

# Home, refuse, and reuse during the Early Helladic III to the Middle Helladic I transitional period

## A social zooarchaeological study of the Asine *bothroi*

### Abstract\*

The practice of digging, using, and filling large pits, cut into the ground and sometimes lined with clay, was extensive from the Early Helladic III to the Middle Helladic Period I (c. 2,200–1,900 BC) in large parts of the Aegean area. This particular type of feature is called *bothros* and has been reported since the early 20th century from many settlements, mainly from the Greek mainland. Although the *bothroi* are numerous in the archaeological record, few studies of them have been made. During the excavations at Asine, a prehistoric coastal settlement in the Argolid, a number of *bothroi* were identified. This paper is a contribution to the study of *bothroi*, and in particular of the faunal remains found within these features. I propose that the *bothros* was an important part of the domestic organization at Asine. Not only did it reflect spatial boundaries but it was also vital in the construction of “home”. This is based on the zooarchaeological analysis and subsequent statistical processing of the faunal remains recovered from the features. New radiocarbon dates are presented which are used in establishing a chronology of the *bothroi* at Asine.

*Keywords:* Asine, *bothroi*, Early Bronze Age, social zooarchaeology, correspondence analysis, waste management, home

### Introduction

Located a few kilometres to the west of Nauplion in the Argolid, Asine is a prehistoric settlement with long continuity. It was excavated by Swedish scholars in two large and several small campaigns during the 20th century.<sup>1</sup> It is foremost fa-

mous for its Middle Helladic (MH) and Late Helladic (LH) settlements and burials, but the excavation of the site during the 1920s also revealed remains of an Early Helladic (EH) settlement. During the earlier campaigns, several pits called *bothros* (pl. *bothroi*) were found, which since then have remained relatively neglected in the general literature. The *bothros* is defined as a large, often find-rich, pit. It is usually found cut in the bedrock or clay-lined.<sup>2</sup> The function of this type of pit has been much discussed since the findings of the first *bothroi* at the EH settlement of Orchomenos.<sup>3</sup> Disregarding the discussion of the function, for now, the fact that they were relatively common during a certain period of time would indicate that the maintaining of a *bothros* was an important part of social life at many places.<sup>4</sup> This of course presupposes a good established chronology of the *bothroi*.

In this article I attempt to illustrate the social importance of the *bothroi* at Asine by analysing the faunal remains found in them. The *bothroi* contain other categories of finds, especially ceramic artefacts, which need their own separate study and will not be considered here. A zooarchaeological perspective can give new knowledge and information on this feature type. By examining the animal bones I aim to study how the management and deposition of the animal remains can reflect social boundaries and behaviour or traditions regarding the closing of the features. To underline the importance of chronology in terms of restricted temporality of the *bothroi*, this

---

\* The animal bones from the Asine *bothroi* are part of the Asine collection at Museum Gustavianum, Uppsala University, and I am grateful to the Museum for the loan of the material as well as the permit to sample it for radiocarbon dating. This study has gratefully received financial aid for the radiocarbon dating from the Karin & Hjalmar Tornblads Fond, Kungliga Fysiografiska Sällskapet. For valuable comments and feedback on early drafts, I wish to thank Dimitra Mylona and Anne Ingvansson-Sundström, Michael Lindblom, and Gullög Nordquist. I am also very grateful for the information on typological dating and general assess-

---

ments of the pottery from M. Lindblom and G. Nordquist. Additionally, I wish to thank Michael MacKinnon and one anonymous reviewer who provided valuable comments on an earlier version of this article. Any faults or misconceptions are my own.

<sup>1</sup> E.g. Frödin & Persson 1938; Hägg & Hägg 1973; Nordquist 1987.

<sup>2</sup> Cf. Strasser T.F. 1999.

<sup>3</sup> Bulle 1907.

<sup>4</sup> Cf. Weiberg 2007.

paper includes an overview of the results of radiocarbon dates recently acquired from animal bones from these features.

The animal bone assemblages are investigated by traditional zooarchaeological methods as well as through statistical processing. As the title suggests, in the final discussion I use three thematic approaches in the discussion of the *bothroi*. First, I discuss them with regard to their place in the EH III household organization and the possible connection to the concept of home. Secondly, I illustrate the importance of the *bothroi* as refuse pits and the social management of this. Thirdly, the remembrance of *bothroi* after they were actively used is briefly touched upon.

### THEORETICAL PERSPECTIVES

Central to my attempt to connect the household with the *bothroi* from a zooarchaeological perspective is the concept of waste management. This notes the inevitability of waste production and consequences that may come from handling the waste. Any society must deal with this, and does so in its own specific ways.<sup>5</sup> When applied to zooarchaeological material, it gives importance to the animal remains as refuse and not only as mirroring the animal husbandry on the site. The concept of waste management implies active decisions and management tied to cultural norms and organization in regard to waste and waste production. It is used here as an alternate approach to the concept of structured deposition, which is a much-used and discussed term, describing the nature of material patterning often as symbolically meaningful.<sup>6</sup> Waste management is particularly useful regarding zooarchaeological material, which is produced by many means, such as consumption or production. The material properties of organic animal waste will change as it decomposes, and this influences the ways that people handle it. Change in smell is one such example. Since waste is connected to consumption activities as well as the living space, the waste management system can be connected to a level of practice, as for example in the physical acts of handling waste. As such it has been discussed as an important factor in everyday life on a domestic level.<sup>7</sup>

During the 1990s the concept of home and its applicability in archaeology was of interest.<sup>8</sup> It has not been widely used since then, probably because it is difficult to use as an absolute concept in archaeological settings. We cannot know what the idea of home comprised for members of prehistoric communities; one's concept of home is contained within a specific

time and place.<sup>9</sup> Home is created by the people within it only to dissolve when the household members no longer feel the sense of or need for solidarity that keeps the home together. According to M. Douglas, the home is a kind of space organized over time by responding to memory of events, such as hot summers.<sup>10</sup> Storage, she says, is a common feature of the home, and involves an intentional planning for the future. The home is contained within strict rules of behaviour, and to break them implies a threat to the community sharing the home.<sup>11</sup> Even if it is problematic to use the idea of home in archaeological contexts, it is important to be able to think about the home since it is a universally known and vital idea. In other words, even if we can never fully know what "home" comprised on an individual level in prehistory, we should be able to discuss general features of the home, or specific aspects of home.<sup>12</sup> Such features could be, for instance, common architectural elements of dwellings and traces of depositional practices, which are also important when studying household organization.<sup>13</sup>

### METHODS

The animal remains found within the *bothroi* have been zooarchaeologically examined to determine species and anatomical element. Too few fragments could be used for age or sex assessment, and so this aspect of study is not in focus here. Taphonomic markers such as weathering, gnawing, and thermal modification were noted.<sup>14</sup> The osteological examination was made with access to a large zoological reference collection at the Osteological Laboratory at Lund University. The assemblage is quantified by Number of Specimens (NSP) and Number of Identified Specimens (NISIP).

In this study I have chosen to analyse the data by means of correspondence analysis (CA). CA is a statistical analysis that aims to visualize the dependency between rows (objects, e.g. bones) and columns (variables, e.g. species, body parts) in a contingency table, i.e. a cross-table.<sup>15</sup> The CA produces coordinates of each observation in the table, based on chi-square

<sup>5</sup> E.g. Douglas 1966; Strasser S. 1999.

<sup>6</sup> E.g. Richards & Thomas 1984; Hill 1995; Garrow 2012; Rudebeck & Macheridis 2015.

<sup>7</sup> Martin & Russell 2000; Marciniak 2005; cf. Bourdieu 1977.

<sup>8</sup> E.g. Tringham 1995; Kent 1995.

<sup>9</sup> In other words, home is a concept which has an emotional and ideological connotation; it is private and intimate. The archaeological consideration of home should not be confused with the household. One can live in a household, yet never call it one's home. In this article it is used as a term for briefly discussing emotional attachments to the household and its organization.

<sup>10</sup> Douglas 1991.

<sup>11</sup> Douglas 1991, 304.

<sup>12</sup> Cf. Rapoport 1995, 46.

<sup>13</sup> Discussions of households can be found in e.g. Glowacki 2007; Routledge 2013; Weiberg 2007.

<sup>14</sup> Weathering: Behrensmeier 1978; fire and gnawing: Lyman 1994.

<sup>15</sup> For a practical introduction on correspondence analysis, see Greenacre 2007. For an illustrative archaeological application of the method, see Alberti 2013.

statistics. Each observation point (observation with coordinates) is then plotted on a map, or rather a developed scatterplot, similar to principal component analysis (PCA) and factor analysis (FA).<sup>16</sup> These co-ordinates form the basis of distances of the observations to the average profile, meaning the relative distribution of observations in each row on average. This average is placed where there is no variation from the average, i.e. where the assumption of homogeneity would be placed.<sup>17</sup>

This procedure is related to the concept of inertia, which measures the variation in the contingency table visualized by the CA. The inertia will be higher with higher association between rows (objects) and columns (variables), and it will be lower as more observations conform to the average.<sup>18</sup> This correspondence or association is visible on the map as proximity between the variables or the objects, and/or the average. A crucial aspect of CA is the so called reduction of dimensions. In large data sets, the number of columns can be high, but since it is hard for us to observe any points in more than three dimensions, we need to reduce the number of dimensions in which they are present.<sup>19</sup> CA tries to do this by “locking” the data where all points are represented. How successful this has been is measured by the percentage of inertia. If 90% of the inertia, which as mentioned above is a measure of variation, is visible in the display, i.e. on the map, it means that 10% of the variation is not displayed.<sup>20</sup>

The graphical display produced by CA facilitates interpretation of large data sets. The distances between different points can help the analyst interpret any correlation between them and specific variables. If we are interested in how certain artefact categories are combined in graves, and in which grave categories, as well as if this change with time and how, CA is an excellent tool for archaeological interpretation. CA has in this way been used in archaeology, in the study of activity areas,<sup>21</sup> in detecting traces of ritual behaviour and depositions,<sup>22</sup> and for seriation.<sup>23</sup> The software used to analyse the data is CAP-CA—an add-in to Microsoft Excel.<sup>24</sup>

## THE EH III *BOTHROS* IN AEGEAN ARCHAEOLOGICAL RESEARCH

*Bothroi* from EH III contexts are numerous, and they have been reported from many settlements in the Aegean, although predominantly from the Greek mainland. During the excavations at Lerna, on the western outskirts of the Argive Plain, c. 200 *bothroi* were uncovered.<sup>25</sup> At Orchomenos so many *bothroi* were identified that the excavator named the archaeological horizon in which they occurred after them.<sup>26</sup> Further away, instances of *bothroi* are found at, for example, Troy, and Thermi in Lesbos.<sup>27</sup> Other EH III *bothroi* have been recorded at prehistoric settlements at Korakou, Malthi, and Berbati.<sup>28</sup> Even if we focus just on the EH III period, it is worth mentioning that instances of earlier EH *bothroi* have been found at sites such as Tzoungiza and Aghios Kosmas, as well as Lerna and Orchomenos.<sup>29</sup> At the two latter settlements however, the EH III *bothroi* are much more numerous and frequent.

H. Bulle was the first to use the term *bothros* when describing this type of pit from a prehistoric setting.<sup>30</sup> The explanation he offered for the Orchomenos *bothroi* differs from most of the later reports of the 20th century. Bulle came to the conclusion that they seemed to have had ritual significance, in part because of the clay lining and the ash layers with burnt animal bones within them.<sup>31</sup> He suggested that the ash itself was of religious importance and through the conservation of this in the pits the power of the substance was kept.<sup>32</sup> Since Bulle’s ritual explanation of the Orchomenos *bothroi*, the general view on this feature type has shifted to a more functional one. Based on ethnographic analogies, it has been suggested that they were built as some sort of oven,<sup>33</sup> or containers of ash.<sup>34</sup> Some scholars saw them as refuse pits.<sup>35</sup> However the most popular explanation is that they were constructed for storage, more specifically silos or granaries.<sup>36</sup> According to T.F. Strasser, the storage idea is supported by their construction, i.e. that they were clearly cut in rock, or clay-lined, which would protect from dampness, and also by the amount of ash

<sup>16</sup> Ringrose 1992; Greenacre 2007; Alberti 2013.

