TURUN YLIOPISTON JULKAISUJA
ANNALES UNIVERSITATIS TURKUENSIS

SARJA - SER. B OSA - TOM. 308

HUMANIORA

Animals in an Urban Context

A Zooarchaeological study of the Medieval and Post-Medieval town of Turku

Auli Tourunen

ACADEMIC DISSERTATION

To be presented, with the assent of the Humanistic Faculty of the University of Turku, for public examination in Tauno Nurmela Lecture Hall on April 26th , 2008, at 12 o'clock noon.

TURUN YLIOPISTO
TURKU 2008

From the School of Cultural Research
Department of Archaeology
University of Turku, Finland

Supervisors:

Professor Jussi-Pekka Taavitsainen
Department of Archaeology
University of Turku

Jan Storå PhD, Associate professor
Osteoarchaeological Research Laboratory
University of Stockholm

Reviewers:

Pirkko Ukkonen PhD
Department of Archaeology and Ancient History
Historical Osteology
Lund University

Lembi Lõugas PhD
Institute of History
University of Tallinn

Opponent:

Lembi Lõugas PhD
Institute of History
University of Tallinn

ISBN 978-951-29-3534-5 (PDF)
ISSN 0082-6987

TURKU UNIVERSITY
Archaeology

TOURUNEN, AULI: Animals in an Urban Context. A Zooarchaeological study of the Medieval and Post-Medieval town of Turku

Doctoral dissertation,
April 2008

Abstract

The aim of this study is to explore the role and importance of different animal species in Turku through an analysis of osteological data and documentary evidence. The osteological material used in this study is derived from two town plots in Turku dating from the 13th century to the 19th century. The osteological material deposited in Turku represents animals bred both in the town and in the surrounding landscape. Animal husbandry in SW-Finland can also be examined through a number of historical documents. The importance of animals in Turku and its hinterland are closely connected and therefore the roles of the animals in both urban and rural settings are examined.

The study has revealed the complexity of the depositional patterns in medieval and post-medieval Turku. In the different areas of Turku, characteristic patterns in the osteological material and different deposit types were evident. These patterns are reflections of the activities and therefore of the lifestyles practiced in Turku. The results emphasise the importance of context- awareness in the study of material culture from archaeological sites.

Both the zooarchaeological and historical sources indicate that cattle were important in animal husbandry in Turku from the Middle Ages up to the 19th century. Sheep were the second most common species. When taking into consideration the larger size of cattle, the dominance of these animals when it come to meat consumption seems clear even in those phases where sheep bones are more abundant. Pig is less abundant in the material than either cattle or sheep and their importance for subsistence was probably fairly modest, albeit constant. Goats were not abundant in the material. Most of the identified goat bones came from low utility body parts (e.g. skulls and lower extremities), but some amount of goat meat was also consumed. Wild species were of minor importance when it came to consumption practices in Turku.

The changes in Turku's animal husbandry patterns between the medieval and post medieval periods is reflected in the change in age of the animals slaughtered, which was part of a wider pattern seen in North- and Central Europe. More mature animals

are also present in the assemblages. This pattern is related to the more pronounced importance of cattle as a manure producer and a draught animal as a result of the intensification of crop cultivation. This change seems to occur later in Finland than in the more Southerly regions, and indeed it did not necessarily take hold in all parts of the country.

CONTENTS

ACKNOWLEDGEMENTS

This has been a long hard journey which has reached its end. During the past number of years, the passion for animals bones that originally led me to write my MA dissertation and then, as a natural progression, this thesis, has been challenged many times. I did not stand alone during this test; thus, I wish to express my gratitude to all the people that were there for me.

First of all, my deepest gratitude goes to my supervisor Jan Storå PhD. My work would not have reached the level it is now at without your ability to see the bigger picture and your contagious enthusiasm. You saw the cosmos in my chaos and showed me the way. I would also like to express my gratitude to my other supervisor, Professor Jussi-Pekka Taavitsainen, and the reviewers of my thesis, Pirkko Ukkonen PhD and Lembi Lõugas PhD for their valuable comments.

I owe my sincere gratitude to Professor Terry O'Connor and Professor Don Brothwell from the University of York for their help with the bone pathology identification.

The people in Turku Provincial museum and in Aboa Vetus et Ars Nova- museum provided me with the research material and helped with various practical issues. The thesis was financially supported by the Jenny and Antti Wihuri Foundation, Turku University Foundation and Artturi H. Virkkunen Foundation. I am grateful for this opportunity to have conducted full time research as a doctoral student.

The multi-disciplinary aspect of this thesis would not have been possible without the help of several people. I was privileged to be surrounded by helpful and inspired people, who kindly shared their knowledge and results with me. Liisa Seppänen, Janne Harjula and Heidi Kirjavainen-Heino – thank you for your time and effort. My great adventure in the fascinating world of historical documents could not have occurred without the help of the Department of Finnish History in Turku University – especially Suvianna Seppälä and Anu Lahtinen. Also Kari Uotila and Anna–Maria Vilkuna provided valuable help with the documents. I want to express my cordial thanks to Professor Kaisa Häkkinen for your kindness and guidance.

Along the way, so many of you have helped me through. A big, big thank you goes to Maija Wallén and Tuire and Kaarlo Nygrén in Ilomantsi Game Research Station. When I first saw your station I said I would never leave. In a way, I never did. Thanks to everyone that helped me to collect my reference material, especially to Paavo Tikkanen and Uma Aaltonen. All my friends in need, patiently listening to my dead animal monologues – I could not have survived without you. Sara and Damian, the newest members of the crew – you have seen the worst of it, in so many ways. If I am ever in a position to name a cattle breed, I promise to use my imagination. Tanja and Heli, providing shelter for the lonely traveller – thanks.

Finally, I would like to thank my family- you are extraordinary. Olli – thanks for the Marsusoft. Mum and Dad -not so many people would have tolerated their daughter collecting dead animals in your house without ever –*ever-* questioning my quest. Your love and support is my Northern Star.

Cork in March 2008

Auli Tourunen

List of Figures

List of tables

List of Appendices

Appendix 2	Properties of different contexts at Åbo Akademi. Consistence: Ma = manure, Mi = Mineral, O = Organic, W = Woodchip, V = Variable. Closed=deposited in a confined space inside a solid structure. Average weight of fragments and percentage of unidentified fragments. Signs of crafts: Y = yes, P = perhaps and N = no. Abundance of skeletons: X indicates ‰ -value over 10. Abundance of species: Three contexts where highest percentages of species were present. C = cattle, S/G = sheep/goat, P = pig. Number 1 indicates the highest proportion, 2 second highest and 3 third highest.
Appendix 3	Properties of different contexts at Aboa Vetus. Closed = deposited to limited space inside solid structure. Average weight of fragments and percentage of unidentified fragments. Signs of crafts: Y = yes, P = perhaps and N = no. Abundance of skeletons: X indicates ‰ -value over 10. Abundance of species: contexts where highest percentages of species. C = cattle, S/G = sheep/goat, P = pig.
Appendix 4	Number of infant and articulated skeleton specimens (in italics) in the contexts at Åbo Akademi excavations. The frequency of infant and articulated skeleton specimens is counted as per mil of the total number of specimens in each contexts.
Appendix 5	Number of infant and articulated skeleton specimens (in italics) in the contexts at Aboa Vetus excavations. The frequency of infant and articulated skeleton specimens is counted as per mil of the total number of specimens in each contexts.
Appendix 6	Chewed (C) and gnawed (G) specimens at Åbo Akademi excavations.
Appendix 7	Chewed (C) and gnawed (G) specimens at Aboa Vetus excavations.
Appendix 8	Proportions of high and low utility body parts at Åbo Akademi contexts. LU = large ungulate, SU = small ungulate. For closer definition of high and low utility elements see chapter 1.
Appendix 9	Proportions of high and low utility body parts at Åbo Akademi contexts when infant bones and whole skeletons are removed from the material. LU = large ungulate, SU = small ungulate. For closer definition of high and low utility elements see chapter 1.
Appendix 10	Proportions of high and low utility body parts at Aboa Vetus contexts. LU = large ungulate, SU = small ungulate. For closer definition of high and low utility elements see chapter 1.
Appendix 11	Proportions of high and low utility body parts at Aboa Vetus contexts when infant bones and whole skeletons are removed from the material. LU= large ungulate, SU = small ungulate. For closer definition of high and low utility elements see chapter 1.
Appendix 12	Number of identified specimens of major domestic animals excluding the infant bones and whole skeletons and their proportion at Aboa Vetus contexts. LU = large ungulate, SU = small ungulate. For closer description see text.
Appendix 13	Number of identified specimens of major domestic animals excluding the infant bones and whole skeletons and their proportion at Åbo Akademi contexts. LU = large ungulate, SU = small ungulate. For closer description see text.
Appendix 14	Number of all identified specimens of major domestic animals and their proportion at Åbo Akademi contexts. LU = large ungulate, SU = small ungulate. For closer description see text.
Appendix 15	Number of all identified specimens of major domestic animals and their proportion at Aboa Vetus contexts. LU = large ungulate, SU = small ungulate. For closer description see text.
Appendix 16	The number and relative proportions of sheep and goat specimens.
Appendix 17	The number and proportion of hare specimens counted from all specimens in

1 INTRODUCTION

1.1 Turku

The town of Turku is situated by the River Aurajoki in the coastal area of Finland Proper. From the early medieval period onwards Turku (with other areas belonging to modern Finland) was part of the Kingdom of Sweden until the early 19th century when it became an Autonomous Grand Duchy in the Russian Empire. Finland gained independence in 1917.

According to Hiekkanen (2003: 45-46) Turku was founded by the Swedish Kingdom, the Church and the Dominicans Order in the late 13th century. This would have been a part of the restructuring of Finnish society, contemporary with the construction of the castles at Turku, Häme and Vyborg. However, the early history of Turku is still debated. Gardberg presents the function of early Turku as a centre of trade (Gardberg, Heininen & Welin 2000: 36-37). Archaeological excavations in 2005 in the centre of Turku revealed some structures. Probably dating to the late 13th century, but the town seems to have expanded during the early 14th century (Pihlman & Majantie 2006: 49). Excavations continued in 2006; and a more accurate picture of the early development of Turku will be created when the results are analysed as part of ongoing post-excavation work. No pottery or other artefacts predating the 1280´s have been recovered from the excavations (Hiekkanen 2003: 45).

Nevertheless, Turku soon became the centre of ecclesiastical and secular power for the Swedish Kingdom on the eastern side of the Baltic Sea (Kuujo 1981: 17, 45; see also Hiekkanen 2003: 47-48). It was also an important trade center the most important exports being animal products, namely butter, hides, train oil and horses (Kallioinen 2000: 191). Kallioinen (2000: 49) has estimated the number of inhabitants in Turku at approximately 1700-2000 in the late 16th century. In the 14th century most of the townsmen in Turku were of German origin, but during the 15th and 16th centuries the number of local (that is, Swedish or Finnish) townsmen, reaching up to 98-99 % in the latter half of the 16th century (Kallioinen 2000: 139, table 3). The centrepieces of medieval Turku were the Cathedral, Town Hall and Dominican Convent, which had its own school (Gardberg 1971: 264; Hiekkanen 2003: 46-48). In addition, the inhabitants of Turku were educating their sons abroad: some are mentioned in the books of the University of Paris in the 14th century (Gardberg 1971: 310). Turku itself consisted of both wooden and stone buildings (Seppänen 2003; for further information see Kykyri 2003; Uotila 2003). Numerous fires have caused destruction in Turku during this period, and left traces in the archaeological record as burned remains. In addition, the fires provoked further building activities in the town (Seppänen 2003: 96).

In Finland Proper, the beginning of the medieval period is traditionally regarded as starting around 1150 AD. The border zone between the medieval and post-medieval is usually placed in the middle of the 16th century, but with some variation (e.g. Haggren 2000: 39; Kallioinen 2000: 24).

1.2 Aims of this study

This study aims to reveal what the role and importance of the different animal species in Turku was. This question is studied through the osteological data and documentary evidence, from the medieval to the post-medieval period and from an urban-rural perspective. "The animals in Turku" are seen as a complex entity, being formed by the interaction of different agents; a mixture of animals bred in the town itself and those brought from rural areas, the combination of domestic and professional needs, all framed by the cultural practices. Moreover, medieval and post-medieval Turku was a complex entity with segregated areas for different activities. These activities will be reflected in the bone material. Thus, the presence of handicrafts and variations in the social structure of different parts of the town during different periods is examined.

Animal husbandry in Turku has been studied previously. Several osteological assemblages from the Turku town area have been analysed (Kylänen 2001; Peltonen 2002; Poutiainen 1995; Poutiainen 1999; Tourunen 2002a; Tourunen 2004; Vuorisalo & Virtanen 1985: see below for more details). The results of these studies confirm the importance of domestic animals in Turku, especially cattle (*Bos taurus)*. Wild mammals were scarce or absent, with the exception of wild birds. Horse (*Equus caballus*), dog (*Canis familiaris*) and cat (*Felis catus*) bones were identified in small amounts. Besides giving information about the species present, previous studies have also highlighted the anatomical distribution of animal bones, the sex- and the age structure of the slaughtered animals and size ranges of domestic animals. Some light has been shed on different activities like tannery practices inside the town boundary, consumption patterns and the aims of animal husbandry. However, all previous osteological studies have been based on rather small assemblages. This has limited the possibility to create reliable sets of data. Moreover, these studies have often examined material from one site only, or material dating to only one period.

A picture of animal husbandry in Finland and especially in Turku can also be formed through a number of historical documents. However, many questions are left unanswered if literary sources only are used. To begin with, the documentary evidence is scarce before the 16th century. Moreover, these sources have usually been created by the Crown for other purposes than the description of animal husbandry or animal utilization. Information about strategies in animal husbandry and every-day life is usually missing. Species like dog and cat occur only occasionally in the documents, and their presence in Turku is obscured if only written sources are used.

Information about animal husbandry from written sources has been studied previously, but these again have concentrated on a limited subject or period and the information gathered from historical sources summarised (e.g. Nikula 1971; Tornberg 1973). The combination of osteological data and written sources is not a simple or easy task. The very nature of these sources (fragments of bones versus written documents) is different. However, they provide a different type of data and different keys to the question in hand: the importance of animals in Turku.

In order to create a more comprehensive picture of the importance of animals and animal products in Turku, a zooarchaeological study was conducted. In the present study, two large faunal assemblages dating from the 13th century to the 19th century were analysed, deriving from the Åbo Akademi and Aboa Vetus sites. The Åbo Akademi site is situated on the SE side of the Cathedral, while Aboa Vetus is situated near the river Aurajoki (figure 1). Archaeological finds from the Åbo Akademi site indicate a wealthy settlement (Pihlman 2003: 73), and at the Aboa Vetus site remains of stone and brick buildings imply that this area was also prosperous (Uotila 2003). The large body of material deriving from these two locations and dating from the medieval and post-medieval periods made it possible to utilise a wide variety of analytical tools, as well as studying the variation in time and place. Moreover, the purpose of species occurring only occasionally in the material, such as cat, dog, horse and wild animals can be studied in more detail.

Turku was not self-supporting when it came to animal products, but some of the animals consumed in the town were derived from the surrounding rural area. The complex network of urban and rural production and consumption will be examined. The subsistence strategies reflected in the osteological material are examined: the large body of species-, age- and sex data produced by this study enables the analysis of the animal husbandry strategies. In addition, the meaning of wild animals in urban contexts is explored.

However, animals were not merely objects of economic value and manipulation. They also had a meaning beyond rational utilisation. Even if these kinds of meanings are difficult to ascertain through the osteological material, they are more evident in the historical sources. An attempt is made to highlight the underlying criteria when categorising the animals in these historical records. Which properties of the animals were valued highly? In order to gain an impression of the physical properties of the animals in Turku, their outer appearance, such as size, horns and colour is examined.

The observed pattern of animal utilisation in Turku will be compared to several other assemblages from Finland, Sweden and Estonia. The aim of this comparison was to search for similarities and differences in the animal husbandry and consumption patterns in different countries and locations as well as social and economical differences.

In the present study, the cultural background of animal husbandry in Finland Proper and the previous osteological studies are presented first. Next, the challenges of combining historical sources and osteological data are examined and consulted sources and materials are presented. The animal husbandry as it is known through the historical sources is presented as well as the theoretical background to osteological studies. In order to understand the formation processes that have affected the osteological material, the taphonomic history of the contexts is examined first. In the results section, the abundance of animal species is studied. In addition, the anatomical distribution, age, sex and size data is presented, as well as pathological changes. The signs of craft activities in the material are examined. The discussion combines the data available from osteological analysis and the data from written sources in order to study the importance of animal species and the strategies and local adaptations of the animal husbandry. Finally, this data is compared with assemblages from Finland, Sweden and Estonia, and with other European data.

1.3 Cultural background of Finland Proper

By the early Middle Ages Finland was divided into two different agricultural zones; the western field cultivation area, the eastern border of which followed the distribution of fine grained soil types (clay and silt), and the eastern slash and burn- cultivation area (Orrman 2003a: 91). Turku and its surroundings belong to this western cultivation zone, which formed the most North-easterly part of the West European field cultivation culture (Orrman 2003a: 91). To be more specific, Turku belongs to the Finland Proper cultural area, which historically has been the centre of Finnish cultural and economical development, partly due to contacts outside of the Finnish cultural area (Talve 1990: 395-396).

In medieval Finland Proper, a two-year rotation plan was the major cultivation method (Orrman 2003a: 92-93). In the early Middle Ages barley was the most important cultivation plant, but during the medieval period the importance of rye increased considerably (Orrman 2003a: 97). A typical feature of this area was the use of draught oxen (Vilkuna 1936) and some other types of agricultural utensils or food types, for example certain plough and sledge types, frame cheese and sausages (SKKK: 62, 112, 116, 140; Talve 1990: 396).

There were some differences in animal husbandry practices between various parts of Finland. The use of draught oxen in Finland Proper has already been mentioned above. Cattle were an important manure producer within the Western field cultivation area, but not in the eastern slash and burn area, where cattle were less connected with crop cultivation (Talve 1990: 78-80). In Central-Ostrobotnia animal husbandry was the main form of subsistence, due to the abundance of good pasture (Talve 1990: 400). Possible regional differences should thus be remembered, when comparing information form different locations in Finland, or between Finland and Sweden. Some of the main differences will be discussed in more detail in later chapters.

1.4 Animal husbandry in different sources

In the past, animals and animal husbandry has provoked the interest of scholars from different scientific disciplines. From their own perspectives, researches from diverging fields such as archaeology, biology, agricultural science, ethnography, history and linguistics have studied human-animal relationships. Therefore, many different sources are available when exploring the importance of animals, all providing slightly different insights on the subject. All these perspectives are used in the present thesis in order to complement the osteological data. However, the historical sources are the most abundant and versatile for the present work. Even if the main emphasis is zooarchaeology, the historical and ethnological sources have been used as a complement when osteological data is scarce or even lacking. A survey of the data available from historical sources is presented to gain insights into the importance of animals and animal resources in Turku and its surroundings.

1.4.1 Animal husbandry in written sources

Many studies concerning animal husbandry in light of historical research have been published in Finland and Sweden (e.g. Myrdal 1999; Myrdal & Sten 1994; Säihke 1963; Tornberg 1973; Vilkuna 1998). Several of these have summarised parts of the original archival material (e.g. Hausen 1881; Kivistö 2000: 74; Säihke 1963; Tornberg 1973; Vilkuna 2003). The most important sources in Finland are tax rolls, accounts of castles and landed estates and estate inventory lists such as the Silver tax rolls of 1571 (Fi: Suomen Hopeaveroluettelot), and accounts from the castles of Häme and Kuusisto and estate inventory lists from Oulu (Fi: Oulun kaupungin perunkirjoitukset).

Examining the importance of animal husbandry in Turku is a complex matter. The importance of animals was probably different for each group, be they the urban dwellers, rural folks, wealthy merchants, or poor craftsmen living in the town. A picture of animal husbandry and the utilisation of animal resources in Turku and its surroundings should be formed by using both historical and ethnological sources as well as through the osteological analyses of faunal remains. The mainstay of animal husbandry in Turku was probably located in its rural hinterland and therefore an understanding of the rural setting is essential for the interpretation of the osteological material found within the town. Historical sources include some information concerning breeding strategies, animal care and status in the society. The zooarchaeological record provides insights into similar matters, but also sheds light on other elements.

The value and status of animals and their role in subsistence were closely linked. Historical sources reveal how different animals were classified and valued in economic terms. The horse was considered the most valuable domestic animal, followed by cattle (e.g. Suomen hopeaveroluettelot; Oulun kaupungin perunkirjoitukset). Horses were taxed by their value, which could vary considerably (from 2 to 30 marks) (Suomen hopeaveroluettelot, Uusimaa). Three different categories of horses are mentioned; horses, mares and foals. It seems that mares were not regarded as highly as "horses", with 'horse' apparently meaning stallions and geldings. In the documents cattle are usually subdivided into detailed groups such as *calves* (which is a rare group in the records), 1-4 (sometimes 5)-year old *heifers* and young *oxen*, and adult *bulls*, *oxen* and *cows* (e.g. Eerik Flemingin maakirjat; Suomen Hopeaveroluettelot; Grotenfelt 1897; Hausen 1881; Vilkuna 1998). One of the most detailed descriptions is found in BFH V: 476 (Bidrag till Finlands Historia). For some reason bulls are not mentioned in the silver tax rolls of 1571. They are included in the later tax rolls from the 17th century and onwards (Luukko 1958: 100-101). Other categories of animals are described in less a precise manner.

From the 18th century estate inventory lists for the town of Oulu, some information can be gathered about the value of cows of different ages (Oulun kaupungin perunkirjoitukset). The category "old" can be seen as either a negative or a positive attribute. For example, in an estate inventory list from the year 1771 an "old cow" was priced at 42 dr (dr = Sw: daler) while a "younger cow" was only worth 33 dr. Sometimes "old" appears to be a negative adjective, as in an estate inventory from the town of Tornio in 1775, when one "old, limping cow" is mentioned (Tornion kaupungin pesäluetteloja 1666-1800). In the inventories cows were sometimes divided into "better" and "worse" animals. The quality of a cow was therefore not simply the function or the age of the animal.

Some information is available about the age of steers and oxen. A solitary document dating to the 16th century describes some farms and their cattle in detail, following the confiscation of the property from its owners. Here oxen and steers aged 2, 4 and 5 years as well as steer calves are mentioned (Grotenfelt 1897: 104-105). The fact that 5 year old animals were referred to as steers rather than ox is of particular interest. According to ethnological data from Finland, a steer, that is a young oxen (Fi: kalpehärkä) was 1 ½ – 2 years old when training for traction work began, with the younger animal usually paired with an older and more experiences oxen (Vilkuna 1936: 60-61). This training in the Baltic countries begun at the age of three (Viires 1973: 441) and in Sweden (again according to 16th century sources) at the age of four, though the transition to full oxen took some time (Granlund 1969: 108; Myrdal 1999: 254).

Ages of pigs (*Sus scrofa*) are often reported in the Oulu estate inventory lists, and in this case age does seem to have been the most important factor when valuing the animals (Oulun kaupungin perunkirjoituksia). Here the term "old" does not by any means mean "poor", on the contrary: older pigs were valued higher than younger ones. This is rather logical: compared to their modern descendants medieval and post-medieval pigs were later maturing, slow growing animals; thus older animals yielded more meat.

No sex division is made in the rolls between male and female sheep (*Ovis aries*) or pigs, but female and male goats (*Capra hircus*) are separated, even if they were taxed at the same rate. This implies that the role of female and male pigs and sheep in animal husbandry did not differ notably, but the role of female and male goats did. In the later tax rolls different monetary values are sometimes given for sheep and goats (e.g. Melander 1897: 212; Vennola 1901: 163). The economic value of the animals varies in the historical documents, but usually the following order is given; sheep, goat and pig (for example Eerik Flemingin maakirjat; Suomen hopeaveroluettelot; Oulun kaupungin perunkirjoitukset). This, however, does not necessarily reflect their financial value alone (see Vennola 1901: 163) but also a more broad rank order of status.

1.4.2 Previous zooarchaeological studies in Finland and neighbouring areas

A number of osteological analyses are available from Turku. The faunal assemblage from the Old Great Market (Vanha Suurtori) was analysed by Poutiainen (1999). The assemblage is of relevance to the present study because of its date (phase A: 1275-1330, B: 1330-1500, C: 1600-1730) and the location between Åbo Akademi and Aboa Vetus (Poutiainen 1999: 66). However, the assemblage only comprises a total of 28 kg bones. Another interesting although small assemblage, Mätäjärvi, was analysed by Vuorisalo and Virtanen (1985). The site was situated near Lake Mätäjärvi ("the Rotten Lake") in a more remote area of Turku. The Layers date from the mid 15th century to the post-medieval period (Pihlman 1989: 71). For the excavations at Turku City Library some osteological small screen-samples were analysed, which produced a large amount of fish bones (Tourunen 2004). The rest of the osteological material recovered from this excavation has yet to be analysed.

