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BURNT, FRAGMENTED AND MIXED: IDENTIFICATION AND INTERPRETATION OF DOMESTIC ANIMAL BONES IN FINNISH BURNT BONE ASSEMBLAGES

Abstract

The interpretation of domestic animal bones from prehistoric contexts in Finland is challenging because of the difficulties in identifying to species fragmentary burnt bone and because of the shallow and uncertain stratigraphy within which the bones are located. In this paper, burnt and unburnt bones from several archaeological sites were analysed and radiocarbon-dated in order to examine the potential for osteological analysis in studying the beginnings of animal husbandry in Finland. Archaeological bone material was found to represent broadly the economy practised at the site, but caution is needed when interpreting the abundance of different species, as well as the phasing and dating of individual bone fragments

Keywords: burnt bone, species identification, domestic animals, animal husbandry

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INTRODUCTION

Despite the accumulating evidence concerning the past economy offered by osteological analysis, the evidence for domestic animals in Finnish prehistoric bone samples remains scarce and its interpretation difficult (e.g., Mannermaa & Deckwirth 2010).

For example, in earlier studies the Finnish Corded Ware culture was thought to practise agriculture and/or pastoralism, but after several decades of archaeological research, solid evidence for domestic animal remains associated with Corded Ware is still absent. There are unburnt cattle and sheep or goat bones from Corded Ware sites, but as the bones have not been radiocarbon-dated, interpretation of their presence varies among archaeologists (e.g., Zvelebil 1981: 60; Núñez 1999: 137–8; Huurre 2003: 23–6; Salo 2005: 27).

The situation is partly caused by the nature of the available material. Because of the acidic soil, most of the surviving bone material found in Finland is burnt, with unburnt bone having been preserved only in rare and special instances. Burnt bone is usually highly fragmented, which creates difficulties identifying the species. The potential difficulties in identifying domestic species from burnt material is rarely discussed (Mannermaa & Deckwirth 2010: 66–7), even if it is acknowledged that some species are easier to identify in the burnt bone samples than others (see below).

Moreover, the bone material recovered from excavations often derives from different settlement periods, possibly spanning thousands of years, with no clear stratigraphy separating the different occupational phases, which makes interpretation of the bone finds difficult. Unlike some archaeological artefacts, such as pottery, jewellery and metal objects, which can be dated on typological grounds, animal bones cannot be dated by means other than radiocarbon-dating (Stone Age Northern pike [*Esox lucius*] and modern Northern pike are identical in morphology).

Thus, it is very difficult, and sometimes virtually impossible, to distinguish animal bones belonging to separate phases of an occupation in the absence of a clear-cut stratigraphy.

Bone preservation in Finland

As a rule, unburnt bone survives only rarely in the acidic Finnish soil (Fortelius 1981: 11; Kurtén 1988: 36; Ukkonen 1993: 249; Ukkonen 2001: 7; Mannermaa & Deckwirth 2010: 54). However, there are exceptions, as the geochemical conditions in the deposits vary. For example, even though geological deposits in Finland do not contain fossils or subfossils in abundance, some 30000–40000 year old mammoth bones have been recovered from Finnish glacial deposits (Kurtén 1988: 35; Ukkonen 2001: 7, 15). Bone may also survive embedded in water sediments, such as certain seal bones dating back over 9000 years (Ukkonen 2002: 6), or the middle Iron Age human and animal bones deposited in waterlogged soils, recovered from the Levänluhta site (Formisto 1993: 42; Wessman 2009). However, in typical Finnish archaeological strata significant numbers of unburnt bones are only found at sites that date to the Late Iron Age or the historical period.

For the purpose of this article, it is useful to differentiate between unburnt bone, tooth enamel, tooth root (dentine) and burnt bone, as they are all preserved differently. Tooth enamel is the hardest skeletal material, but most of the tooth (inner structure and roots) consists of dentine (Carlson 1990: 533–5), which is less resistant to decay than enamel, but harder than bone as it contains less organic material (Carlson 1990: 533).

Bone matrix consists both of organic and mineral material and the preservation of bone depends on its percentage of inorganic material and structural density (Schiffer 1987: 183–4; Lyman 1994: 234–58; Reitz & Wing 1999: 40). The mineral fraction of mature bone constitutes approximately 65% of its weight (Francillon-Vieillot et al. 1990: 514). Burnt bone survives better than unburnt bone due to the changes in its biochemical composition and the destruction of the organic component necessary for bacterial activity (Chaplin 1971: 12; Iregren & Jonsson 1973: 97; Ukkonen 2001: 7). However, even burnt bone can be destroyed in certain parts of the cultural deposits (Okkonen 1991). Of unburnt bone, tooth enamel is most resistant to decay and is often the last part of the skeleton to survive (e.g., Ratilainen & Tourunen 2003: 26; Riikonen 2003: 22). However, tooth enamel – especially of adult, full-grown teeth – is often destroyed by fire because of the brittleness that accompanies hardness (Gejvall 1947: 41).