<sup>17</sup> Greenacre 2007; Alberti 2013.

<sup>18</sup> Greenacre 2007, 29; Shennan 2006, 315.

<sup>19</sup> Greenacre 2007, 41–47.

<sup>20</sup> Cf. Greenacre 2007, 48. CA is thus suitable to visualize general characteristics of large data sets, rather than unique phenomena, which are often easily detected without statistical techniques.

<sup>21</sup> E.g. Alberti 2013; Blasco *et al.* 2013.

<sup>22</sup> E.g. Welinder *et al.* 2009.

<sup>23</sup> E.g. Bolviken *et al.* 1982; Shennan 2006, 342.

<sup>24</sup> This software was created by Madsen (2012).

<sup>25</sup> Caskey 1960; Banks 2013.

<sup>26</sup> Bulle 1907.

<sup>27</sup> Troy (Blegen *et al.* 1950) and Thermi in Lesbos (Lamb 1936).

<sup>28</sup> Korakou (Blegen 1921), Malthi (Valmin 1938), and Berbati (Säflund 1965).

<sup>29</sup> Tzoungiza (Pullen 2011, 93) and Aghios Kosmas (Mylonas 1934), as well as Lerna (Caskey 1960) and Orchomenos (Bulle 1907).

<sup>30</sup> Bulle 1907.

<sup>31</sup> Bulle 1907, 30–34.

<sup>32</sup> Bulle 1907, 34.

<sup>33</sup> Wace & Thompson 1912, 95.

<sup>34</sup> Valmin 1938; Marinatos 1968.

<sup>35</sup> Säflund 1965; Caskey 1960; More recently, J. Rutter acknowledges that *bothroi* might have had many functions, but that they ultimately ended up as pits for refuse disposal (Rutter 2008, 463).

<sup>36</sup> Blegen 1921; Mylonas 1934; Hutchinson 1935, 1936; Strasser T.F. 1999; Banks 2013; Nilsson 2014; cf. Marinatos 1968.

present, which Marinatos, using ethnographic analogies, suggested was used for the conservation of food.<sup>37</sup>

In a recent study of the numerous Lerna IV (EH III) *bothroi*, E. Banks identifies many different types of function. It seems that different types can be assigned to the three phases within Lerna IV.<sup>38</sup> The results of her work underline the diversity of this feature type in morphology and perhaps function. Banks suggest that many *bothroi* may have started out as cooking pits, but that storage is proposed for many of them throughout the Lerna IV phase.<sup>39</sup> M. Nilsson<sup>40</sup> argues that the management of storage was communal during the early part of the EH. Instances of *bothroi* are found in the EH I–II, but not in the same frequencies as in the EH III period. By then, the *bothros* truly becomes a common denominator for mainland settlements; the cultural management of storage has shifted to household-based,<sup>41</sup> or at least changed. Since this paper deals with the EH III *bothroi* from a zooarchaeological perspective, it will not delve much into their original function. However, I propose that *bothroi* were indeed household-based and reflect domesticity. In this aspect, Nilsson's interpretation lies close to my own perception of the *bothroi* during the EH III.

## The prehistoric *bothroi* of Asine

During the initial excavations at Asine several *bothroi* were excavated. Some of them were reported in the publication, but most are described in the excavations journals only.<sup>42</sup> A total of 17 *bothroi* are presented, located on Terraces I–III. They represent the documented set of *bothroi* excavated during the 1926 season. *Table 1* illustrates the general morphology and other characteristics of the Asine *bothroi*. The zooarchaeological analysis and the CA is, however, restricted to the 14<sup>43</sup> *both-*

*roi* containing bone dated to the EH III–MH I periods.<sup>44</sup> *Fig. 1* presents a plan of Terraces I–III at Asine with mentioned *bothroi* located. As illustrated, the largest number was found on Terrace III. No *bothroi* were found inside houses, as opposed to at Orchomenos.<sup>45</sup> The information about their location and general characteristics is gathered from the detailed descriptions made by the excavator of the area, E.J. Knudtzon.<sup>46</sup>

## CHRONOLOGY

The stratification and the small-scale taphonomy of each *bothros* are very important for investigating patterns in cultural deposition. For the Asine *bothroi*, this is problematic. In the publication few notes on the stratigraphy of the *bothroi* were made.<sup>47</sup> The excavators kept very detailed diaries, now archived at the Museum Gustavianum, Uppsala University. From notebooks as well as the find labels, it has proven possible to reconstruct, in relative terms, the stratigraphy of some *bothroi*. *Table 2*, which presents a general chronology of each *bothros* (Bs), includes the number of separated fills, if possible. The stratigraphy of these pits should not be considered fully reconstructed. But the information we do have, is that some *bothroi* contained many different layers (such as Bs-11), while some fewer (such as Bs-2). Perhaps this reflects different depositional histories, where some *bothroi* were open during a longer time. I will return to this later.

The problem of recorded stratification is also related to chronology. In order to supplement typological dates and to establish an absolute chronology, 19 animal bones were sampled for radiocarbon dating from 12 *bothroi*. These *bothroi* were selected because of their clear stratigraphy and well-preserved bone content. The sampling of them aimed to represent as many stratigraphic levels as possible, including both stratigraphically older and younger fills. Bs-1, -13, and -15 provided suitable bone samples from the older levels. Bs-15 was excavated in spits meaning that we do not know whether this pit contained different fill layers or not. The sampling of other *bothroi* with more than one layer<sup>48</sup> (*Table 1*) remains restricted to the middle and upper stratigraphic levels, due to various degrees of bone quantity and quality.

<sup>37</sup> Strasser T.F. 1999; Marinatos 1968.

<sup>38</sup> Examples of interpretations from Banks (2013, 413–416) are foundation *bothroi*, clearing *bothroi*, *bothroi* with special features (Lerna IV:1–2), *bothroi* marked with slabs or stones, clay-lined *bothroi* (Lerna VI:3), storage *bothroi* and *bothroi* with metallurgical activities (Lerna VI:3). See also Rutter's work on EH III drinking behaviour in the Aegean (Rutter 2008). He bases his arguments partly on the ceramic contents of two Lerna *bothroi*, Bothros B-Uu and Bothros B-O.

<sup>39</sup> Banks 2013, 416–417.

<sup>40</sup> Nilsson 2014.

<sup>41</sup> Nilsson 2014.

<sup>42</sup> Frödin & Persson 1938, see Nordquist & Hägg 1996, 14; Hutchinson 1935, 3.

<sup>43</sup> This count excludes Bs-21 since it is from an earlier period, see below discussion on stratigraphy and absolute dates. Bs-5 and -10 are also excluded, because they contained no animal bones. Bs-10 was not excavated, but why Bs-5 contained no bones could be interesting to investigate. This is not within the scope of the article, which focuses on *bothroi* with bone assemblages.

<sup>44</sup> The chronology used here follows Voutsaki *et al.* 2009. According to the authors, the EH III period ends at approximately 2,100 BC, while MH I lasted to approximately 1,900 BC.

<sup>45</sup> Bulle 1907.

<sup>46</sup> Knudtzon 1926. This field diary concerns the excavation of Terrace III at Asine during the 1926 season. It is catalogued as Diary 3.

<sup>47</sup> Frödin & Persson 1938.

<sup>48</sup> Of specific interest are Bs-11 which contained seven layers, as well as Bs-4 and Bs-2, of which both contained four layers each.

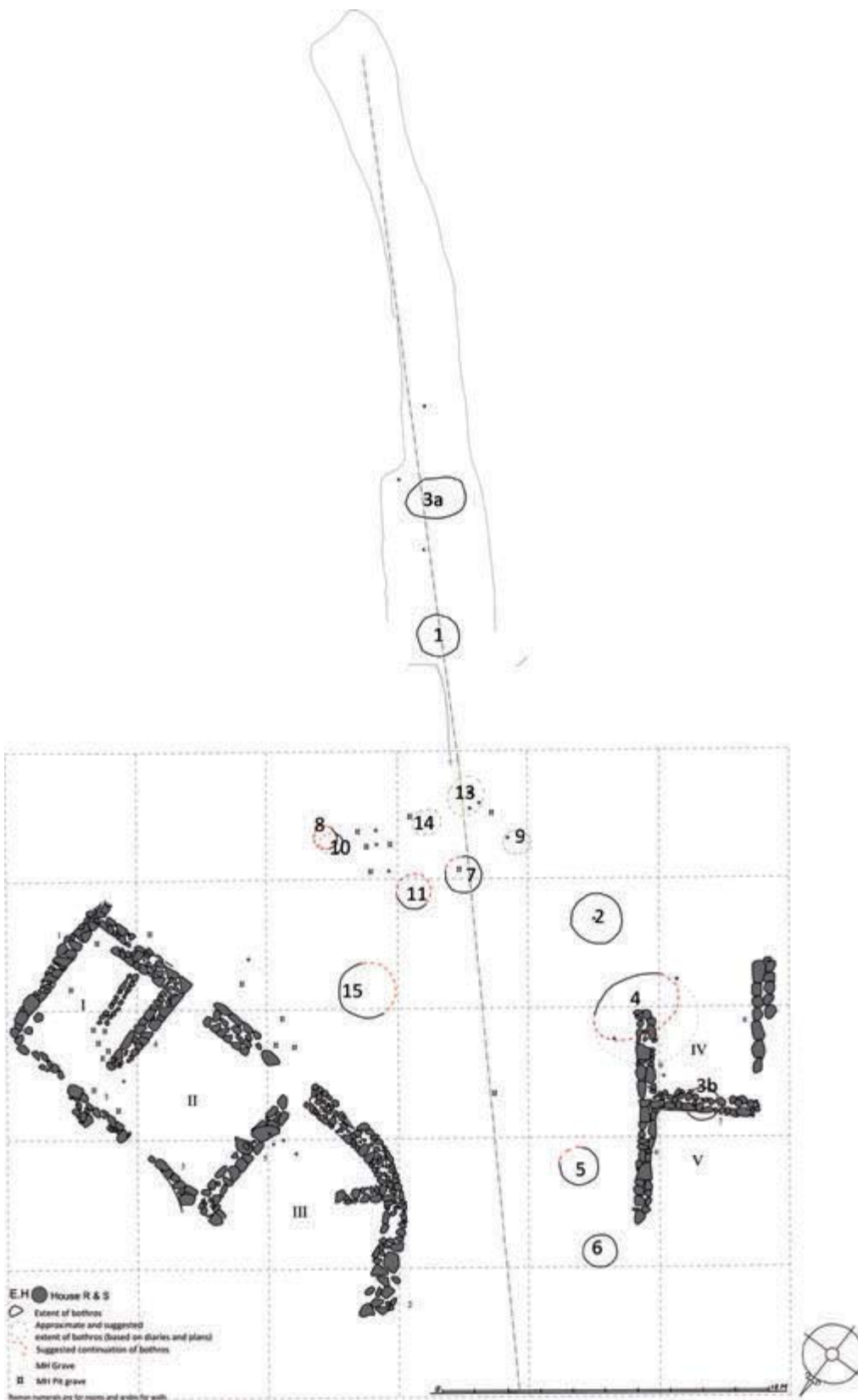


Fig. 1. Plan of mentioned bothroi and EH houses on Terraces I–III. Locations of bothroi are marked with the large-sized arabic numerals. The locations of bothroi -12 and -21 were not found when examining the documentation from the excavations. The drawing of Terrace III is from Frödin & Persson 1938, 92, fig. 68. The drawing of Terraces I–II is from Nordquist 1987, fig. 68. Both drawings of Terraces I–II and Terrace III are slightly modified.

Table 1. The morphology of the EH bothroi at Asine. EJK is the initials for Erik Jo Knudzon.