From the Åbo Akademi excavations the faunal remains in some of the contexts (M 504, M 172 and M 19) were previously analysed (Peltonen 2002; Tourunen 2002a). Context M 504 dates to late 14th century – early 15th century and corresponds with phase 1 at Åbo Akademi used in the present study. The faunal assemblage included a total of 236 kg of bones (Tourunen 2002a: 40). Context M 172 dates to the early medieval period while M 19 dates to the post-medieval period (Peltonen 2002: 19). The exact size of the assemblages cannot be established, but the total weight of both must be less than 122 kg (see Peltonen 2002: 19). In addition, samples of bones from birds and wild animals were analysed from various contexts of the Åbo Akademi material (Kylänen 2001). Since more than six tons of bone material was recovered in the Åbo Akademi excavations (Pihlman 2003: 71), these studies have dealt with rather limited samples. In addition to this work a small part of the faunal assemblage from the Aboa Vetus site has been analysed (Poutiainen 1995) but the preliminary study was performed without a reference collection and only on a sample assemblage from each context (Poutiainen 1995: 30). In the present study, all faunal remains from the Aboa Vetus excavations were re-analysed.

There are not many zooarchaeological studies of medieval and post-medieval assemblages from Finland outside of Turku (table 1). Moreover, most of the previously studied materials are small (few exceed over 100 kg) which hinders reliable comparisons. However, information is available from the towns of Helsinki, Pori, Oulu and Tornio (Puputti 2005; Puputti 2006; Söderholm 1999; Tourunen 2000a; Tourunen 2000b, Tourunen 2002c) and the ecclesiastic sites of Kuusisto bishops castle and the Franciscan monastery of Kökar (Fisher 1996; Mutikainen 1989). The Helsinki assemblage consists of 62 kg of bones recovered from the 17th century yard area (Tourunen 2000b). The material from Pori, 19 kg in total and dating to the 16th-19th centuries, also represents urban domestic waste (Tourunen 2000a). The material analysed from Oulu, in total 659 fragments dating to the 17th and 18th century, derives from two excavation areas of different social status, a more and a less prosperous one (Puputti 2005: 77). The material from Tornio, 8453 fragments, derives from two excavations, and dates to the 17th century and early 18th century (Puputti 2006:19).

The Friary site at Hamnö on Kökar, situated on the Åland Islands was occupied in the medieval and post-medieval period, first as a Franciscan friary and later as a Lutheran parish church (Fisher 1996). Excavations have yielded a total of 14953 bone fragments, derived from two different contexts, a waste pit and the refectory (Fisher 1996: 6). Kuusisto castle was controlled by the Bishop during the medieval period (Hausen 1881). The analysed material, a total of 30 kg, was recovered in two excavation areas, one situated outside of the defensive walls and one inside (Mutikainen 1989: 1, 5, 8 & 12). In addition to these analyses, part of the bone assemblage recovered from the manor of Suitia, Siuntio have been analysed (Tourunen 2001). A large collection of cattle metapodials dating to the early 16th century were recovered from a cellar.

Some studies on animal husbandry in urban contexts from neighbouring areas is available. Osteological material from the towns of Skara (Vretemark 1997), Birka (Wigh 2001) and Lund (Ekman 1973) have been used as comparative assemblages for the material from Turku. Some studies of urban bone assemblages from the towns of Tartu and Pärnu from Estonia are also available (Maldre 1997 a and b).

1.4.3 Combining historical sources and osteological data

Only a few studies have combined both historical sources and osteological data in detail. The examination of historical sources in combination with zooarchaeological data can shed light on different aspects of animal husbandry and the importance of different animals (e.g. Myrdal 1997). It is advantageous to gain different perspectives, although direct comparisons between the two data sets remain difficult. MacKinnon (2004) used written sources from Roman Italy to study the production and consumption of animal products in different parts of Italy. The difficulties and possibilities in combining these two different types of data have been examined by Albarella (1999) and Myrdal (1997). Doll (2003) considered both written and pictorial sources in her research of butchering procedures in Germany. Thomas (2005) explored the animals and economy in Dudley Castle through examination of both written and osteological data.

According to MacKinnon (2004: 16-19), the intended audience affected the content of the texts and, in addition, the temporal and regional differences in texts may limit their value as references. Finally, different sources and their reliability should be considered individually, on a case-by case basis. Even if MacKinnon's sources differ from those found in Finland, his conclusions have a general relevance. The reliability of Finnish historical sources, especially different tax rolls, have been considered in a number of studies (for discussion see Tornberg 1973: 9-33).

Historical sources usually describe live animals and sometimes pieces of meat or hides. The osteological material consists of fragments of bones from slaughtered or hunted animals. Albarella (1999) has provided important insights on these matters. He points out that the proportion of living animals in historical documents and the proportion of different species found in archaeological excavations are not directly comparable, e.g. if the life expectancy and the age of slaughter of the two species are different.

This point can be demonstrated by using an example. During the lifetime of one horse numerous pigs can be slaughtered. Let us imagine a small farm that owns one horse and each year buys, raises and slaughters one pig. Each year a Crown official comes to make an inventory list and each year one pig and one horse are counted, lets say, during ten years. From historical documents we have a series of documents showing a steady rate of 50% horse and 50% pigs raised on this farm. However, if we excavate this place we would find some ten times more pig bones than horse bones. Efficient reproducers would therefore be over-represented in the bone material or under-represented in written documents- depending on the point of view.

Curiously enough, this seems not to be true with the example Albarella (1999) gives. Here the number of sheep given in the historical documents is remarkably *higher* than in the osteological materials. This discrepancy should lead to the critical overview of both sources of information.

In addition, Albarella (1999) compares written documents and osteological results considering slaughter and meat disposal, as well as discussing cases when animals are missing in the historical records and missing in the archaeological record. The careful study of historical records can reveal some insights into the depositional history of the bones found in archaeological excavations through information on the slaughtering practices, meat processing, and craftsmanship. Animal species are also represented differently in these two types of sources. For example, the historical sources mention dog and cat very rarely, but these are often found in the osteological material. On the other hand, some species are difficult to trace in the osteological material, but occur in historical sources. Albarella (1999) mentions donkeys and goats as examples of this, and for Finland the wild fauna, especially the fur bearing animals, can be added to the list.

Some other aspects should be considered when comparing written data and osteological material. Osteological material has usually been deposited over a long period of time. Some exceptional deposits can be produced during a very short period such as one day, but usually one context or feature consists of bones deposited during years, even tens or hundreds of years. Moreover, the single contexts are usually united into larger units such as phases. Thus, the typical bone assemblage represents on average several decades or even hundreds of years, while the historical sources typically describe a situation during one specific day or summarise the events during one year. If the year in question or the described situation is typical or not is generally unclear. Sometimes records are available from several years and fluctuations can be studied. For example, in the castle of Hämeenlinna the proportion of milking cows varied from 17,6% to 30,6 % of the livestock between the years 1540-1571 AD, the average being 23,1 % (Vilkuna 1998: 271-272). Moreover, goats are only present between the years 1540 and 1546 AD (Vilkuna 1998: 271-272). The picture formed from the historical documents can therefore be dependent on the year used for comparative analysis.

1.5 Animal husbandry in the light of historical sources

1.5.1 Animal care

One cattle breeding experiment carried out in the 18th century gives valuable insights into the practices of cattle keeping (Niemelä 1998: 256). The purpose was to raise and feed one calf with special care: it was fed with milk and hay, the floor of the shed was kept dry and clean and the animal was regularly cleaned. All these efforts were apparently considered exceptional (Gadd 1769; see also Niemelä 1998: 256). The animal grew larger than the other cows and produced more and better (that is, fattier) milk. Usually, calves were not allowed to suckle their mothers for a long period. They were fed with a little milk at first but this was soon exchanged for a flour drink (Gadd 1751: 132-133).

Pigs were not actively raised but rather left alone to roam around and look for their own food. In fact, in the years of 1547 and 1626 there were concerns about pigs and dogs digging up bodies in the churchyard in Turku (Ruuth 1923: 176). It is most probable that pigs were running loose in the yards and in the streets. In the town of Pori loose pigs and piglets were banned several times in the 16th century but apparently with little success (Ruuth 1958: 299). However, some shelter was offered to pigs. In the 17th century in Turku one pig house is mentioned in the records, and is again seen in the town of Oulu in the 18th century (Oulun kaupungin perunkirjoituksia: 303, 305; Utdrag ur Åbo Stads Dombok 1638: 42).

1.5.1.1 Feeding

The careful division of cattle in the written sources into several groups gives us an idea of their complex value and importance. Cattle were kept in the rural area of South-West Finland mainly for manure and traction, *i.e.* in order to serve agricultural needs (Nummela 2003: 176; Soininen 1974: 201). Even if butter was an important tax product, in order to get sufficient manure farmers were forced to keep more animals, even though their scarce food resources did not allow them to be adequately fed. This compromise resulted in farmers having plenty of ill-managed animals. From the farmers point of view butter and meat were seen as secondary products with less importance for the direct subsistence economy (Nummela 2003: 176; Soininen 1974: 201, see also chapter 1.5.3.1). The importance of horse and cattle compared to the other domestic animals is also reflected in the feeding practices. Hay was not cultivated; rather it had to be collected from locations such as natural meadows and roadsides. Therefore, hay was scarce and was mainly reserved for horses: only limited amounts of hay were given to cattle, preferably to the milking cows - oxen were not used during the wintertime and therefore fed mostly with straw (Nummela 2003: 176; Säihke 1963: 48-49; Vilkuna 1998: 128). Oat was grown as fodder but was reserved for horses (Vilkuna 1998; 101).

Cultivation was heavily dependent on the number of cattle available and the manure they could produce. The need for manure forced people to keep as many animals as they could. The amount of cattle that could be kept was dependent mainly on the amount of fodder that could be collected for the winter (Nummela 2003: 176; Soininen 1974: 201; Säihke 1963: 48; Tornberg 1973: 140). The balance between the winter-fodder and the number of livestock kept was one of the most central issues in the medieval and post-medieval animal husbandry.

In Finland, livestock had to be kept indoors and fed with hay or other fodder for approximately seven months of the year due to frost and snow cover, with this period usually running from the end of September to the beginning of May. In the landed estates of Turku castle during the 16th century the winter feeding period was 30-31 weeks (Säihke 1963: 48; Vilkuna 1992: 125, 269; Virtanen 1938: 4-5). The conflict between the number of cattle and the fodder supply often led to animal starvation. Cattle were fed with straw, dried leaves, horse manure, and anything that kept them alive (Szabó 1970: 26-28; Säihke 1963: 49; Virtanen 1927: 68). Sometimes even old straw roofs were torn down in order to feed the animals in the spring (Kalm & Cavander 1753: 14; Soininen 1974: 224). After the long winter in the dark and cold cowshed animals were sometimes so weak that they could not walk out without assistance (Soininen 1974: 224-225; Säihke 1963: 48-49). In the early spring and later after the harvest animals could graze in the field and yards, but in the summertime they were herded in the woods (Virtanen 1938: 4).

Horses are sometimes described in written sources by their use ('draught horses' or 'mounts') or their equipment are described (for example 'with summer collars') (e.g. Oulun kaupungin perunkirjoituksia, BFH IV, 186ff). In particular, draught horses were not necessarily needed in the summertime, when oxen could be used for traction (Virtanen 1938: 114). Horses could therefore be put out to pasture on the islands or, further inland, simply released to the woods where they could unite into larger herds (Vilkuna 1935: 157; Vilkuna 2003: 53; Virtanen 1938: 115). However, some animals were apparently lost in the woods (Oulun kaupungin perunkirjoituksia: 138, 152; Szabó 1970: 90).

If suitable islands were available, such as in the coastal or lake-districts, sheep were often transported to them in the summertime or they were left to graze in the woods (Säihke 1963: 50-51; Vilkuna 1935: 155-156; Virtanen 1938**:** 108). In the winter, sheep were fed with dried leaves and with a little hay, if any was available after the feeding of the horses and the cattle (Säihke 1963: 48, 62; Vilkuna 1998: 128).

The historical records reveal less information about the feeding of goats and pigs. In the crown estates pigs were sometimes fed with grain (Kivistö 1999: 51; Seppälä 2002: 137; Säihke 1963: 63). The feeding of goats was not especially difficult. They managed with simple food such as twigs and branches (Grotenfelt 1918: 185; Gadd 1783: 109). Goats, as well as pigs, were capable of finding their own food. However, it seems that the goats were sometimes too opportunistic and damaged the crops of neighbours. Goats were often the subject of court actions and keeping them was occasionally restricted **(**Gadd 1783: 109; Tornberg 1973: 63-64). Pigs could also damage crops if they got into the fields. The records mention several pig owners who had to pay compensation for damage (Ranta 1975: 517).

1.5.1.2 Maturation

The often poor care animals experienced caused them to remain small and as a result their physical development was probably slow. The conditions necessary for animal breeding were affected by several factors, which had consequences when it came to the growth and maturation of the animals.

In the tax rolls and other documents, the careful definition of young cattle of up to four or even five years is noteworthy. The maturing of cattle obviously occurred later than nowadays, but at which age did the animals mature and enter their productive age, for example for traction, milk production or slaughter? Some sources claim that heifers (Fi: hieho, Sw: kviga) were served only in their third or fourth year (Hausen 1881; Myrdal 1999: 254). In the inventory accounts of the landed estate of Kuusisto, eleven four year old heifers are mentioned as "becoming cows" (Sw: "äre bleffne köör" Hausen 1881).

However, a cow which had calved once could have been called a heifer, as is mentioned in Oulu in the 18th century (Oulun kaupungin perunkirjoitukset; 548). This estate inventory was made at the end of July and apparently the young cow had calved three or four months earlier. Unfortunately, we do not know the exact age of this animal, but it had been valued as less expensive than the other cows, even the poor or the barren ones. The heifers, which had calved once, were sometimes also taxed at a lower rate than other cows (Vennola 1901: 29-31). Therefore, it seems reasonable to expect that some of the animals classified as heifers had already given birth. An animal that had calved once probably produced less milk than an animal that had calved several times (Gadd 1769: 53). In the 18th century sources a cow that conceived in her second summer is mentioned (Gadd 1769: 52), but this animal was part of an experiment and even calving during the third year was considered unusually young.

Judging from the historical sources it seems apparent that the physical maturation of cattle occurred later than it does today (when heifers are inseminated while only 15 months old) and perhaps later than in the 19th century (Myrdal 1987:28; Vretemark 1997: 175). According to the historical records, the age of four years seems to represent a boundary of sorts, which occurs in both tax records as well as in inventory reports, and which was used for both male and female animals. It seems that four years can be used as an approximate age when cattle were considered adults, with a fully adult capacity. This seems to hold true even in cows had started to produce milk and oxen had been used as draught animals at a slightly younger (or even later) age.

It has been shown that medieval pigs matured at a later date than their modern counterparts do (Kulturhistorisk lexikon för nordisk medeltid (KL) XVII; 568). Modern wild boar sows can give birth in their first year, but more often produce their first litter in their second year (Jensen 1994: 280). In traditional Finnish pig breeding a method called the "winter pig system" was known, where two pigs, one sow and one boar were kept over the winter to produce a new litter (Virtanen 1927: 61). In this system, sows produced offspring in their second spring. In the Kuusisto castle manor inventory two old sows and seventeen young sows are listed, as well as ten piglets (alive) and three dead ones (Hausen 1881). When comparing the amount of offspring to the amount of sows, it seems likely that not all of the young sows had given birth.

1.5.1.3 Reproduction

The poor care of animals may have had other consequences aside from late maturation. Swedish landed estate records reveal that only ca 70 % of cows calved each year and that only 65-70% of the calves survived (Norrman 1998: 124). Björnhag and Myrdal (1994: 76-77, 88) present similar observations. The mortality of lambs was 17% and that of piglets 31% (counted from the information given in their article). Calves are not always present in the Oulu estate inventories, but when they are, their numbers are noteworthy. For example, in July 1781 one small herd of seven milking cows, two heifers and one calf was listed (Oulun kaupungin perunkirjoitukset). As cows are mentioned as “milking” (Sw: mjölkande) one would expect them to have calved earlier in the summer, but only one calf is mentioned; it is possible that the other may have died. Some calves most likely died of natural causes, but other could have been slaughtered (see below). The presence of barren animals in the livestock is evident in the primary documents, for example in some of the butter tax lists (Vennola 1901: 30-31). In addition, it is likely that miscarriage and infertility also occurred given the conditions the animals lived in.

In the crown estates in Sweden, calving occurred throughout the year in order to produce butter continuously (Björnhag & Myrdal 1994: 80). In Finland the situation was different, and at least among ordinary farmers cows could produce milk only in the summertime; due to poor feeding during autumn and winter the production of new calves was avoided (Grotenfelt 1918: 31; Säihke 1963: 67; Vilkuna 1935: 159). Calving principally occurred between March and May, though the information in the written records is scarce (Tornberg 1973: 19-20). One possible autumn calf is mentioned in Oulu in year 1755 (Oulun kaupungin perunkirjoituksia).

There is limited information about the calves and their use as food. In Häme castle calves were slaughtered on special occasions for food or provisions (Vilkuna 1998: 134). We know that in later periods traditional Finnish food practices did not involve the consumption of calves, with animals that had lived for more than one summer being preferred (Talve 1973: 43-44; Vilkuna 1935: 159). However, the stomach of newborn or 3-4 day old calves could have been used for rennet (Grotenfelt 1918: 131). The Oulu estate inventory lists a “milk calf” (Sw: mjölkkalv), but it is unclear if this was an animal fed for slaughter or just a very young animal still feeding on milk (Oulun kaupungin perunkirjoituksia). It was valued very low in the list, which implies the latter alternative. The document is dated to the beginning of September 1755, which means it was either a rare autumn calf or it had been fed with a special diet over the summer, to be slaughtered as a delicacy (vealer). Since calf hides were an important product, dead animals were probably skinned before the animals were discarded, if not consumed (Grotenfelt 1887: 149-150; Suomen hopeaveroluettelot Satakunta: 90-95; Vilkuna 1935: 159).

The lambing of sheep probably occurred in spring. “Sheep with lamb”, which could be interpreted as a ewe and her offspring are mentioned in March at the earliest (Oulun kaupungin perunkirjoituksia: 313). It seems that ewes produced one or two lambs (or one or two of them survived) but the information is too scare and unreliable to draw further conclusions. Modern Finn Sheep produce an average of 2,3 living lambs per ewe (Alasuutari & Syrjälä-Qvist 1998: 4).

From the historical sources it is apparent that pigs bred at various times of the year (Oulun kaupungin perunkirjoituksia). Half-year old pigs as well as piglets are mentioned in documents dating to all seasons. One detailed account is available. On the 3rd of

September 1782 two nine weeks old piglets are mentioned in Oulu, apparently, born at the beginning of July (Oulun kaupungin perunkirjoituksia). However, according to some sources and ethnological evidence spring breeding was the normal practice in Finland Proper (Tornberg 1963: 19-20).

1.5.1.4 Size and physical fitness

The scarcity of food caused animals to become small and lean. The withers height of Finnish horses was approximately 120-130 cm in the 17th and 18th centuries (Korhonen 1939: 386; Vilkuna 1967: 22). Unfortunately, the historical sources do not reveal any withers height estimates for cattle. However, the size, or rather the smallness of cattle is commented upon in some 18th century sources (Gadd 1751: 130; Gadd 1783: 108; Rudenschöld 1899: 53). Clarke (1997: 227) claims that the cows in Lapland were only slightly bigger than English suckling calves in the late 18th century. Carenius (1759: 53) concluded that the small size of cattle in the parish of Huittinen resulted from poor feeding; calves were fed with hay for their first year only (after which they were fed mainly with straw).

An impression of the size of cattle can be obtained from the historical records where data on the slaughter weights of animals has been reported. For adult cattle the slaughter weights given in the documents varies between 4 ½ to 14 *lispound* (Seppälä 2000: 124; Seppälä 2002: 136; Säihke 1963: 50; Tornberg 1973: 138). One *lispound, (Fi: leiviskä, Sw: lispund),* corresponds to 6,6 kg- 8,5 kg. Apparently the weight of one *lispound* changed from from one locality to another, for example 1 *lispound* in Häme was 1,5 *lispound* in Stockholm (Grönros et al. 2003: 101; Seppälä 2002: 147; Vilkuna 1998: 232). These figures are problematic, and it is not always clear if partial carcasses and fresh, salted or dried meat are being described, which all have different weights (Björnhag & Myrdal 1994: 85). The live weight of a modern animal is between 45-50% of the slaughter weight (Björnhagen & Myrdal 1994: 86). Säihke (1963: 50) estimates that the live weight of cattle would have been 125-170 kg (corresponding approximately 56 – 85 kg slaughter weight). In Sweden the slaughter weight of a cow (although with some reservation) has been estimated to be 70-80 kg in the 16th century (Björnhagen & Myrdal 1994: 86; Forssell 1884: 107-111).

One adult sheep produced approximately 1 *lispound* of meat (6.6-8.5 kg) while a lamb produced between a half to 1 *lispound* (3.3 -8.5 kg) (Tornberg 1973: 138; but see also Säihke 1963: 50 for lower figures, 8 pound (*Fi: naula)* or 3.4 kg). As with the cattle carcasses, it is difficult to judge if a whole or partial animal, fresh or conserved meat is being described. In 1999, the average live weight of 4-month-old lamb was 30 kg, and slaughter weight 19 kg (Savolainen 2000: 24-27).

1.5.1.5 Physical properties

Some descriptions of the physical properties of domestic animals are present in the historical sources. Unlike other domestic animals, horses are often described in some detail. The Oulu estate inventory lists provide us with plenty of information about the colour, size, sex and fitness of horses (Oulun kaupungin perunkirjoituksia). The horses in 18th century Oulu were a colourful pack, and this observation is supported by other documents (Vilkuna 1935: 153). In Oulu white, black (and "mice black"), grey, red (dark and light red) brown (dark brown, red brown, light brown and blackish brown) and "Sv. mörklett" horses are mentioned, the latter probably being horses of "dark" colour. Some other information on colour is also available. Horses could have white marks like blazes or a light, white or pendulous mane. One horse is described as a "red gelding with white spots" (Oulun kaupungin perunkirjoituksia: 383). Other attributes mentioned for horses are sex, age and fitness. It seems that horses did reach rather advanced ages. One horse is described as being almost 30 years old, and several are over 15 years of age. The physical fitness of the horses was commented upon, with very skinny, big, small, lame, weak and faulty animals being of note. For one animal we are even provided with a name; in 1796 the 23-years old "Grålle" is mentioned (Oulun kaupungin perunkirjoituksia: 495, 521). Detailed descriptions were probably complied to assist in determining the monetary value and for the later recognition of animals, as well as to avoid fraud by insuring proper taxation.

In the Oulu estate inventory lists the size, colour or the horns of cattle is sometimes mentioned (Oulun kaupungin perunkirjoituksia). In 1742 three cows were described in more detail; one "red cow with horns", one "small red- flecked", and one "white without horns" (Oulun kaupungin perunkirjoituksia: 145). In 1769 one polled animal is mentioned (Oulun kaupungin perunkirjoituksia: 322). Other colours, which appear in the estate inventory lists, are red and white, black and white and grey (Bouppteckningar i Helsingfors stad 1679-1808: 115; Oulun kaupungin perunkirjoituksia 1966: 428, 444). A curious list with cows names from Oulu is dated 30th of July 1799 (Oulun kaupungin perunkirjoituksia: 548). This mentions "better cows" named Pöykkäri, Valkko and Ruskia as well as "worse cows" named Junno, Mahopunanen and Fikoria. Several of the names suggest the colouring of the cattle and this small cowherd reflects the multicoloured nature of the cattle population at the end of the 18th century: "Valkko" is a name for a white cow, "Ruskia" for a brown one and "Mahopunanen" literally means "barren-red". Other descriptions of animals can be found from Ikaalinen, where in 1710 white-flecked and red-flecked heifers and red and black-flecked bull calves are mentioned (Vappula 1999: 91). In Merikarvia in 1815 cattle called Mustakorva ("Blackear"), Rödskin ("Redskin"), Svana (possibly from Sw. svan, swan, thus, white) and Svartsida ("Blackside") are mentioned (Rasila 2003: 420-421). The names of oxen also testify to the variation in colour: black, white, red and brown animals with various white marks are present in the 18th and 19th century nomenclature of the historical records (Vilkuna 1936: 67-8).

1.5.2 The urban lifestyle: animals in towns

1.5.2.1 Animals living inside the town boundaries

The historical documents tell us little about the role of animals in the towns prior to the 17th century, and even the data from later centuries is scarce. Livestock was abundant in urban environments during the medieval and post-medieval periods. Tornberg (1973: 90-91) estimates that the overall decrease in the number of livestock kept in Turku during the 17th century was associated with the growing number of proper town occupants without a connection to their rural surrounding, i.e. the population became less self-supporting. However, even in the 18th century plenty of livestock were kept inside the town boundaries (e.g. Nikula 1971: 397). The number and type of livestock kept in different towns and during different time periods has varied. Even if it is difficult to form a detailed picture of the role of animal husbandry in towns from the scattered historical data, they still provide very interesting insights into animals in an urban environment (e.g. Tornberg 1973: 176).

Animal husbandry inside the boundaries of Turku had somewhat different purposes than in the surrounding rural areas. The inhabitants in Turku were less dependent on agriculture than the surrounding area. For example, the need for draught oxen was small, and most of the cattle kept in town were probably milking cows (Tornberg 1973: 176). In addition, the need for manure was reduced with the neighbouring parishes buying manure from Turku (Mäntylä 1960: 329; Oja 1946: 126). Horses were common animals in Turku and in the 17th century their number varied between 17 and 92 according to the tax lists (Tornberg 1973: 177). The number of cows in Turku varied annually between 96 and 408 animals in the late 17th century (Ranta 1975: 868). Cattle were pastured outside of the town area with herders (Nikula 1971: 397-8; Virtanen 1938: 15). Some cattle were also grazed in the neighbouring parishes (e.g. Oja 1960: 124).