Species identification in the burnt material

Exposure to fire will inevitably destroy some bone material (Sigvallius 1994: 27) and thus can change the anatomical distribution and species composition of the original sample. However, even if burning deforms and shrinks bone material (e.g., Iregren & Jonsson 1973; Fortelius 1981: 11; Lyman 1994: 384–92), the burning itself does not substantially affect the identification potential of the material (Sigvallius 1994: 17–29). Burnt complete or semi-complete bones are almost as identifiable as similar unburnt bones. It is the high fragmentation rate of burnt bone material, typical of archaeological samples, which represents the challenge and is one of the most important factors affecting the possibilities for identification and interpretation (Ukkonen 1996: 67).

The fragmentation of bone material affects identification at species level to different degrees. In general, smaller species are more easily identifiable from fragmented burnt bone material as their bones are more often recovered in a more complete state. By contrast, large animal bones tend to fracture into numerous, unidentifiable fragments (Ekman & Iregren 1984: 14; Ukkonen 1996: 67; Ukkonen 2001: 14). If the bone material consists mostly of large species, it may include only a few identified cattle (*Bos taurus*), European elk (*Alces alces*) or wild forest reindeer (*Rangifer tarandus fennicus*) bones or only bones categorised as 'large mammal' or 'large ungulate' (hoofed animal).

Seals (*Phocidae* sp.) are likely to be overrepresented in the identifiable burnt bone fraction. Their bones have very characteristic shapes and structures, which make their identification relatively easy (Ukkonen 2002: 5). Moreover, in an experiment where seal, elk and brown bear (*Ursus arctos*) bones were burnt in an open fire, seal bones did not burn as well as those of elk and bear, probably due to the higher mineral density and smaller marrow cavity (Vaneeckhout et al. 2010: 12–5). Seal bones were also found to be better preserved than elk or bear bones (Vaneeckhout et al. 2010: 12–5).

Thus, the identification of different animal species from burnt material depends partly on the size of the animal (and size of its bones) and partly on any characteristic bone features present. As no wild mammals in Finland have horns (only antlers), any horn fragments belonging to the Bovidae family must indicate the presence of cattle, sheep (*Ovis aries*) or goat (*Capra hircus*). Cattle, reindeer, elk and horse (*Equus caballus*) have quite similar anatomies, all belonging to the superorder of ungulata (hoofed animals). For many bones, especially if fragmented, it is difficult to separate them securely. Sheep, goat or pig (*Sus scrofa*) bones are often found in a more complete state than those belonging to larger mammal (as they are smaller species). Even after extensive analyses of osteological materials dating to the Stone Age, no secure finds of small cervids – like roe deer (*Capreolus capreolus*) – or wild boar have been found in Finnish prehistoric samples (Ukkonen 2001: 26). These species have an anatomy similar to that of the small domesticates, sheep, goat and pig. Therefore, bones belonging to the group of 'small ungulates' recovered from archaeological excavations are likely to belong to domestic animals. It seems that sheep, goat and pig bones are more likely to be identified in burnt material than are cattle bones.

Estimating the age of domestic animal bones from archaeological sites

Although unburnt bone survives rarely in Finnish prehistoric cultural layers, some unburnt bone is nonetheless regularly found in excavations (e.g., Deckwirth 2008; Mannermaa & Deckwirth 2010; Tourunen & Troy 2011). Such bones are often interpreted as being younger than the rest of the find material. This interpretation often seems to be valid, as recent bone material may have been deposited at the site in subsequent periods of use and, given the thin cultural layers typical of Finland, such disturbances are difficult to detect (Ukkonen 2001: 13). There are several examples of sites where radiocarbon-dating has shown a longer period of use than was indicated by the material culture excavated (e.g. Naarankalmanmäki in Lempäälä and Rikala in Salo; see Raike & Seppälä 2005; Mäntylä-Asplund & Storå 2010).

Interpretation of the unburnt animal bone material from prehistoric archaeological sites lacking clear stratigraphy is difficult. However, sometimes the zooarchaeologist is able to make an estimate of the most likely age of an individual bone. The criteria used are typically preservation, size or species in question (e.g. Lahtiperä 1970: 203; Vormisto 1985: 152; Ukkonen 1996: 75–6; Mannermaa 2003: 6). If the species itself is an introduction to the local fauna, like muskrat (*Ondatra zibethica*) or raccoon dog (*Nyctereutes procyonoides*) (Siivonen & Sulkava 1999: 154, 169), the specimen is most likely to post-date the introduction of the species. Naturally, if the faunal history is poorly known or if the species has existed in the neighbouring areas (like roe deer), where its bones, or especially antlers, could have been an item of trade, this approach should be practised with caution.

Sometimes it is the bone itself that gives the impression of being younger than rest of the material. The state of preservation (e.g. unburnt bone among burnt remains) or colour of the bone could differ from the others, indicating different age or at least different depositional history. Sometimes the modern bones still have soft tissue attached or they are even noticeably greasy to the touch, both being obvious signs of recent deposition even if they are found in the same context as archaeological finds (Fig. 1).

Modern improved domestic animals are usually noticeably larger and sturdier than unimproved and less efficiently fed ones in the past. Thus, sometimes the sheer size and robustness of the remains can indicate a recent date for the

Fig. 1. Thin archaeological layers sometimes result in mixing of modern and ancient bones. Modern unburnt (right), burnt ancient (down left) and unburnt ancient (upper left) bones from Liinmaa castle, all found in the same layer and grid square close to the surface. Modern bones still have some soft tissue attached and are likely to represent wild species living on the site or having been transported there by other animals. Photo: Auli Tourunen.