Bothros no.	Shape	Width (m)	Depth (m)	Cut in bedrock	Ashy layers	Clay-lining	Min. no. of infill layers	Other	Diary reference
Bs-1	Round	1.10	1–1.15	Yes	No <sup>4</sup>	No <sup>4</sup>	2		EJK 3:2, 21ff.
Bs-2	Round	1.40–1.50	1.15–1.50	–	No, but inclusions of charcoal	No <sup>4</sup>	4		EJK 3:1, 79, 81
Bs-3a	Slightly oval	c. 1–1.50	–	Yes	No <sup>4</sup>	No <sup>4</sup>	1	Cist grave (MH 98) abutting	EJK 3:2, 24
Bs-3b	Round	c. 1–1.50	–	Yes	No, but inclusions of charcoal	No <sup>4</sup>	–	Overbuilt by House S	EJK 3:1, 44f.
Bs-4	Round or lunate	c. 0.80–1.80 <sup>1</sup>	>1	No <sup>1</sup>	No <sup>4</sup>	No <sup>4</sup>	4	Overbuilt by House S; lunate stonepaving laid on top	EJK 3:1, 53–54
Bs-5	Round	c. 0.80–1.80 <sup>1</sup>	–	Yes	No <sup>4</sup>	No <sup>4</sup>	–	No bones	EJK 3:1, 45
Bs-6	Round	0.80–1 m	1.30–2	Yes	No <sup>4</sup>	No <sup>4</sup>	–	First 50 cm not recorded and mixed with surrounding soil	EJK 3:1, 52, 62
Bs-7	Round	c. 0.80–1.80 <sup>1</sup>	–	Yes	No, but inclusions of charcoal	No <sup>4</sup>	3	Infant grave (MH 70) dug into it	EJK 3:1, 81, 89–90
Bs-8	Round	c. 0.8–1.20 <sup>2</sup>	–	Partly	No <sup>4</sup>	No <sup>4</sup>	–	Partly dug into Bs-10	EJK 3:1, 95
Bs-9	Round	c. 0.80–1.20 <sup>2</sup>	–	No <sup>1</sup>			2		EJK 3:1, 95–96
Bs-10	Round	c. 0.80–1.20 <sup>2</sup>	–	Yes	No <sup>4</sup>	No <sup>4</sup>	–	No bones; not excavated	EJK 3:1, 96
Bs-11	Round	c. 0.80–1.80 <sup>1</sup>	–	Yes			7		EJK 3:1, 103–105
Bs-12	Round	c. 0.80–1.20 <sup>3</sup>	–	Yes	No <sup>4</sup>	No <sup>4</sup>	–		EJK 3:1, 105
Bs-13	Round	c. 0.80–1.80 <sup>1</sup>	–	Yes	No <sup>4</sup>	No <sup>4</sup>	6		EJK 3:1, 110
Bs-14	Round	c. 0.80–1.20 <sup>3</sup>	–	No <sup>1</sup>	No <sup>4</sup>	No <sup>4</sup>	–		EJK 3:1, 112–113
Bs-15	Round	1.40–1.45	0.90	Yes	No	No	– <sup>5</sup>	Until 3 April 1926 called “the well” by EJK	EJK 3:1, 37–38
Bs-21	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	–	Not found on map or in diary	

<sup>1</sup> No description was given in the field diary.<sup>2</sup> Size reconstructed from stratigraphic descriptions in the field diary specifying its location in regards to other features.<sup>3</sup> Described as a “small *bothros*” in the field diary.<sup>4</sup> No mention of ashy layers and/or clay-lining exists in the description in the field diary.<sup>5</sup> Bs-15 was excavated in five units (or spits). This means we cannot use them as separated contexts.

The radiocarbon dating was performed at the Laboratory of Radiocarbon Dating at the Geological Department of Lund University. Most of the samples are dated to the EH III/MH I transitional period (2,200–2,000 cal. BC), regardless of stratigraphic level. The typological dates based on the pottery from the *bothroi* also point to this general tendency; those *bothroi* which are relatively dated are normally assigned the periods EH III or EH III/MH I.<sup>49</sup> This is roughly con-

sistent with the most intensive *bothros*-digging at Lerna IV,<sup>50</sup> but also at Orchomenos<sup>51</sup> and Berbati.<sup>52</sup> In Table 2, we can see the calibrated <sup>14</sup>C dates. Additionally, Figure 2 shows the most probable date range for the features when combined, which

<sup>50</sup> Banks 2013.<sup>51</sup> Bulle 1907; Sarri 2010, 43.<sup>52</sup> Säflund 1965.<sup>49</sup> Lindblom and Nordquist, pers. comm., 2015.

is *c.* 2,135–2,028 BC.<sup>53</sup> The true date is possibly in the early years of this time span, i.e. 2,135–2,078 BC, indicated by the distribution of the higher percentages. Two samples deriving from *bothroi* Bs-4 and -21, which are discussed in the next section, deviate from this date range.

#### Stratigraphic relations in relation to <sup>14</sup>C-dates

Houses R and S were the only buildings that were erected in the EH III period among the excavated remains. Previously, the construction of House R had been suggested to belong to the EH II period.<sup>54</sup> House S overlies Bs-3b and -4.<sup>55</sup> The stratigraphic relations with those *bothroi*, as well as the pottery indicate an EH III date.<sup>56</sup> Bs-4 is dated both by pottery and radiocarbon analysis to EH II–III, and seems to have been used for a longer period than the others. This stratigraphic circumstance could indicate that House S was the younger of the two EH houses. If so, House R would perhaps have been contemporary with the construction and usage of at least Bs-3b and -4. Perhaps we have the remains of a sequence of at least two *bothros* phases. First the *bothroi* beneath House S were used when this area was an open space. When the need to build another house (House S) arose, they were closed and new ones were constructed between House R and S. This would explain the earlier dates in Bs-4. Either way, House T was built over many of the *bothroi* in the early MH, destroying parts of House S and perhaps R during its construction.

The cluster of *bothroi* south-east of the middle ground between Houses S and R consists of Bs-7, -8, -9, -11, -13, and -14 (Fig. 1). Within this little gathering of pits we can observe the largest collection of MH graves on Terrace III, except for Room I of House R. In Bs-7 a burial of an infant of six ± two months of age (MH 76) was buried, during the construction of House T.<sup>57</sup> Graves have also been dug in Bs-9 and -13. Bs-8, -10, -11 and -14 are in close proximity to graves. The placement of so many graves in and around this *bothros* cluster might not be random. I suspect these *bothroi* would have been noticed when digging the graves. This visibility might have been important when choosing the spot for the burial. This in its turn could help us establish a relative sequence for them.

Among the *bothroi* (Bs-3b, -4, -5, and -6) in the vicinity of House S, only Bs-4 was in the close proximity to a burial and none of them was directly cut by burials (Fig. 1). Since graves often were made close to or in closed *bothroi*, as discussed

above, this could be explained by the fact that these pits were already covered by House S and/or its surroundings. In that case, they should be considered to belong to the “first” *bothros* phase, and belonged to House R, while the rest would have been constructed later between House R and S. This observation and the relation between graves and *bothroi* at Asine will be further explored in the discussion.<sup>58</sup>

Bs-2 and -6 were not overbuilt by any constructions; however, their dates indicate the same time period as most of the other. Since they were not overlaid by any construction, then the fact that the radiocarbon dates are so consistent with those also overlaid by walls shows that the stratigraphy is not very mixed, and indeed that we can recognize closed units excavated during the 1920s. In that case, it is very probable that a distinct break, after which the *bothroi* were no longer used, filled up and closed, occurred. That time would have been the end of EH III, or early MH I.<sup>59</sup>

The two earliest dates come from Bs-4 and -21. As mentioned above, Bs-4 seems to have ceased to be in use approximately the same time as the majority of *bothroi*, but was made much earlier. The sample from Bs-21 came from its uppermost layer. This suggests it was used and sealed in an earlier period than the other and should perhaps be dated late EH I to EH II. Because of its much earlier date, Bs-21 is excluded from the following analysis, which concentrates on the *bothroi* closed in the transitional period (EH III/MH I). Further studies on the early *bothroi* are needed to fully understand the evolution of the feature.

## Distribution of animal bones: analysis and results

The reconstructed stratigraphy has shown that there seem to be several fill layers in some *bothroi*, while some were filled up more quickly. Regardless, the filling of these pits is dated to somewhere between 2,135–2,028 BC, most likely 2,135–2,078 BC (Table 2, Fig. 2). This is based on dates from both older and younger layers in the *bothroi*. The animal bones found in these layers should represent waste materials from this period. In this section I present an overview of the animal bones from the *bothroi* of Asine.<sup>60</sup> This is followed by an

<sup>53</sup> Calculated with the “combine date” function in Oxcal v. 4.2, web interface. All acquired dates have been calibrated with Oxcal v. 4.2 (Bronk Ramsey 2001; 2009), using IntCal13 atmospheric curve (Reimer *et al.* 2013).

<sup>54</sup> Caskey 1960, 301; cf. Pullen 1987.

<sup>55</sup> Frödin & Persson 1938; Nordquist 1987, 71.

<sup>56</sup> Nordquist 1987, 72.

<sup>57</sup> Nordquist 1987; Ingvarsson-Sundström 2008, 60.

<sup>58</sup> The connection between graves and closed *bothroi* at Asine does not mean that all *bothroi* in Greece during this period became places for burials. This is a contextual observation, and is maybe relevant for Asine.

<sup>59</sup> This break is also noticed at Lerna (Banks 2013), Berbati (Säflund 1965), and other sites (see Hutchinson 1935; Strasser T.F. 1999).

<sup>60</sup> It should be mentioned that the animal bones were at least not discarded, as was often the case during the early years of archaeological excavation projects (e.g. MacKinnon 2007, 475). They are now stored at the facilities of Museum Gustavianum, Uppsala University.

Table 2. Chronology of the EH bothroi at Asine. Calibration of  $^{14}\text{C}$  dates derived from Oxcal v 4.2 (Bronk Ramsey 2001; 2009). The LuS nos are the numbers assigned by the Radiocarbon Dating Laboratory, Lund University.

Bothros no.	Asine no.	LuS no.	Uncal. $^{14}\text{C}$ -date BP	68.2% probability (cal. BCE)	95.4% probability (cal. BCE)	Typological date	Proposed date
Bs-1	2262	10927	3725 ± 40	2198–2040	2279–1982	EH III	EH III–MH I
Bs-1	5168	10934	3655 ± 45	2129–1956	2192–1911		EH III–MH I
Bs-2	4659	10935	3715 ± 40	2195–2036	2275–1978	EH III–MH I	EH III–MH I
Bs-2	4523	10936	3655 ± 45	2129–1956	2192–1911		EH III–MH I
Bs-3b	2402	11548	3725±35	2197–2042	2275–2024	EH/MH I	EH III–MH I
Bs-4	5201	10938	3935 ± 45	2488–2346	2569–2292	EH II–III	EH II–III
Bs-4	2307	10939	3690 ± 40	2136–2025	2199–1960		EH III–MH I
Bs-7	5196	10930	3625 ± 35	2031–1940	2129–1892	EH/MH	EH III–MH I
Bs-8	4851	10940	3700 ± 45	2191–2030	2266–1951	EH III–MH I	EH III–MH I
Bs-9	4655	10941	3680 ± 40	2136–1984	2196–1950	EH III–MH I	EH III–MH I
Bs-11	5127	10928	3670 ± 40	2134–1979	2195–1939	EH III–MH I	EH III–MH I
Bs-11	5115	10929	3655 ± 40	2127–1961	2141–1918		EH III–MH I
Bs-13	2294	10931	3700 ± 40	2141–2031	2203–1972	EH III–MH I	EH III–MH I
Bs-13	5171	10932	3595 ± 45	2019–1894	2129–1777		EH III–MH I
Bs-14	5242	10933	3660 ± 40	2131–1965	2190–1926	EH III–MH I	EH III–MH I
Bs-15	4615	11528	3730 ± 35	2198–2044	2276–2028		EH III–MH I
Bs-15	4512	11529	3700 ± 35	2137–2036	2201–1978		EH III–MH I
Bs-15	2856	11530	3710 ± 35	2190–2036	2204–1981		EH III–MH I
Bs-21	2237	10942	4135 ± 45	2864–2628	2875–2581	EH I (II)	

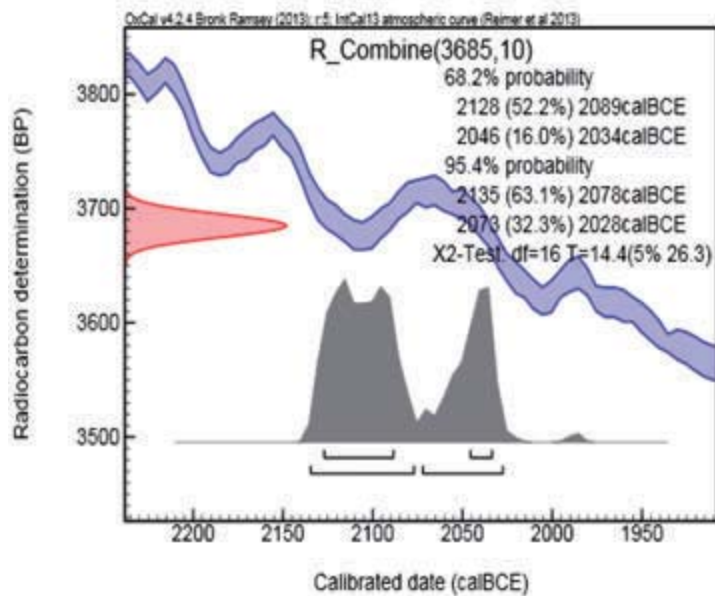


Fig. 2. Combined date range for radiocarbon dates from the bothroi of Asine. This figure includes all derived dates except the early date from Bs-4, As 5201 (Table 2). It was made using Oxcal v 4.2 (Bronk Ramsey 2001; 2009).



investigation of possible material patterning by means of correspondence analysis. The CA is done twice, for the species distribution and for the distribution of body parts.