Sheep seem not to have been common animals in Turku during the 17th century, even thought they were common in the surrounding rural area. Only a few individuals are mentioned in the historical documents (Lindholm 1892: 27; Tornberg 1973: 91, 176). Apparently, sheep were more common in smaller towns like Rauma, Uusikaupunki, Tammisaari and Pori (Ruuth 1958: 296; Suomen Hopeaveroluettelot Uusimaa; Tornberg 1973: 91, 176). However, in 1571 sheep were also kept in Vyborg, which cannot be considered a small town (Suomen hopeaveroluettelot Karjala; 132-147). Some information is available about the breeding of sheep in 18th century Oulu, and sheep occur less frequently in the estate inventories than cows (Oulun kaupungin perunkirjoituksia). Due to the fragmentary information in the historical documents no uniform picture of the importance of sheep in the town economy can be formed.

Pigs were not raised to any great extent in the countryside, but they seem to have been very abundant in Turku (Suomen hopeaveroluettelot Varsinais-Suomi). In the 17th century they were approximately as common as cows inside the town boundary (Tornberg 1973: 176). In Vyborg pigs were also numerous, with some of the inhabitants owned as many as 13 pigs in 1571 (Suomen hopeaveroluettelot Karjala: 132-147). Pigs were also kept in smaller towns but to a less extent (Tornberg 1973: 176). Due to their diet, raising pigs in the closed quarters of a town was probably easier than with other animals. Pigs did not need hay or pasture and were to some extent self supporting.

The abundance of goats seems to vary considerably depending on locality and time period. In Turku one goat is mentioned in 1632 and 1633. This might even be the same individual (Tornberg 1973: 176). However, in the 18th century, goats were abundant in Turku (TMA GI: 27,28). In the 17th century goats were kept in Uusikaupunki, Pori and Rauma but not in Naantali (Ruuth 1958: 296; Tornberg 1973: 176).

1.5.2.2 Urban and rural interactions

1.5.2.2.1 Meat supply

Many townsmen owned farms near Turku. By 1336 Garhard Paris had bought a farm on an island near Turku (Kallioinen 2000: 155). From records in the silver tax list of 1571 it becomes evident that the townsmen owned farms in the nearby parishes, with the same being true during the 17th century (Suomen hopeaveroluettelot Varsinais-Suomi; Melander 1896: 456; Tornberg 1973: 97-98). It is reasonable to expect that the livestock of some of the townsmen in Turku was used to feed the households in the town. In addition to this meat, livestock was also bought from farms. The livestock then walked into the town and was slaughtered there. This practice has been described in the 18th century (Nikula 1971: 531-532) and in medieval Sweden (Vretemark 1997:112-113).

1.5.2.2.2 Professional needs

For some specialized groups of inhabitants the livestock had an importance beyond the basic utilisation of meat and milk. Slaughterers, tanners, shoemakers, merchants and other craftsmen all utilised animal products in a slightly different way than the common folk. Most of the animals or animal products used by this group were supplied from the rural area. In the historical records, some slaughterers are mentioned among craftsmen in the Middle Ages (Grotenfelt 1887: 41; Kallioinen 2000: 217). In the 18th century the administrative court of the town reported that city dwellers “for their poverty and because it has been the custom” (translation by the author) slaughtered their own animals themselves and only required help from professionals on special occasions (Nikula 1971: 531; see also Melander 1896: 498-499). Slaughterers were rare, and their occupation included permission for the retail sale of meat. Because the need for fresh meat was limited in this rather self-sufficient town, the slaughterers supplemented their income by selling meat (purchased from rural areas) to Stockholm (Nikula 1971: 531-532).

Crafts related to the leather-industry were also connected to animal husbandry. Shoemakers could tan their own leather (Hellichius 1986: 13). The same person could therefore treat hides, tan them and produce shoes: for example in Stockholm there were no specialised tanneries in the Middle Ages (Dahlbäck 1987: 87). Specialised tanneries are present in Turku from at least the beginning of the 18th century (Nikula 1971: 542-547). The furriers (Sw. *Skinnare*) obtained, tanned and sold all skins and furs except for cattle hides, which could be processed by tanners only (Hellichius 1986: 55; KL XVI: 515). More specialised was the chamois-leather maker (Sw. *sämskare)*, who produced chamois, a fat tanned skin (Hellichius 1986: 115). In 1573 Pietari (Peter) the chamois-leather maker is mentioned in Turku (Grotenfelt 1887: 151). Skins of female and male goats, sheep, elk and calf were used for chamois (Grotenfelt 1887: 151; Nikula 1971: 549). In contrast to the abundant information on leather and fur working, craftsmen related to bone and horn working are absent in the historical sources from Turku (Grotenfelt 1887: 41; Kallioinen 2000: 216-217).

For the merchants the rural area was a source for butter and hides, which were among the most important items exported from Turku to Stockholm and towns on the eastern coast of Baltic sea, for example Lübeck (Kallioinen 2000: 191). Cattle hides were evidently exported from Turku in the 16th century but the trade was probably established by the 15th century (Kallioinen 2000: 190-191). In the 16th century buck skins had a higher economic importance than cattle hides, which were the second most important (Grotenfelt 1887: 32-33, 152). Butter was an important export from the 15th century onwards, and was also an important tax good (Kallioinen 2000: 190-192; Kivistö 1999: 50).

1.5.3 The importance of animals in historical sources

1.5.3.1 Utilisation of cattle

A picture of the dual importance of cattle emerges from the historical sources. On the one hand, cattle were essential for agriculture as an aid in traction work and as manure producers. Thus, cattle were essential for the basic subsistence economy. On the other hand, the by-products like butter and hides were important as a monetary source and as a means to pay taxes. As Soininen (1974: 201) points out, the farmers and the authorities considered cattle differently. For the farmers, cattle were above all a part of agriculture, while the authorities also viewed cattle as a source of commodity products like butter and hides. These different requirements in some cases competed with each other.

The importance of butter is emphasized in many documents related to taxation or trade. The contemporary authorities were not concerned with how much milk a cow produced, but instead with the amount of butter one could produce from the milk (Arwidsson 1851: 108; Niemelä 1998: 156-157). Even if there were serious concerns about butter production, no foreign cattle were brought into Finland to the same extend as was seen with sheep (see below). In the 16th century a Finnish nobleman Iivar Fleming imported a "beautiful bull with blue back" from Gotland, but this animal was stolen and killed (Säihke 1963: 50). From the year 1800 there is information on "cattle of Dutch origin" (Oulun kaupungin perunkirjoituksia). These animals were not valued more highly than domestic animals. In fact, the cows' value was estimated so low that a printing error has to be expected. The given value of 4 Rdr should perhaps be 40 Rdr, which would be in line with the value of the domestic animals. It seems that milk production was highly dependent on the local care and feeding of the animals. Both in Sweden and Finland the milk production of the imported cattle decreased when animals were kept and fed like domestic cattle (Myrdal 1994: 26-27; Niemelä 1998: 257).

An examination of the products exported from Finland in the 15th and 16th centuries reveals that animal products were of great importance for the merchants. The amount of surplus that animal husbandry produced was probably highly dependent on natural factors which affected the feeding as well as the general health of the animals. The 17th and 18th century data testifies to strong fluctuations in the number of cattle, caused by hay failure and animal disease (Gadd 1783: 108; Soininen 1974: 220; Tornberg 1973: 43-49). Up to a third of the animals in a population may have died (Gadd 1783: 108; Soininen 1974: 220; Tornberg 1973: 43-49). It is highly likely that this situation had parallels in earlier time periods. These fluctuations would have affected trade.

The animals that died of natural causes were probably not used for food. However, sometimes the hides of animals that died of natural causes or as a result of attacks by beasts were evidently used. The inventory lists of the landed estate at Kuusisto mentions skins or hides of animals that had died of natural causes, which the estate had not been able to recover (Hausen 1881). From the 16th century there is information on some elk (*Alces alces*) hides that had been obtained from drowned animals (Melander 1920: 12). Von Linné (1732: 172) mentions animals that had died as a result of consuming the poisonous plants *(Cicuta virosa*, Cowbane, Fi. Myrkkykeiso) being skinned in Tornio. There are no records available which would enable us to ascertain if animals that died of disease were also skinned. The 17th century court book from Rymättylä mentions that it was illegal to leave the entrails or other parts of an animal that had died as a result of disease in a place where other animals (pigs) could eat them (Virtanen 1938: 117). Apparently, animals that had died of natural causes were often processed in some way, despite other sources claiming that these animals were not skinned (Tornberg 1973: 138). Butter production would also have suffered from the scarce fodder and health of the animals. There are large fluctuations in the volume of exported butter and the number of cattle hides exported from Turku in the 16th century (Grotenfelt 1887: 32-33, 151-153).

1.5.3.2 Utilisation of sheep

The historical sources describe sheep utilisation for milk, wool, skin and meat. Even the manure was collected as tax for the manufacture of saltpetre (Melander 1896: 414-415). The keeping of sheep for milk is somewhat unclear. It is mentioned in the 16th century documents, but probably the utilisation diminished during the 17th century (Säihke 1963: 62; Tornberg 1973: 139). The pasturing of sheep on islands dates back to at least the 16th century, but the tradition is most likely older (Iivar Flemingin maakirja: 5). Animals were kept on their own, and apparently no milking occurred during the grazing period.

The importance of wool is difficult to evaluate. The poor quality of the Finnish sheep's wool has been commented upon in many historical documents (Säihke 1963: 62; Vilkuna 1998: 164-168). Even if many animal products were exported from Finland, wool was not included among the most important ones. However, frieze fabrics and woollen artefacts were exported in some quantities (Grotenfelt 1887: 32-33; Kallioinen 2000: 191-192). Broadcloth was even imported to Finland (Grotenfelt 1887: 30-31). In contrast to butter, which was considered a luxury item, wool was essential in households for clothing.

The importance of sheep breeding grew in the Southern and Western areas of Finland Proper during the 17th century (Tornberg 1973: 66). One of the main reasons could have been the growing demand for wool in the broadcloth factory founded in Turku in the 16th century (Tornberg 1973: 66). However, the wool of Finnish sheep was not suitable for finer textiles and in this factory the wool of imported animals was used (Säihke 1963: 62; however, see also Oja 1944: 391).

Many efforts were made to improve the quality of the wool of Finnish sheep. By the 16th century sheep from location such as Sweden and England were imported to Finland and bred with the domestic stock in the hope of improving the quality and quantity of the wool (BFH V: 476; Eerik Flemingin maakirjat: 30; Säihke 1963: 62; Vilkuna 1998: 138). However, the quality of the wool was still poor in the 18th century (Niemelä 1996: 30-31). Foreign sheep apparently produced wool of a higher quality despite the more demanding ecological circumstances in Finland. However, they were seen as less sturdy and required different fodder to that supplied to the domestic stock (Myrdal 1994: 28; Niemelä 1996: 37). One of the main problems encountered by sheep breeders in the 18th century was the winter-feeding of the animals. Another problem associated with feeding was the small amount of animals that could be kept over the wintertime. This was an obstacle for breeding (Niemelä 1996: 34). The late spring wool had the potential to be of the highest quality, although this was dependent on the proper feeding of the animals (Niemelä 1996:

33). Usually the spring wool was scarce and dirty, and as a result, the main shearing occurred in the autumn (Gadd 1751: 132-133; Vilkuna 1998: 137). Hausen (1881) uses two different terms for wool, which could mean winter and spring wool.

1.5.3.3 Utilisation of goats

The historical sources provide some information on the breeding of goats. The data is of special interest because in the osteological material goat bones tend to be hidden among those from sheep. This is because of the difficulties in identifying goat from sheep bones, but also due to the dominance of sheep bones in medieval faunal assemblages.

Goats were not common in all parts of Finland. In the 17th century they were raised in the area covering the Southwest coast and Western inland area. In eastern Finland and the Western coastal area goats were scarce and may even have been absent (Luukko 1958: 111). It is possible that in South-Karelia it was forbidden to eat small calves, chicken, blood and goats, a custom probably associated with the Orthodox church (Vuorela 1975: 235 referring to Sirelius 1919 which, however, seem to lack such information). Even in Finland Proper the number of goats varied greatly between neighbouring parishes (Tornberg 1973: 61-63). Goats were rarely (if at all) used as tax goods, in contrast to live cattle and sheep (Kivistö 1999: 51-52).

Goats produced milk, skin, meat and hornsheats for handicraft. Milk was used for the production of cheese; in the 16th century the Crown was expecting ½ *lispound* in tax return on the cheese from one goat (Säihke 1963: 62). The meat and hide were also appreciated products. Goats were kept as inventory stock by the tenants, as revealed in the 16th century records from Erik Fleming's landed property (Eerik Flemingin maakirjat). Surprisingly, the rent to the landlord was not paid in by-products like cheese or hides but rather as "slaughter goats" ("slactgeth"). Other indications of goats as meat animals can be found in Bidrag till Finlands Historia (BFH) V: 476, where Sv. "Giethe kropper", goat carcasses are mentioned in Philippa Eriksdotter Flemings estate inventory list at the end of the 16th century.

According to the customs duty lists and tax lists available from various locations, including Turku, buck hides were an important export item (Grotenfelt 1887: 149; Nikula 1987: 308-309; Suomen hopeaveroluettelot Satakunta: 90-95). The reason for this might be the production of chamois leather from goat hides. Buck hides are of special interest because their proportion of exported hides is far higher that the proportion of goats in the living stock in Finland (Grotenfelt 1887: 32-33, 151-152; Suomen hopeaveroluettelot). In the tax lists from the early 17th century, "old" *i.e.* most likely full-grown bucks were the most valuable goats. Young bucks and old does were valued equally, while young does were the least valued (Vennola 1901: 163). It seems clear that goat hides and especially buck hides had a special value and they were exported more often than the hides from other domestic animals.

Traditionally goats were seen as “poor men's cows”, producing milk with only modest feeding and therefore suitable for poor people that could not afford to keep cattle (Gadd 1783: 109; Grotenfelt 1916: 185; Grotenfelt 1922: 22-23; Säihke 1963: 62). However, the tax lists from the 16th and 17th centuries indicate that the largest goatherds were found in the wealthier households together with several cows. Goat keeping was concentrated in certain geographical areas, where animal husbandry in general was an important source of livelihood (Suomen hopeaveroluettelot Uusimaa ja Varsinais-Suomi; Tornberg 1973: 63). The goats were by no means substitutes for cows. However, in the tax lists of 1751 and 1753 most of the taxed citizens in Turku had either a cow or goat (TMA GI: 27, 28).

Thus, the historical records indicate a complex picture of the importance of goats. On the one hand, goats were appreciated animals that produced milk with simple feeding and hides and horn for sale (Gadd 1783: 109). On the other hand, goats were uncommon or absent in some parts of Finland and sometimes even seen as harmful, destroying young forest (Gadd 1783: 109). It could be argued that goats did not produce anything unique or irreplaceable like sheep and cattle. Sheep were essential for wool while cattle were essential for butter and manure. Both sheep and cattle produced horn and hides. Goats can probably be seen as a some kind of supplementary animal, with goat being characterised as a kind of specialisation within animal husbandry.

Archaeological finds have revealed something more about the use of goats. According to Kirjavainen (2002: 349; 2003: 5, 14) among the Åbo Akademi textile finds some goat haired examples have been discovered. However, these have been found to be coarse textiles used to protect imported goods, and therefore not to be of local production.

1.5.3.4 Utilisation of horses and pigs

Horses are one of the most frequently mentioned animals in the historical sources and their great importance and value is evident (for example Suomen hopeaveroluettelo, Oulun kaupungin perunkirjoituksia). Notes on pigs are far rarer, and the monetary value of pigs seems to have been rather low (for example Suomen hopeaveroluettelo, Oulun kaupungin perunkirjoituksia). Pigs were raised for the production of meat only. Horses are mentioned only for riding or as draught animals and never in a context of meat consumption.

Even if horses and pigs had rather obvious roles in animal husbandry, there is variation in the importance of the animals in different times and areas. Horses and draught oxen can be viewed as being both competing and complementary animals (Luukko 1958: 105-109). Therefore, the importance of horses was probably slightly different within and outside the draught oxen area of Finland Proper. Outside of this area horses were only used as draught animals. In addition, the importance of pigs varied depending on the possibilities for feeding them, for example in urban and rural environments.

1.5.3.5 Utilisation of wild animals

Some information is available in the historical sources concerning the importance of the wild animals in Turku and Finland Proper. However, from the 16th century onwards, when most of the sources appear, hunting was not practiced on a large scale in Finland Proper and had lost its importance in everyday subsistence (Melander 1952). Fishing was of greater importance, and historical sources include descriptions about fishing, fish delivery to the Turku inhabitants and quarrels about fishing territories (Nikula 1971: 398-402; Ranta 1975: 522-525). Descriptions of wild birds are rarely found in the written sources (one of the few Kalm & Cavander 1753: 15), even if they are abundant in the osteological material.

1.6 Animal husbandry in the light of osteology

1.6.1 Bones as a source of information

Zooarchaeological studies can provide a multitude of information on animals, animal husbandry and human –animal relationships in the past. Studies of faunal assemblages can highlight different human activities that have produced different types of patterning in the osteological material (e.g. Gifford-Gonzales 1991; Landon 2005; Lyman 1994; Serjeantson 1989). Bone waste can eventually tell us about the handling and importance of the animals in a society. In the following section some features of bone materials are described, which are useful in the investigation of different activities. In the present study the basic data is formed by bone fragments (specimens) which have been identified to species and skeletal element.

The animal species present in an assemblage can be used to evaluate the importance of different animals and shed light on the character of an assemblage. The composition of species can be compared in different ways. The most common is to establish which species are present and then attempt to evaluate their ratios in the assemblage. The presence or absence of some species can be related to a certain type of activity or depositional pattern. For example, the hunting of certain animals that was reserved for groups such as the nobility; presence of bones from such species in an assemblage can be associated with social status. Even if the same species are present in an assemblage, they can be found in different ratios and again this may be related to social status or sometimes even to a certain religion (see for example Ijzereef 1989). Other factors that need to be considered are environmental or ecological restraints and variations in subsistence strategies. Variations may also be associated with different strategies relating to waste disposal. For example, Maldre (1997a: 99) has noted that in Tartu a higher amount of pig bones compared to cattle and sheep are present in wells than in the other contexts. The number of unidentified specimens is also informative when evaluating bone preservation and taphonomic circumstances. All the above factors have to be considered in the evaluation of the formation processes of a faunal assemblage. In zooarchaeology this field falls within taphonomy and will be discussed in detail later.

The anatomical distribution in a faunal assemblage is an important source of information. The animal carcass can be divided roughly into high and low value anatomical parts. The high value parts are derived from the trunk and the upper parts of the extremities, while the low value parts are from the head, tail and the lower parts of the extremities. This division is artificial but it can also be useful. Most of the parts considered as low utility were consumed as food, for example animal heads and pig trotters. On the other hand, they are probably seldom transported longer distances (van Wijngaarden-Bakker 1984: 200-201) due to low weight-meat ratio. Therefore, the distribution of high- and low utility elements may reflect the types of activities practiced on the site. The "utility" of certain skeletal elements is a combination of different factors, for example the amount of meat, fat or marrow relating to it, anatomical position or physical properties (Binford 1978; Lyman 1994: 225; Metcalfe & Jones 1988; Perkins & Daly 1968). Some low utility skeletal elements may be useful as tools or they can be transported attached to high utility elements ("schlepp effect") (Lyman 1994: 224-225; Perkins & Daly 1968). Some handicrafts (for example hornworkers, tanners and bone artefact makers) utilise selected anatomical parts of animals, which can be reflected in the anatomical representation, e.g. producing a high concentration of horn cores, metapodials and/or pieces of antler.

Sometimes the nature of the context itself influences the anatomical representation. In sheltered contexts, for example in an abandoned well, the preservation of bones may be favourable, resulting in a higher representation of the most fragile bones. Some bones are more fragile than others. This property can be measured as a value of structural bone density (Lyman 1994: 235-258). Tooth enamel is the hardest skeletal tissue, and it can resist some taphonomical processes that destroy other bones (Lyman 1994: 79-80).

The osteological finds provide information on the animals themselves. The age and sex of the slaughtered animals is valuable data when evaluating the importance and patterns of livestock utilisation. Different subsistence strategies are reflected in slaughter patterns or kill-off patterns. For example, animals raised for meat purposes only are often slaughtered when young while the production of milk and wool requires animals of a more advanced age. Further, since milk production is restricted to female animals the sex distribution in an assemblage is of interest. Deviances from the normal sex ratio of 50 % females and 50% males are produced by the selective culling of livestock at different age groups.

The animals themselves can be examined further. The physical properties of horns, polledness or the size of the animals can be studied and reveal information on e.g. breeding strategies. The physical properties of the animals are affected by either conscious breeding or by other pressures affecting the livestock, such as inadequate feeding. Also, skeletal pathologies found in the animal bones reflect the handling and use of the animals, while at the same time revealing attitudes towards animals in the society.

1.6.2 The material is not objective

Several factors have an influence on what kind of data zooarchaeological analysis will provide. Some of these factors have already occurred in the past while some of them occur during excavation and/or analysis the assemblage. The formation process of faunal assemblages has been modelled by many authors and is often referred to as the *taphonomic history* of an assemblage (e.g. Davis 1987: 22-32; Lyman 1994: 12-33; Noe- Nygaard 1987; Reitz & Wing 1999: 110-113). This taphonomic history is usually pictured as a decline in the amount of available information from one stage to another (e.g. Davis 1987: 22-32; Lyman 1994: 17, 19, 65). First, the processes occurring in the life assemblage (animals living in the region that could theoretically enter the bone assemblage) and death assemblage (animals killed or used by humans) and finally in the deposited assemblage (bones that actually are deposited in archaeological layers) should be considered. Human cultural practices play a significant role in assemblage formation (Lyman 1994: Noe-Nygaard 1987). Different biostratinomic factors, such as gnawing carnivores or trampling, affect the bones between death and burial (Lyman 1994). After burial, different post-depositional processes can alter the composition of the original deposited assemblage, an example being root-etching (diagenesis)(Lyman 1994: 17). Finally, of the material which has survived to be revealed during excavations, only part from will be recovered and examined. These different processes can lead to the problem of equifinality, meaning similar patterns produced by different processes e.g. similar anatomical patterns, which may be the result of several cultural practices or even natural processes (Gifford-Gonzales 1991; Lyman 1994: 63). The better we understand the formation processes of a faunal assemblage the better we can find ways to answer our research questions.

1.6.3 The formation of the assemblage

Differences in the composition of bone material can be due to several factors. First, the bone material buried in town layers can originate from very different sources. The utilisation of animal resources may have fulfilled very different purposes in the past, resulting in different but sometimes characteristic depositional patterns. An archaeological context may include finds from different activities such as kitchen waste, waste from slaughter and/or craftsmanship, or bones from animals that have been buried intentionally. For example, we may have a context which contains only kitchen refuse while another one contains a mix of kitchen refuse and tannery waste. In the latter case, the proportion of cattle might be higher due to the accumulation of cattle metapodials. If these two assemblages are compared on the basis of species frequencies alone the resultant information could lead to a bias in evaluating the importance of cattle in the subsistence economy. Other variables such as anatomical representation and other possible qualitative aspects need to be investigated. Some animals that were present in the assemblage, such as frogs and rats, may occur as an indirect result of human activity, or alternatively may have found their way into the layers independently of any human involvement. The questions asked should be in line with the material available, which means that we have to ask the right questions of the right materials (see Dobney et al. 1996: 20).

Secondly, different depositional patterns such as waste disposal practices can also influence the composition of a faunal assemblage. For example, abandoned wells sometimes seem to contain more pig bones in relation to cattle and sheep than the surrounding yard area (Maldre 1997a: 99) or even a completely different species composition (Doll 2003: 20). This is because infant animals (especially pigs) and other non-edible carcasses may have been discarded in these structures. It seems that sometimes certain types of features are associated with specific types of material. The impact of these extraordinary but often small contexts should be considered in the analysis. It is important to consider the presence of species that are not included in a normal households waste when the subsistence economy is studied.

A third factor affecting the comparisons of bone materials is differential preservation. If only the most durable bones are preserved, the information value of the assemblage is limited. As Lyman (1994: 258) presents, there is a correlation between the hardest elements and the low utility elements. This leads to the problem of *equifinality*, where different agents may cause the same pattern. If the context includes an abundance of low utility skeletal parts, a closer examination of the other types of evidence should be conducted in order to evaluate whether differential transport or differential destruction is responsible for the patterning in the anatomical distribution (see also Gifford-Gonzales 1991: 231-233).

Finally, even after taking into consideration all the factors mentioned above, we have to be careful when making generalisations about our data. For example, we might have an increasing frequency of pig bones from the oldest layers to the youngest at an archaeological urban site. Before we draw the conclusion that in this site pork has become more important through the time of occupation, we ought to take into consideration possible sources of error, which are related to a dynamic and changing urban society. For example, do the earliest and the youngest deposits represent the same social status? If the town has grown during the centuries, causing what was the poor outskirts to become a wealthy central area, the change in the bone composition tells us more about the change in the residents welfare than a change in the overall consumption of pork.