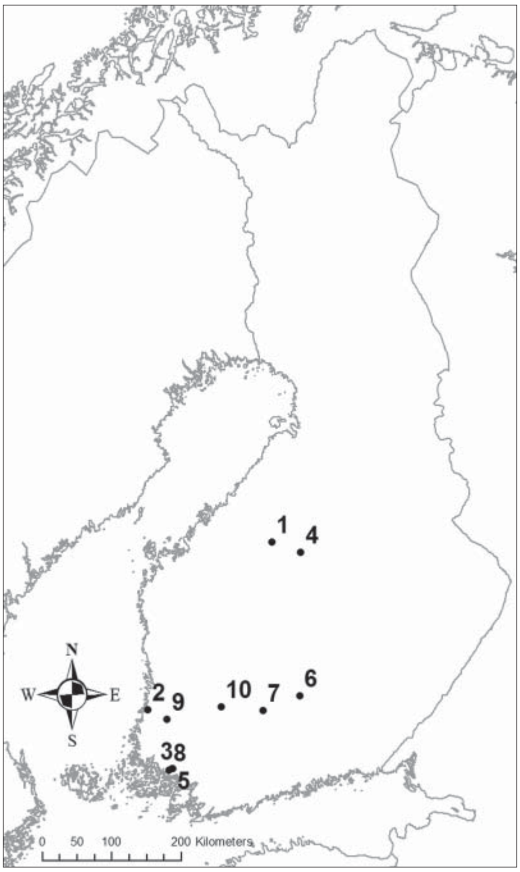


Fig. 2. The location of the sites mentioned in text. Sites: 1. Lestijärvi Anttila, 2. Eurajoki Liinmaa castle, 3. Lieto Vanhalinna, 4. Pihtipudas Hämeensaari, 5. Lieto Aittamäki, 6. Sysmä Ihaniemi, 7. Pälkäne Isosaari, 8. Turku Kanttorinmäki, 9. Eura Luistari and 10. Vesilahti Hinsala Tonttimäki. Map by Hannu Ojanen, MTT Agrifood Research Finland.

specimens; however, it has to be pointed out that there is noticeable variation in animal shape and size in prehistoric and Medieval populations and therefore this criterion should not be used alone. A bone can also have been sawn through, an instance that is more common in modern samples, where powerful electric saws have made it easy to cut straight through the bone. In ancient samples, it is more common that carcasses were dismembered by cutting through the soft tissue in the joints.

These criteria are useful when first estimating the reliability of the sample. An experienced zooarchaeologist can sometimes give reliable estimates concerning the age of the bone deposit simply through visual inspection. However, often the physical characteristics are not sufficient to offer reliable dating of bones, and the only way to be really sure about dating of a particular animal bone is to radiocarbon-date it. Even radiocarbon-dates include a degree of uncertainty. The method often gives a broad range of possible dates or even dates that are categorically too old (so-called reservoir-effect), although this mostly concerns animals with marine diets (e.g. Renfrew & Bahn 1991: 121–3; Hedenström & Possnert 2001; Yoneda et al. 2001; Hallgren 2008: 80–2).

Aims

This article examines the problems related to the identification of domestic animals in burnt material, the interpretation of bone material in multi-period sites and finally, the potential of osteological analysis in investigating the beginnings of animal husbandry in Finland.

MATERIAL

Three bone materials were included in this study (Fig. 2). To examine the identification of large animals in the burnt material, Bronze Age material from Anttila (Yli-Lesti) in the municipality of Lestijärvi was analysed. In order to investigate domestic animals in burnt material and to compare the species and anatomical distribution in burnt and unburnt samples in more detail, animal bones from the Medieval castle of Liinmaa in the municipality of Eurajoki were examined. The aim was to investigate how domestic animals are represented in the burnt material and to understand further the processes that affect the identification of certain species in the archaeological material. Bone material from the Early Medieval site of Vanhalinna in the municipality of Lieto was included as the depositional conditions at this site were more comparable with those of prehistoric sites, yet it included several identified domestic animal bones. Moreover, nine domestic animal bones from seven prehistoric sites were radiocarbon-dated to compare their dating and the dating of the site. The osteological analyses and radiocarbon-datings were done within the Finnarch-project (Niemi et al. 2010), funded by the Academy of Finland.

METHODS

The osteological material was quantified by using NISP (Number of Identified SPecimens) in order to examine the identification of different species in different types of material. Also the proportion of large and small ungulates (large ungulates including cattle and fragments identifiable as belonging to cattle/elk/reindeer/horse only, small ungulates including sheep, goat and pig bones and sheep/goat /pig bones) was calculated so as to examine the identification of small and large animals. In the Liinmaa sample the anatomical distribution was also examined. The material was divided into small bones (including carpal and tarsal bones, sesamoid bones, *os malleolare* and phalanxes), limb bones, flat bones (pelvis and scapula), trunk (vertebrae, ribs and sternum) and head (skull and mandible).

Radiocarbon-dating of the bones was done in the Dating Laboratory of the Finnish Museum of Natural History, University of Helsinki.

