with the following equation: [(observed dimension-mean) / mean)] x 100. Mean values are sex-specific mean values of feral cattle from Amsterdam Island. Negative values indicate that the dimension in question is below the mean, whereas positive values indicate that it is above the mean of the Amsterdam Island cattle.

of postcranial bones, but considerable overlap in bone lengths. Metapodial (metacarpal and metatarsal) breadths are the most useful skeletal dimensions for sexing purposes of all ungulates, due to their pronounced sexual dimorphism and high preservation rate in archaeological material.[10] I will next examine the skeletal size of the Kokytos valley cattle for sex determination and body size estimation purposes. I have used Amsterdam Island feral cattle as a reference population due to their general similarities in body size to prehistoric and Medieval European cattle.[11]

Articular and shaft breadth dimensions of four measurable metapodials from PS 36 are very similar to those of cows representing Amsterdam Island feral cattle, which in turn are a little smaller than the Neolithic period and Roman period cattle, but bigger than the Medieval period cattle. If these four specimens represent cows, the fifth specimen (a metatarsal midshaft) could represent a bull. One of the measurable metapodials from PS 25 represents intermediate size between bulls and cows from Amsterdam Island, but the other one is as big as the average metapodial of an Amsterdam Island bull (Fig. 4).

Due to the small sample size of measurable metapodia, it is impossible to say whether body size of cattle changed between the Early Iron Age and the Hellenistic / Roman period in the Kokytos valley. The safest assumption based on these measurable metapodials is that the Kokytos valley cattle were similar in size to the Amsterdam Island feral cattle. Feral bulls from this island average 130 cm tall at withers and weigh on average 390 kg, whereas cows average 117 cm tall at withers and weigh on average 290 kg.[12] This conclusion is supported by the observation that maximum lengths of two measurable astragali from PS 36 fall within the size range of Iron Age cattle.[13]

PS 36 provided one complete bone (a left metacarpal), the length of which (180 mm) can be used to estimate the withers height. Because slenderness of this metacarpal indicates a cow rather than a bull, I multiplied its length by 6.03, the ratio of metacarpal length to withers height provided by Matolcsi[14] for cows, and derived a withers height estimation of 108.54 cm. Based on its metacarpal length and reconstructed withers

[10] Davis 1987, 44-45.
[11] Berteaux and Guintard 1995.
[12] Berteaux and Micol 1992; Petit 1970.
[13] Davis 1987, Fig. 6.10.
[14] Matolcsi 1970.

height, this specimen was thus about the same size as the Bronze Age, Iron Age and Medieval period European cattle, although somewhat smaller than the Roman period cattle and considerably smaller than recent European cattle.[15] The closest temporal and geographic comparison can be made with cattle from Kastanas, in Macedonia. Matolcsi's ratio provides average withers heights of 116.3 cm, 110.0 cm and 111.1 cm for the Bronze Age (2400-1730 BC), the Late Bronze Age (1600-1250 BC) and the Iron Age (800-200 BC) cattle from Kastanas, respectively.[16] The application of this same ratio to the Hungarian Iron Age cattle provides the withers height range of 102 and 120 cm, whereas the maximum withers height of the Roman period cattle in Hungary was ca. 143 cm.[17]

Ovicaprids

It is impossible to provide accurate estimations of relative proportions of sheep (*Ovis aries*) and goat (*Capra hircus*) due to great difficulties in distinguishing between these two species from partly preserved bones.[18] Not a single positively identified sheep or goat bone was among ovicaprid bones recovered from PS 36. There were two bones positively identified as sheep (*Ovis aries*) bones and two positively identified as goat (*Capra hircus*) bones from PS 25. Both positively identified sheep bones are astragali. Positively identified goat bones include an astragalus and a glenoid fossa of scapula. Sheep generally outnumber goats in most regions where both species are present. In the case of Kastanas, Macedonia, sheep outnumbered goats four-to-one from the Early Bronze Age until ca. 200 BC.[19]

Pigs

Genus *Sus* was represented at both sites although with different frequencies. PS 25 has provided absolutely and relatively more pig bones than PS 36. Deciduous and permanent teeth indicate that both young and mature pigs, as well as wild and domestic pigs, are represented at PS 25.