1.6.4 Archaeological excavation: methods of recovery

During excavations many choices are made concerning the methods of recovery. Firstly, the location of excavations is determined based on needs other than those of the zooarchaeologist. In rescue excavations, which are the case with most of the urban excavations in Finland, the location is dictated by the needs of the contractor. In general, this affects the types of contexts excavated and therefore the types of questions we can ask from the material. For example, if our excavation area is situated in a wealthy residential area in the centre of a town, we have limited opportunities to explore trades such as craftsmanship, which was probably placed more on the outskirts of the town (MacKinnon 2004: 222; Serjeantson 1989: 135; Vretemark 1997: 59).

The choice of excavation method is often crucial for the recovery of faunal remains. In urban excavations in Finland, different techniques of stratigraphical excavations have been used (Saloranta 2003: 55). The excavation method has a great impact on the information value of the material and on the analytical process. Associated with this is the choice of recovery methods, such as sieving. The sieving technique has a significant impact on the recovered of faunal remains. It is clear from several examples that with the sieving method most often practiced in Finnish urban excavations (8-10 mm sieve or table sieving) a great deal of material is lost both in terms of quantity and quality (for example Levitan 1979; O´Connor 2003: 102-106; Payne 1972). It should be remembered that sieving does not impact solely on the recovery of bones from small animals such as fish and birds, but also on the abundance estimates for middle sized animals like pig, sheep and goat. A small scale sieving test conducted during excavations at Turku City Library revealed that a great amount of specimens from middle sized animals were lost during basic sieving, especially vertebrae and ribs (table 2) (Tourunen 2004).

2 MATERIAL AND METHODS

2.1 Excavations

A total of 1277 kg of bone material consisting of 94359 specimens was examined for this study (table 3). The material derives from the central area of medieval Turku, but can be seen to include information about animals and their role in Turku and in its surroundings. However, even if this material can be seen as one entity, at the same time it consists of smaller entities of material separated in time and space and formed as a result of different activities in the town economy. This complex depositional history has formed the entity "the Turku osteological material".

The material for the present study comes from two excavations in the town area of Turku; the Åbo Akademi site and the Aboa Vetus museum site (figure 1), which were both large scale excavations in the central area of medieval Turku. At the Åbo Akademi site (Turku 1/7/4) large excavations (1300 m^2) were conducted in 1998 due to proposed construction work at the site (Pihlman 2003: 70-71). During the fieldwork, a considerable amount of material was recovered, including well-preserved organic finds like leather, textiles and bones (Pihlman 2003: 71). The excavations also revealed several well-preserved wooden structures (Seppänen 1999). The Åbo Akademi excavations revealed an archaeological finds assemblage unique in Finland both in volume and in the exceptional state of preservation of finds (Pihlman 2003: 71). Unfortunately, the excavation had to be hurried due to pressure from the contractor (Lavento & Haggren 1999; Pihlman 1999). Therefore, part of the post-medieval cultural layers was not excavated archaeologically and part of the older layers were excavated by machine (Saloranta 1999: 18; Pihlman 2003: 71). Moreover, in some parts of the excavation area the post-medieval layers were thin (Saloranta 1999: 18). Therefore most of the material from the Åbo Akademi site dates to the medieval period, from the late 14th century – mid 16th century.

At the Åbo Akademi excavations, a single-context excavation method was adopted (Suhonen 1999: 5). The different layers were separated based on their composition (homogeneity), but also by their location, e.g. inside or outside a certain structure, and by technical criteria, such as excavation technique- whether they were excavated by hand or by machine (Suhonen 1999: 6-7).

The Aboa Vetus museum area was excavated at the beginning of 1990's (Sartes 2003: 77). The material used for this study comes from the main excavations carried out in 1994. The site is characterised by a large number of remains of stone buildings, which cover most of the excavation area (Sartes 2003: 78). Nowadays, the structures form a base for the Aboa Vetus museum (Sartes 2003: 78).

A single-context method was also used at Aboa Vetus during the excavations. However, slightly different criteria than those employed at Åbo Akademi were used. Due to the great number of structures in the area, the excavated units were usually defined by adjoining structures (Sartes 2003: 80). The different layers relating to one structure are sometimes difficult to separate from each other. Layers which were interpreted as demolition layers were excavated as one entity, even if some changes in composition were noticed (Sartes 2003: 80). However, the whole excavation area was also divided into 1 x1 m squares and the finds were recovered within each square and layer (Sartes 2003: 81). The material was recorded using a day to day system. (Pers. comm. MA Minna Sartes 2.2. 2006, Aboa Vetus museum). Because medieval structures covered most of the excavated area, the deposits dating to the medieval period were scarce. As a result the bone material principally dates to post-medieval periods.

At Åbo Akademi, the bone material was recovered within each excavation unit (table 4). The bones within each context were recovered as one entity, without any further subdivision of the finds even in the larger contexts (up to 118 kg bone material). The same method of recovery was not used at Aboa Vetus (the excavation methods were described in more detail in chapter 1) (table 5). One context (as context is defined in this study for Aboa Vetus: layers relating to particular structures) can be divided into smaller parts. Regardless of this the bones from each context were treated as one entity. In some cases a subdivision was used to examine more closely the formation process of a particular context.

The following criteria were used when selecting contexts for osteological analysis. First, the material should be datable and, second, large contexts with large amounts of faunal remains were preferred. The main aim was to produce a sizeable osteological sample providing enough data for adequate comparisons. The weakness of choosing large contexts was a less precise definition of the character and depositional history of the faunal remains in the contexts. Contexts which appeared to be secondary in character were avoided if possible. With the Åbo Akademi material this was fairly straightforward, although the depositional history of some of the contexts is perhaps not exactly known. At Aboa Vetus some contexts interpreted as backfills or demolition layers were included in the analysis. This was done because the recovery method applied made it difficult to separate different layers from the same structural entity. A context at Aboa Vetus actually means "all layers relating to a certain structure". In addition, some fills in the cellars seemed to be very interesting osteologically. Small contexts found inside structures were studied even if they could not be dated accurately. This was in order to highlight the process of deposition and the possible differences between different types of contexts.

An attempt was made to collect material evenly from the time-period under study. This, however, proved to be difficult. In general, the younger deposits in Turku are thinner and the organic material is not as well preserved as in the older ones (Harjula 2005: 9,12; Saloranta 2003: 65). The situation is further complicated because part of the upper layers at

Åbo Akademi were removed. As the dating process was not completed when the bone material was sampled, some preliminary dates were later changed. The dates from Åbo Akademi are based on dendrochronological analysis (Zetterberg 2000), ceramic analysed by Aki Pihlman and stratigraphic analysis by Liisa Seppänen. Coins and clay pipes were also used to assist this process. As the dates were preliminary in nature, some changes, though probably not major ones, may still occur. The dating of Aboa Vetus was established by dendrochronological analysis, and examination of the artefacts and structures with the help of Minna Sartes, Kari Uotila and Sanna Jokela (personal communications, e-mails and notes in possession of the author).

On these grounds, the material was divided in three different phases. At Åbo Akademi (ÅA), the earliest phase dates to late 14th century and early 15th century, the second to the 15th -16th century and the latest to the 17th-18th century. At Aboa Vetus (AV) the earliest phase covers a time span from the late 13th century to the early 16th century, but more accurate dates are available for some contexts. The second phase, the backfilling of the cellars, is dated to the 17th century. The latest phase at Aboa Vetus covers the 18th and 19th centuries, but probably principally represents 18th century activity. Phases 1 and 2 at Åbo Akademi and phase 1 at Aboa Vetus are referred to in this study as "medieval", covering the time span from the 13th century to the 16th century. In the present study, some layers may cover a time span up to the late 16th century and still be referred as "medieval". However, these contexts are exceptions and most, if not all, of the medieval material dates to the period before the mid- 16th century. Phase 3 at Åbo Akademi and phases 2 and 3 at Aboa Vetus are referred as "post- medieval", meaning the material dating to the 17th, 18th and 19th century. The different phases contain different amounts of material, which complicates comparisons. This is especially true with phase 3 at Aboa Vetus, which contain only 794 specimens. However, the inclusion of this phase is valuable as a comparison.

2.2 Depositional patterns in Turku- towards taphonomic histories

To better understand the nature of the material as a whole the components which it consisted of were examined (Luff 1993: 24). The contexts of the Åbo Akademi and Aboa Vetus excavations were examined to seek traces of different depositional patterns in Turku; in other words, to investigate the formation process of the bone material. In order to examine large scale changes in the material in time and space, the contexts were fused into six entities representing three chronological phases (ÅA 1-3 and AV 1-3, see above). This chapter investigates the different depositional strategies of the Turku osteological material and the different roles of animals as reflected in the deposition of the bone material. By examining the content of the contexts, analogous patterns and differences between the contexts and phases are revealed

2.2.1 Origin of bone deposits

Before further exploring the depositional patterns in Turku, some attention has to be paid to the depositional history of the contexts. The location of the context in the stratigraphic sequence and the dating of the material are not necessarily equivalent, with one example being that chronologically older material may overlie more recent finds (Harris 1979: 34-35; Saloranta 2003: 61). Therefore it is of importance to know if a context represents a primary deposit or a secondary one.

One criteria used in selecting contexts for the present study was whether the preliminary archaeological interpretation of the contexts designated them as primary or secondary (filling or demolition layer), with the latter being avoided. During the analysis the bone material was examined for signs indicative of secondary deposition. When moved from their original context, bones can suffer due to the changing physical and chemical environment (Ratilainen & Tourunen 2003: 26). The depositional history of the bone material was examined on the basis of the variation in the preservation of the bones, in particular in relation to their colour, angularity and integrity (Dobney et al. 1996: 18- 19). The material was generally well preserved, and bones located within one context were uniform in their colour and preservation. Only a few contexts in the assemblage presented notable deviances in the preservation of the bones: M 503 G (ÅA) presented a small amount of less well-preserved bones with clay attached to them. The bones seem to have primary been deposited in a clay sediment, but were later moved and embedded in the soil of M 503 G. In M 503 E (ÅA) badly preserved cattle metapodials occurred, however M 503 E did not have higher amounts of metapodials than the average contexts. In M 66 B (ÅA) two main kinds of bones occurred: some of the bones were dark and well preserved and others were eroded. However, some specimens were dark on one side and eroded on the other. This context included several eroded sheep metapodials and it was revealed in the subsequent analysis that there was a higher than average ration of them. The reason for their accumulation was probably not associated with craftsmanship but rather due to secondary deposition. Preliminarily dating of this context identified it as medieval, but subsequent chronological investigation revealed that this interpretation is less secure. As a result, this context was not included in general phasing.

The proportion of unidentified specimens varies between 12 % to 53 % of all the fragments in the contexts (appendix 1). There seems to be some correlation between the number of unidentified fragments and the average weight of the fragment; in other words smaller fragments mean more unidentified fragments.

Other signs of primary or secondary contexts were observed in cases where both the diaphysis and the epiphyses were recovered. When soil is moved, the epiphysis and diaphysis of juvenile bones are easily disconnected if the soft tissues have already decayed. Therefore, one could expect to find a lower number matching epiphysis and metaphysis in secondary deposits. Even if the soil was moved and the adjoining bone pieces entered the same location and were found together, the exposed metaphysis would take on the same colour as the rest of the bones as it was not protected by the epiphysis. This phenomenon was observed in well-preserved complete skeletons, where articulating surfaces were often of a lighter colour than the shafts. Metaphyses with a lighter colour than the rest of the bone were observed frequently in both the Åbo Akademi and Aboa Vetus material. It is obvious when material is present in its primary deposit as it is represented by whole, articulated skeletons

Apart form the few contexts mentioned above, there were no obvious signs in the osteological material indicative of secondary deposition. On the contrary, some layers interpreted archaeologically as fills - or demolition layers- namely the cellars at Aboa Vetus (pers. comm. 15.5. 2006 *PhD* Kari Uotila, University of Turku) - produced material which more closely resembled that from well preserved primary contexts. These cellars were interpreted as having been deliberately backfilled, probably rapidly during or after the demolition of the buildings, when, for example, a street was laid over them due to a deliberate change in the city plan (pers. comm. 17.5. 2006 *PhD* Kari Uotila, University of Turku). As will be described below, the cellars included several articulated skeletons. Judging from the original field records, the complete skeletons were distributed in different parts of the layers in the cellars. None of the skeletons was found in situ, but they were usually concentrated in such a small area that they were most probably articulated when deposited.

However, the bones of one dog were found to be scattered in two cellars, namely K 94:12 (AV) and 94:11 (AV). Most of the bones were found in "pit 12" and in an extension, which were test pits opened prior to the full excavation. Pit 12 was dug into K 94:12 and its extension reached K 94:11. It seems that most of the remains of this dog were distributed in a rather small area, while other elements were more dispersed. The thoracic vertebra, humerus, radius and scapula were found near the K 94: 12 floor levels, while the other elements were recovered from the test pits.

The presence of articulated skeletons in the does not necessarily contradict the interpretation of the fill layers. It is possible that these whole animals entered the cellars during the backfilling event. However, the probability that such a number of dead animals would have been buried during this rapid backfilling activity is in my opinion rather low (at least three dogs, two sub-adult pigs, sheep, cat and numerous infant pigs). Moreover, the rest of the bone material does not show any signs of being secondarily deposited. The bones are well preserved, though brittle. Plenty of adjoining epiphysis and diaphysis were found indicating primary deposition. In K 94:11 two partly articulated fish crania were found (LU 2734 and LU 2772), again an indicator of primary deposition. The bones of the crania were found together: in other words, even if the layers appeared to be secondary in character, the bone material seems to represent a primary deposit.

In addition, 22 frog or toad bones were found among the material in cellars K 94:12 and 11. Frogs could have entered the deposits while seeking a place to winter or alternatively they may have been trapped in the deep walled open cellars (pers. comm. 10.2.2006 Senior Curator Juhani Terhivuo, The Finnish Museum of Natural History). The cellars lay close to the River Aurajoki, a suitable habitat for these animals. Whatever the case, this also suggests that these cellars lay open for a while between their abandonment and final backfilling. Even if the other bone material is similar to that of the cellars K 94:12 and 11, it would seem that neither cellar K94:10 nor cellar K94: 8 attracted frogs, perhaps a result of being backfilled more rapidly than the other two examples.

The osteological material was probably been deposited in all cellars K 94:8, 10, 11 and 12 at the same time. Parts of animals were recovered in different cellars (dog skeleton) and were found in doorways between the cellars (pig skeleton). In addition the homogeneity of the assemblage points to this single backfilling episode. Bones from some of the other layers also revealed connections between the contexts. At Åbo Akademi, a dog cranium was found in M 513 B while its mandibles were recovered in M 513. A piece of rib from a large wels catfish (*Silurus glanis*) was found in M 60, while a similar one was recovered in M 60C (see closer chapter 4). Taking into consideration the exceptional size of this animal and the rarity of the species, these two finds are most likely from the same fish. Inside RA 60 G, one of the wells at Åbo Akademi, the articulated skeletons of a cat and a pig were found. These were distributed in several layers, with different consistencies, such as parts of a recovered cat skeleton in M 56 H, J and L, and parts of a pig skeleton recovered in M 56 L and M. These contexts could have been deposited at the same time, with the bones of the individual being dispersed during the depositional process. However, it is possible that some of these layers were disturbed and the bones are redeposited.

2.2.2 Nature of bone deposits

Different activities created different types of bone deposits in Turku. The contexts and their contents were examined in order to discover any differences in depositional patterns between the various types of contexts and eventually, phases (tables 4 and 5). To analyse the type of deposits in each context (and phases), the contexts were divided into different types according to their location and composition (appendices 2 and 3). The presence of infant bones and signs of crafts were examined, as well as the abundance of different species (for closer reference to signs of crafts and abundance of species see chapters 3 and 5). The open area contexts were separated from the contexts deposited in limited space such as lavatories, wells or cellars. The open area contexts at Åbo Akademi were further divided by their content into four types; wooden chip layers, layers containing manure, other organic layers and layers consisting principally of mineral components. At Aboa Vetus this was not possible due to the different excavation techniques employed. The contexts were then examined to discover how the different types of deposits were divided between the different types of contexts.

Some differences were indeed found. Infant bones were present in the majority of the contexts, but rarely did their frequency exceed 10 ‰ (appendices 4 and 5). Comparing these figures with the frequency of complete skeletons, it was revealed the complete skeletons and infant bones often (but not always) occurred together (tables 12 and 13). The closed contexts contained higher frequencies of infant bones and articulated skeletons than the open ones.

The fills of the four cellars found at Aboa Vetus represented quite exceptional contexts. Most of the cellars exhibited moderately high numbers of infant bones, in most cases originating from complete skeletons. None of these bones were considered parts of articulated skeletons during the excavation, and therefore none of them were recovered as such. The bones ended up in the same bag with rest of the material. The large size of these contexts lowers the frequency of infant specimens, even where the total number of infant bones is still high. For example, from cellar K 94:12 a total of 221 infant specimens were found. These bones originated from at least five infant pigs, a calf, a kitten and one lamb or a kid. Moreover, the frequency of skeletons is very high. Several whole pigs, dogs, cats and a sheep had been buried in these cellars. The highest proportion of infant animals of all contexts was found in M 164 B (ÅA), which was excavated inside a lavatory. From this small context, the remains of a minimum of five infant pigs were recovered. M 146 B (ÅA), which was found inside a well, contained 11 infant or juvenile pig bones, probably from one individual. Even if R 50 (AV) and K 28:3 (AV) have high frequencies of infant specimens, this is only due to the very small size of assemblages: n = 12 and 44, accordingly.

Some open contexts exhibited a large number of infant bones. From context M 163 (ÅA) 12 specimens of infant sheep or goat and one specimen of an infant sheep were found, from at least two different individuals. The most interesting was context M 147 (ÅA), which included numerous infant bones. As many as four piglets, three kittens, a puppy dog, a calf and a lamb or a kid were found in this context. In addition, an incomplete juvenile pig exhibiting cutmarks on the sternum was recovered in this context. M 147 comes from a large area (over 50 m^2). It was subsequently discovered that this context consisted of at least three slightly different organic layers, which were all excavated as M 147. The context was associated with several wooden remains, and the possibility that the infant bones were concentrated and directly related to these structures cannot be excluded (Arkeologiset tutkimukset Åbo Akademin tontilla (Turku I/7/4) vuonna 1998, liite 6, 95, also pers. comm. 5.4. 2006 MA Liisa Seppänen, Archaeology, University of Turku). The location of the infant bones in these layers remains unknown, as does the character of M 147 itself.

Not all the closed contexts included infant bones. At Åbo Akademi, a total of nine closed contexts such as barrels, abandoned buildings and lavatories were examined, of which four contained infant bones. Two of these contexts were wells and two were lavatories.

However, other features were also connected to the closed contexts. M 56 C-N (ÅA) formed a rather good example of a closed, protected context, which included an abundance of atypical material. These contexts were excavated from a well, and they contained infant cattle and pig bones as well as an articulated juvenile pig and cat. Compared to the open contexts, M 56 C-N exhibits a high proportion of pig. This is however because an almost a complete skeleton of a juvenile pig was found, and of a total of 95 specimens at least 56 bones derive from this single animal. In addition, hare bones were found to be more abundant in M 56 C-N than in other contexts. The difference in sample size has to be considered and quantitative patterns are difficult to evaluate with such a small context. However, some qualitative aspects can still be noted. For example, wells seem to include more fragile elements such as skulls, which are often more complete than in other types of contexts. M 56 C-N included two almost complete hare skulls and one fragmentary one, two almost compete and one fragmentary bird skull and a rat skull.

In addition, the open contexts also contained skulls of these small animals, but they were often fragmented. The contexts M 113A-F were excavated inside a water container. Among this material an assemblage of juvenile domestic chicken bones (MNI at least 3) were found as well as a partial skeleton of a juvenile pig. Young bird bones are difficult to identify to species, but in this case the uncertainty of the identification is minimal. Context M 128 F was found inside a barrel. It contained a small but interesting assemblage of 4 cattle horn cores, 5 horns and a pig trotter (2 carpi, 2 Mc, 5 phalanx). The contexts M 118B-C were found inside a building (R 53 F) and included a high frequency of whole cattle and sheep metapodials. M 75, found inside a barrel, contained otherwise "normal" material, but none of the bones had been gnawed by carnivores. Instead, a high number of rodent tooth marks were present (appendix 6). The number of chewing marks seems to decrease from the medieval to post-medieval period (appendices 6 and 7, figure 2); although a similar reduction is not discernible with rodent teeth marks.

All the contexts contained anatomical elements from both high and low utility body parts: none of them could be classified as consisting of pure kitchen- or craftsmanship waste (appendices 8-11). Some contexts show high numbers of high utility body parts like M 94:10 (AV) and M 60 C (ÅA). These frequencies, however, are not only associated with kitchen related activities but might indicate a certain lack of craftsmanship activities. Signs of craft processes were mostly found in the open contexts (see chapter 5. However, see also M 118 B+C (ÅA) and M 128 F (ÅA), the contexts from which are difficult to interpret because of their small size). There seems to be no connection between the type of deposit and craft processing.

Thus, the different types of contexts can reveal various information about the depositional patterns in Turku. Closed contexts, providing a more protected environment for the bone material and preventing disturbing factors like scavenging animals, can exhibit a more detailed picture of one specific depositional event. Open contexts provide more general information about the activities around the location. These two types of contexts complement each other and together create a complex picture of the activities and deposition patterns at the site.

2.2.3 Species abundance and anatomy in the contexts: the question of equilfinality

After examining the special characteristics of the different contexts, an attempt was made to find out the reasons for these differences. The possible affecting agents were divided in three groups, representing biostratinomy, diagenesis and analysis (Gifford-Gonzales 1991; Lyman 1994). Firstly, variation can be generated in the past by the accumulation of material created by different subsistence strategies. Secondly, different diagenetic factors can influence the assemblages between burial and recovery. Thirdly, during the excavations and zooarchaeological analysis some data might be lost or misinterpreted.

As the low utility skeletal elements (including metapodials, which are here considered a possible sign of craft activities) are structurally durable (Lyman 1994: 246-247), the reason for their accumulation can be the destruction of more fragile elements, as well as differential transportation by humans. The preservation of bone was monitored by two different means. Firstly, during the analysis a subjective estimate was taken regarding the preservation. Due to the great size of the assemblage preservation was not recognised specimen by specimen; instead, a general level of preservation in each context was estimated. Damage like exfoliation and abrasion on the bone surface were used to evaluate the preservation of the material. Usually the material was in very good condition, the specimens being hard with a shiny outer surface. This was especially true for the layers consisting of organic matter. Secondly, the proportion of unidentified specimens (including specimens identified to element but not species) as well as the mean specimen weight was counted for each context (appendix 1). This was carried out in order to examine possible signs of trampling and other factors which can reduce the skeletal elements into pieces.

The contexts with a dominance of structurally durable elements, in this case, metapodials, were examined carefully to evaluate the possible effect of taphonomic factors on the anatomical representation. In some contexts, the dominance of the metapodials is most likely due to human activities causing the selective accumulation of the bones (contexts M 114 D (ÅA), M 118 (ÅA) and M 163 (ÅA)). These contexts included well-preserved bones with none or only few abraded specimens. However, in some contexts moderately high levels of cattle metapodials (M 511 B (ÅA), M 66 (ÅA), 17 (ÅA) and 14 (ÅA)) might be caused by preservation factors. In these contexts, specimens exhibited somewhat abraded surfaces. Low fragment weight and a high amount of unidentified fragments were also observed. M 78 B (ÅA) presents more complicated case. It included specimens showing some rate of abrasion. It has one of the highest numbers of unidentified specimens and one of the lowest numbers of mean specimen weight. Thus, the high metapodial rates could be caused by taphonomic factors as a result of the destruction of the low-density elements. On the other hand, the premaxilla, which was also found in abundance, is not a very hard bone. Moreover, 63 % of the metapodial specimens come from juvenile animals, which imply that preservation is perhaps not responsible for the anatomical distribution. As a whole, the reason for the accumulation of low utility skeletal elements in M 78 B seems to be caused by human activities, not by the differential preservation.

Different factors influence the abundance of a species. In appendix 2 the three contexts which exhibit the highest percentages of cattle, sheep or goat and pig are listed from Åbo Akademi. From the Aboa Vetus material, only the highest rates are listed due to the smaller amount of contexts (appendix 3). The small size of the contexts has already been mentioned as one of the reasons for the diverging numbers, and therefore all the small contexts have been discounted from further analyses (NISP under 300). In addition, complete skeletons can affect the abundance of animals. This is especially true for the small contexts excluded from this analysis, but it can also affect the larger ones; therefore complete skeletons were excluded during the analyses. In a few contexts the high number of certain species seems to be due to craft activities: M 78 B (ÅA) cattle and M 66 (ÅA) sheep/goat and perhaps M 159 (ÅA) sheep/goat. In M 104 (ÅA) the high number of cattle cannot be explained by craft activities. M 114 D shows a high number of sheep metapodials and horn cores, so higher rates of sheep and not cattle would be expected. The same applies to M 511B, where the abundance of sheep or goat cannot be explained by craft activity. It is also interesting to note that the highest abundance of pig is concentrated in phase 1 at Åbo Akademi. These comparison show that craft activities may have an effect on the abundance of animals in different contexts, but the effect is usually minor or even negligible. Therefore, the effects of craftsmanship should be considered during the analyses if the aim is to discover the abundance of animals from normal domestic waste.