RESULTS

Bone assemblages

One example of the difficulties in identifying large mammals (in this case, reindeer and elk) in burnt material and interpreting the economic setting of the site is the excavation at Anttila (or Yli-Lesti) in the municipality of Lestijärvi. Because of the large hunting pit system nearby, it has been interpreted as being a Bronze Age hunting camp associated with specialised cervid (most likely forest reindeer) hunting (Siiriäinen 1978; Holmblad 2010: 145). The bone material (NM 17487) consists of 2198 fragments of burnt mammal bone, most of which remained unidentified. The identified species include European beaver (*Castor fiber*, 27 fragments and 5 uncertain fragments), elk (2 fragments) and reindeer (1 fragment). In addition, two fragments were identified as elk or reindeer and 26 as large mammal (most likely elk or reindeer). In the identified portion, beaver is the most common species, but all the large mammal bones, and probably most of the unidentified bones, belong to reindeer and/ or elk. Moreover, all of the beaver bones could derive from one individual and represent a single deposition event.

The animal bone material from Liinmaa castle in Eurajoki offers an excellent opportunity to examine burnt domestic animal bone material and the effect that burning has on the identification of different animal species. A total of 26 kg of animal bone was recovered from the site in excavations carried out between 1978 and 1979 (TYA 140 & 162, Ohtonen & Luoto 1987: 80) and a further ca. 450 g was recovered in 2005 (NM 2005069, Uotila 2011). The bone material derives from two ditches dug through the castle yard (years 1978 and 1979) and from small pits excavated in 2005 (Fig. 3). The material consists of unburnt, charred and

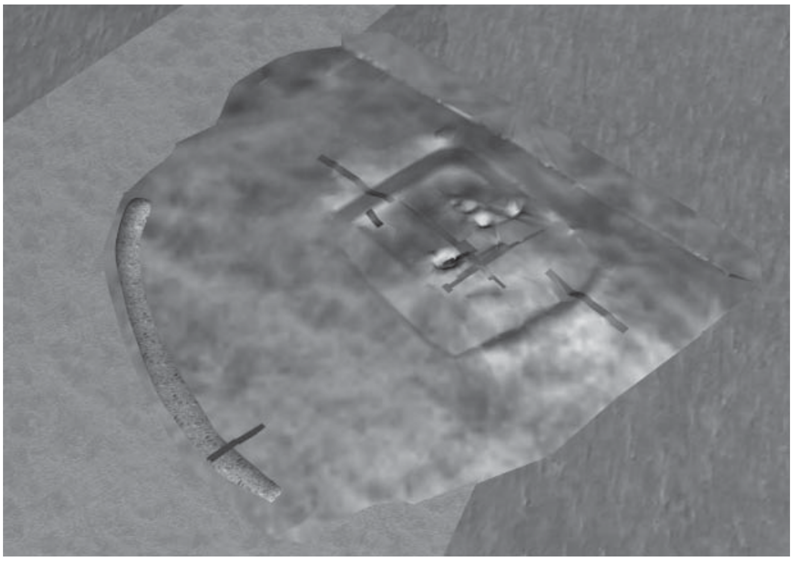


Fig. 3. Location of excavation dithes (1978, 1979 and 2004–2006) in Eurajoki Liinmaa castle. Bone material was recovered inside castle. Map by Kari Uotila.

completely burnt bones, including cattle, sheep or goat and pig bones. The castle probably burnt down (perhaps twice), which would explain the large amount of burnt material (Luoto 1987: 70; Uotila 2011). The animal bone material from the 1978–1979 excavations was first analysed by Arvo Ohtonen (Ohtonen & Luoto 1987), but as no report describing the burnt and unburnt fraction in detail has been saved in the Turku University archives, the material was re-analysed for this study, together with the material recovered in 2005. It is assumed here that the bones of sheep, goat and cattle were equally likely to get burnt and that the burnt and unburnt fractions of the material represent random subsamples of a single uniform sample. In other words, the assumption is that burnt and unburnt materials at Liinmaa castle include approximately the same proportion of animal species.

It is evident that large ungulates are less often identified in burnt material than small ungulates, and that cattle are less often identified in burnt material than sheep/goat and pig (Figs. 4–5). The high number of large ungulates in the charred material is interesting. It could be attributable to the small sample size (n=48), but it could also relate to the brittleness of charred bone, which in turn could lead to the destruction of smaller elements.

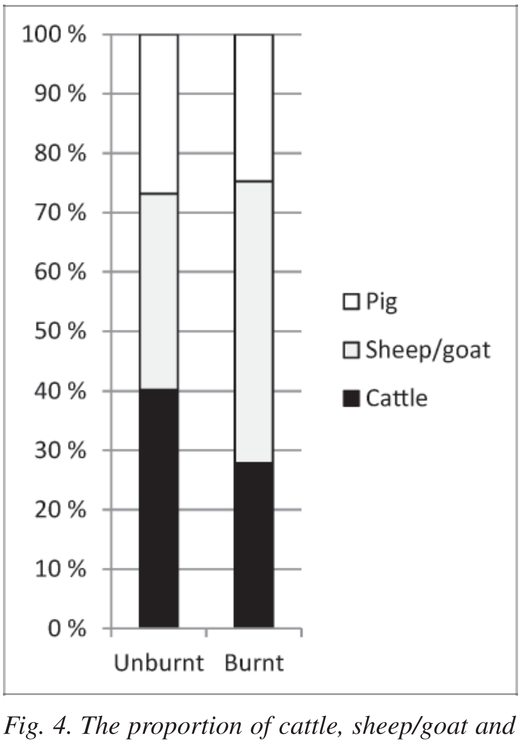


Fig. 4. The proportion of cattle, sheep/goat and pig at Liinmaa castle, and the percentages of unburnt and burnt bone material (NISP unburnt= 82, burnt= 449).