The 14 *bothroi* zooarchaeologically investigated contained 861 animal bone fragments (8,703 g), of which 339 were identified to genus. As mentioned above only data on species and body parts and the distribution of these are presented, since too few fragments were suitable for age or sex assessment. A quantitative distribution can be seen in Fig. 3. As is visible, most fragments derive from Bs-4, -11, -13, -14, and -15, while the *bothroi* with the fewest bone fragments were Bs-3a, -6, -8, and -12. Cattle, sheep/goat, pig, red deer, horse, dog, and tortoise are identified.

Many *bothroi* are dominated by cranial fragments, but this is not always the case. For example, Bs-3b, -7, -8, -9, and -12 contained more post-cranial than cranial fragments.<sup>61</sup> This can be important information because cranial fragments, especially loose teeth, are known to be more prone to survive harsher conditions. That bone fragments deriving from all body regions are identified indicates, rather, that there is relatively good preservation of the bones. The occurrence of spongy bones in the different *bothroi* is also a sign of good preservation, as well as the well-preserved juvenile human remains from graves elsewhere on the site.<sup>62</sup> The lack of fragile bones in some features could be a consequence of taphonomic loss. Because there are little to no different geological circumstances between the features, this speaks against it being a pure post-depositional bias. Although the bones are in good condition, the assemblage probably suffers from size bias caused by the excavation methodology.<sup>63</sup> The animal bones were recovered during 1926, as part of the Swedish Asine project. The finds were hand-picked and not sieved, meaning that smaller fragments such as from fish, might have been a part of the depositional assemblage but were not recovered during excavation.<sup>64</sup>

In Table 3, different taphonomic frequencies are presented. As one can see, the most common taphonomic marker amongst the bones is weathering. It seems that this process did affect some bones (51 fragments), but this is still a minor part (c. 8 %) of the total NSP. In addition to this, root etching appeared on 19 fragments. This could indicate that the assemblages in the *bothroi* were exposed for some time before deposition. However, this cannot be ascertained since root

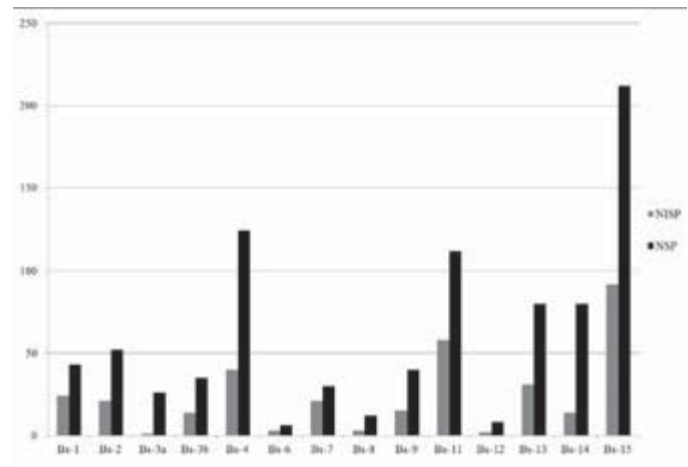


Fig. 3. Quantitative distribution of animal bone fragments in bothroi of Asine, including total NISP and NSP counts.

marks have been found also on human remains from graves, and roots might have reached deep under the ground. Furthermore, it has been said that the *bothroi* of Asine contained calcined bones.<sup>65</sup> I have found no such indications: of all the bones recorded, only eight fragments were burned, and they were not calcined. Probably, these few fragments represent food preparation or something similar.

A closer look at Table 3 reveals that weathering is not recorded from all features. Only in about half of the *bothroi* are there bones which evidence this process. Together with the fact that gnawing appeared on fragments from almost all *bothroi*, perhaps it indicates that there were different strategies in the filling of the *bothroi*. The *bothroi* with the most fragments with weathering are Bs-14, from which no stratigraphy could be reconstructed, and Bs-4. If Bs-4 was in use the longest, which is supported by the <sup>14</sup>C dates, it would be logical that it had been exposed for a longer time. Even if the lack of gnawing, weathering and other taphonomic markers does not automatically correspond to a quick depositional history, it does not contradict it. That the animal bone fragments are relatively well-preserved do point to a more likely scenario of closed refuse accumulation or quick filling events. Judging from the reconstructed stratification of the *bothroi* (see Table 2), and the taphonomy of the bone fragments, it does seem that some of the assemblages bear signs of longer accumulation periods, that is, time exposed, while others were relatively quickly deposited, perhaps during a year, some months or even less. It can thus also be argued that different modes of

<sup>61</sup> Animal bone fragments assigned to body regions, and their distribution within the *bothroi*, are included in Table 5 below, which is the data set for the correspondence analysis of body regions.

<sup>62</sup> See Ingvarsson-Sundström 2008.

<sup>63</sup> See Bannert 1973.

<sup>64</sup> See Mylona 2003 on archaeological fish remains in the Greek region.

<sup>65</sup> Hutchinson 1935, 3.

Table 3. Distribution of taphonomic markers in the animal bone assemblages from the bothroi of Asine.

Bothros no.	Cut marks	Gnawing	Fire	Weathering	Root etching	Post-depositional markers	Excavational/post-excavational markers
Bs-1	1	1	0	0	0	0	8
Bs-2	2	2	0	6	2	2	12
Bs-3a	0	0	0	0	0	0	22
Bs-3b	2	0	3	5	1	0	10
Bs-4	5	3	3	14	6	1	37
Bs-6	0	2	0	0	0	1	1
Bs-7	0	0	0	0	0	0	19
Bs-8	0	2	0	0	0	0	3
Bs-9	0	2	2	1	1	1	16
Bs-11	6	3	0	6	1	1	37
Bs-12	0	2	0	0	1	0	5
Bs-13	1	1	0	7	3	3	33
Bs-14	2	0	0	12	3	0	30
Bs-15	8	9	1	0	1	1	200
<b>Total</b>	<b>27</b>	<b>27</b>	<b>9</b>	<b>51</b>	<b>19</b>	<b>10</b>	<b>433</b>

handling the faunal remains, eventually deposited in *bothroi*, existed. The pottery sherds from the *bothroi* seem to be fragmentary in general, but not extremely worn. They appear to derive mainly from pots related to storage and cooking. For now, it appears that the handling of the material deposited in *bothroi* was different from case to case: some material was accumulated and exposed over a longer period while some was deposited relatively quickly. To confirm or contradict this general picture, more detailed studies of the pottery are needed.<sup>66</sup>

### CORRESPONDENCE ANALYSES

I have chosen to use correspondence analysis to visualize the distribution of animal bone fragments in the *bothroi*. The reason to use CA is that it is a way to get a more detailed overview of larger data set, such as this one, than general species lists and distributions of body parts. It is also a more effective way than producing graphs of frequencies of species and body parts for each *bothros*, and then to try to manually compare them. The assumption that underlies this exercise is that patterns of the discarded body parts within the *bothroi* reflect patterns in refuse disposal or management of these in the features. The CA is done once on species distribution and once on body part distribution. All data used in the analyses are presented in *Ta-*

*bles 4–5*. The statistical analyses are restricted to cattle, sheep/goat, pig, and red deer. These are chosen because they are the dominant taxa of the assemblages from the *bothroi*. It is true that the NISP for red deer is low ( $n=28$ ), but the numerous antler fragments/raw material refuse found elsewhere in the settlement make it interesting to include this animal.<sup>67</sup>

First, we test the species distribution in the *bothroi* to see if it is random or not. The variables are cattle, sheep/goat, pig, and red deer. Also, in the data set in *Table 4* we can already now see that red deer did not occur in each *bothros*, and might have been differently deposited. We want to know if there are specific associations between these four taxa, and if there is any clustering of *bothroi* in relation to the species distribution.

Second, we want to test the body part distribution among the *bothroi*. There seem to be an overrepresentation of cranial fragments, such as teeth, in some *bothroi*. But also more fragile bone fragments occur, which might indicate a diverse picture of the *bothroi* contents in terms of body parts. The aim of the second CA is to examine the body parts, in order to investigate if there are any useful patterns which can be used for the discussion of waste management of different body parts, butchery strategies, or activity areas in connection to the

<sup>66</sup> Preliminary information on the general characteristics of the pottery from the *bothroi* is provided by Lindblom and Nordquist, pers. comm.

<sup>67</sup> Frödin & Persson 1938, 253–254; Nordquist 1987, 31, 40; cf. Moberg Nilsson 1996, 115. Most of these instances are later, dated to the MH. Still, it is interesting to test whether a different use of remains of red deer can be traced further back or not.

Table 4. Data set for the correspondence analysis of species composition within the bothroi, *Asine*.

Bothros no.	<i>Bos</i>	<i>Ovis/Capra</i>	<i>Sus</i>	<i>Cervus</i>
Bs-1	7	11	5	0
Bs-2	1	11	7	0
Bs-3a	1	0	0	0
Bs-3b	2	5	2	4
Bs-4	15	9	11	4
Bs-6	0	1	1	1
Bs-7	2	1	7	1
Bs-8	0	1	1	1
Bs-9	3	3	9	0
Bs-11	21	12	22	2
Bs-12	0	1	0	1
Bs-13	2	8	20	2
Bs-14	4	4	6	0
Bs-15	23	23	32	12

Table 5. Data set for the correspondence analysis of body parts' distribution within the bothroi, *Asine*.

Bothros no.	Head	Axial	Upper extremities	Lower extremities
Bs-1	13	0	6	4
Bs-2	6	1	10	2
Bs-3a	1	0	0	0
Bs-3b	5	0	5	3
Bs-4	11	5	17	6
Bs-6	0	1	1	1
Bs-7	3	1	6	1
Bs-8	1	0	2	0
Bs-9	5	1	8	1
Bs-11	24	7	19	7
Bs-12	0	0	1	1
Bs-13	16	2	8	6
Bs-14	7	1	4	2
Bs-15	44	5	28	13

houses. The assumption here is that different parts of the body from the most abundantly represented animals provide the best alternative to study patterning concerning refuse disposal or management of these in the *bothroi*.