2.2.4 Discussion

The Åbo Akademi area is characterized by open contexts; closed contexts are in the minority in all of the phases, and are absent altogether in phase 3. Phases 1 and 3 at Aboa Vetus the contexts are open in character, however this area lacks the massive open deposits which characterise the Åbo Akademi area. Phase 2 at Aboa Vetus is represented by closed contexts only, namely the cellars. Some of the phases have more contexts which show signs of craftsmanship than others. For example, these signs are clear in phase 2 at Åbo Akademi and in phase 2 at Aboa Vetus, but lacking altogether in phases 2 and 3 at Aboa Vetus (see chapter 5). These differences affect the anatomical representation and species composition of the phases. Therefore, different types of deposits play some role in the composition of the material in different phases, and they should therefore be considered in subsequent analysis.

The disposal of the infant animals, especially pigs in closed contexts, requires some attention. The originally deposited material could have been the same in both closed and open areas, but the better preservation conditions of the former have caused the differences found in them today (Reitz & Wing 1999: 113). It is also possible that these sheltered contexts offered an opportunity for people to discard certain types of waste. It seems that both of these mechanisms are responsible for the differences found in these two depositional types. A carcass deposited in a small context is usually better protected from disturbance than one buried or discarded in an open context. Moreover, a carcass that was deposited in a context of limited space and thus of limited size will probably increase the frequency of infant specimens pronouncedly (especially NISP values). However, there is also a strong reason to believe that these contexts actually tempted inhabitants to dispose some inedible carcasses or body parts. The high number of dog bones found in the Aboa Vetus cellars is not produced due to preservation alone or the small size of the context. This is an indication that animals, in fact, were intentionally buried in the old cellars.

There also seems to be other differences between open and closed contexts. The main process responsible for the high levels of infant bones in the closed contexts seems to be the disposal of animal carcasses. For the open contexts the craft processes, namely the use of the infant hides and skins, seem also to play some role. This can be seen in the higher numbers of infant sheep or goats.

Small contexts are to be avoided when using the numerical, quantitative data but sometimes they are useful in more qualitative approaches. Naturally, they are also used in later analysis when fusing the individual contexts into larger entities. Different depositional patterns that have created variation on the context level also affect the chronological comparisons of phases. One single atypical context does not necessarily affect the whole phase, although it is possible in some cases. Therefore, it is important to control how much of that variation is due to one single context when interpreting the differences between phases. For example, signs of crafts might reflect anatomical distribution for a phase. As closed contexts include plenty of atypical material, their presence might have an effect on species and anatomical distributions. Therefore, in this study the data from every context that is included in the phases is shown individually in tables for comparative purposes. The tables also include NISP-information (N) (and not only percentages), to enable the estimation of the effect of small contexts with high % but with low NISP.

There are differences in the contexts between different phases and sites. At Åbo Akademi the average weight of a specimen decreases and the proportion of unidentified specimens increases when approaching the later deposits, and this is especially true of the phase 3. All the Aboa Vetus phases have rather low average fragment weights. However, in phases 1 and 3 at Aboa Vetus there is quite a low rate of unidentified specimens. In phase 2 at Aboa Vetus the number of unidentified specimens is therefore high. This is probably explained by the more accurate sieving practiced in Aboa Vetus. There is also a change in the overall composition of the layers. The older layers consist of mainly wooden chips, manure and other organic matters. The younger layers contain much more mineral components. These factors are most probably linked to each other, as the organic layers have preserved bone material better (Harjula 2005: 12 made similar observations with the respect to the leather material).

2.3 Osteoarchaeological methods

2.3.1 Osteological analysis

During the excavations at Åbo Akademi the bones were placed in cardboard boxes without any cleaning or sorting. However, the boxes were weighed, so a rough picture of the amount of bone material in each context was obtained. At Aboa Vetus some of the bones were cleaned during the excavation. However, since not all the bones from a certain context were cleaned and weighed no precise picture of the total amount of bones belonging to each structure or context was available beforehand. After the selection of the contexts for analysis, the bone material was gathered and cleaned. The Åbo Akademi material was particularly covered in dirt. Several bone artefacts and other small finds were recovered among the bones. The dirty condition of the bones proved to be favourable in one sense. Some small bones which were attached to the dirt were recovered during the cleaning process. These include half of a mouse which was found inside a cattle cranium fragment.

After cleaning, the bones were analysed and the observations were registered in a computer database. A program created by MS Olli Tourunen for the purpose was used. The specimens were counted and weighed. Specimens exhibiting a recently fractured surface were glued together if possible and then recorded as one specimen. An attempt was made to unite the bones that may have been separated, such as the epiphysis of an adjoining diaphysis. For example, infant crania with open sutures were fitted together and counted as one specimen. Every specimen was investigated to ascertain the bone type, species in question, side and status of epiphyseal fusion. Cutmarks, gnawing and possible pathological changes were also recorded. From the jaws the presence of alveoli and milk- or permanent teeth were recorded, as was the wear of the mandibles.

The authors own reference collection was used for the identification of the material. Seal bones were identified to species with the help and methodology of *PhD* Jan Storå, University of Stockholm (see Storå 2001). The identification of Wells catfish was made possible thanks to the kind help of MA Katariina Nurminen from the University of Helsinki and *PhD* Lembi Lõugas from Ajaloo Institut, Tallinn. The juvenile bird bones recovered from context M 133 A-F were identified by MA Kristiina Mannermaa, University of Helsinki.

For all of the bone types the completeness of each specimen was recorded. For the recording of pelves, scapulae, mandibles and the long bones the model presented by Lepiksaar (1989) was applied with some modifications. With this model it is possible to record the portion of the bone present. Moreover, some additional information was gathered to ensure an accurate quantification procedure. Specific features of the bones were noted and their presence or absence was recorded in order to aid the quantification process (especially for MNE counts). For long bone epiphyses the completeness was recorded to the nearest 10 %. For vertebrae the presence of upper, lower right and left sides of the articular surfaces were examined. From the other bones, such as the tarsal and carpal bones, the percentage of bone surviving was recorded.

It should be noted that the different recovery methods employed in the Åbo Akademi and Aboa Vetus excavations have affected the practical analysis of the material. In Åbo Akademi all the bones from one context were recovered as one entity. This means that in the case of large contexts important spatial information is missing, *i.e.* in which corner of the area bones were found, and if some concentrations of bones were present. On the other hand, it was relatively easy to fit bones together, because all the bones belonging to one entity were present on the worktable at the same time. Conversely, with the Aboa Vetus excavations it was easier to follow the finer distribution of the bones inside one context. Here the bones were recovered from one square metre units. On the other hand, bones belonging together (like the loose epiphysis and the corresponding diaphysis) may have been sorted into separate bags and therefore recorded as two different specimens.

2.3.1.1 Identification

The osteological material itself poses limitations to the questions that can be posed. The identification of the bone fragments in an assemblage is one of the principal procedures in zooarchaeological studies. Identification forms the very basis of research; the next step is the quantification of what has been identified. The criteria and practices for e.g. species identification should be clearly defined in every study, and this should also be applied to the quantification methods used.

Not all specimens can be identified to species. It is important to present the criteria used for the identification of bone fragments which could not be identified to a specific species. The question of sheep and goat is central. Sheep and goat have a similar skeletal structure and bones of these two rather different species are difficult to distinguish from one another (Boessneck 1969). For example, elements such as horn cores and metapodials are relatively easy to identify, but for most of the vertebral column and ribs accurate identification is very difficult. The bones of sheep and goat are therefore often divided into three categories: those identified as goat, those identified as sheep, and those which can only be identified as sheep or goat. This problem can be dealt with differently according to the amount to the amount of goat bones in assemblage. In some studies all the "sheep or goat" specimens are assumed to belong to sheep, because the number of identified goat bones is very low and goat bones represent different sizes than sheep bones (O'Connor 2003: 114). Often these kind of assumptions are made for practical reasons; for example data relating to age from sheep and goat bones are often presented as the age structure for sheep (see e.g. Wigh 2001: 88). In addition, the proportions of sheep and goat have been evaluated statistically (Bartosiewicz 1999).

The best skeletal elements for the separation of sheep and goat are found in the cranium (especially horn cores), the deciduous dentition and metapodials. Some studies have used these elements only in combination with the deciduous premolar, pd 4, from the lower jaw for the identification of sheep and goat (according to Payne 1985: Ekman 1973: 81,Table 3a; Vretemark 1997:76). Even if other elements are more difficult to identify they are crucial for the evaluation of the relative abundance of sheep and goat. Since the horn cores and metapodials of goats were used as raw material for handcraft, the frequencies have to be interpreted with caution. We might see a pattern which is related to handicraft, and not necessarily frequencies, which are related to animal husbandry or more precisely the utilisation of goats (and sheep), as a resource for meat or milk.

In the present study, sheep and goat specimens were identified according to Prummel and Frisch (1986) and Boessneck (1969) and milk teeth according to Payne (1985). Identification was ascertained from horn cores, parietale, lacrimale, atlas, axis, scapula, humerus, radius, ulna, pelvis, femur, tibia (distal), calcaneus, talus, metapodials and phalanges. Specimens that could not be identified strictly to species were recorded as sheep or goat. The group formed by these two species is in the present study called small bovids.

Hare is the most common wild mammal found in Turku. Because the European hare (*Lepus europaeus*) did not arrive in Finland until the late 19th century, and the rabbit (*Oryctolagus cuniculus*) has never been part of Finnish fauna, all the bones identified as Leporidae are assumed to belong to Arctic hare (*Lepus timidus*), referred to as hare in the text (Siivonen & Sulkava 1999: 140-143).

The identification of bones from large ungulates (cattle, horse, elk and forest reindeer) and small ungulates (sheep, goat, pig and roe deer) also require some attention. Some elements such as vertebrae and ribs of species belonging to these animal groups are difficult to identify to species level. Some researchers have put aside difficult bones such as vertebrae and ribs (Ekman 1973: 10, see also Luff 1993: 13) and when these elements have been identified, different solutions have been used to deal with uncertain identifications (e.g. Backe 1995: 84, O'Connor 2003: 114-116).

In the present analysis the categories large and small ungulate have been used for specimens that could not be identified to species, but which on morphological criteria could be identified to the superorder Ungulata *and* defined as "large" or "small" (cf. Luff 1993: 12). In other words, specimens without necessary diagnostic criteria are assigned to indeterminate, as well as specimens that originate from animals of uncertain size. Most of the vertebrae and ribs could be categorised in this way. Even unidentified shaft fragments were divided into "large", "small" and "indeterminate size". Large ones were then grouped into large ungulates and small ones to small ungulates. To form a guideline for the basic differences of the bovids and cervids, the Prummel and Frisch (1988) guide for the distinction of red deer (*Cervus elaphus*) and cattle was utilised. Many of these criteria were readily applicable for the other cervids too, but the ultimate identification was made with the help of the reference collection. There is a slight possibility that some of these specimens (this concerns mostly the shaft fragments) might belong to another animal group like carnivores, but the amount of these specimens can be estimated to be very low.

The identification and categorisation procedure creates some unbalance in the material. Only some of the vertebrae of large ungulates were identified to species (atlas, axis, sacrum and caudal vertebrae) but none of the ribs. Due to the great size of the material no attempt to identify these ribs to species was made. The material included no identifiable vertebrae or ribs of equids, which differ from those of the ruminants. The ribs and most of the vertebrae of cattle, elk and forest reindeer are difficult to separate from one and another; especially given the fragmented state in which they are found. However, part of the fragments came from broad ribs, and they are more likely to belong to cattle than cervids. The underlying assumption is that most, if not all, of these ribs belong to cattle. As a result, only a few of the specimens belonging to this body section are present in cattle NISP (*The Number of Identified Specimens*). The identification of vertebrae and ribs from pig and small bovids is easier, due to the special structure of the pig vertebrae and the proximal part of the ribs. However, most of the fragmentary vertebrae and ribs could not be identified to species but instead ended up in the small ungulate category. The consequence of this is that more specimens of pig, sheep and goat are identified to species (or species group) than those of cattle. Therefore, the proportion of cattle, small bovids and pig were compared in different ways (see chapter 3).

2.3.1.2 Anatomical distribution

The anatomical distribution of the material was examined in order to explore the nature of the activities which created them. the specimens were divided into three groups; high utility skeletal parts including spinal column (except tail), ribs, sternum and the upper part of the limbs, low utility skeletal parts including the head, lower jaw, tail, metapodials, carpals, tarsals and phalanges. The "others" group includes loose teeth, sesame bones, hyoideum and shaft fragments.

The term household waste is used here to stand for the bone deposits created by private households in their every day life. Kitchen waste is considered a more specialised type of waste, deriving from the preparation and serving of meat dishes consisting mainly of high utility body parts. Part of the household waste is thus kitchen waste, but in this self-supporting way of life it also includes slaughter waste consisting of low utility body parts.

Part of the deposited bone material derives from activities related to craftsmanship. In each context the representation of horn cores, metatarsal and- carpal bones of cattle, sheep and goat and distal parts of the lower jaw and premaxilla of cattle were investigated in order to recognise any signs of craftsmanship. The percentages of horn cores were counted from skull specimens. The small bovid horn core percentage was counted by dividing the number of horn core specimens by the sum of the skull specimens of the species in question and the skull specimens of sheep or goat. Thus, the formula for sheep is: Sheep horn cores / (Sheep skulls + Sheep or goat skulls). The percentages of metapodials were counted from the long bones of sheep and goat in the same manner as horn cores.

2.3.2 Ageing

The age of the animal is usually determined by morphological criteria using tooth eruption, tooth wear and epiphyseal closure. The size, shape and the porous structure of the bone can sometimes be used in identifying and ageing neonatal or infant bones. Tooth eruption can be used to determine the age of young animals while tooth wear can be used to estimate the age of an adult animal. In the present study the figures given by Silver (1969) were used for the study of dental eruption and the method developed by Grant (1982) was used to record the wear in mandibular teeth of cattle, small bovids and pig. Different authors have formed slightly different age groupings according to the dental wear, which are not necessarily completely uniform due to the different methods. The correlation made between O'Connor's (2003: 160) age division and Vretemark's (1997: 39) division is shown in table 6.

The epiphyseal closure stage can be used to divide the bones into categories of “open”, “closing / fusing” and “closed / fused” and further into the age categories “younger than” and “older than” (open epiphysis: separates once cartilage breaks down, fusing: some bone has to be broken to separate the epiphysis from the shaft, closed: there are no open areas along the fusion line, according to Bull and Payne 1982: 69). For the epiphyseal age data, the epiphyses in a closing stage were counted with the fused ones. For the timing of epiphyseal closure data from Silver (1969) and Habermehl (1975) were used. Cat epiphyseal closure was examined according to Smith (1969). In the comparisons three age groups were used; “early”, “intermediate” and “late” according to the time of fusion of the epiphyses (table 7) (cf. Benecke 1988: 17-19; Schmölcke 2004: 39, 47, 55; Vretemark 1997: 41; Wigh 2001: 60, 78, 88).

The reliability of these ageing methods has been widely discussed (Bull & Payne 1982; Bullock & Rackham 1982; Grigson 1982a; Legge & Rowley-Conwy 1991; Moran & O´Connor 1994; Noddle 1974; Sten 2004; Vretemark 1997). Examinations of contemporary skeletons have shown that dental eruption seems to be more constant than epiphyseal closure (Bull & Payne 1982: 65, 70; Bullock & Rackham 1982; Hatting 1983: 119-120; Noddle 1974: 200). The epiphyseal closure can be delayed by castration (Brännäng 1971: 77-78; Davis 2000: 383; Hatting 1983: 119-120; Noddle 1974: 200; however Moran & O´Connor 1994: 281 state that this delay may restrict to the epiphyses fusing in intermediate state of life). It is possible that the nutritional conditions could also affect the timing of epiphyseal fusion (Bullock & Rackham 1982: 79). Some variation in the timing of epiphyseal closure has been given in literature (see review in Moran & O´Connor 1994). The ages of fusion given by Silver (1969), which are employed in this study, is one of the most used sources and is not contradictory to results obtained from diverse modern material by Moran and O´Connor (1994).

The reliability of dental wear as an age indicator has raised some discussion (O'Connor 2003: 163-164; Sten 2004: 50). It should be remembered that the rate of attrition is not necessarily constant between animal populations, for example populations feeding on different kinds of food or grass contaminated by sandy soil could change the attrition (Magnell 2006: 38). Also the animals sex can affect the rate of dental wear (Davis 2000: 381). The relationship between tooth eruption, wear stages and calendar ages has been widely discussed in literature and different practices of connecting the three have been developed (Benecke 1988; Moran & O'Connor 1994; O'Connor 2003; Prilloff 2000; Sten 2004; Vretemark 1997). In this study tooth wear, tooth eruption and calendar age are combined by using results from previous studies (Benecke 1988; Grant 1983; O'Connor 2003; Vretemark 1997).

The properties of the explored bone deposits should be considered when interpreting age data. It is not uncommon that data compiled using different ageing methods can give deviating results (Maltby 1982: 84-86; O'Connor 2003: 168-169; Vretemark 1997: 99). There may be various reasons for these discrepancies. First, the ageing methods embody a degree of inaccuracy as has been described above. Second, the differential preservation and recovery can bias the results. Young bones can have a poorer revival rate than adult ones due to their fragility (Munson 2000: 404; Payne 1972: 76). Third, differences the age data could be due to the different origin of the bones. The underlying assumption in the comparison of data from epiphyseal closure and dental data is that the animal population where these bones derive from is the same. However, a bone assemblage can consist of bones from different sources. Some of the bones may represent food waste while another parts represent handicraft or butchery refuse. Thus, the mandibles and the long bones can derive from different animals (Maltby 1982: 86; O'Connor 2003: 169). In this study, both epiphyseal fusion and dental ages are used for creating animal age profiles. However, in each case a careful study of the different factors described above will be made.

2.3.3 Sexing

Some bones enable determination of the sex of an animal. This can be done on the basis of size or shape differences, or by the presence or absence of some unique features such as the antlers of male elks. Sex assessment based on size dimorphism may be complicated due to breeding strategies such as domestication, improvement and castration. Selective breeding tends to produce animals with different body proportions to those of their wild ancestors. Changes in the facial region of the skull, horns and diminishing of size are the usual effects (Clutton-Brock 1987: 22-24), but also the overall shape of the body can change. The high value of meat in the hindquarters has produced animals which have bigger back parts of the body (Bartosiewicz et al. 1997: 85-86; Hammond 1962). Moreover, castration will affect the possibility of determining sex. Castration alters the hormone production of the animal and therefore the ossification and closing of the epiphyses is delayed (Brännäng 1971: 77-78). In the present study the sexual dimorphism of the following skeletal elements were investigated; metapodials, pelvic bones, horn cores and teeth.

As an example, cattle metapodial shape is dependent on the sex of the animal. This is especially true for the metacarpals, and this bone has been widely used in sex determination. Sexual dimorphism is more obvious in the front legs of cattle, because the centre of gravity of bulls lies in front causing stress to the frontal legs (Boessneck 1956: 84). As the bones are scaled to the proportion of the animals mass, and the mass increases in proportion to the cube of a body´s linear dimension, bones of large animals have relatively more robust bones than those of small animals (Kardong 1995: 127). Therefore, bulls have more robust metacarpals than cows, which can be clearly seen in aurochs (Howard 1963: 93-94).

Due to the delayed epiphyseal closure, castration produces longer and more slender metacarpal bones on oxen when compared with bulls (Brännäng 1971: 73). This offers an opportunity to study differences between cows, oxen and bulls by examining the horizontal and vertical dimensions, *i.e.* the form of the metacarpal bones. This is achieved by plotting the length and breadth related measurements (or indexes derived from them) against each other (Doll 2003: 53; Howard 1963; Mennerich 1968; O'Connor 1989: 23; Wigh 2001: 66-69). However, the picture is rather complicated and there is often some overlap in the indices of cows, oxen and bulls (Howard 1963: 93-94). The age of castration affects the form and size of the metacarpals of oxen. Animals castrated later in life more closely resemble bulls, while early castration creates animals exhibiting long and slender bones (Brännäng 1971: 74-75). Other factors that can have an effect on the body proportions are phenotypic differences, nutrition, the conditions in which animals are kept, and traction work (Bartosiewicz et al.1997: 99-105).

Metacarpals have also been used for sex determination in sheep (Davis 2000: 385; O'Connor 1982: 29; Wiig 1981: 36-37). The metacarpals of rams are short and robust, those of ewes are short and slender and the metacarpals of wethers are long and slender (Davis 2000: 289). However, signs of sexual dimorphism in sheep metacarpals have not emerged in all studies (Klein & Reichstein 1977: 36). In addition, the sexual dimorphism of goat metacarpals has been studied. In Klein and Reichstein's study (1977: 34) the metacarpals of goats were sexed by plotting the length- and breath measurements against each other.

The sex determination of the pelvis is based on two different features: the shape of the bone, especially the shape of the os pubis (Luff 1982: 49) and the thickness of the medial edge of the acetabulum (Luff 1982: 49; Vretemark 1997: 43-45). In the present study all specimens from the pelvis were examined and the sex was determined, if possible, according to one or both of these features. If the measurement of both the medial edge and the morphological determination was possible, the morphological features were examined first in order to avoid the knowledge of the measurement. The threshold between the sexes seems to vary somewhat between different materials (Vretemark 1997: 43; Wigh 2001: 66). This is probably due to the limited size of the investigated material but also because of the size variation between the different animal populations. Here, as with other methods where sex is determined according to one measurement only, the threshold should be examined and possibly defined individually for every material or separate animal population.

In sheep and goat the overall shape of the pelvis and especially the shape of os pubis differs between the sexes (Boessneck 1969: 344-347; Clutton-Brock et al. 1990: 28; Hatting 1995). Besides morphological criteria, the thickness of the medial edge of the acetabulum was also used for sex determination in the present study. Some studies have defined the threshold for sex separation of medial edge thickness in sheep. Ewes have the smallest edge, and rams have the thickest, while castrates fall partly in between overlapping the rams (Vretemark 1997: 44-45) or the ewes (Clutton-Brock et al. 1990: 52). This measurement was also applied to determine the sex from goat pelves.

Cattle horn cores can be used in sex determination. In general, bull horn cores are described as short and robust while cow horn cores are more slender. The horn cores of oxen resemble those of cows but are longer and exhibit a greater basal circumference. The horn cores of bulls are usually described as having an oval basal cross-section, with those of cows and oxen being more circular (e.g. Armitage & Clutton-Brock 1976: 332; see also Prilloff 2000: 30-31 for summary of several authors). Caution is called for when sexing horn cores of different lengths and type. Cows from cattle breeds that have long or robust horn cores may resemble males with a more slender type of horning (Armitage & Clutton-Brock 1976: 334).

The sexing of horn cores can also be performed using the basal circumference alone. The values can be expected to exhibit a two-peaked distribution (Benecke 1988: 21; Grigson

1982b; Prillof 2000: 31; Vretemark 1997: 106; Wigh 2001: 45). Different diagrams and indices have been used for the separation of female and male animals and oxen and bulls. Müller (1959: 198-199) used the length of the horn core and the basal circumference to separate bulls (short horns with moderate basal circumference) from cows (moderate length and small to moderate basal circumference) and oxen (long horns with great basal circumference). Benecke (1988: 21) utilized an index counted from the minimum and the maximum basal diameter compared to the basal circumference (castrates are assumed to have the greatest basal circumference). Only horn cores from mature individuals can be successfully measured and sexed. The criteria presented by Armitage (1982) were used to determine the age categories of the horn cores, and horn cores deriving from juvenile and young adult individuals were excluded from any further analysis. These were recognised by the porous surface of the core.

Both maxillary and mandibular canine teeth can be used for the sex determination of pigs. The morphological differences presented by Mayer and Brisbin (1988) were used to identify the teeth of female and male pigs in this study. The most useful properties in distinguishing the lower canines were the form of the enamel covering and cross- section comparison. The male canines have open roots in both the upper and lower jaws. The upper canines were usually also easily recognisable, due to the very different shape of the female and male teeth.

2.3.4 Body size of animals

The size of the animals can be studied osteometrically. The bones from adult fully-grown animals should be used for this type of analyses. However, not all of the measurable bones possess epiphyses, which can help in the determination of the age of the animals, the talus being one example. The status of epiphyseal closure of a skeletal element may be unclear when using fragments of elements where only one epiphysis is present such as the distal end of the tibia lacking the proximal part. The sexual dimorphism (or trimorphism, if castrated animals are present) can also affect size data. Males are usually larger than females: moreover, castration causes bones to grow longer than those of intact bulls (see sex determination above). The size of the bone is difficult to determine if only one measurement is available, because one dimension alone can not convey the shape of the bone. Therefore measuring both the length and the width of the bones enables better documentation of their size and shape. Moreover, some epiphyses tend to grow after closure (Davis 2000: 384). Careful selection of the measurements used and caution when interpreting size data are therefore important.

The measurement standards created by von den Driesch (1976) were used in the present study. The measurements can be used as such to represent the size of the animals. For the estimation of the withers heights of the animals the methodologies of the following authors were used: for cattle Matolsci (1970), for sheep Teichert (1975), for pig Teichert

(1969), for goat Schramm (1967) and for dog Harcourt (1974). In addition to the measurements taken, some non-metric traits and morphological features were also recorded, such as the presence of horns in sheep or the absence of the foramen supratrochleare in pig humeri.

2.3.5 Pathological changes

The distribution of pathologies in the first phalanx of cattle was investigated using the pathological index (PI) as set out by Bartosiewicz (et al. 1997: 20; see also De Cupere et al. 2000: 257-258).

PI = (sum of scores – number of variables)/ (maximum score – number of variables).

For the phalanx 1 the sum of the pathological scores for each of the five observed variables (in phalanx 1, proximal and distal lipping, proximal and distal exostosis and osteoarthritis) were counted. The three first variables were given values between 1-4 and with the latter two receiving values between 1-2. The formula for phalanx 1 is therefore

PI(ph1) = (sum of scores – 5)/ 11.