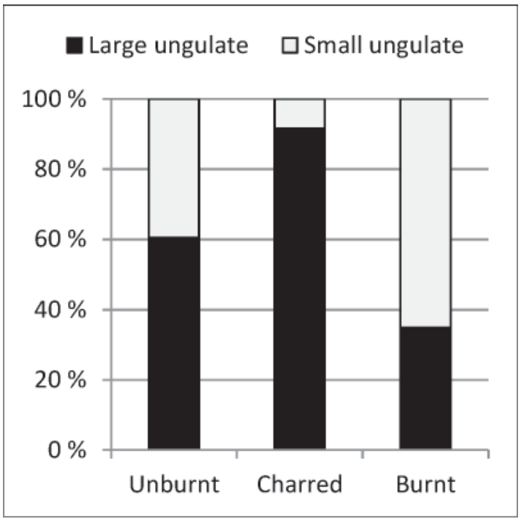


Fig. 5. The proportion of large and small ungulates at Liinmaa castle, and the percentages of unburnt and burnt bone material (NISP unburnt = 489, charred = 48, burnt =2055).

In all three species the proportion of identified small bones is larger in the burnt bone fraction and the proportion of trunk elements smaller (Figs. 6–7). This difference is particularly clear for cattle bones. The number of identified unburnt small bones was only ten and most of them were from cattle: this could reflect the easier destruction of small, unburnt bone elements. These small bones are also easily lost in the course of excavations if the excavated material is not sieved, but this would affect the number of small burnt bones as well. Also, in the burnt sample the number of identified limb and flat bones deriving from pig and sheep/goat was larger than in the unburnt sample (Figs. 8–9). Thus, it seems that the large bones with few identifiable features (such as limb bones, scapulae and pelvises) are underrepresented in the burnt fraction.

It could be argued that the Liinmaa sample is not comparable to typical prehistoric material in Finland. Indeed, the average fragment size in Liinmaa was larger than in a typical prehistoric sample. Thus, one could expect even larger differences in the identification of large and small mammals in prehistoric materials. In order to examine bone samples with a deposition history more comparable to prehistoric samples, but

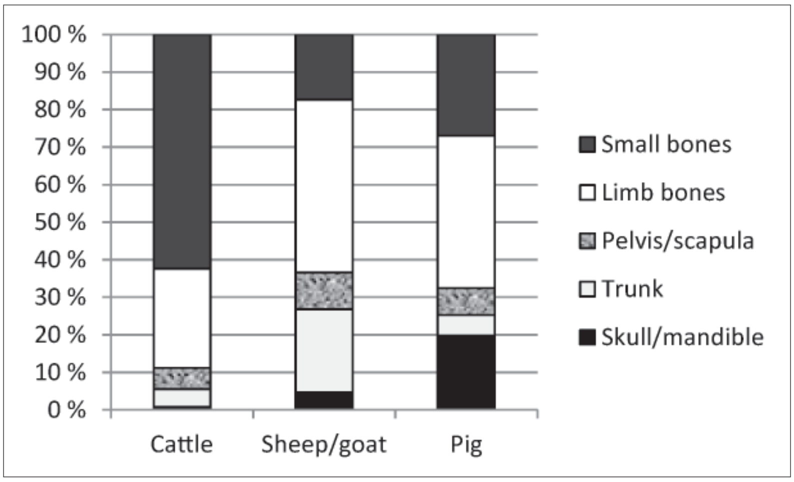


Fig. 6. Proportion of different bone types in cattle, sheep/goat and pig bones in the sample of burnt bones from Liinmaa castle. (NISP cattle = 125, sheep / goat = 213, pig = 111).

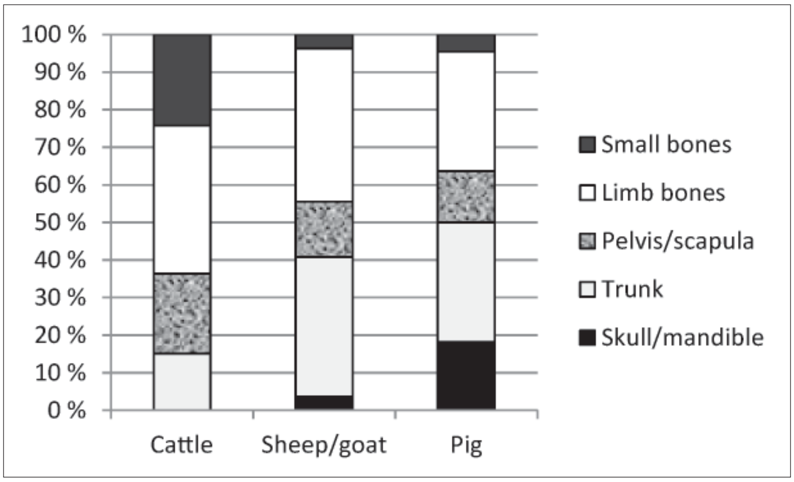


Fig. 7. Proportion of different bone types in cattle, sheep/goat and pig bones in the sample of unburnt bones from Liinmaa castle (charred bone is included). (NISP cattle =33, sheep / goat = 27, pig = 22).