I have chosen not to separate the taxa in the second CA since this would lead to very low NISP counts resulting in insignificant statistics. The variables used are *Head* (*calvarium*, *cornu*, *mandibula*), *Axial* (*vertebrae*, *costae*), *Upper* (*scapula*,

*humerus*, *radius*, *ulna*, *ossa coxae*, *femur*, *tibia*, *fibula*), and *Lower* (*ossa carpi/tarsi*, *metapodia*, *phalanges*). This division of the body is a simplified categorization of the bulk of the animal body. It could be translated to meat-bearing regions (axial and upper extremities) and non-meat-bearing parts (head and lower extremities). This division is not entirely correct as the head is full of nutrients, although it takes longer to butcher.<sup>68</sup> In many societies, the head, or parts of it, is considered to be a delicacy. I will not further relate these simple categories to cultural preferences as it is not my intent to equate them with a prehistoric concept of the animal body.

### Species composition

The results of the analysis can be seen in *Fig. 4a–c*, which illustrates the graphs produced by the CA. All inertia, basically meaning variability,<sup>69</sup> is contained within the first three dimensions. The percentage of inertia in the first axis, or dimension, is 42%, the second 33.4%, and the third 24.8%.<sup>70</sup> This means that 75% of the variation is captured in *Fig. 4a* (first–second axes), 66.8% in *Fig. 4b*, etc.

As suspected, the most dominant pattern involves red deer and is visible in *Fig. 4a*. Here, the variable red deer is distanced from the other domesticates. Red deer explains the first axis with *c.* 83%, meaning it is the most important variable in shaping the distances and/or proximities of the *bothroi* (rows) and variables (columns). Bs-3b, -6, -8, and -12 are forming a group around the red deer variable. This pattern is also clear in *Fig. 4b*, where the first and the third axes are combined. The second pattern lies with the three domesticates where cattle remains seem to have been deposited differently from the sheep/goat and pig. Cattle contribute with *c.* 71% to the second axis; sheep/goat with 55% and pig 23%. Cattle is thus the biggest factor in shaping the plotting of the observation points. This is visible in *Fig. 4a* along the second dimensions and in *Fig. 4c*. The sheep/goat variable is slightly closer to the middle, or the centroid, in *Fig. 4a*, indicating that it is of less significance in explaining any variability.<sup>71</sup> The same can be said for cattle in *Fig. 4b* (third axis). Returning to the data set, we can see that cattle seem not to be as abundantly represented as sheep/goat and pig in general. Also, when pig remains appeared in larger counts, the number of cattle fragments became proportionally smaller, while sheep/goat remains approximately the same. This relationship is visible along the second axis in *Fig. 4a*.

In *Fig. 4b*, we can observe that pig and cattle seem to be associated. This is probably because of the even number of cattle and pig in Bs-4 and -11. Two *bothroi* cluster around the sheep/

<sup>68</sup> E.g. Stiner 1991, 471.

<sup>69</sup> Shennan 2006, 315.

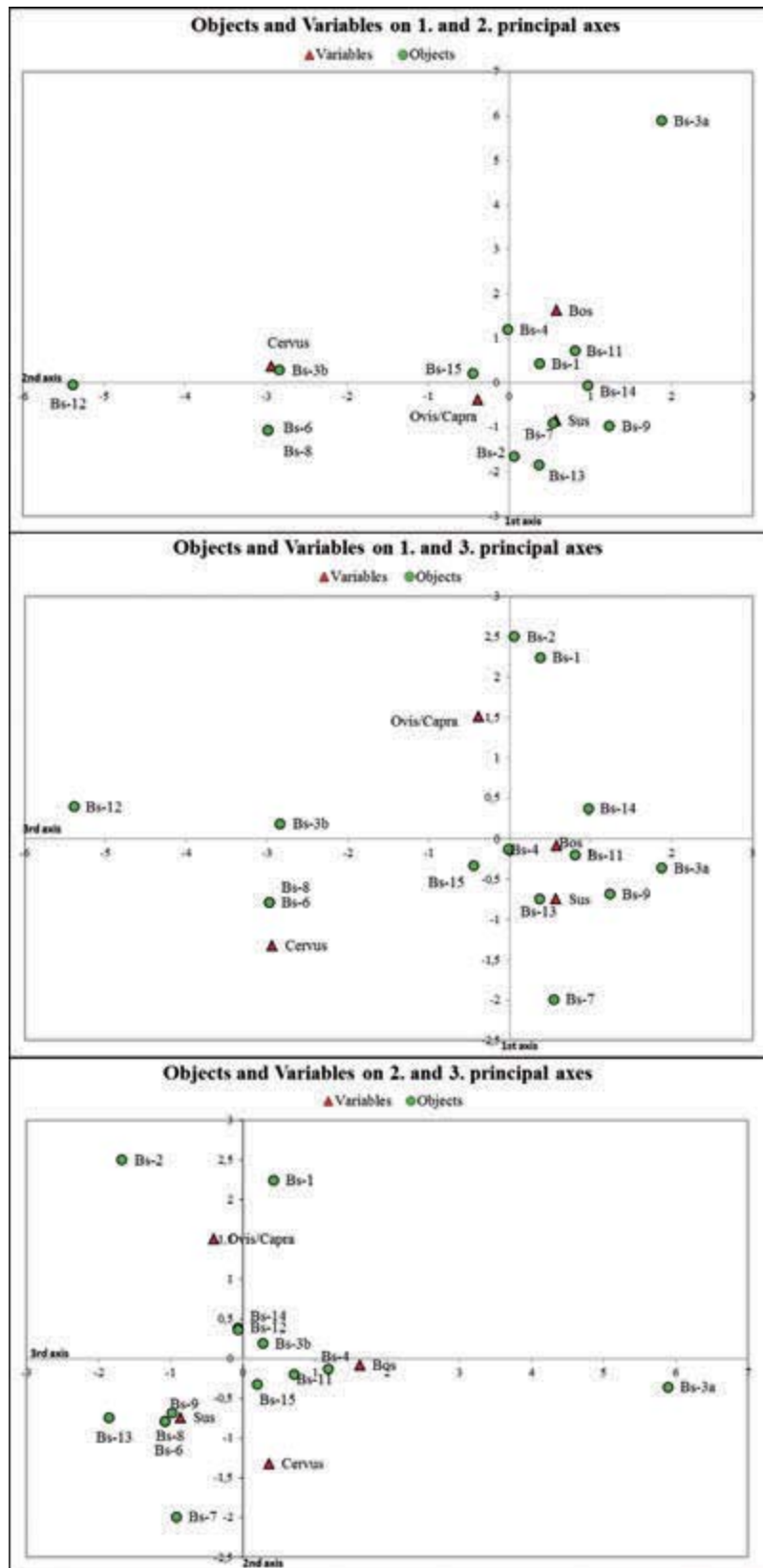
<sup>70</sup> Cf. Greenacre 2007; Shennan 2006.

<sup>71</sup> Greenacre 2007, 22.

goat variable (Bs-1 and -2). This is because ovicaprine remains are more abundant in those pits than both cattle and pig, and red deer is not represented at all. Three *bothroi*, Bs-7, -9, and -13, remain close to the pig-variable in all dimensions. This could indicate that pig was specifically deposited in these pits. This is partially confirmed by returning to the data set in *Table 4*, where we can see that pig is indeed most numerous of all taxa in these *bothroi*.

Bs-15 is always close to the average. This can probably be explained by it actually being unique and ordinary at the same time. It is unique because of its rich bone content of all animal species. However, its relative proportions seem to be quite common in relation to the rest of the data set, that is, the contents of this particular *bothros* do not deviate from the calculated average profile of all objects (rows). This average has a low proportion of red deer and more even cattle and sheep/goat abundances, and a slightly higher content of pig.

All in all, according to the CA of species distribution, the typical pattern in a *bothros* at Asine is that all domestic animals are represented relatively evenly, with a low proportion of red deer. Depending on their abundance, the *bothros* will deviate from this pattern. This is visualized by closeness and distances of these variables in *Fig. 4a-c*. Red deer, which we already knew was much less abundant, did not cluster with the domesticated taxa. This probably indicates that red deer was not as commonly consumed, and it was not deposited in all *bothroi*. When it was deposited, it mainly ended up in Bs-3b, -6, -8, and -12. In general, cattle do not associate with sheep/goat and pig. This does not mean that they are not found together, but that there is a tendency of frequencies of cattle being lower when pig and sheep/goat occur in higher numbers. This could mean that some *bothroi* were more frequently used for the deposition of medium-sized domesticates.



*Fig. 4a-c (from top to bottom). Results of correspondence analysis of species composition (cattle, sheep/goat, pig, and red deer) within the bothroi, Asine. 4a) observations along the first and second principal axes; 4b) observations along the first and third principal axes; 4c) observations along the second and third principal axes.*

### Body part distribution

In *Fig. 5a–c* we see the graphical results of the second CA, which investigated the body parts distribution between the *bothroi*. The first dimension contains *c.* 56% of the total percentage of inertia, the second 26% and the third 18%. The highest variation is thus explained in *Fig. 5a* (82%) and *Fig. 5b* (74%).

The first and third axes (*Fig. 5a–b*) both show a similar pattern where fragments from the head together with those from *Lower* are opposing those from *Axial* and *Upper*. In *Fig. 5a–b* we can observe two groups of *bothroi* returning. One group is associated with *Axial* and *Upper* (Bs-2, -4, -7, -8, -9, and -12) and one with *Lower* and *Head* (Bs-1, -3b, -13, -14, and -15). This pattern indicates dissociation between body parts with easy access to meat (*Axial* and *Upper*) and body parts with less meat or special in other ways (*Lower* and *Head*). It can be a sign of differentiated handling of the remains from butchery workshops or consumption areas. Bs-11 is close to the average in *Fig. 5a–b*, probably reflecting that its distribution of body parts is homogenous.

A second pattern lies along the second axis, visible in *Fig. 5c*. Here we see *Head*, but also *Upper*, close to the average, the centroid. Many *bothroi* are placed around the centroid. This is because they contained *Head* and *Upper*. Bs-3a is much distanced, because it only contained one cranial fragment. Similarly we have Bs-8, which contained both *Head* and *Upper* but not the other, and Bs-6 (*Axial*) and Bs-12 (*Lower*) where the opposite situation is occurring. Returning to the data set in *Table 5*, we can see that the “normal” distribution consists of well-represented *Head* and *Upper* parts,

*Fig. 5a–c* (from top to bottom). Results of correspondence analysis of body parts' distributions of cattle, sheep/goat, pig, and red deer within the *bothroi*, *Asine*. *5a*) observations along the first and second principal axes; *5b*) observations along the first and third principal axes; *5c*) observations along the second and third principal axes.