For the metatarsal the sum of the pathological score is counted from proximal lipping, proximal and distal exostosis, broadening of the distal articular surface, distal depressions, proximal and distal eburnation and striation. In metacarpals the fusion of the rudimentary metacarpal and development of the proximal facet were also counted but not the striation.

PI(mt) = (sum of scores – 8)/16

PI(mc) = (sum of scores – 9)/17

Each bone exhibits a value between 0-1; 0 being bone with no pathological changes and 1 being bone with fully developed changes for all variables.

2.3.6 Quantification

2.3.6.1 NISP and MNI

NISP (*The Number of Identified Specimens*) is one of the most popular and most widely used quantification methods. There are good reasons for this. It simply means counting all the specimens identified and placing them in certain taxon or taxonomic groups. Thus, the NISP gives us the overall picture of the scale and composition of the material (O'Connor

2003: 135). The method is simple and the results are easy to achieve during normal analysis, without any exhausting calculations. It also facilitates easier merging of results from different units (see for example Klein & Cruz-Uribe 1984: 25). However, several flaws has been pointed out when NISP is used to measure the relative frequencies of e.g. different taxa. Klein and Cruz-Uribe (1984: 25) summarize some of these: the differences in the number of bones in the skeletons of different species, underemphasizing the significance of species that are brought into the site already processed, and lastly sensitivity to bone fragmentation. Reitz & Wing (1999: 192-193) add further complicating factors, such as the unequal identifiably of different species and bones, the different survival of bones of different species and the bias caused by inadequate recovery techniques. Moreover, because big animals give more meat than smaller ones, the NISP ratio does not reveal the importance of different species in the diet (Uerpmann 1973: 310). Finally, it is hard to decide which bones are interdependent and which belong to the same individual (Grayson 1979, 202).

The use of MNI (*The Minimum Number of the Individuals*) in complex collections such as urban animal bone assemblages is widely discouraged (Doll 2003: 15; O'Connor 2003: 134; Vretemark 1997: 33; Wigh 2001: 45). MNI represents the minimum number of animals that are needed to form the bone assemblage (e.g. two skulls must derive from at least two individuals). MNI is not derived from individual specimens, but rather the minimum number of elements (MNE, see below). The fragments represented are counted; as one bone can be fragmented into several pieces, the 'original' number of each element is reconstructed. The most abundant element represents the MNI. However, the value of employing this method on a limited basis to selected parts of urban assemblages has been conceded (O'Connor 2003: 135). Despite the flaws, MNI is still used in some urban bone analysis (Prilloff 2000; Schmölcke 2004). MNI is a useful tool in analyzing well preserved assemblages, which are sealed or even deposited in a single event. It is also of use where the comparison of mammals, birds, fishes, reptiles and molluscs is relevant (Reiz & Wing 1999: 199).

Both the NISP and MNI methods can be used for the quantification of the relative abundance of species. The NISP has been seen as a maximum number of individuals (if every fragment presents one individual) and MNI as a minimum number (Klein and Cruz-Uribe 1984: 30). Some attempts have been made to overcome some of the above mentioned flaws of the NISP method. O'Connor (2003: 139-140) counted "pig equivalents" by using eight different homologous skeletal elements. He used the number of pig's elements as 1 to compare between the number of cattle and sheep elements. This would, according to O'Connor, unravel the problem of differential fragmentation. Luff (1993: 13) counted "indications" (IND) to avoid the recovery-problems affecting NISP. IND comprises selected skeletal elemental parts where more than 50 % is present. In the present study the MNE- method was used to overcome some of the problems related to the NISP-method.

2.3.6.2 MNE and MAU

The MNE (*The Minimum Number of Skeletal Elements*) is a quantification method used mostly in skeletal element abundance analysis. Lyman (1994: 102) defines MNE as "the minimum number of a particular skeletal element or portion of a taxon". MNE is ascertained in similar manner to MNI, and therefore MNE figures are affected by the same problems as MNI. The result are dependent on the method of calculation and which attributes (age, sex, size or distribution of the elements) that are taken into consideration (Lyman 1994: 102). There is considerable variation in the application of the method and even the nomenclature: however, all these variants have a similar purpose; to avoid the effect of fragmentation in element numbers (for summaries for this topics see Lyman 1994: 102-104; Reiz & Wing 1999: 215-217). This underlines the importance of the use of clear method definitions to be used in every study including species identification, fragment counting and quantification.

MNE can be further processed into MAU (*The Minimum Number of Animal Unit*) or %MAU. The latter estimate considers that different elements are found in different numbers in animal skeletons (Binford 1978: 69-72, however, referred to these figures as MNI, see Lyman 1994: 105). For example, there is one skull but two femora and seven cervical vertebrae in every mammal skeleton. Therefore, an assemblage unaffected by depositional, taphonomic or recovery biases, should have twice the number of femora and seven times more cervical vertebrae than skulls. To gain the MAU values the MNE figures are divided by the number of times the element occurs in a particular skeleton (Lyman 1994: 104; Binford 1978). %MAU presents this data as a percentage of the highest MAU. The higher %MAU value, the more common the element in question is.

2.3.6.3 Quantification methods used in this study

In the present study the patterns in the faunal assemblage were investigated using several quantification techniques, namely NISP, MNE and MAU. NISP was chosen for the investigation of the general material characteristics. It is also the most widely used and therefore most suitable for comparisons to other materials. For a deepened picture of the properties of the material MNE and MAU were used and in some instances the MNI has also been calculated. MNI was used when investigating the occurrence of infant bones found. Element is defined in this study according to Lyman (1994:507) as "an anatomically complete bone or tooth (a discrete anatomical organ) in the skeleton of an animal". Specimen is defined as "part of a skeleton that can consist of a complete bone or fragment thereof" (Lyman 1994: 514).

The basic NISP numbers include all solitary specimens, including those which belonged to partial or complete skeletons. Because the infant bones and articulating skeletons are probably not related to meat consumption, they should be removed if the abundance of consumed animals is to be judged (for further detail see above in chapter 2.2.3). Therefore, some numbers referred as NISP do not contain all the identified specimens. The detailed description of the selection of the specimens can be found in chapter 3.

MNE values were counted to further examine anatomical distribution and age structure. Therefore, the articulating skeletons and infant bones were excluded from the MNE values. In the MNE estimations all epiphyses were divided into right and left sides and classified as open, closing and closed. MNE:s were derived for each of the epiphyses separately and were then added to form the resulting MNE estimate for each particular element. As the bones were recorded part by part (modified version of Lepiksaar's (1989) method), MNE:s were also derived for the diaphyses. MNE:s were occasionally derived on the basis of a special feature occurring in the elements, such as the *fossa plantaris* in femur or the *fossa mandibularis* of the skull. When deriving MNE:s for small bovids the categories sheep and goat were also considered. However, this was rarely relevant, because bones identified as "sheep or goat" were by far more abundant than those identified as either 'sheep' or 'goat'. In a few cases (such as metapodials) the greatest MNE of small bovids was achieved by counting the sheep and goat MNE:s together. For cattle both large ungulate and cattle bones were used for the counting of MNE. This was most relevant when dealing with the vertebrae and ribs.

2.4 Historical and ethnological sources

The present studies purpose is to analyse the available historical documents in order to extract all information of relevance to the research question posed. The nature of the documents and their potential for error are briefly discussed here. Such information has been provided in some previous studies, for example in Tornberg (1973), Vennola (1901) and Vilkuna (1998 and 2003). In the present study information has been gathered from historical and ethnological sources from various areas in Finland as well as from Sweden: the sources consulted are listed below. Geographical variation in animal husbandry should be expected, and therefore it has been difficult to judge how representative one solitary note may be. The castles in Finland were ruled by the Swedish administration, and therefore belong to a different cultural background than most of the inhabitants. As a result, the sources are more abundant for these contexts than from the surrounding rural area (Vilkuna 2003: 55-56). Therefore, the comparisons of animal husbandry in castles and rural animal husbandry can only be made with caution. For example, draught oxen were abundant in Häme castle, but were only used in certain parts of Häme.

The ethnological sources mostly date from the 19^{th}-early 20^{th} centuries and originate from various locations. Caution should therefore remain when making analogies between 19^{th} century animal husbandry and medieval animal husbandry, which is the focus of the present study. A cultural break in agriculture emerged in the late 19^{th} century with new inventions such as hay cultivation (Korhonen 2003; Östman 2004). However, some old practices remained in more peripheral areas. Moreover, this information can give us a new perspective on animal husbandry as the 19th century practices were still primitive compared with those of today.

Only a small number of medieval accountancy documents have survived in Finland (Kivistö 2000: 74). Gustavus Vasa, the King of Sweden-Finland, reinforced the government in the 16th century by introducing a more effective administration which created numerous tax- and accountancy documents (Vilkuna 2003: 21-25). This has produced many useful sources for example, the accounts of Häme castle (Vilkuna 1998 and 2003) as well as the landed estates surrounding the castle of Turku (e.g. Hausen 1881; Säihke 1963).

Tax rolls are useful in several ways. First, taxes were still paid in kind in the 16th century in Sweden and Finland (Vilkuna 2003: 21). Different tax goods were collected from different locations, and the records highlight the economic structure of the parishes (Kivistö 1999; Seppälä 2000). Secondly, in some cases tax collectors created lists of the taxed animals. The silver tax rolls from 1571 as well as other taxes have proved to be useful tools. Silver tax was collected for the ransom of the castle of Älvsborg (situated on the west-coast of Sweden), which was lost in a war to Denmark. Among other property, the livestock was taxed and listed in the tax rolls in some detail (Suomen hopeaveroluettelot 1571, Häme). These rolls provide an extensive picture of the livestock in Finland. Of special interest for this study is the information available from towns, such as Pori and Vyborg. Tax practices varied from town to town, with some livestock and merchandise goods listed while others are not. Unfortunately in Turku livestock was not taxed, or at least not separated in the surviving documents (Suvianne Seppälä 3.6. 2005 pers.comm.) and the documents are not published.

In the 17th century livestock was taxed rather regularly, which gives us an opportunity to study fluctuations in the numbers of animals (Melander 1897; Tornberg 1973: 9-11, 34ff). From the same century some data has survived concerning the livestock kept in Turku (Lindholm 1892: 27; Tornberg 1973: 176-177). Some estate inventories date back to the 17th century, but most of them, and usually the more detailed ones which contain information about animals, date to the 18th century (e.g. Oulun kaupungin perunkirjoituksia; Utdrag ur Åbo Stads Dombok 1638). In addition to these sources, animals are mentioned sporadically in many other documents such as travel literature (e.g. Acerbi 1799; von Linné 1732) and the economic reports from various parishes (e.g. Carenius 1759; Forsius 1757; Gadd 1751). At first, these pieces of information may appear meaningless, but following closer study they offer valuable insights into attitudes towards the animals and the breeding practices. This kind of sporadic information can be found in many documents.

Historical documents embody both quantitative and qualitative data: both are valuable sources of information. The tax rolls and inventories give quantitative, numerical data about the amount of livestock. Plenty of qualitative data about the animals is also present, concerning their breeding and economic value. Sometimes this information has to be read "between the lines". The silver tax rolls of 1571 are fine examples of how different information can be embodied in one document (Suomen hopeaveroluettelot). These rolls include the number of livestock in every taxed farm in Finland. This numerical data can be used, as an example, to evaluate the amount of livestock and the species frequency in different parts of Finland. However, more information can be extracted from the structure and the basis of these rolls. When animals are listed in the documents a certain order is usually obeyed, dictated by the value or status of the animals.

3 ABUNDANCE OF ANIMALS

3.1 Introduction

Most of the Åbo Akademi and Aboa Vetus material derives from domestic animals (97% of the identified fragments, the category of 'large' and 'small' ungulates are excluded due to the possibility of the presence of elk, forest reindeer and roe deer specimens among them) with wild species being in minority. This chapter investigates the abundance of the four major domesticates (cattle, sheep, goats and pigs) as it emerges through the osteological material. Abundance is a complex concept, as is revealed when assessing the different potential results given by different quantification methods. This data is examined in the following chapter.

First, only specimens that were identified to species level were used; in other words, the "small and large ungulate" bones were ignored, although specimens identified as "sheep or goat" were included (figure 3). In this comparison, the amount of cattle was expected to be too low compared to pig and small bovids. Only a minor part of the vertebrae were identified as cattle (atlas, axis, sacrum, caudal vertebra) and none of the ribs, while part of the vertebrae of pigs and small bovids and some of the ribs were identified to those species. In the second comparison, the specimens from "large ungulate" category were added to those identified as cattle. This led to what is probably too large a number of cattle specimens because the large ungulates included all the large ribs and vertebrae, while part of the pig and small bovids vertebrae and ribs in the small ungulate category were not included in the comparison. In the third comparison, all the small ungulate bones (including pig, sheep, goat and small ungulates) were compared to those of large ungulates (cattle and large ungulates).

There are numerous quantification methods which are used for the study of the abundance of species in osteological research (see chapter 1). In any method, there is usually a gap between the information the material actually provides and the questions we want to ask. Zooarchaeologists are usually interested in learning which species were present in an assemblage and their contribution to subsistence (for example Lyman 1994; Perkins 1973). Establishing this relationship between the specimens, elements or individuals in an osteological assemblage and the past animal population or subsistence techniques is a matter of interpretation and the basis for this are quantitative data. Different quantification methods are used to highlight different aspects of a faunal assemblage.

3.1.1 Identification

The different methods for the estimation of the abundance of the major domestic animals used in the present study are described in chapter 1. The impact different identification and quantification methods have on the abundance of species in different phases is clear in figure 3. All three phases at Åbo Akademi show similar changes in each method. The abundance of cattle is lowest when both large and small ungulate fragments are excluded from the analyses, and highest when large ungulates are included. When including both large and small ungulates in the analyses abundance of cattle falls between the two previous figures. However, with all three methods cattle is the most abundant species at the Åbo Akademi. As ungulates are excluded from the analysis of phase 1 and 2 at Aboa Vetus, small bovids are the most frequent species when NISP is calculated. However, when bones identified as "large ungulate", belonging mostly if not completely to cattle, are included in the comparison the most frequent species is cattle. In phase 3 at Aboa Vetus cattle is the most abundant species when all three methods are applied. In the present study it is the last two methods which have been principally applied: large ungulates with cattle included and the comparison of small and large ungulates.

There is also variation at context level. If the complete assemblage is used for comparisons, the greatest numbers of cattle bones are found either in the context M 78 B (ÅA), M 114 D (ÅA) or M 503 E+F (ÅA) depending on the method used (appendices 12 and 13). When only the specimens identified strictly as cattle are used, the most cattle are found in context M 78 B. When the specimens identified as large ungulates are included, M 114 D has the greatest numbers of cattle. However, the most reliable method for the examination of small-large animal abundance is counting all small ungulates and large ungulates together. With this method, context M 503 E+F has the highest number of cattle (or large ungulates).

3.1.2 Infant animals

The amount of different animals identified is dependent on the type of material we choose to examine. Different specimens have their origin in different activities. Some bones derive from food preparation and consumption, some from craft activities. The infant bones and complete skeletons of animals of any age most probably represent non-consumed animals, which should be removed from the analysis if only animal consumption (in form of meat or other products) is to be explored. The definition of complete is here deemed to mean a skeleton or partial skeleton, originating from an animal not consumed but discarded while still articulated. The removal of these specimens from the material affects the animal frequency. This can be seen in phase 2 at Aboa Vetus, which included several infant pigs and complete pig skeletons (appendices 14 and 15). The proportion of pig is lowered from 17,1 % to 10,3 % when these bones are removed from the analysis. In other phases the number of infant bones is low compared to the total number of pig specimens. In other words, if a number of small contexts have a high abundance of pigs they will not have a great affect on the abundance ratio of the separate phases.

However, in those contexts in which infant pig bones and whole pig skeletons are abundant, the effect of the removal of these bones is notable. These bones especially make a clear impact on the abundance of pigs in small closed contexts like M 164 B (ÅA) (a lavatory), where the relative abundance of pigs is 28 % of the four major domestics (cattle, small bovids and pig) when all the specimens are included, but only 12% when infant bones and articulated skeletons are removed. The removal of infant pig bones and complete skeletons do not only influence the smaller contexts, but also some of the larger ones are likewise effected, such as with the cellar K 94:10 (AV, n = 1856, from 22 % to 11 %) and M 147 (ÅA, n = 2626, from 13% to 7%). Complete skeletons of infant animals were excluded in the following comparisons, as they were not considered part of a normal household waste.

3.1.3 Craft activities

The accumulation of the bones that are related to craft activities can also have an effect on the species representation in a context. However, in the present material the proportion of craft related waste seems to be quite low, and has not had much effect on the animal abundance estimates or anatomical representation. Therefore, no attempt has been made to exclude these bones from the comparisons. The proportion of specimens that have been accumulated in connection with craftsman activities is not very high in any of the contexts. The presence of these bones and their effect on the species data should however be kept in mind.

3.2 NISP

3.2.1 Main domesticates

The proportion of the four major domesticates vary rather little on a context level. Without the infant bones and articulated skeletons, cattle dominate in all contexts independent of the methods used for counting except in K 94:11 (AV) and K 94:12 (AV). Therefore, there is almost no variation in the ranking of the species between the different contexts: most of the specimens derive from cattle, followed by small bovids and pig. The proportion of small bovids remains relatively constant compared to the other species. However, the proportion of these two species varies. Goat specimens form 2 %- 33 % of all the sheep and goat specimens (small contexts excluded) (appendix 16).

Comparisons of the abundance of the species reveal some minor differences between the phases and the excavation areas (infant bones and articulated skeletons excluded). As could be predicted from the context data, cattle is again the most abundant species followed by small bovids and pig. At Åbo Akademi the amount of large and small ungulates remains quite constant through the centuries, approximately 60% of the large and 40% of the small ungulates. At Aboa Vetus the picture is slightly different. In all three phases there is approximately 50% large and 50% small ungulates. Phase 2 at Aboa Vetus exhibits slightly less cattle. A closer examination reveals that the differences are mainly due to a larger amount of small bovids in the Aboa Vetus material and to some extent the larger amount of pigs in phase 2.

The analysis of the abundance of sheep and goat in an osteological assemblage is complicated by the difficulties associated with their identification. Sheep specimens are more abundant than goat both at Åbo Akademi and at Aboa Vetus. However, when interpreting sheep and goat data it should be remembered that the data might be biased and affected by the difficulty in separating goat and sheep bones, which proves more troublesome with these species than with any other domestic animal types. The bones most readily identified as sheep and goat are the horn cores and metapodials, both of which are associated with craftsmanship. They are often imported from a larger area and can therefore serve as signs of specialisation and raw material use. For this reason these bones might be of limited use when examining the abundance of sheep and goat in relation to other aspects of animal exploitation.

Indeed, the proportion of sheep and goat is dependent on the elements used for comparison and the anatomical distribution of these animals (table 8). If only the low utility skeletal parts are analysed (cranium, horn cores, mandible, calcaneus, talus, metapodials and phalanx) then 76% of the sheep and goat specimens at phase 1 of Aboa Vetus belong to sheep. Conversely, when the high utility skeletal parts are analysed (atlas, axis, scapula, humerus, radius ulna, pelvis, femur and tibia) the proportion of sheep as to goat rises to 95%. This is due to the different anatomical distribution of the two species, which in turn has consequences when it comes to the differential importance of sheep and goat. Therefore, it is not enough to directly compare the proportion of the sheep and goat specimens. The anatomical distribution should also be examined.

An interesting chronological change can be seen in the proportion of goat bones from Åbo Akademi (all identified specimens were used for the comparison) (figure 4). The number of goat specimens compared to sheep increases in phase 3, i.e. the post-medieval period. A different pattern is found at Aboa Vetus, where the proportion of goat specimens is similar in the first two phases (medieval and the 17th century) but decreases in phase 3 (the 18-19th century).

There is also a chronological change in the proportion of high and low utility skeletal parts (table 8). In the three medieval phases the proportion of high utility goat parts is lower than in the post-medieval phases. Phase 3 at Aboa Vetus fails to provide enough information for conclusions to be drawn.

In phases where most of the goat specimens derive from low utility body parts, horn cores and metapodials, it is possible that most of the existing goat bones have indeed been identified as such since these elements can quite easily be separated from those belonging to sheep. Consequently, the number of goat specimens in the "sheep or goat" category is probably very low. In phases where high utility skeletal parts of goats are common, it is more likely that a higher proportion of "sheep or goat" specimens derive from goats, for example vertebrae and ribs. However, the proportion of goats seems to be low; only in phase 3 at Åbo Akademi, where the number of goat specimens is the highest, could the numbers, theoretically at least, approach the abundance levels of pigs.

Taking into account the fact that the category "sheep and goat" derives from two different species, even if sheep seem to be far more common than goat, cattle seems to be the most frequent species in the material as a whole when assessing abundance using the NISP method. In all of the identification methods employed pigs are revealed as less numerous than cattle and sheep. Goats are probably the most infrequent species of these four animals, even if the problems associated with their identification makes it difficult to judge their abundance compared to those of pig specimens.

3.2.2 Other species

Some of the contexts contain bones from rare species that occur only sporadically in the material. The importance of these species can be difficult to judge because they are usually isolated specimens. However, when connected with other evidence they can sometimes be linked to past activities, such as the furrier occupation (see chapter 5). The only wild species that occurs in such quantities that the abundance can be examined at a context level is hare (table 9-10). Hare specimens are present in all the larger contexts, but their proportion is always low. All the hare body parts are represented in all the phases. The different sieving methods in Åbo Akademi and Aboa Vetus have likely caused some bias in the hare anatomical distribution. At Aboa Vetus there are smaller bones like the phalanx, tarsi, teeth and metacarpals, while these are rarer at Åbo Akademi.

It should be noted that this kind of discrepancy in the anatomical distribution is likely to cause some differences in the relative abundance of the bones. Indeed, even if in phase 2 at Aboa Vetus the proportion of hare bones is slightly higher than in phase 1 at Åbo Akademi, the MNE- values of these two phases are very similar (with most of the bones MNE's of 3-4 obtained in both areas). There is no reason to expect that hare meat would have been more important at Aboa Vetus than at Åbo Akademi. The variation is related to the different anatomical representation.

There are some differences between phases at Åbo Akademi and at Aboa Vetus. There is less hare in phase 1 at Åbo Akademi than in phases 2 and 3, and less hare in phase 1 at

Aboa Vetus than in phases 2 and 3. However, the differences between the phases can partly be explained by finds in certain contexts containing several hare bones. It can be seen in appendix 17 that the abundance of hare is not higher in contexts belonging to phase 2 than in those belonging to phase 1. There are a few contexts with an elevated abundance of hare bones, which affect the whole data set. The removal of one single context, M 56 C-N (found inside a well) slightly decreases the proportion of hare in phase 2 from 0,94 % to 0,82 %. However, the same does not apply for the other phases. Even if caution is called for, it seems plausible that consumption of hare meat increased slightly during the centuries.

Some differences between the phases can be observed in other species (tables 9-10). At Åbo Akademi seal bones are concentrated in the younger layers. In phase 1 at Åbo Akademi only one seal bone was found, an os baculum (penis bone), another one was recovered in phase 2. Even if the seal bones are not very common in the later phases either (n = 10), a trend is discernible. However, this is not the case with the Aboa Vetus material. Here the seal bones occur in both phases 1 and 2, but not in phase 3. The distribution of horse bones is different: they are concentrated only in the medieval phases. At Åbo Akademi there are no horse bones found from phase 3, and at Aboa Vetus only one from a trial pit in the cellars which most likely belongs to phase 2. Bear bones were found only at Åbo Akademi phase 1 and 2. One bear claw has been found in later excavations in the Aboa Vetus museum in 2005, but this material is not included in this study.

3.2.3 Infant animals – signs of local production?

Historical sources, osteological material and archaeological finds show that the inhabitants of Turku owned cattle, goats, pigs and sheep. Historical sources most often mention cows and pigs, sometimes goats and only rarely sheep. In the osteological material, the presence of infant bones is usually seen to indicate local production as they are interpreted as from stillborn animals or from neo-natal animals. In archaeological excavation thick layers of animal manure as well as buildings interpreted as animal shelters have been found (e.g. Kykyri 2003: 114; Seppänen 2003: 99).

Pig is the most abundant species among the infant bones, followed by cattle. The number of infant sheep or goat bones compared to those of cattle and pig is low. However, when using the infant bones as a sign of urban animal husbandry in Turku (thus assuming that they are the result of natural mortality), some potential for error has to be taken into consideration. These animals could have been brought into the town for consumption. However, the often complete state of remains suggest that infant animals were not eaten. The absence of cutmarks supports the idea that these individuals or the infant animals were not consumed. The only exception is a sternum of a half-year old pig from M 147 (ÅA), which had been cut through in an anterior-posterior direction. Only 17 bones belonging to this animal were found, including the skull, lower jaws, pelvis and some long bones from the lower parts of the limbs. It is possible that this animal was indeed slaughtered, with the high utility parts like the trunk and upper limbs removed and the rest of the animal discarded. This animal was also excluded from the consumption analysis, because it does not represent typical food waste, if indeed it represents food waste at all. This pig could have been slaughtered for a number of reasons, e.g. for rennet (Grotenfelt 1918: 131; Ränk 1966: 101). Pigs aged a little over six months were rarely slaughtered in Turku: bones from these juvenile animals are not common and derive usually from whole carcasses and not from isolated bones as with the food debris. However, some signs of consumption of infant animals have been found in Finland (Puputti 2005: 79). Consumption of these animals does not necessarily create cut marks (Thomas 2005: 54). Differential preservation and deposition of carcasses can lead to the dispersal of the remains of different animals. For example, a newborn calf or lamb could have been skinned and deposited in a skin working area. Equally, some bones from the lower limbs could have entered the town attached to skins. Piglets would not have such a use.