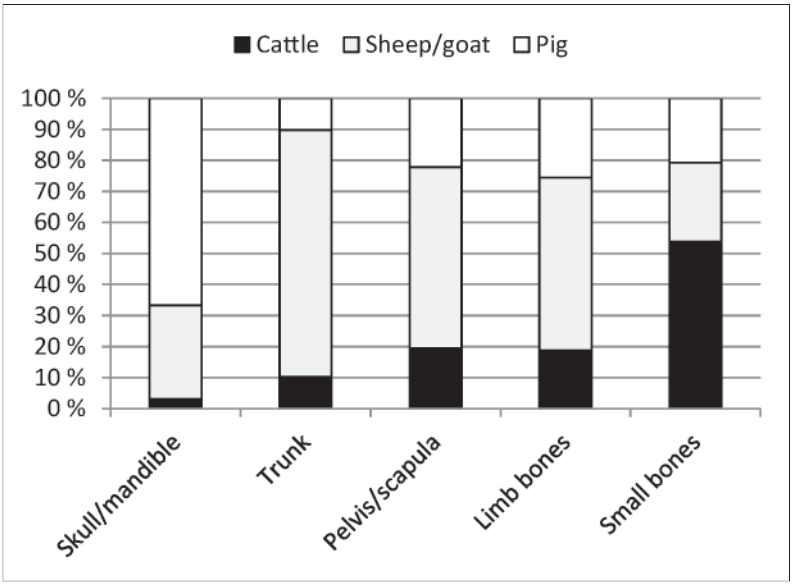
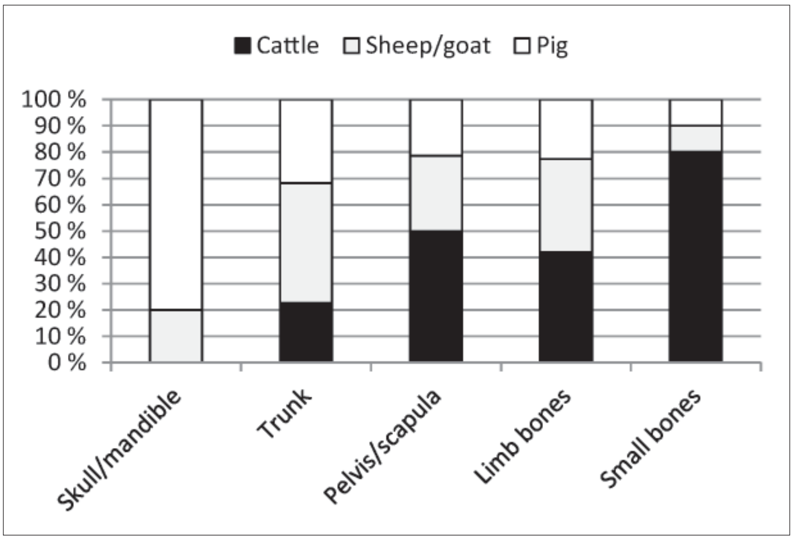


Fig. 8. Proportion of identified species in different bone types in the Liinmaa castle burnt bone sample. (NISP skull/mandible = 33, trunk = 59, pelvis/scapula = 36, limb bones = 176, small bones = 145).

Fig. 9. Proportion of identified species in different bone types in the unburnt bone material from Liinmaa castle. (NISP skull/ mandible = 5, trunk = 22, pelvis/scapula = 14, limb bones = 31, small bones = 10).



nonetheless from domestic animals, a bone sample from the site of Vanhalinna in the municipality of Lieto was analysed. Vanhalinna is a rural dwelling site used from Late Iron Age to the Medieval period (TYA 796, 818, 823; Korkeakoski-Väisänen 2009). Here, the deposition and fragmentation of bone resembled that of a typical prehistoric site in Finland. Nevertheless, domestic animals (cattle, sheep and pig) and fish bones were identified, in addition to a single human bone (Table 1).

Bones from multi-period sites – results of radiocarbon-dating.

There are some examples that call for a cautious approach to prehistoric animal bone assemblages, as the archaeological material and layers are not always easy to date or interpret. For example, Hämeensaari, in the municipality of Pihtipudas, has been interpreted as being a Late Iron Age or Early Medieval settlement and burial site (Miettinen 1993; Ukkonen 1994). However, unburnt sheep (NM26584:4) and cattle[1] (NM27198:39) bone from the site gave a date that most likely falls in the Post-Medieval period (Table 2), and therefore represents later use of the site not evident in the rest of the archaeological material. Sometimes, however, bones may date older than expected. Unburnt cattle bone (TYA 597:102) from the site of Aittamäki in the municipality of Lieto, recovered from a Viking Age burial ground (so-called ‘cremation cemetery under flat ground’), proved to belong to the Roman Iron Age phase of the cemetery (Table 2), represented mostly by isolated cremations (Pälikkö 2009).