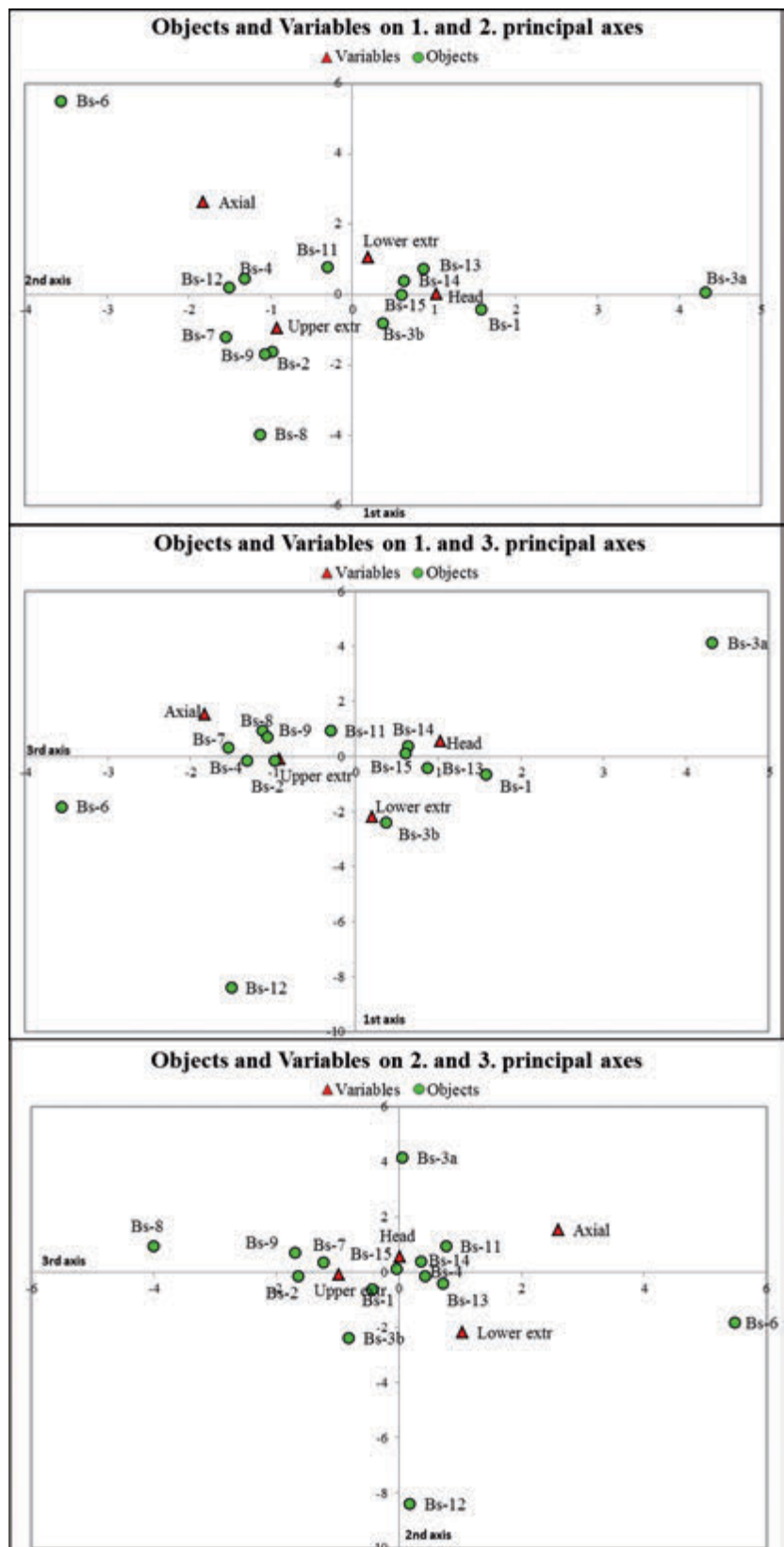


Table 6. Categorization of the *bothroi* of *Asine* according to the interpretation of the correspondence analysis.

Group	Bothros no.	General characteristics	Explanation	Interpretation
A	3b, 6, 8, 12	Association with red deer	Red deer and medium-sized are present, but not cattle.	<i>Bothroi</i> for the deposition of butchery and consumption waste from red deer, not cattle (sheep/goat and pig still present).
B	4, 11, 3a	Association with cattle and pig	Cattle and pig predominant. Presence of cattle in this proportion quite ordinary, therefore Bs-11 close to <i>origo</i> . Bs-3a is almost an outlier because it only contained one cattle fragment.	<i>Bothroi</i> for the deposition of cattle and pig.
C	7, 9, 13, 14, 2	Association with sheep/goat and pig	Sheep/goat and/or pig predominant. Proportionally low inclusions of large herbivores. Bs-7, -9, -13 dominated by pig.	<i>Bothroi</i> for the deposition of mainly medium-sized animals.
D	1, 13, 14, 15, 3a, 3b,	Association with head and lower extremities	Relatively unusual large proportions of head and lower extremities.	<i>Bothroi</i> for the deposition of mainly butchery waste.
E	2, 4, 7, 9, 8, 6, 12	Association with axial and upper extremities	Relatively unusual large proportion of axial and/or upper extremities.	<i>Bothroi</i> for the deposition of mainly consumption waste.

while the other two variables are more unusual. This reflects a taphonomic issue because cranial fragments such as teeth and compact fragments from long bones are more resistant to decomposition and density-mediated attrition, i.e. more prone to be overrepresented in zooarchaeological assemblages.<sup>72</sup> This pattern is thus probably taphonomically biased, showing the features as deviating simply because they contained either only better-preserved body parts or unusually high degree of normally not as abundant body parts which are more prone to destruction after deposition.

### Short summary

The two correspondence analyses revealed some interesting patterns. First, we have detected that red deer disassociates with the domesticated animals, and is specifically associated with Bs-3b, -6, -8, and -12. This does not mean that the domesticated animals did not occur in these *bothroi*. Further, red deer is also found, although sporadically, in other features. Cattle is not represented in Bs-6 and -8. Secondly, we can see that cattle contrasts with sheep/goat and pig. Bs-1, -2, -7, -9, -13, and -14 should be associated with the deposition of mainly medium-sized animals. In a similar way, cattle should be associated with mainly Bs-3a, -4, and -11. In Bs-4 and -11 pig remains were also abundant. Again, this does not presuppose a lack of other animals in these *bothroi*, as e.g. cattle is abundant in Bs-1 and -14. But, it might mean that certain animal remains were deposited in certain *bothroi* rather than others, even if this rule was not followed strictly.

The third and the fourth patterns I choose to discuss are based on the CA of body parts' distributions. The third consists of an association between *Head* and *Lower* while *Upper* and *Axial* group together. This might reflect a division in the deposition of meat-rich vs. non-meaty limbs and the head. At *Asine* this might translate to consumption and butchery waste. Finally, the fourth pattern is that of taphonomic bias in terms of post-depositional disturbance, in the sense that normal proportions of body parts are strongly overrepresented by *Head* and *Upper*. A majority of pits conform to this pattern. Thus, the CA has shown that while taphonomic processes have affected the material we have a stronger pattern which probably can be connected with the archaeological handling of bones or bodies at the settlement.

In Table 6 I have made a categorization of the *bothroi* according to the results of the above analyses. When considering Table 6, it is important to retain the notion that there is a taphonomic bias which strongly shaped the distribution of observations, and that these categorizations are based on deviations from it. I will not discuss the taphonomy more in this article, but it is clear that the analysis illustrates the potential of this method within the field of vertebrate taphonomy, and should be explored in future studies.

I have distinguished five groups in Table 6. Groups A, B, and C are based on species distribution. They do not correlate with groups D and E which are based on body part distribution. This means that each *bothros* is assigned two groups: one on basis of species composition and one relating to distribution of body parts. Bs-11 and -15 are exceptions because Bs-15 could not be tied to any groups in the CA of species distribution; the same concerns Bs-11 in the CA of body part's distri-

<sup>72</sup> Lyman 1994; Orton 2012.

bution. In these instances, these *bothroi* were placed close to the centroid of the CA, thus not conforming to any pattern.

While one *bothros* might have been the destination of primarily consumption waste from cattle and pig, another could have contained mainly butchery waste of medium-sized mammals. I do not wish to categorize them any further, e.g. “butchery waste from red deer”, since the results do not really support more detailed interpretation. Many of the Asine *bothroi* are represented by small sample sizes. For example, the “red deer” *bothroi* Bs-6, -8, and -12, contained very few bone fragments, as did Bs-3a. Their assignments to any of the anatomical groups D or E are perhaps dubious. Because of this quantitative issue, the categories in *Table 6* remain interpretative in their nature. Nevertheless, the use of CA can, even in small samples, provide general patterns of archaeological interest.

### SPATIAL CONNECTIONS

In *Fig. 6*, I have merged my interpretations of the *bothroi* and their location on the map. Additionally, my perception of the chronology of the *bothroi* has been added. The reconstructed stratigraphy combined with absolute and relative dates indicates that although different strategies existed while filling the *bothroi*, they were probably filled up during the same approximate period. This could be during the same year, but it could also be two generations, if following the narrowest span of the calculated combined date, c. 2,135–2,078 BC (*Table 2*). It is thus possible that House S was not in use for a very long time. Shortly after filling up the *bothroi*, graves were dug into some of them and House T was erected. Phase 1 refers to the *bothroi* presumably older than House S. Phase 2 refers to *bothroi* in the middle of Houses R and S, and seems to constitute the last phase of usage. “Unknown phase” refers to the *bothroi* of Terraces I–II which might actually belong to phase 1, or more probably another household not yet excavated.

The most interesting spatial connections based on the CA and the categorization in *Table 6* is contained within the cluster of *bothroi* south-east of the middle between Houses S and R. They formed two rows aligned north–south with three *bothroi* each: to the west Bs-7, -9 and -11, and to the east Bs-8, -13, and -14. Two of the western *bothroi*, Bs-7 and -9,<sup>73</sup> are categorized as destinations of mainly consumption waste from medium-sized mammals (sheep/goat and pig), while the third one, Bs-11, is labelled a “cattle/pig” pit. Two of the eastern *bothroi*, Bs-13 and -14, contained butchery waste from medium-sized mammals (sheep/goat and pig). The third *bothros* in the eastern row, Bs-8, is labelled a “red deer” pit. Thus, it seems that the western *bothroi* in the cluster between Houses R and

S were destinations for mainly consumption waste, while the eastern pits might have been intended for butchery waste.

Southeast of this small cluster, we find Bs-1 and -3a which are not assigned to any phase on *Fig. 6*. They are also categorized as *bothroi* for butchery waste. If they were to be included in Phase 1, the interpretation that the eastern *bothroi* were destinations for mainly butchery waste would be reinforced. In the sense of spatial patterning, Phase 1 *bothroi* do not show any specific tendencies. Phase 1 organization might thus have been less formalized than phase 2, for reasons unknown.

## Discussion

### THE BOTHROS AS PART OF THE HOUSEHOLD ORGANIZATION

The results show that the distribution of animal bones in the Asine *bothroi* is not random. At least in the stage of closing the features, they should not be considered as uniform. This confirms my initial impression that the material is not coherent, but complex and variable. It is also probable that more than one phase in the life of a *bothros* existed.<sup>74</sup> The patterns apparent in this study would support the hypothesis that *bothroi* were built at a domestic level. It is relatively clear they were constructed in similar manners, according to similar traditions. This is visible in the architecture and also in the chronology at Asine. Phase 1 *bothroi* might have been less formalized than phase 2, because they were connected to only one household (*Fig. 6*). In this case, it is possible that when either the household became crowded or the settled area became denser, it necessitated a more formal place of storage, the *bothros*. These pits then conveniently became places for stricter waste management. This formalization combined with the diversity of the filling strategy would indicate that the digging of these features for one’s household was part of the normative behaviour connected to the idea of the “home”.<sup>75</sup>

The concept of home at Asine was probably different from one household to another. We have no idea of the structure of family. Even if we did, we do not know if the family was the “embryonic community” that structured one’s home. What we can discuss however are house plans and storage features, refuse materials and consumption remains, which we connect to the household or the domestic sphere. It is obvious that *bothroi* were part of human life on a domestic as well as on a community level. The hypothesis that a *bothros* was constructed for storage on a domestic level includes an assumption that it was part of the household organization. It is thus possible

<sup>73</sup> Bs-11 could not be categorized according to body parts, see previous section.

<sup>74</sup> This is also how I read Bank’s detailed study where the functional diversity of *bothroi* at Lerna IV is emphasized: Banks 2013.

<sup>75</sup> Douglas 1991.