PS 36 provided a very small third lower molar of a pig. Its length (17.5 mm) is very small even for a prehistoric domestic pig. In comparison, the lower third molar lengths of recent wild boars from the Balkans are 41 mm (31-45 mm) for males and 37 mm (25-42 mm) for females,[20] whereas those of domestic pigs from the eastern Mediterranean are 25-35 mm.[21] PS 25 provided a large third molar of a pig. Its large size (length 41.5 mm) indicates much more likely a wild boar than a domestic pig (maximum length 35 mm). The presence of domestic pigs at PS 25 is demonstrated by the very small size of boar tusks (at most 50 mm).

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[15] Davis 1987, Fig. 8.7.
[16] Becker 1986, Tab. 8.
[17] Bökönyi 1984, 28.
[18] Boessneck 1969.
[19] Becker 1986, 294-295.
[20] Herre 1986, Tab. 5.
[21] Davis 1987, Fig. 6.13a.

Horse

PS 36 provided two specimens of genus *Equus*: one left metacarpal and one tooth. The maximum length of the metacarpal is 214 mm (Fig. 5). This length indicates either a horse or a mule, because only a few domestic donkeys have metacarpals that are longer than 190 mm[22] and their mean is only 172 mm. This metacarpal is quite similar in length to metacarpals of Przevalsky's horse, "Celtic" pony and mule, whose mean metacarpal lengths are 220 mm, 213 mm and 214 mm, respectively.[23] The Roman period horses from Tác-Gorsium, Hungary, averaged somewhat bigger. Their mean metacarpal length is 227.9 mm, as computed from data provided by Bökönyi. Only four of a total of 62 metacarpals recovered from this Roman town had a metacarpal length less than 214 mm.[24]

It is impossible to be absolutely certain whether this metacarpal is from a horse or a mule, because it is quite difficult to separate horses and mules from each other based on the metacarpal size and proportions.[25] However, I consider this specimen much more likely a horse than a mule because early Greek horses were generally quite small[26] and thus unable to produce mules as large as modern mules when crossed with donkeys. Also, there is no osteological evidence of mules in southeastern Europe before about the eighth century BC.[27] Since this specimen even may predate the eighth century, we can safely conclude that it almost certainly is a horse.

I estimated the withers height of this horse from the metacarpal length (214 mm) by using the withers height-metacarpal length ratios of domestic ass, mule and different breeds of horses computed from data provided by Willoughby.[28] If proportioned like an Arabian horse, a Przevalsky's horse and a domestic ass, this horse would have had

Fig. 5. A left metacarpal of a horse from PS 36.

[22] Davis 1987, Fig. 1.12.
[23] Willoughby 1974, Tab. 31.
[24] Bökönyi 1984, Tab. 15(e).
[25] Bökönyi 1984, 64.
[26] Karageorghis 1967, 154-180.
[27] Bökönyi 1984, 64.
[28] Willoughby 1974, Tab. 31.

a withers height of 124-125 cm. If proportioned like a "Celtic" pony or a mule, its withers height would have been 131-132 cm. If we allow 5 cm for inter-individual differences around the mean values, this horse stood anywhere between 119 and 137 cm at withers. It would have been very similar in size to most late prehistoric and early historical period horses of the Circum-Mediterranean region, although smaller than the specially bred and well-fed Roman cavalry horses, which stood 138-154 cm at withers.[29]

Sex determination of horse from skeletal dimensions is far less inaccurate than that of cattle, due to the very low level of sexual dimorphism in all species of *Equus* and because the absolute and relative dimensions of bones vary considerably between different horse breeds. The sex of this specimen is thus unknown.

The single horse tooth was from the same location (PS 36, A4, Loc. 3, P. 6) as the above-discussed horse metacarpal. The small size of the tooth indicates a small horse as does the metacarpal size. However, it is not possible to say whether these horse remains are from the same animal.

Deer

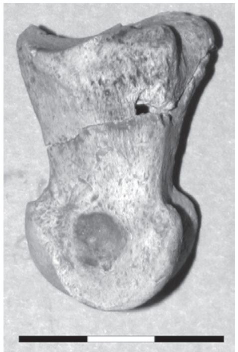

Fig. 6. A phalange of a red deer from PS 25.

PS 36 has not provided diagnostic bones of genus *Cervus* or other wild game animals. Trench A of PS 25 provided two specimens representing genus *Cervus*: antler fragments and a second phalanx (Fig. 6). The overall size of the antler fragments, as well as the size and morphology of the phalanx, indicate a mature red deer (*Cervus elaphus*) stag. For instance, the maximum diameter and circumference of base are 40 mm and 127 mm, respectively. The phalanx size (maximum length 44.5 mm; distal medio-lateral breadth 18.5 mm) indicates more likely a stag than a hind.