Sometimes archaeological layers might represent a long period of use, and the different phases evident in the archaeological material are mixed within the same context. For example, unburnt sheep or goat and cattle bone from the same layer (and recorded under same catalogue number NM 32291:552) at the Iron Age/Early Medieval site of Ihananiemi in the municipality of Sysmä proved to date four hundred years apart (Table 2) (Poutiainen 2000; Mannermaa 2002). No clear difference in the preservation of the two bones was noted.

Some domestic animal bones from Stone Age sites have also proved to date to later periods. For example, an unburnt cattle tooth from Isosaari in the municipality of Pälkäne (NM 13407: 67), a dwelling site dated to the Stone Age and Metal periods (Kankkunen 2005), was radiocarbon-dated

Table 1. Species represented in the Vanhalinna (northeastern slope) sample, Southwest Finland (NISP).

Species	NISP
Cattle	3
Sheep	1
Sheep/goat	7
Pig	5
Large ungulate	16
Small ungulate	26
Human	1
Pike	6
Carp fish	4
Fish	4
Unidentified	408
Total	481

Table 2. *Sites with radiocarbon-dated domestic animal bones*

Site	Species	Archive number	Code	Date	cal AD (2σ)[1]
Pihtipudas Hämeensaari	Sheep	KM26584:4	Hela-2322	342±30 BP	1465–1640
	Cattle	KM27198:39	Hela-2579	323±30 BP	1479–1645
Lieto Aittamäki	Cattle	TYA 597:102	Hela-2587	1814±44 BP	84–330
Sysmä Ihananiemi	Sheep/goat	KM32291:552	Hela-2350	1093±31 BP	890–1020
	Cattle	KM32291:552	Hela-2549	637±30 BP	1284–1397
Pälkäne Isosaari	Cattle	KM13407:67	Hela-2528	408±30 BP	1430– 1625
Turku Kanttorinmäki	Sheep	KM20120:671	Hela-2527	200±30 BP	1645–1955
Eura Luistari	Cattle	KM25480:646[2)]	Hela-2586	Modern	–
Vesilahti Hinsala Tonttimäki	Cattle	TYA 335:330	Hela-2578	Modern	–

[1)] calibrated with Oxcal v. 4.1.7, [2)] Grave 1000.

and proved to be only 400 years old (Table 2). The site is a modern-day field cleared originally in 1926 (Kankkunen 2005) and the tooth offers interesting indication of Medieval or post-Medieval activity in the area. The rest of the bone material from this site was burnt. Naturally, burnt bone can also be intrusive: a burnt sheep *tibia* fragment from Kanttorinmäki in Turku (NM 20120:671; Sarkki 1977), a site associated with the Late Stone Age Kiukainen culture, proved to date to the post-Medieval period (200±30 BP, cal AD 1645–1955, Hela-2527). The bone was found in the first proper excavation layer and did not differ visually from the rest of the bone material, which included seal and pike bones.

Even modern bones can be mistaken for prehistoric ones as bone can deteriorate rapidly under certain conditions. An unburnt cattle mandible from a grave found in the Late Iron Age cemetery of Luistari in Eura (NM 25480:646; Lehtosalo-Hilander 1982) proved to be a modern intrusion (Hela-2586, modern), even though its outward appearance was not obviously modern. Likewise, a very eroded unburnt cattle toe bone (phalanx 2) from an Iron Age cairn located in Hinsala in Vesilahti (TYA 335:330; Antikainen 1987) was dated and turned out to be modern (Hela-2578, modern). This bone derives from the second excavation layer at the site, which otherwise yielded prehistoric material and bore no obvious signs of disturbance (Antikainen 1987). However, the site was situated near a modern settlement and there had been recent activities near the cairn (Antikainen 1987).

DISCUSSION

The identification of different species from burnt bone material is affected by the degree of fragmentation and deformation of the material. As evident in the Liinmaa sample, the small compact bones are often the most readily identifiable ones. There are some differences in the cervid and bovid anatomy that favour the identification of elk and reindeer over cattle. Elk and reindeer both have rudimentary second and fifth metapodials and phalanges that consist of small and compact bones, often recognisable in burnt material (Fig. 10). Cattle lack these bones (except for an occa-

Figure 10. Elk and cattle metacarpals. Note the rudimentary II/V metacarpal and phalanx bones of elk. Photo Auli Tourunen.

sional rudimentary fifth metacarpal). This does not mean that cattle cannot be identified, but they have fewer bones that are likely to remain identifiable after burning and fragmentation. In the burnt bone sample from Liinmaa castle a total of 107 cattle, 563 large ungulate and two possible cervid bones (elk/reindeer) were identified. Thus, even if it is often challenging to differentiate between cattle, elk and reindeer bones, and even though a large number of specimens belonging to these species are often categorised as large ungulates, the identification of cattle is possible in burnt material. Sheep, goat and pig are relatively easy to identify and even when a certain fragment can only be identified as coming from a small ungulate it still implies the presence of domestic animals as no comparable wild species exist in Finland. Moreover, domestic animals (including cattle) have been found in Iron Age funerary burnt materials even if no (or only a few) wild animals were present (e.g., Formisto 1996: 84; Tourunen & Troy 2011: 13. The situation is similar in Sweden (e.g., Iregren 1974:81; Sigvallius 1994). Thus, if present, domestic animals seem to be identifiable even in prehistoric burnt bone samples.