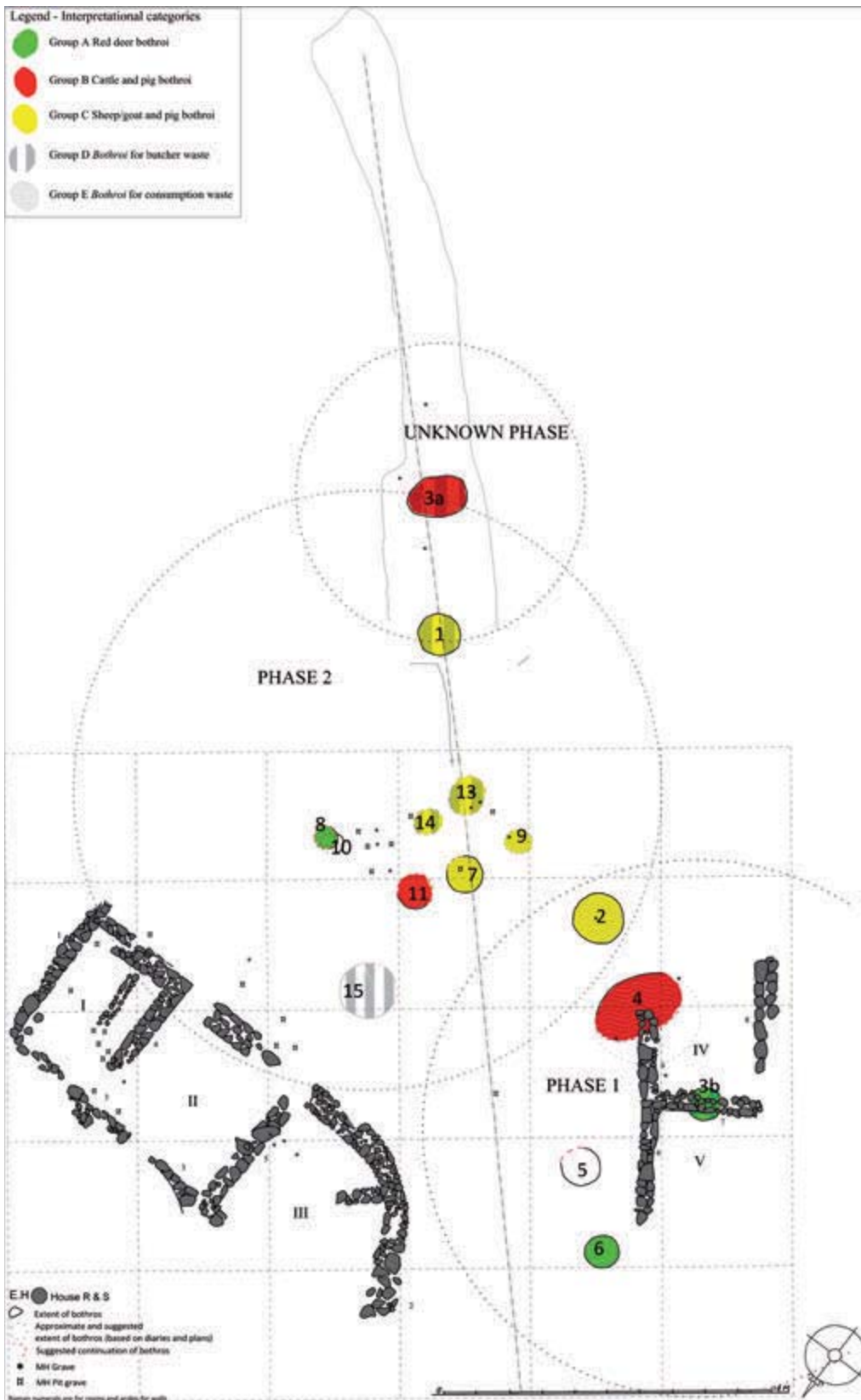


Fig. 6. Plan of the Asine bothroi used in the correspondence analyses, including interpretative categories, see Table 6.



that the *bothros* was a part of many persons' home at Asine. It was important for the structuring of space and the function was tied to the memory of perhaps hot summers (storage). They were even important when used as refuse pits, in the sense that they continued to structure space and to direct movement and labour.<sup>76</sup>

#### WASTE MANAGEMENT AND DIVERSITY: THE CLOSING OF A *BOTHROS*

I have proposed that *bothroi* were built as part of the household organization. I suggest they were filled up at approximately the same time period, i.e. between 2,135–2,078 BC, although a more narrow date range might be possible. The features were filled up in different ways as suggested by the reconstructed stratigraphy. The most formalized deposition of faunal remains seems to regard the similar-sized *bothroi* clustering between Houses R and S. It is possible to argue that these pits were used in connection with different activities, reflected in the refuse disposal. Whereas Bs-13 and -14 were used for butchery waste of primarily sheep/goat and pig, Bs-7 and -9 were used for consumption waste of the same. In Bs-11 we found an association with cattle and pig. The above mentioned features differ finally from Bs-8 in which remains of red deer is associated.

Since the faunal remains should derive from the filling period, which could have been over several years, another scenario might be suggested. The *bothroi* could be seen as waste management systems, where certain remains of certain animals and/or body parts were thrown in certain pits. This would explain the presence of red deer specifically tied to certain *bothroi*, sheep/goat to others, and pig to yet others. It would also explain the seemingly linear disposal of the axial body and upper extremities versus heads and lower extremities, which in the Asine case can perhaps be translated into meaty versus non-meaty body parts. In this sense it is reasonable to think that in the closing of the *bothroi*, the type of refuse deposited in them would also have been sorted or at least considered. It does not necessarily imply strictly ritual behaviour. This waste management could have been directed from the perspective of activity areas (as butchery versus consumption areas), or simply waste categories (such as red deer versus cattle). It could be argued to have involved both, especially when regarding the “sheep/goat-and-pig-*bothroi*” where “non-meaty” parts were associated with Bs-13, -14, perhaps also Bs-1 and -3a, to the east, and meat-rich parts in Bs-7 and -9 to the west.

Spatial and social organization in relation to waste management can be observed in most societies. In modern Swe-

den, there is a rigorous practice concerning the everyday sorting and categorizing of waste. This is directed and normalized through governance and education.<sup>77</sup> In this setting, bones and other food waste are integrated in the same category. For the Dogon people of Mali, domestic waste is a positive disorder and is used to manifest the vitality of the household, while bodily waste and menstrual blood is considered dangerous and polluting.<sup>78</sup> On Greenland, the Inuits had for a long time an ideal practice of “nothing is wasted” regarding the consumption of caribou, meaning that virtually nothing was considered waste and only bone splinters would remain as waste from the animal body.<sup>79</sup> More ancient examples of waste management strategies have been evidenced from Neolithic Çatalhöyük, Central Anatolia, where refuse would have been handled as an intricate part of everyday life by removing it from the house context.<sup>80</sup> Other examples can be found at Early Neolithic Almhov, Scania, where refuse was disposed in certain pits,<sup>81</sup> or the accumulation of refuse in the Late Bronze Age “midden sites” in the United Kingdom.<sup>82</sup> As the above ethnographic and archaeological examples demonstrate, the part of life involving the handling waste was and still is important. The *bothroi* seem to have been important in the spatial arrangement of things, in the social organization of the living area. The disposal of faunal remains, or rather, the remains of food consumption and animal processing, were probably a part of this arrangement. In this article the faunal remains are central to the discussion of household organization, and indubitably waste management is a part of this.

This study would definitely benefit from the comparison and inclusion of other zooarchaeological assemblages from waste-related contexts at the site. It would make it possible to test if the patterns from the *bothroi* are specific to the feature type or similar to general trends on site. This would in its turn also provide knowledge about the feature type as well as site function in terms of animal husbandry and economy. It would also add another spatial dimension of the management of waste. While this is clearly a desirable aspect, it is at the moment not possible, because the animal bones from the *bothroi* constitute the largest Asine assemblage from the EH III to the MH I transitional period at the moment. Hopefully more animal bones will be dated to this narrow time period in the near future. This study has focused on the zooarchaeological remains; however, other find categories found in the *bothroi* are important to include in future research. Such studies can

<sup>76</sup> I.e. reinforcing the idea of how it should be done at home. Cf. Douglas 1991.

<sup>77</sup> Åkesson 2012.

<sup>78</sup> Douny 2007.

<sup>79</sup> Pasda & Odgaard 2011.

<sup>80</sup> Martin & Russell 2000.

<sup>81</sup> Rudebeck & Macheridis 2015, 181–185.

<sup>82</sup> Needham & Spence 1997.

test the hypothesis proposed in this article, as well as contribute to the increased understanding of this pit phenomenon.

Few other zooarchaeological studies in the Aegean area focus solely on *bothroi*. P. Halstead has studied the animal bones from the Neolithic to Bronze Age settlement Tsoungiza in the Nemea Valley. Some of these bones derive from *bothroi*, but most are dated to EH I–II.<sup>83</sup> At Tsoungiza contextual differences in bone content in pits,<sup>84</sup> floors, and fills exist. Even so, Halstead acknowledges that individual variation within the context types is apparent (i.e. bone content can vary between pits) which suggests that the remains may reflect differential discard.<sup>85</sup> This is consistent with the above interpretation of the Asine *bothroi*.

### THE AFTERLIFE OF A *BOTHROS* AT ASINE

A few words can perhaps be devoted to the importance of the *bothroi* after their usage and closing. While erecting House T or perhaps directly after, Bs-7, an infant burial was still visible.<sup>86</sup> On the plan in *Fig. 6*, all MH graves on Terraces I–III are plotted and we can observe a possible connection between them and the *bothroi*. Perhaps this meant that people were reminded of the past by the *bothroi*, at least for a few generations. This visibility does not necessarily mean that the original perception of the feature, i.e. as a pit, was transferred. The remains—a circled coloration and clustering of pottery, could be enough for it to transform in function and importance. In this sense, the *bothroi* were perhaps long-lived in prehistoric memory, although this is more of a speculative suggestion. In either case, the construction and use of *bothroi* was abandoned, and this happened quite abruptly. Could it be in association with new-coming ideals or migrants? Perhaps the settlement grew and *bothroi* fell out of fashion, because the spatial social organization changed? Since we see similar trends elsewhere on the mainland, perhaps these questions should be more regional relevant as well. Regardless of what processes triggered its existence and disappearance, the *bothros* can provide a good example of the social dynamics of this transitional period, in the sense of activity, function, and management of the household.

<sup>83</sup> Halstead 2011, 780, 783.

<sup>84</sup> *Bothroi* are called pits, a category which seems to include other types of pits such as suggested cisterns (e.g. EH I Cistern 2) (Halstead 2011, 783). This makes it hard to in detail use this study as comparative material.

<sup>85</sup> Halstead 2011, 782–784. For example, the animal bones from Pit 55 contained remains of many neonates, but low degrees of gnawing, post-neonatal fragmentation, and no cattle, while Pit 32 contained higher fragmentation and gnawing, but few neonates.

<sup>86</sup> Nordquist 1987.

### Concluding remarks

In this paper the EH III/MH I *bothroi* of Asine have been examined from a zooarchaeological perspective. The faunal remains from the features have also been studied by means of correspondence analysis (CA), in terms of species composition and body parts' distribution. The CA of body parts distribution revealed a strong pattern related to taphonomy, most probably to post-depositional processes affecting the assemblages. This pattern consisted of higher proportions of cranial and compact fragments from the upper extremities. The fact that such a pattern can be visualized and strongly indicated by means of CA opens up to future studies of the identification of cultural versus natural processes in a specific material.

One important result is that the diversity of the faunal remains' distribution in the *bothroi* further problematizes the view of them as functionally one type of unit. It is possible that they were tied to different activity areas within the settlement. Some were storage for grain or other food, some perhaps drying pits for food. Most, maybe all of them, ended up as refuse pits. Some were reused for burial, and some were not. The common denominator is the morphology of the pits and the synchronicity in the closing of them.

In this contextual and zooarchaeological study, I propose that the *bothroi* were part of the household organization. In that sense, they could have been connected to the cultural formal idea of home for many of the inhabitants at Asine. Even if this theory might suit the *bothroi* at Asine, it is however hard to use for explaining the multitude of *bothroi* at Lerna IV. As Weiberg proposes,<sup>87</sup> the digging of this multitude of *bothroi* can indeed be seen as meaningful. However, the filling of them might also have been significant actions for the prehistoric people, but perhaps in another sense. Refuse disposal was necessary at Asine, just as in any other society. I have proposed there was an intentional waste management strategy tied to the filling and closing of the *bothroi*. This waste management should be connected to activity areas of butchering or consumption, as well as to formalized ideas of where to throw certain remains of certain animals.

STELLA MACHERIDIS  
Department of Archaeology and Ancient History  
Lund University  
Helgonavägen 3  
SE-221 00 Lund  
stella.macheridis@ark.lu.se

<sup>87</sup> Weiberg 2007, 116.