When studying the frequency of the infant bones differential amount of offspring per female and the different rate of newborn deaths has to be taken into consideration. As stated earlier, the mortality among the calves and piglets seem to be higher than that among the lambs (chapter 1). A cow generally gives birth to just one calf, in contrast to the larger litters produced by sows. The productivity of modern Finn Sheep is high: average of 2,3 living lambs / ewe (Alasuutari & Syrjälä-Qvist 1998: 4, taulukko 2; Ryder 1983: 19). It is possible that similar figures might be true for the medieval period, although the rate of survival may have been different.

If the infant bones derive from fetuses rather than from new-born animals, then it is also possible that the bones derive from pregnant animals that have been slaughtered. This explanation has been proposed by Boessneck & von den Driesch (1979: 132-133; see also Vretemark 1997: 95-96) for the infant pig bones derived from pregnant sows slaughtered in late autumn. Compared to the diaphysis lengths of the pig fetus bones given by Habermehl (1975: 140), the infant bones from Turku seem to derive from new-born piglets rather than fetuses. The possibility of the presence of fetuses has also been considered with the other domestic animals. Indeed, some of the infant cattle bones are so small and under-developed that they must derive from a fetus rather than a newborn calf. The idea of slaughtering carrying cattle in a society which greatly appreciates butter and thus, milk production is somewhat curious, but of course not impossible. In the case of the hay failure even the productive stock was probably reduced. However, bones of fetuses can also come from miscarriages, which should not be a rare phenomenon in circumstances where cattle were kept during the winter.

Infant bone data indicates that milking cows were more common in Turku than reproductive ewes and female goats. Both infant sheep and goat bones have been found in the material, which implies that both species were kept in town. However, the infant sheep and goats could only be identified from the metapodials, which could also have entered the town attached to skins. Other skeletal parts could only be identified as sheep or goat. Infant pig bones are plentiful in the material compared to the proportion of pig bones in the assemblage. The abundance of infant pig remains is partly explained by the large size of the litters and high mortality.

3.3 MNE

MNE is usually used for the comparison of the anatomical distribution. However, MNE values can be used for the examination of the abundance of species. As the impact of the different fragmentation has been minimised the MNE method gives more controlled and standardised numbers for the different elements and thus, the abundance of species. The comparison of the total number of MNE is, however, not without problems. Due to the sieving procedure, a larger amount of small bovid and pig small bones are probably missing, and there are some differences in the identification procedure which might affect the estimates. Ribs are overrepresented in the cattle MNE-estimates compared with those for small bovids and pigs (figures 5-10, appendices 18-20). This is due to the different identification accuracy. Only the complete proximal parts of the ribs were identified as small bovid or pig. The shaft fragments as well as the broken, worn or otherwise unidentifiable proximal parts were set into the category “small ungulate”. Furthermore, even the incomplete proximal parts of cattle ribs were categorised as large ungulates and therefore quantified. Indeed, the highest cattle (large ungulate) rib MNE comes from the *angulus costae,* that is, just behind the articular surfaces, which are often cut or chewed off or otherwise destroyed.

Using MNE results in lower proportions of cattle and higher proportions of small ungulates (tables 11-12). The difference is greatest in phase 1 at Åbo Akademi, where cattle abundance decreased from 67 % to 52 %. The same effect has been noted in previous studies (Luff 1993: 32, 45; Thomas 2005: 18: in these studies the term MNE is not used but the methods are very similar).

Thus, the frequency of small ungulate bones in the material is higher when the estimates are based on MNE:s than on NISP:s. The dominance of cattle in the material seems to be partly associated with the level of recovery, identification procedure and finally the analytic procedures used. The abundance of species obtained through the MNE-method is likely to be more reliable than that with NISP. However, even with this method the cattle are still the most abundant species in all six phases.

4 THE ANIMAL BONES

In this chapter each species is studied in detail. Anatomical representation, age and sex structure, size and pathological changes, are examined to form a general picture of animal roles in Turku in different periods.

4.1 Cattle

4.1.1 Anatomical representation

The anatomical distribution of cattle was studied using NISP and MNE (%MAU) (appendix 21). In anatomical figures the large ungulate and cattle specimens are combined, because most of the high utility skeletal parts of cattle are identified as large ungulate (see chapter 1 and 3). Some differences can be detected in the distribution of high and low utility skeletal parts between the phases (NISP) (figure 11). At Åbo Akademi, the number of high utility skeletal parts is rather constant in the two medieval phases but in phase 3 they increase in number. At Aboa Vetus a different pattern is found. Phase 1 exhibits the highest number of large ungulate high utility skeletal parts, while phase 2 exhibits the smallest part. The pattern of phase 3 resembles that of phase 2 but the small sample has to be considered.

Some differences can also be detected in the frequency of craftsmanship waste, which is discussed in more detail in chapter 5. However, what is noteworthy is the small number of horn cores in phase 3 at Åbo Akademi and in phases 2 and 3 at Aboa Vetus. There seems to be a change in the disposal of horn cores between the medieval and post-medieval phases.

The MNE data was also used to more closely analyse the anatomical distribution of cattle. The MNE values were converted to %MAU figures to standardize the comparisons of different phases (figures 12-13). These comparisons reveal some similarities as well as differences between the different areas and phases. There seem to be more low utility skeletal parts at Åbo Akademi than at Aboa Vetus. There is a chronological change in the number of cranial parts, which is lower in the latest phases. The small number of vertebrae, ribs and small bones is a rather common phenomenon when quantification of MNE or MAU is used, partly because of the identification procedures, but also due to preservation and recovery (cf. White 1992: 294-314). A common feature is also the lower numbers of phalanx 2 compared to phalanx 1 and the lower numbers of phalanx 3 compared to phalanx 1 and 2 (with the exception of phase 3 at both Åbo Akademi and Aboa Vetus). The cranium, mandible, calcaneus and metatarsals are well represented in the material and they exhibit the highest MAU values. At Åbo Akademi the anatomical distribution of the two earliest phases are similar, representing plenty of cranial and lower parts of the legs. The major difference is the higher number of atlas, axis and calcaneus in phase 1. Phase 3 at Åbo Akademi exhibits more high utility skeletal parts than the two previous phases. This is due to the smaller proportion of cranial parts, while the lower legs are well represented. In phase 1 at Aboa Vetus the anatomical distribution is the most even, but with a dominance of high utility skeletal elements. The elements of the upper front leg are especially abundant. Phase 2 at Aboa Vetus has a larger gap between the maximum MAU value (cranium) and the rest of the values. In phase 3 cranial parts are poorly represented.

4.1.2 Age

4.1.2.1 Age data from mandibles – eruption and wear

Some differences in the age composition of the mandibles can be detected in the material. In cattle, phase 1 at Åbo Akademi contains more mandibles of young animals than phases 2 and 3 (figures 14-18, appendix 22). At Åbo Akademi the number of mandibles of young animals decreases through the centuries and in phase 3 only a few mandibles in the youngest age categories are present. A similar trend can be observed at Aboa Vetus, where phase 1 contains more mandibles from young animals compared to phase 2, where a clear peak of older mandibles can be seen. As a whole, there seems to be more mandibles from more elderly cattle at Aboa Vetus than at Åbo Akademi. Phase 3 at Aboa Vetus contains only four mandibles, two of them from young animals (SA 2), two of them from old (A 3) animals. The medieval phases at both sites have similar age structures: there is one peak of younger animals (SA 2 and / or A 1) and another of adult animals, separated by lower numbers of category A 2 mandibles (however, more mandibles in category E were observed in the Aboa Vetus). In the post-medieval phases the two oldest age categories dominate. Phase 1 at Åbo Akademi is distinguishable from the other phases by the greater amount of young cattle. This however, is mostly caused by one context, a wooden chip layer M 173, which contains a great number of young cattle mandibles. M 173 included mandibles from the following categories: 3 I, 1 SA 1, 3 SA 2, 3 A 1 and 2 A 3. If the information from M 173 is omitted from the graph, the remaining figure is more consistent with the other medieval phases, though there is still a slightly higher amount of young cattle. Obviously, some larger contexts have a significant impact on the overall pattern.

In order to compare different ageing methods, the MWS was estimated for cattle mandibles from phase 1 at Åbo Akademi using the methodology laid down by Grant (1982). The comparison of the results gained with those from O'Connor's (2003) method and the MWS method reveals some differences (figures 14 and 19). The former method gives a more varied picture of the age division of the mandibles, while the latter method produces a more generalised one. There are some possible reasons for these differences.

Slightly different mandibles are used for these figures. O´Connor's method requires the presence of the last erupted teeth. He claims that in his material the earlier erupted molars are missing more often than the later erupting molars, and the missing teeth are therefore usually of minor importance (O'Connor 2003: 159). However, this is not necessarily the case in Turku. Particularly with the cattle mandibles (but also with small bovids and pigs) the preserved toothrows in the majority of cases consisted of PM 4 / pm 4 and M 1 and 2. Mandibles were often broken at the junction of the mandibular ramus and corpus, i.e. close to the alveolus of M 3, which was then broken and the tooth was missing or broken. Even so, in phase 1 at Åbo Akademi 51 mandibles could be set into age categories according to O'Connor's method, and 49 according to Grant's MWS.

Comparison of the age structures estimated by the two methods is not straightforward. Vretemark (1997: 39) presents data on tooth wear, MWS and animal age. Accordingly, slight wear in cattle M 3 and the MWS of 30-38 predict an age of 2,5-4 years. M 3 in slight wear corresponds to categories A 1 and A 2 by O'Connor (2003: 160). In Turku, a closer examination of mandibles that have reached MWS 30-38 reveals that some of them exhibit medium wear in M 3 (for example stage g). These mandibles correspond to stage A 3 of O'Connor. For the comparison, the age groups were divided into three categories: for the O'Connor method neonatal to sub-adult 2, adult 1 and 2 and elderly, for Grant in MSW groups of under 30, MWS 30-38 and MSW over 38. The results show that with MWS the proportion of older animals is smaller than with O´Connor's method, and the middle category including mandibles with MWS 30-38 is larger. This might be due to the presence of mandibles that have M 3 in medium wear.

The O'Connor method seems to reveal more accurate fluctuations in the stages of mandibular wear. It should be remembered that these age categories do not necessarily represent uniform lengths of time. While some wear stages can last for only a short period, others can be called "standstill stages", because they last for longer period of time with an example being category g (O'Connor 2003: 161). Therefore, if a repeated pattern of peaks for one age group is observed, there is a possibility that this peak may just represent a longer time period, not necessarily a concentrated kill pattern. In cattle, category A 2 is rare in all phases. This possibly represents a period of rapid wear (teeth with Grant's wear stages c and d).

The age data gathered from cattle mandibles from the medieval and post-medieval phases differ rather prominently from each other: in medieval phase 1 there is an abundance of mandibles of young animals, but not in the post medieval phases, where mandibles of old animals dominate. In the next chapter the post-cranial epiphyseal data will be examined and compared to these results.

4.1.2.2 Age data from postcranial bones –epiphyseal fusion

It could be expected that the epiphyseal data would follow the pattern seen in the mandibular age data (figures 20-25, appendix 23). Indeed, in the phases at Åbo Akademi the epiphyseal data seems to follow the patterns seen in the tooth data rather closely: in phases 1 and 2 plenty of cattle were slaughtered young, but older animals are also present in the figures, and in phase 3 older animals dominate. Phase 1 at Aboa Vetus follows the same lines as phase 1 and 2 at Åbo Akademi. The higher proportion of older mandibles (category e) is not reflected in the epiphysis data. In phase 2 at Aboa Vetus there seem to be less open epiphyses than in phase 1 at Aboa Vetus, but the number of fused epiphyses is still rather low compared to tooth data. In phase 3 at Aboa Vetus open epiphyses dominate in the material. The differences between the mandible and epiphyseal data might be caused by the specialised meat trade, and therefore by the different origin of mandibles and epiphysis.

In addition, the fusing of the vertebrate was examined (table 13). The fusing starts from the lumbar region and proceeds towards the cervical vertebrae, which fuse after 8 years of age (Habermehl 1975: 106-109). Therefore, a higher number of fused lumbar vertebrae would be expected. Indeed, there are more fused lumbar vertebrae than others in most phases (exception: phase 3 at Åbo Akademi), but the frequency of fused cervical vertebrae is usually also higher than the number of fused thoracic vertebrae (exception: phase 1 and phase 3 at Aboa Vetus). In phase 1 at Åbo Akademi there are less open and more fused vertebrae than in phase 2 at Åbo Akademi. This is quite the opposite of what was revealed by the tooth data. It is surprising that even if other age data suggests that less young cattle are present in phase 3 at Åbo Akademi, there are more young vertebrae than in phase 1 at the site. Phase 1 at Aboa Vetus shows high levels of open vertebrae, as expected, and with less present in phase 2. However, there are still plenty of open vertebrae in phase 2 at Aboa Vetus when compared to the results of the tooth data. In phase 3 at Aboa Vetus open vertebrae are as abundant as the epiphyseal data indicates. However, it must be remembered that there is a total MNE from the vertebrae of only 22 for this phase.

4.1.3 Sex distribution

The sex of cattle was investigated through the horn cores, metacarpals and pelves. However, only two phases included enough material for comparison in all three categories, namely phases 1 and 2 at Åbo Akademi (figure 26). In phase 1 at Aboa Vetus horn cores could be used for analysis, while at phase 2 of the same site horn cores and pelves could be used. The results of the different methods of sex determination are not necessarily uniform throughout a single phase, nor are the results from two different phases alike. The question of the presence of castrated males (oxen), in the osteologocal material was investigated in detail. As has been stated above, the form of metacarpals of oxen is dependent on many different aspects, including the age of castration, age of death and workload (see chapter 1). Three factors are given special consideration here: the length and form of the horn cores and metacarpals as well as pathological changes observed in the bones.

4.1.3.1 Horn cores

Osteometric sexing of horn cores presents some difficulties. Different authors tend to separate cows, oxen and bulls based on different criteria (see chapter 1). The basal circumference of horn cores exhibits a bimodal distribution, which is connected to different sexes (for example Grigson 1982b). The female horn cores are smaller than those of males. The boundary zone between sexes has been set in Iron Age or medieval cattle at 150-160 mm (Prillof 2000: 30-34; Vretemark 1997: 106; Wigh 2001: 65). This boundary zone also seems to be applicable in Turku (figure 27).

With reference to previous studies, a transition zone between 150-160 mm females and males was applied in the present study (Prillof 2000: 30-34; Vretemark 1997: 106; Wigh 2001: 65). The 150-160 mm zone is uncertain, as it may include either larger cow or smaller bull (or late castrated oxen) horn cores (Armitage & Clutton-Brock 1976; Benecke 1988: 334; Müller 1959). This is especially true with phase 2 at Åbo Akademi, where bones in the border zone are frequent. With this criterion, in phase 1 at Åbo Akademi 93% of the horn cores derive from females which drops to 73% in phase 2. In phase 1 at Aboa Vetus 84% of the horn cores come from females.

The horn cores in the border zone of 150-160 mm at phase 2 at Åbo Akademi require some attention. It is possible that the border zone is not as applicable in this phase as it seems to be in phase 1 at Åbo Akademi. Phase 2 exhibits a rather continuous size distribution with the most obvious gap between 160-170 mm. There might be a chorological change in the size or shape of the horn cores, with animals in the later periods possessing smaller horns. Horn cores in the border zone may also be derived from animals group not well represented in other phases, such as late castrated oxen.

Interpreting the large horn cores as males is perhaps not always justified. The horn cores of oxen are longer and larger than those of bulls (Benecke 1988: 20-21; Müller 1959: 198-199) and in comparisons based on visual examination, the horn cores of bulls and cows cluster close to each other, with oxen only separated by size alone (Benecke 1988: 20-21; Müller 1959: 198-199). There is no uniform criteria available for separating cows and bulls: Müller (1959) has interpreted the length to be the main separating factor, and the bulls in his material have small basal circumference (under 120mm). In Benecke's (1988) comparison the bulls and cows are separated by both the size of the horn and form of the horn core base: bulls are large (over 150 but under 170 mm) and exhibit a more round than oval base (larger minimum diameter of horn core base/maximum diameter of horn core base x 100- index).

The metric data of horn cores was plotted according to Benecke (1988) and Müller (1959) to compare the different methods (figures 28-33). Larger horn cores (basal circumference over 150) do not appear to be significantly more oval than others (oval horn cores have a smaller minimum diameter / maximum diameter x 100 than round ones). At phase 2 at Åbo Akademi there seems to be plenty of round smaller horn cores. Instead, larger horn cores seem to form a more uniform group, with of the indices falling between 75 and 85 mm in contrast to the smaller ones, which exhibit a higher degree of variation in form.

Most of the horn cores are of short- or medium size, with few being small or long (table 14) (according to criteria used by Armitage & Clutton-Brock 1976: 331). For those horn cores that have yielded both a length measurement and basal circumference, only few have a basal circumference exceeding 150 mm (figures 31-33). The thinner core of oxen horn cores may have broken more easily, which may lead to an under-representation of long horn cores (Armitage & Clutton-Brock 1976: 332). At Åbo Akademi phase 1 only one horn core was more than 150 mm in basal circumference and was rather short. In phase 2 at Åbo Akademi horn cores with basal circumferences larger than 150 mm line are longer, but still not present in great quantities. The comparison is complicated by the uncertainty of the timing of castration. Castration at a late age creates oxen that can closely resemble bulls (e.g. Armitage & Clutton-Brock 1976: 332-333). Castration will be discussed in more detail later in chapter 4.2.3.4.

4.1.3.2 Metacarpals

The metacarpals have been sexed according to Mennerich (1968) (figures 34-36). Bones falling below his thresholds (index 1 16,5, index 2 29,5) have been interpreted as females and the rest as males. In phase 1 at Åbo Akademi 53% of the metacarpals were determined as females, rising to 62% in phase 2. In phase 2 at Aboa Vetus only 35 % of the metacarpals come from females. As this method when applied to the Turku assemblages placed many equivocal determinations in the male category, other methods were also used to confirm the distribution.

Results obtained by Howard's (1963) methods for the most part agree with the Mennerichs indices (figures 37-39). The distribution of the distal breath of the metacarpals is bimodal (or even trimodal), where the border between the females and the males seems to be at approximately 52 mm with some overlap (figures 40-41). To closely explore the relationship between these different methods, the distribution of the distal breath measurements of metacarpals sexed according Mennerich (1968) was studied (figure 42). Indeed, 52 mm seems to be a valid border zone for the separation of male and female metacarpals, albeit with some overlap in both directions. The female metacarpals exhibiting a 'large' Bd and males with a 'small' Bd were then studied further. Most of the metacarpals were interpreted as male bones, and with a Bd below 52 mm have a Mennerich index 1 below 16,5 but index 2 of over 29,5. Metacarpals interpreted as coming from females with a Bd between 55 and 60 mm were extremely long- in fact one bone is among the longest bones in the assemblage. They might come from larger cows, but are likely to be gracile oxen. In other studies the border between female and male cattle has been set somewhat higher, for example in at Birka 55-58 mm (Wigh 2001, 66) and in Skara at 55-56 mm (with some overlap of sexes between 52-57mm) (Vretemark 1997: 108). This might be due to a greater absolute size of cattle compared to Turku (see chapter 6.5).

The proportion of females estimated from the distal breath (Bd < 52 mm) is approximately the same as that of Mennerich's method in phase 2 at Åbo Akademi and in phase 2 at Aboa Vetus (according to Mennerich: phase 2 at Åbo Akademi 62 % female, phase 2 at Aboa Vetus 35 %, according to Bd: phase 2 at Åbo Akademi 68 % female, phase 2 Aboa Vetus 36 %). In phase 1 at Åbo Akademi the Bd- method shows a higher frequency of females (67%) than Mennerich's thresholds (53%). This however seems to be due to six broken metapodials, all of which have a Bd under 52, where only the distal part has survived and which are therefore not included in Mennerich's method.

The methods described above have zones of overlap between the sexes and therefore there are probably males included among females and vice versa. However, the comparison did shed light on the overall distribution of sexes in material.

4.1.3.3 Pelvis

47% of the pelves in phase 1 at Åbo Akademi were determined as females, rising to 60% in phase 2. At Aboa Vetus 42 % of the pelves come from females. It seems that at Åbo Akademi the number of female animals is increasing in every advancing age category. There are more females in phase 2 at Åbo Akademi when pelves and metacarpals are considered, but more female horn cores in phase 1 at Åbo Akademi. At Aboa Vetus comparisons are difficult to make, as they should be made on different elements. In phase 1 at Aboa Vetus there are more female horn cores than female pelves or metacarpals at phase 2. In phase 2 at Aboa Vetus the proportion of males rises in every available (that is, two) age categories.

For pelves, the threshold for the medial edge thickness of the acetabulum between the sexes varies a little between different materials (Vretemark 1997: 43; Wigh 2001: 66). This variation is probably caused by the limited size of the investigated materials, but also because of the size variation between the animals from different populations. Here, as in other methods where sex is determined according to one measurement only, the threshold should probably be defined and investigated individually in every assemblage or separate animal population. In Turku, the threshold separating the sexes seems to fall at approximately 9,5 mm of acetabulum medial edge thickness. In the other studies threshold has been placed at 9,8 mm such as in Birka (Wigh 2001: 66) and 9-10 mm in Skara (Vretemark 1997: 44-45). The threshold in Turku was determined on the basis of the distribution of pelves sexed by morphological criteria (figure 43) but also on the patterning emerging in the distribution of medial edge values (figure 44). However, the morphological features indicating sex are not totally in line with the measurements: the largest value for a female pelvis medial edge is 8,7 mm but the smallest for a male pelvis 6 mm. The presence of castrated males is probably blurring the picture. It is possible that some males fall among the females in the comparisons. The possible post-fusion growth of the acetabulum and as a result the later development of the sexually dimorphic characters of the pelvis than the actual fusion age of the bone, could lead to some erroneous estimation where some females in fact are young males. The early age of fusion for the acetabulum is a complicating factor in the comparisons.

4.1.3.4 Oxen in osteological material

Long metacarpal bones have been considered an indication of castrated animals, although the reality is more complex. Wigh (2001: 66-69) separates cows, bulls and oxen by plotting the distal breath of the metacarpal (Bd) against the greatest length of the bone (GL). In the resulting figure oxen are supposed to lie on the right upper corner of the figure with the greatest values of both measurements, in other words, with broad but long metacarpals. In Swedish material, where metacarpals of oxen have been discovered to be longer than those of bulls or cows bones, this is a reasonable assumption and seems to work with the Birka material (Sten 1994: 44-47; Wigh 2001: 66-69).

In the previous studies from Finland it has been found that the length of ox bones is not greater than those of bulls or cows (Tourunen 2002a: 138). For the study of length of male metacarpals, the greatest length was plotted towards distal breath (figures 45-47) (cf. Schmölke 2004: 48; Wigh 2001: 67). Among metacarpals that have a Bd larger than 52 (probable males), both long and short bones exists, however, most being short bones. This is especially clear in phase 2 at Åbo Akademi.

The connection between the form and size of the bones can also be studied if Howards index Bd/GL x 100 is plotted against the greatest length of the bone (figures 48-50) (O´Connor 1982: 23; Wigh 2001: 69). The threshold between the male and the female animals seems to be at approximately 30 of the Bd/GL x 100 index with some overlap (see Howard 1963: 93; Maltby 1979: 33; Wigh 2001: 69). According to Howard (1963: 93), castrates have a smaller Bd/GL x100 index than bulls. The male area in phases 1 and 2 at Åbo Akademi can be divided into two clusters according to the Bd/GL-index with a separation at approximately 34. However, the bones of the assumed castrate group do not seem to be longer than those assumed to belong to the bull group. On the contrary, the male metacarpals often seem to be shorter than those of the cows. Some larger bones are present in the material, but they are in the minority. However, it is clear that a small Bd and a small GL do not correlate very strongly, in fact the pattern visible is quite the opposite. As a consequence, male metacarpals do not seem to be longer than female ones in fact they are shorter.

Oxen are considered to have longer horns (and horn cores) than bulls (see for example Armitage & Clutton-Brock 1976: 332). Therefore, horns with a greater basal circumference and horn core length are probably from oxen. Unfortunately, only four horn cores with both measurements can be assigned unequivocally to the male category. One of these is longer than the others, while the rest are of average length. Again, most of the available adult males more closely resemble bulls rather than oxen. Vilkuna (1936: 60) mentions that oxen which have been castrated as adults had short and sturdy horns. Oxen castrated as calves had longer and more "cow-like" horns.

Another way of tracing oxen in the osteological material is to search for the pathological effects of draught work on the animal bones. Some caution should be exercised here. Firstly, pathologies can occur in animals that were never used for traction (Johannsen 2005: 42). Secondly, light traction work does not necessarily leave any marks on the bones especially if the animal was culled at a young age (Johannsen 2005: 47). Thirdly, cows can also be used as draught animals, so pathologies that link into traction work are not necessarily certain signs of oxen (Groot 2005: 55-56; Johannsen 2005: 47). However, it is of interest that Olaus Magnus (777) claims that cows were not used for traction in Sweden in the 16th century.