Red deer bones have also been recovered from other sites in northwestern Greece. For example, 81.3% of the wild game animal bones recovered at Kassope are from this species.[30]

The fallow deer (*Dama dama*) was the prevailing wild ungulate in Kastanas, Macedonia, during the Bronze Age and the Iron Age.[31] It is possible that one astragalus from PS 25 is from a very small fallow deer.

Birds

PS 36 provided one bird bone, whereas PS 25 provided five (Fig. 1). All of these bones were fragments of long bones. Species were identified, but the size of these fragments indicates that these bird bones are from duck- and chicken-sized birds. Since bird bones are more fragile than mammal bones, it is likely that bird bones are probably underrepresented in this bone assemblage.

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[29] Hyland 1990, 68.
[30] Boessneck 1986, Tabelle c.
[31] Becker 1986, 295.

Fish

There is one fish vertebra from PS 25. It size indicates the large trout size category. Fish probably had a more prominent role in the food economy than this single fish vertebra indicates. Fish bones are simply less likely to be preserved in the archaeological record than bones of larger mammals. For example, fish represent only 0.1% of the bone assemblage in Kastanas, Macedonia, although this Bronze and Iron Age site was close to a marine bay with quite large freshwater areas and lagoons.[32]

Discussion and conclusions

The shift in relative abundance of cattle and ovicaprid bones is considerable between these two sites, located relatively close to each other but differentiated in age by at least some 400 years.[33] Relative frequencies of cattle and ovicaprid bones were essentially reversed between the Early Iron Age and the Hellenistic / Roman period. This shift very likely indicates a considerable shift in subsistence practices and even in the economic system. Similar temporal shifts in relative proportions of different domestic mammal species have been recorded also from elsewhere in northern Greece. For example, in Macedonia near the modern village of Kastanas, cattle were the main supply of meat during the Early and Middle Bronze Age; sheep/goat and pigs were about equally important during the Late Bronze Age, but cattle regained their position as the most important meat-providing domestic mammal during the Iron Age.[34]

Why these shifts occurred in the Kokytos valley and elsewhere in northern Greece is unclear. At least in the Kokytos valley, there is no evidence of natural environmental (e.g. climatic) changes that would have demanded a shift in animal husbandry practices and species preferences. However, it is possible that the human population growth after the Early Iron Age has something to do with this shift.

Preliminary archaeological research indicates that the Early Iron Age in Thesprotia was a period of relatively few archaeological finds in comparison to later periods. It is thus possible that the "Dark Age" human population was rather small and that the local environment was not overburdened by herds of domestic animals. There may have thus been adequate grazing for cattle, explaining the relatively high frequency of cattle bones among the Early Iron Age animal bone finds. Also, this region receives quite a lot of rain, which in turn makes it more suitable for cattle than most regions of Greece. This situation may have changed with the increasing human population and increased grazing by domestic animals over the following centuries. Poorer quality of grazing lands due to centuries of overgrazing may have made the local environment less suitable for cattle, resulting in the observed shift to a broader spectrum of species utilization. This broad-spectrum utilization is indicated by a more than three-fold increase in the frequency of pig bones, as well as by the growing importance of sea food and game.

Large quantities of bones recovered from the city of Kassope, dated to ca. 360-30 BC, provide a similar example of this broad-spectrum utilization. Kassope, which is

[32] Becker 1986, 294.
[33] Assuming that most finds from PS 36 predate ca. 700 BC and most finds from PS 25 antedate ca. 300 BC.
[34] Becker 1986, 293-295.

located only ca. 30 km to the south of the sites in the Kokytos valley, provided bones of both domestic and wild mammal species, as well as several species of birds, fish and shellfish. Interestingly enough, there is also a change in the frequencies of different species represented over the four centuries, which reminds one a bit of the situation in the Kokytos valley. Thus, in Kassope the frequency of pig as well as of wild game, and especially red deer, rises throughout time whereas the frequency of cattle drops from the third until the first century BC.[35]

The observed change in subsistence economy may also have occurred independently of environmental changes, as a result of social and political changes. Political and social developments during Classical and Hellenistic times, and especially during the Roman Period, may have simply affected the subsistence economy through changes in the human settlement pattern.

Further recoveries of bones from PS 36 and PS 25 will probably increase sample sizes of bones representing different species. These larger sample sizes of archaeological bones will allow more accurate reconstructions of temporal changes in subsistence economy in Thesprotia.

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[35] Boessneck 1986, 136-140, esp. fig. 137.

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