As the number of identified fragments at a single site is usually small, pure chance may affect the results. For example, the bones resulting from the very last activity at the site may be undisturbed and therefore overrepresented, or bones deriving from a single easily identifiable species may dominate the sample. This could be the case at the Anttila site. The material can be interpreted in two different ways. It could represent a specialised reindeer hunting station, where small mammal (beaver) only is abundant as its bones are easier to identify than those of elk or reindeer or by chance. However, it is also possible that people living at the site practised wider exploitation of the local resources than just cervid hunting. Thus, species abundance – especially in the smaller samples – should be considered only as suggestive. However, as all of the major domestic species have frequently been identified in the burnt bone materials, it seems that burnt bone samples represent a good general overview of the economy practised at the site (although the above-mentioned constraints should be kept in mind).

When an unburnt domestic animal bone is found among burnt material it is often interpreted as a recent intrusion – especially, when the species in question is not found among the burnt material. However, unburnt or poorly burnt wild mammal bones already present in burnt material are sometimes interpreted as contemporary with the rest of the material, as they represent similar activities. For example, both burnt and unburnt seal bones from the Bronze Age cairn of Kaunismäki in the municipality Harjavalta have been interpreted as being contemporary, but unburnt cattle bone from the same site was deemed a recent intrusion (Lahtiperä 1970: 203). Poorly burnt or unburnt seal bones were also found from Isosaari in Seinäjoki (KM 38574: 947; Kankkunen 2009; Tourunen 2011). Seals are well represented in the burnt bone material from the site (Tourunen 2010; 2011). Thus, it seems likely that the seal bones belong to the Stone Age phase of the site, especially as the site is currently (due to isostatic land uplift) located ca. 40 km inland. On the other hand, the bone material from Isosaari also included one complete unburnt cattle phalanx. The cattle bone, which derived from a large individual, was found in the upper layers of the site and was well preserved (much better than the above-mentioned seal bone). Because recent human activity was present near the site and cattle were not represented in the burnt material, the unburnt cattle bone was interpreted as being a modern intrusion.

Obviously, a solitary unburnt bone is not automatically an intrusion: sometimes burnt and unburnt bones can belong to the same cultural period. It needs to be considered whether the lack of unburnt bone depends on taphonomic factors or if it might be explained through different cultural practices, as in the case of solitary unburnt animal bones found among cremated human remains (cf. Formisto 1996). It should also be kept in mind that bone preservation may vary considerably within a small area, e.g. due to the deposition of earlier archaeological material (Ekman & Iregren 1984: 13).

Radiocarbon-dating is often the only reliable method for estimating the age of individual fragments of bone recovered from the thin cultural layers typical of Finnish prehistoric sites. As Finnish prehistoric dwelling sites are often used for several centuries, or even millennia, the bone material can consist of fragments representing a variety of different uses and use periods. Where radiocarbon-dating has not been employed, any dates ascribed to animal bone material should be regarded with caution. In future, more extensive use of radiocarbon-dating may refine our knowledge of the survival potential of unburnt bone in Finnish archaeological layers. For example, unburnt seal bones have been found from several prehistoric sites that nowadays are located in the inland regions: any seal bones found at such sites are thus likely to be prehistoric. These sites include Kärsämäki in Turku (Maaria), Vainionmäki in Laitila and Troihari in Seinäjoki (probable seal bone) (Formisto 1996: 84; Tourunen & Troy 2011).

CONCLUSIONS

Even if animal bone material is a valuable source of information about past livelihoods, the associated data must be evaluated carefully. Individual bones representing forms of subsistence different from the majority of the material (such as unburnt domestic animal bones among burnt seal bones) should be regarded with caution and an acute awareness of their context. Radiocarbon-dating is often the only way of acquiring reliable dates for prehistoric animal bones. Tooth enamel and dentine are more likely to survive than other bone elements in unburnt samples due to their hardness, but enamel cannot be reliably radiocarbon dated and this reduces its value if enamel is the only evidence of animal husbandry at the site.

Smaller domestic animals, such as sheep, goat and pig, have plenty of small bones easily identifiable to species level even when burnt. Cattle bones, by contrast, are more difficult to identify due to the possible presence of elk and reindeer in the samples and due to the larger size of the bones. Limb bones, scapulae and pelvises are less likely to be identified than smaller bones like carpals, tarsals, sesamoid bones and phalanges.

Finnish prehistoric bone material is challenging to interpret and the nature of the material limits the research questions. However, it is possible to examine the broad outlines of past economies, for example the beginnings of animal husbandry, with the help of burnt bone materials, keeping the constraints in mind. For one single site with a limited amount of identified bones, it is more useful to concentrate on the available evidence (what was identified) than to draw conclusions on the basis of the missing species. Also the species abundance in the identified bone fraction might not represent any original ratio of the species. However, the most important restriction in the interpretation of the burnt bone material is the small number of identified fragments. As the osteological data accumulate, more general conclusions about the economy practised during a certain time period or geographical location can be drawn.

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NOTES

[1] This bone was originally identified as cattle or elk by Pirkko Ukkonen. The author's opinion is that it derives from cattle.

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