## Bibliography

- Åkesson, L. 2012. 'Waste in overflow', in *Managing overflow in affluent societies*, eds. B. Czarniawska & O. Löfgren, New York, 141–154.
- Alberti, G. 2013. 'Making sense of contingency tables in archaeology: The aid of correspondence analysis to intra-site activity areas research', *Journal of Data Science* 11, 479–499.
- Banks, E.C. 2013. *Lerna: A preclassical site in the Argolid 6. The settlement and architecture of Lerna IV*, Princeton, New Jersey.
- Bannert, D. 1973. 'Geologische Bemerkungen zur Ausgrabung am Barbouna-Hügel', in *Excavations in the Barbouna area at Asine*, Fasc. 1. *General introduction, bibliography, geological background and a report on the field-work in the Levendis sector, 1970–1972* (Boreas. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilisations, 4:1), eds. I. Hägg & R. Hägg, Uppsala, 16–21.
- Behrensmeyer, A. 1978. 'Taphonomic and ecological information from bone weathering', *Paleobiology* 4, 150–162.
- Blasco, R., J. Rosell, M. Dominguez-Rodrigo, S. Lozano, I. Pastó, D. Riba, M. Vaquero, J.F. Peris, J.L. Arsuaga, J.M.B. de Castro & E. Carbonell 2013. 'Learning by heart: Cultural patterns in the faunal processing sequence during the Middle Pleistocene', *PLoS ONE* 8, e55863, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0055863>
- Blegen, C.W. 1921. *Korakou. A prehistoric settlement near Corinth*, Boston.
- Blegen, C.W., J.L. Caskey, M. Rawson & J. Sperling 1950. *Troy I. General introduction. The first and second settlements*, Princeton, New Jersey.
- Bolviken, E., E. Helsing, K. Helsing, I.M. Holm-Olsen, L. Solheim & R. Bertelsen 1982. 'Correspondence analysis: An alternative to principal components', *WorldArch* 14, 41–60.
- Bourdieu, P. 1977. *Outlines of a theory of practice*, Cambridge.
- Bronk Ramsey, C. 2001. 'Development of the radiocarbon calibration program OxCal', *Radiocarbon* 43(2A), 355–363.
- Bronk Ramsey, C. 2009. 'Bayesian analysis of radiocarbon dates', *Radiocarbon* 51:1, 337–360.
- Bulle, H. 1907. *Orchomenos I. Die älteren Ansiedlungsschichten*, München.
- Caskey, J.L. 1960. 'The Early Helladic period in the Argolid', *Hesperia* 29, 285–303.
- Douglas, M. 1966. *Purity and danger*, London & New York.
- Douglas, M. 1991. 'The Idea of home: A kind of space', *Social Research* 58, 287–307.
- Douny, L. 2007. 'The materiality of domestic waste: The recycled cosmology of the Dogon of Mali', *Journal of Material Culture* 12, 309–331.
- Frödin, O. & A.W. Persson 1938. *Asine 1. Results of the Swedish excavations 1922–1930*, Stockholm.
- Garrow, D. 2012. 'Odd deposits and average practice: A critical history of the concept of structured deposition', *Archaeological Dialogue* 19, 85–115.
- Glowacki, K. 2007. 'House, household and community at LM IIIC Vronda, Kavousi', in *Building communities: Houses, settlement and society in the Aegean and beyond: Proceedings of a conference held at Cardiff University* (BSA, 15), eds. R. Westgate, N. Fisher & J. Whitley, London, 129–139.
- Greenacre, M. 2007. *Correspondence analysis in practice*, Boca Raton.
- Hägg, I. & R. Hägg 1973. *Excavations in the Barbouna area at Asine*, Fasc. 1. *General introduction, bibliography, geological background and a report on the field-work in the Levendis sector, 1970–1972* (Boreas. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilisations, 4:1), Uppsala 1973.
- Halstead, P. 2011. 'Chapter 13. The faunal remains', in *The Early Bronze Age village on Tzoungiza Hill* (NVAP, 1), Princeton, New Jersey & Athens, 741–803.
- Hill, J.D. 1995. *Ritual and rubbish in the Iron Age of Wessex: A study on the formation of a specific archaeological record* (BAR-BS, 242), Oxford.
- Hutchinson, R.W. 1935. 'Bothroi', *JHS* 55, 1–19.
- Hutchinson, R.W. 1936. 'Early Bronze Age. Hearths and house-pits', in *Excavations at Thermi in Lesbos*, ed. W. Lamb, New York, 55–64.
- Ingvarsson-Sundström, A. 2008. *Asine III. Supplementary studies on the Swedish excavations 1922–1930*, Fasc. 3. *Children lost and found* (ActaAth-4°, 45:2), Stockholm.

- Kent, S. 1995. 'Ethnoarchaeology and the concept of home: A cross-cultural analysis', in *The home: Words, interpretations, meanings, and environments*, ed. D.N. Benjamin, Aldershot, 163–180.
- Knudtzon, E.J. 1926. 'Stora profilen, Tredje terrassen uppifrån, Våren 1926', Unpubl. field diary, archived at Museum Gustavianum, Uppsala.
- Lamb, W. 1936. *Excavations at Thermi in Lesbos*, New York.
- Lyman, R.L. 1994. *Vertebrate taphonomy*, Cambridge.
- MacKinnon, M. 2007. 'Osteological research in classical archaeology', *AJA* 111:3, 473–504.
- Madsen, T., ed. 2012. *CAPCA, Version 2.2*, <http://www.archaeoinfo.dk/>
- Marciniak, A. 2005. *Placing animals in the Neolithic: Social zooarchaeology of prehistoric farming communities*, London.
- Marinatos, S. 1968. 'Some new evidence on ash pits or *bothroi*', *AAA* 1, 89–90.
- Martin, L. & N. Russell. 2000. 'Trashing rubbish', in *Towards reflexive method in archaeology: The example at Çatalhöyük* (British Institute of Archaeology at Ankara Monograph, 28), ed. I. Hodder, Cambridge, 57–69.
- Moberg Nilsson, K. 1996. 'Animal bones from Terrace III in the Lower Town of Asine', in *Asine III. Supplementary Studies on the Swedish Excavations 1922–1930* (ActaAth, 45:1), eds. R. Hägg, G.C. Nordquist & B. Wells, Stockholm, 111–116.
- Mylona, D. 2003. 'Archaeological fish remains in Greece: General trends of the research and a gazetter of sites', in *Zooarchaeology in Greece: Recent advances* (BSA Studies, 9), eds. E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble & P. Elefanti, London, 193–200.
- Mylonas, G.E. 1934. 'Excavations at Haghios Kosmas', *AJA* 38, 258–279.
- Needham, S. & T. Spence 1997. 'Refuse and the formation of middens', *Antiquity* 71, 77–90.
- Nilsson, M. 2014. 'A note on domestic vs. communal grain storage in the Early Helladic Period', *OpAthRom* 7, 223–239.
- Nordquist, G.C. 1987. *A Middle Helladic village. Asine in the Argolid* (Boreas. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilisations, 16), Uppsala.
- Nordquist, G.C., & R. Hägg 1996. 'The history of the Asine excavations and collections, with a bibliography', in *Asine III. Supplementary studies on the Swedish excavations 1922–1930* (ActaAth, 45:1), eds. R. Hägg, G.C. Nordquist & B. Wells, Stockholm, 11–18.
- Orton, D.C. 2012. 'Taphonomy and interpretation: An analytical framework for social zooarchaeology', *International Journal of Osteoarchaeology* 22, 320–337.
- Pasda, K. & U. Odgaard 2011. 'Nothing is wasted: The ideal "Nothing is waste" and divergence in past and present amongst Caribou hunters in Greenland', *Quaternary International* 238, 35–43.
- Pullen, D.J. 1987. 'Asine, Berbati, and the chronology of Early Bronze Age Greece', *AJA* 91, 533–544.
- Pullen, D.J. 2011. *The Early Bronze Age village on Tzoungiza Hill* (NVAP, 1), Princeton, New Jersey & Athens.
- Rapoport, A. 1995. 'A critical look at the concept "Home"', in *The home: Words, interpretations, meanings, and environments*, ed. D.N. Benjamin, Aldershot, 25–52.
- Reimer, P.J., E. Bard, A. Bayliss, J.W. Beck, P.G. Blackwell, C. Bronk Ramsey, C.E. Buck, H. Cheng, R.L. Edwards, M. Friedrich, P.M. Grootes, T.P. Guilderson, H. Hafidason, I. Hajdas, C. Hatté, T.J. Heaton, D.K. Hoffmann, A.G. Hogg, K.A. Hughen, K.F. Kaiser, S.E. Marian, J.R. Southon, R.A. Staff, C.S.M. Turney & J. van der Plicht 2013. 'IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP', *Radiocarbon* 55, 1869–1887.
- Richards, C. & J. Thomas 1984. 'Ritual activity and structured deposition in Later Neolithic Wessex', in *Neolithic studies. A review of some current research*, eds. R. Bradley & J. Gardiner, Oxford, 189–218.
- Ringrose, T.J. 1992. 'Bootstrapping and correspondence-analysis in archaeology', *JAS* 19, 615–629.
- Routledge, B. 2013. 'Household archaeology in the Levant', *BASOR* 370, 207–219.
- Rudebeck, E. & S. Macheridis 2015. 'The proper way of dwelling at the Early Neolithic gathering site of Almhov in Scania, Sweden', in *Neolithic diversities: Perspectives from a conference in Lund, Sweden* (ActaLund-8°, 65), eds. K. Brink, S. Hydén, K. Jennbert, L. Larsson & D. Olausson, Lund, 173–187.
- Rutter, J.B. 2008. 'The Anatolian roots of Early Helladic III drinking behavior', in *The Aegean in the Neolithic*,

- Chalcolithic and the Early Bronze Age: Proceedings of the international symposium, Urla-Izmir, October 13–19, 1997* (Ankara University Research Center for Maritime Archaeology Publication, 1), eds. H. Erkanal, H. Hauptmann, V. Şahoğlu & R. Tuncel, Ankara, 461–481.
- Säflund, G. 1965. *Excavations at Berbati 1936–1937* (Stockholm Studies in Classical Archaeology, 4), Stockholm.
- Sarri, K. 2010. *Orchomenos 4. Orchomenos in der mittleren Bronzezeit*, München.
- Shennan, S. 2006. *Quantifying archaeology*, Iowa City.
- Stiner, M.C. 1991. 'Food procurement and transport by human and non-human predators', *JAS* 18, 455–482.
- Strasser, S. 1999. *Waste and want: A social history of trash*, New York.
- Strasser, T.F. 1999. 'Bothroi in the Aegean Early Bronze Age', in *Meletemata: Studies in Aegean archaeology presented to Malcolm H. Wiener as he enters his 65th year* (Aegaeum, 20), eds. P.P. Betancourt, V. Karageorghis, R. Laffineur & W.-D. Niemeier, Liège, 813–817.
- Tringham, R. 1995. 'Archaeological houses, households, housework, and the home', in *The home: Words, interpretations, meanings, and environments*, ed. D.N. Benjamin, Aldershot, 79–108.
- Valmin, N.M. 1938. *The Swedish Messenia Expedition* (SkrLund, 26), Lund.
- Voutsaki, S., A.J. Nijboer & C. Zerner 2009. 'Middle Helladic Lerna: Relative and absolute chronologies', in *Tree-rings, kings, and Old World archaeology and environment: Papers presented in honor of Peter Ian Kuniholm*, eds. S.W. Manning & M.J. Bruce, Oxford & Oakville, 153–161.
- Wace, A.J.B. & M.S. Thompson 1912. *Prehistoric Thessaly*, Cambridge.
- Weiberg, E. 2007. *Thinking the Bronze Age: Life and death in Early Helladic Greece* (Boreas. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilisations, 29), Uppsala.
- Welinder, S., C. Hadevik, K. Gidlöf & E. Rudebeck 2009. 'Grismonster i gropkaos: en korrespondensanalys av djurben i tidigneolitiska gropar', in *Tematisk rapportering av Citytunnelprojektet*, eds. C. Hadevik & M. Steineke, Rapport 48, Arkeologienheten, Malmö, 137–156.