Keeping these factors in mind, pathological changes in the metapodials and phalanges were examined according to the system created by Bartosiewicz et al. (1997). Few of the metacarpals examined exhibited pathological changes. The most common type of pathological change found in the metacarpals was the broadening of the distal epiphysis. This, in turn, leads to greater distal breath values. A majority of the Bd values over 59 mm came from animals with pathological lesions. All the metacarpals with pathologies have been sexed as males. To ascertain the greatest length of the pathological metacarpals and other metacarpals a comparison was made with the phase 2 material from Åbo Akademi, where the largest sample of metacarpals with pathological changes was obtained (table 15). The results show that the average length of the metacarpals with pathological lesions is lower than the average length of the other metacarpals that have been sexed as males. Indeed, the average GL for the male metacarpals is lower than the GL of the female ones. However, the smallest depth of the diaphysis of these pathological metacarpals is larger than in the other male and female groups. In short, the bones with pathological lesions indicative of traction work are short and broad- i.e. bones that are usually described as bull bones. The pathological bones in phase 2 at Åbo Akademi seem to be concentrated in certain contexts, namely the M 159 and M 104. Neither of them show signs of processing for cattle hides, which could explain the concentration of ox metapodials, as their hides were more highly valued than those of cows (Grotenfelt 1887: 152). M 159 is a large context, and the spatial relationship of these bones is therefore unclear. It is possible that they formed a small concentration of metapodials due to specific slaughter or tannery activities.

4.1.4 Size

During the analysis, a number of measurements were taken from the bones to gather animal size data. For cattle, the comparison of measurements of the different bones does not reveal any uniform pattern or change in the measurements between phases (table 16). For example, the greatest length for the metatarsal bone seems to decrease during the centuries (except at Aboa Vetus phase 3), but the tibia distal breath seems to increase. The lateral greatest length of the talus shows an increase from phase 1 to phase 2 at Åbo Akademi but a decrease in phase 3. At Aboa Vetus the GLl of the talus shows steady increases through all phases.

The metacarpal bone was chosen for a closer examination of cattle size, to eliminate possible sources of error caused by the sex and age of the animals. This bone can be aged and sexed, and it is therefore possible to eliminate the possible effect that animal sex can have on size data. The metacarpals were considered to derive from a female according to Mennerich's technique (1968) (female when index 1 was less than 16,5 *and* index 2 less than 29,5). As it was difficult to separate bull and oxen in Turku the Matolsci (1970) formula was chosen to convert the greatest length of the metacarpals to withers height (see chapter 1). Matolsci gives only one factor for male animals, while Fock (1966) separates the factors used for oxen and bulls.

The metacarpal bones give quite a uniform picture of the body size of the cattle (table 17). Measurement from the bones from all phases, except phase 2 at Aboa Vetus (and 3, which had too few measurements for comparisons), show a withers height for cows of approximately 106 cm (range 106,1-106,5), while phase 2 at Aboa Vetus shows a withers height of 104 cm (but n = 6). The males also see to be of a similar size through all the phases, at approximately 108 cm (range 107,2-109,5). In any case, the size of cattle seems to have been rather constant in Turku through the centuries.

A further study was conducted to examine the distribution of measurements in different phases. The GL of the metacarpal bone, the metatarsal bone and the calcaneus were used (table 18). These are all length measurements from bones, the age of which can be controlled by reference to the fusion of the epiphyses (cf. talus) and which have yielded many measurements for comparisons. Minimum and maximum values were counted, as well as standard deviation. Although no great changes in maximum and minimum values were detected between the older and the younger phases, it should be remarked that all the greatest values occur in the medieval phases and two of the three minimum values occur in the later phases.

In Turku the withers height of the cattle has changed relatively little through the centuries. However, the breath of the distal end of the tibia increases from the older deposits to the younger ones. This might indicate a more robust type of cattle being raised in later periods. According to Higham (1969: 64-65) the breath measurements tend to be more sexually dimorphic than those of length, and he also claims that the distal end of the tibia does not exhibit a marked sexual dimorphism. However, Wigh (2001: 72) suggests that the measurements from Birka show some level of dimorphism. Even if this measurement cannot be used for separating the sexes due to the overlapping of the size range, the larger males probably have larger tibiae which affect the average. Therefore, the estimation of the robustness of the animal population by breath measurements is easily affected by the proportions of different sexes in the material. Indeed, in Turku the size distribution for the distal breath of the tibia could have been formed by two overlapping bimodal curves (figures 51 and 52). Therefore, the effect of sex ratio on these measurements cannot be estimated. The range of the measurements from the medieval and post-medieval contexts is almost equal: 45-59 mm in the medieval phases and 46-60 mm in the post-medieval phases. Another breath measurement, the distal breath of the talus, does not show the same kind of pattern as tibiae from Åbo Akademi. However, at Aboa Vetus the measurement increases through the phases. The data from the measurements is not equivocal: however it seems that there was no great change in the size of cattle from the medieval to post-medieval period, and the increase in the distal breath of the tibia is likely to be caused by the larger proportion of males in the material.

4.1.5 Pathologies in cattle

4.1.5.1 Arthropathies

Diseases of the joints were the most commonly found pathologies in cattle bones. The abundance of certain pathological types found in different species can be due to number of factors; different life spans, protection offered by humans or use for traction or riding (Baker & Brothwell 1980: 117; Murphy 2005: 21). The pathological changes related to draught animal exploitation have been studied previously (Bartosiewicz et al. 1997; De Cupere et al. 2000; Fabiš 2005; Groot 2005; Johannsen 2005; Telldahl 2005). Some of the pathological changes that occur in cattle bones are related to the strains of draught work; however, certain arthropathies can also occur in animals which have never been harnessed (Bartosiewicz et al. 1997: 62-72; De Cupere 2000: 255-256; Johannsen 2005: 42). Pathological changes can be used as an important source of information when exploring draught animal exploitation.

4.1.5.1.1 Arthropathies in cattle bones: results of draught animal exploitation?

Cattle metapodials and phalanges were examined according to the methodology presented by Bartosiewicz et al. (1997). The pathologies observed include proximal and distal exostosis, proximal and distal lipping, distal broadening, distal depressions, proximal and distal eburnation, striation, fusion and proximal facet morphology. In addition, other diseases of joints such as arthritic changes are examined here, as described in Baker and Brothwell (1980) and applied to other studies (Bartosiewicz et al. 1997; De Cupere et al. 2000; Fabiš 2005; Groot 2005; Johannsen 2005; Telldahl 2005).

4.1.5.1.2 Phalanges

In this study 6,9 % of a total of 1804 whole fused phalanges displayed some pathological changes (figure 53, appendix 24). No changes were observed in phalanges with open or closing epiphyses, indicating some level of correlation between age and pathological changes in the bones. The highest occurrence of pathological changes was observed in the first phalanges (9,1 % of fused specimens), followed closely by the second phalanges (7,9 %). In the third phalanges pathological changes were comparatively rare (1,8 %).

The most common type of pathological change in the phalanges was proximal lipping, followed by proximal exostosis. Distal exostosis was found in phalanx 1 only, and no case of eburnation was observed. The overall number of pathological phalanges exhibiting pathological changes as well as the severity of the changes is relatively low.

4.1.5.1.3 Metapodials

Most of the pathological changes were found in the metapodials of fully matured animals. Pathologies were observed in only two metatarsals from young animals, one exhibiting a stage 2 lipping in the proximal epiphysis, the other exhibiting a mild arthritic change in the proximal articular surface. Of all (complete elements) fused metacarpals 5,8 % showed pathological changes while 12,0 % of the fused metatarsals exhibited changes. The most common type of pathology found in the metacarpals was a broadening of the distal epiphysis while in the metatarsals it was lipping of the proximal epiphysis (appendix 25). The distribution of the PI-values is similar for both the metacarpals and metatarsals, showing that most of the elements have a PI-value of 0 while approximately 10 % exhibit some level of changes (figures 54-55). The distribution is similar to that found in the phalanges.

Pathological changes in the proximal articular surface of both metatarsal and metacarpal bones were rather common. Observations range from rather mild changes to more severe eburnation and pitting, and finally to fusion of the tarsals. The condition where the metatarsal fuses with one or more of the tarsals is called spavin (Baker & Brothwell 1980: 117-118). In typical spavin the articular surfaces are not effected and union of the bones occurs, the result of exostosis in the margins of the bone (Baker & Brothwell 1980: 118). Spavin is a condition which does not necessarily relate to draught activities as it can also be hereditary (Bartosiewicz et al. 1997: 70). Although some of the cases in Turku may be caused by spavin (without radiological examination it is difficult to judge the condition of the surfaces) some of the observed ankylosis may be a result of the destruction of the articular surfaces or by a combination of both exostosis and the rupture of the articular surfaces.

The fusion of bones in the tarsals and proximal metatarsal region is a common phenomenon in cattle hind limbs in Turku, and can be caused by either spavin or arthritic destruction of articular surfaces (41 Ct showed fusion with either Mt or T2+3). Bartosiewicz et al. (1997: 71) state that in their Romanian draught oxen assemblage the ankylosis of the bones started with the fusion of the proximal metatarsal and the T 2+3. However, an alternative progression of the fusion process has been suggested (Hüster 1990:46). In Turku the fusion of the T2+3 and metatarsus was rare: only in one case is the T2+3 and metatarsal fused together. In three cases both the T 2+3 and Ct were fused to the metatarsus. However, the fusion of the Ct and T 2+3 was more common. 38 Ct had fused to the T 2+3 which is 13,5 % of the total number of Ct specimens.

A similar kind of pathology can be found in the front legs of cattle (Baker & Brothwell 1980: 117) but in Turku no such metacarpal-carpal fusion was found. One Cr and Ci were fused together and lipping was found in three carpal bones.

4.1.5.1.4 Other elements

There are a few other pathologies found in cattle bones which could be related to draught activities. The osteoarthritic changes in the shoulder and hip joints could be caused by the additional pressure created by pulling heavy equipment such as a plough. However, other explanations such as old age are also possible (Baker & Brothwell 1980: 117; Bartosiewicz et al. 1997: 11-12; De Cupere et al. 2000: 255; Groot 2005: 54-56). Seven cattle femoral heads in Turku showed eburnation, with some exhibited exostosis (6 % of all femoral heads). Three acetabuli exhibited changes in the articular surfaces while four showed lipping or exostosis on the margins (1%). Lipping was also found in two scapulae (1 %). Some of these changes could be due to the draught use of the animals. However, another etiology may have to be considered. Two pathological acetabuli (one showing eburnation and the other lipping) were identified as females on the basis of morphological criteria. There is no evidence for the use of female cattle as draught animals in Turku or in the cultural area of Finland Proper.

Exostoses were found in two calcanei. Both specimens had extra growth under the *sustentaculus tali*. In addition, two tali exhibited pathological changes. In the first the head of the talus was flattened, while the other had eburnation on the lateral side of the trochlea. These changes could have been caused by the heavy loading of the muscles and joints (see also Telldalh 2005: 65).

Changes in the vertebrae have been linked to draught animal activities (Bartosiewicz et al. 1997: 12; De Cupere et el. 2005: 255; Fabiš 2005). In Turku pathologies were noticed among the large ungulate (in practice, cattle) cervical, thoracic and lumbar vertebrae (in a total of 9 vertebrae). Among the typical changes in the vertebrae articular bodies was eburnation, pitting, exostosis and lipping in various combinations. The changes are comparable to the pathologies of draught ox skeleton found in Svodín, Slovakia (Fabiš 2005).

The pathological traits described above are likely to be connected to the use of cattle as draught animals. Some of these changes may also occur in individuals not used for traction work. The relatively low frequency of the changes compared to the number of oxen in the assemblage indicates that not all oxen exhibit pathological alterations in their skeletons.

4.1.5.2 Trauma

A number of healed and unhealed cattle (large ungulate) rib fractures were found in Turku. Two thoracic vertebrae also exhibited signs of trauma (figure 56). The spine (or spines) were broken and healed at an almost 90 degrees angle to the original plane. The fracture had led to the formation of a false joint between the ventral part of the lower spina and the dorsal part of the spina, which had been broken off. One cattle pelvis had extra bone growth in the ilium (*tuber coxae*) which could be due to an old fracture.

The only case of traumatic injury seen in the cattle long bones was a badly deformed pathological bone. This clump of bone included the distal part of the humerus and the proximal part of the radius. No remnants of the ulna were present. The specimen had suffered some level of post-mortem surface erosion, but it appears that the elbow joint was perhaps completely crushed and healed in a deformed and possibly fixed position.

4.1.5.3 Oral pathologies

Dental pathologies were among the most common found in Turku. In the cattle, three cases of missing cattle mandibular PM 2 were noticed. Without radiological examination it is difficult to judge if the tooth is actually missing or if it was lost ante mortem. In two cases the bone structure implies that the tooth had never erupted. Few teeth showed evidence of abnormal development. Eleven cattle lower M 3 lacking the third cusp were found. This condition has been reported in many zooarchaeological studies (e.g. Murphy 2005: 16; O’Connor 2003: 182-183).

4.1.5.4 Inflammation

A number of bones showed pathological changes characteristic of inflammation, some of which may initially be caused by trauma. One cattle first phalanx had a shallow depression in its shaft with periosteal reaction at the bottom. One second phalanx diaphysis was covered with porous new bone formation, indicating inflammation in the periosteum. One cattle (large ungulate) lumbar vertebra had a complex pathological lesion, perhaps as a result of trauma. The ventral half of the cranial epiphyseal plate was missing. In the middle of the cranial articular surface was a pit with bone changes, indicating inflammation. It is possible that the epiphysis had been fractured which then caused the inflammation. However, the remaining piece of the plate had not remained in direct contact with rest of the corpus. One cattle (large ungulate) rib exhibited severe alteration of the cortex, perhaps due to a well-healed inflammation (figure 57). The bone was markedly flattened, exhibiting almost a scapula-like thin structure, with some sinuses showing remnants of earlier draining holes. The surface of the bone was smooth and no signs of acute inflammation were visible.

4.1.5.5 Abnormalities

Some abnormalities were observed among the bones studies. Many cattle cranial bones exhibited abnormal pitting or even holes in the occipital region. The cause of these perforations has been the topic of much discussion. It has been suggested that the lesions could be caused by draught activities, although a congenital origin also has to be considered (Baker & Brothwell 1980: 37-38; Baxter 2002: Dobney et al. 1996, 36-37).

4.2 Sheep and goat

Sheep and goat (small bovid) bones cannot always be identified to species. Therefore they are both dealt with in this chapter. Even if most of the general data relating to anatomical distribution or age can only be dealt with at small bovid-level, the species related information is examined where possible. As most of the small bovid specimens derive from sheep, small bovid figures are seen to represent sheep rather than goat.

4.2.1 Anatomical distribution

The abundance and the anatomical distribution of the goat is of special interest, because they vary a lot from one context to another. In some contexts goat bones may only include horn cores and metapodials, but sometimes most of the goat bones derive from high utility skeletal parts (appendices 8-11).

The number of goat high utility skeletal elements increases in the post-medieval period. In phases 1 and 2 at Åbo Akademi and in the phase 1 at Aboa Vetus under 10% of all goat bones come from high utility body parts. In phase 3 at Åbo Akademi this increases to almost 20%, and in phases 2 and 3 over 30% (although the number of goat bones in phase 3 at Aboa Vetus is too small to draw more detailed conclusions).

The number of horn cores of small bovids diminishes in the later phases at both Åbo Akademi and Aboa Vetus (see closer chapter 5). The higher numbers of goat horn cores in phase 3 at Aboa Vetus is probably due to the small sample. Although the number of horn cores seems to decrease at Åbo Akademi by the 17th century, at Aboa Vetus this is true only for goat: sheep horn cores are found in abundance in phase 2.

The MNE (MAU%) data was also closely analysed to study anatomical distribution (figures 58-59, appendix 26). MNE-values for small bovids were counted combining the 'sheep', 'goat and sheep' or 'goat' data. The %MAU-data revealed some interesting patterns in small bovid anatomical features at Åbo Akademi and Aboa Vetus. At Åbo Akademi the first two phases were rather similar, presenting an abundance of mandibles and metapodials. There are slightly more metapodials in phase 2 at Åbo Akademi, probably due to craft activities relating to sheep skin working. Phase 3 at Åbo Akademi includes many high utility skeletal parts, thus the number of metapodials is still rather high. At Aboa Vetus the anatomical distribution in phase 1 seems to be similar to phases 1 and 2 at Åbo Akademi. Phase 2 at Aboa Vetus is also similar, but there are more cranial elements. Phase 3 at Aboa Vetus resembles phase 3 at Åbo Akademi, with higher numbers of high utility skeletal parts. However, the number of observations at phase 3 in Aboa Vetus is small. The main difference between the two areas is a higher number of metapodials at Åbo Akademi, which is likely due to the craft activities at the site. It also seems that an increase of high utility skeletal parts occurred later at Aboa Vetus (not until phase 3) while this trend is already clear in phase 3 at Åbo Akademi, i.e. contemporary to phase 2 at Aboa Vetus.

4.2.2 Age

Tooth eruption and dental wear patterns on the small bovid mandibles exhibit a somewhat different age pattern compared to that of cattle (figures 60-64, appendix 27). All phases at Åbo Akademi show a rather similar age distribution, consisting of one mandible peak for young animals (SA 1) and one peak for those deriving from older ones (A 3). However, in phase 3 there are more mandibles from young animals, from groups I and SA 2, than in phases 1 and 2. In phase 1 at Aboa Vetus the common pattern of two peaks is found. In phase 2 one distinct peak for younger animals occurs, with less adult animals than in the other phases. Phase 3 contains only four mandibles: three mandibles from young individuals (I, SA 1, SA 2) and one from an older individual (A 2). For small bovids the age distribution exhibits the opposite pattern from that revealed with cattle: the post-medieval layers contain more mandibles from young animals than the medieval ones.

The epiphyseal data for small bovids shows that less open epiphyses are present in phase 1 and 2 at Åbo Akademi than in phase 3 (figures 65-70, appendix 28). Thus, the dental age data and epiphyses data are in line with each other. The same pattern can be found at Aboa Vetus there are less open epiphyses in phase 1 than in phase 2. However, in phase 3 the number of open epiphysis seems to be rather higher than in phase 2.

According to Habermehl (1975: 121) the vertebrae of sheep fuse at the age of 4-5 years. The vertebral epiphyses also show more open epiphyses in phase 3 at Åbo Akademi than in phase 1 and 2 of the site (table 19). The same pattern emerges at Aboa Vetus, where plenty of open epiphyses are present in phase 2 compared to phase 1. In phase 3 at Aboa Vetus only 14 epiphyses were available for study, of which 7 were open and 7 closing or fused.

4.2.2.1 Goats among sheep: problems in age data

The above presented age data for small bovids principally represents sheep, as goat bones in general were rare at Turku. There is not enough material available for a comprehensive examination of the age structure for goats. The data relating to the age distribution of goats based on the epiphysis is in general difficult to interpret, because the bones with open epiphyses (=young) are more difficult to identify as either sheep or goat, as the epiphyses are often missing. The presence of fused goat bones shows that adult goats are present in the material, but the absence of goat bones with open epiphyses does not mean that there are no young goat bones present in the material.

However, some observations on the age structure for goats is possible based on mandibles and metapodials. Metapodials are the skeletal elements for which identification as sheep or goat is not dependent on age. They often represent, (though not always), skin working activities or slaughter rather than meat utilisation. On the other hand, mandibles are not usually left attached to hides and are likely to represent animals slaughtered and consumed in the town. Thus, if the metapodials in the material are derived from tannery activities, the adjacent mandibles are likely to be missing.

Only the mandibles from young animals (under approximately 2 years) can be identified as sheep and goat, as the fourth milk molar is still in place (table 20). In phases 1 and 2 at Åbo Akademi goat mandibles were scarce compared to sheep mandibles. In phase 3 at Åbo Akademi and in phase 1 at Aboa Vetus they were more common, while in phase 2 at Aboa Vetus they were rather abundant. Most of the goat mandibles fall into age category SA 1 with only one in category I. Most of the sheep mandibles also belong to category SA 1, with categories J, I and SA 2 also represented. It is not possible to determine the species of the mandibles with respect to the adult or elderly categories (A or E), as by this stage milk molar has been replaced by permanent teeth. The goat mandibles were excluded from the age study on small bovids, but it cannot be ruled out that there are some adult goat mandibles among the mandibles identified as "small bovid".

The high number of high utility body parts of goat in phase 1 at Aboa Vetus is indicative of goat consumption in this area. Therefore, in this context, the metapodials are likely to represent slaughtering rather than tannery waste. All the goat metapodials found in phase 2 at Aboa Vetus have their distal epiphyses open (table 21). Late fusing epiphyses, in either a fused or fusing state were rare. It seems that the animals slaughtered in this phase were mainly young goats. The age profile for the small bovids is probably not heavily influenced by the adult goat mandibles. Likewise, in phase 3 at Åbo Akademi the goat remains more representative of kitchen waste than of skin working activities. In addition, most of the metapodial epiphyses are unfused, with later epiphyseal fusing scarce. The number of adult goat mandibles is likely to be low in this phase.

In phase 1 at Åbo Akademi a different age pattern for goats is in evidence. Here most of the metapodials are fused, and there are several fused goat bones in phase 1 at Åbo Akademi which are totally absent in phase 2 at Aboa Vetus. Only four goat mandibles have been identified in phase 1 at Åbo Akademi. The age structure of the mandibles is in line with the age structure of the goat bones, as young goats seem to be rare in this phase. Thus, the presence of adult goat mandibles in phase 1 at Åbo Akademi is possible. However, the number of goat bones in this phase is so low that no serious influence on the age figure is to be expected.

In phase 3 at Åbo Akademi phase and 1 at Aboa Vetus most of the goat bones derive from horn cores and metapodials, and the number of young goat mandibles is rather low. As this goat bone assemblage apparently represents craftsmanship activities related to the hide trade, the number of adult mandibles can be expected to be low. Approximately half of the metapodials are unfused, with the other half fused.

4.2.3 Sex distribution for small bovids

4.2.3.1 Sheep

Sex estimations of the sheep pelvis bones were determined based on the thickness of the medial edge of the acetabulum as well as the morphology of the pubic bone. Vretemark (1997: 45) gives some limits to the medial edge values for ewes, castrated males (wethers) and rams. According to her, ewes have a medial edge thickness below 4,1 mm, wethers 4,9-7,5 mm and rams 6,2-8,9 mm (see also Clutton-Brock et al. 1990: 52). In Turku no clear grouping of values emerge which could be interpreted as ewes, wethers and rams (figure

71). In contrast to Vretemarks data there seems to be an overlap with values that could be interpreted as wethers and probable females.

Additional information was necessary to determine if Vretemark's threshold of 4,1 mm is applicable in Turku. Therefore, the morphological data from pubis was examined (figure 72). The highest value for the medial edge of the acetabulum identified morphologically as ewe was 5,7 mm. This is however an isolated value, and the remaining higher values cluster between 4,2-4,3 mm. The pelves that were identified as males have one very low value (3,2 mm), with the other values giving a more constant lower limit of 3,7-3,8 mm. Therefore, it seems possible that in this material the wether and ewe medial edge values overlap. The threshold of 4,1 mm (Vretemark 1997) was therefore considered unreliable for this material. A border zone of 3.5 – 4.5 mm was applied: values under it were considered females, those above it were considered males.

It seems that there are some differences in the sex data between the phases (figure 73). Phases 1-2 at Åbo Akademi and phase 1 at Aboa Vetus consist of approximately 70% females and 30% males. Phase 3 at Åbo Akademi and phases 2 and 3 at Aboa Vetus have a higher number of male animals (though there is only 6 measured bones from phase 3). In both Åbo Akademi and Aboa Vetus the post-medieval phases seem to include more females.

4.2.3.2 Goat

The metric sexual dimorphism of goats has not been extensively studied. Sometimes goat pelves are not separated from sheep pelves, with the same (sheep) threshold applied to separate the sexes (MacKinnon 2004: 108; Vretemark 1997: 45). The issue of castrating goats is not usually discussed either. For the sex measurements, previously analysed goat pelves and metacarpal measurements from M 504 (Tourunen 2002a) were included to increase the available data. To examine the threshold between the sexes, morphological observations (according to Boesneck 1969) were combined with the acetabulum medial edge measurements (figure 74). The zone of overlapping values of female and male goats seems to occur between 4,4 and 4,9 mm (one morphologically identified male at 4,4 mm and one female at 4,9 mm). Most of the pelves derive from males (figure 75), 64% according to the morphological criteria. The proportion of males in the assemblage is even higher, if values under 4,4 mm are counted as females and values over 4,9 mm as males (25% females, 75 % males). Some castrated animals are likely to be present, overlapping with the females. The one very high value could represent an intact male, but is probably anomalous.

Klein and Reichstein (1977: 33-36) found sexual dimorphism in a goat metacarpal at the early medieval site of Haithabu, Germany. Following their methods, Åbo Akademi and Aboa Vetus goat metacarpal Bd (Distal breath), SD (smallest depth of diaphysis) and Bp (proximal breath) were plotted against GL (greatest length) (figures 76-78). In the Haithabu material the long metacarpals were also broad and were interpreted as males (Klein and Reichstein 1977: 34-35). However, it is not completely clear if male goat metacarpals are necessarily longer than those of females. Noddle (1974: 201-204) presents data from female, male and castrated goat metacarpals, where the castrated one is the longest and the intact male exhibits the shortest. However, this division is based on only three individuals, and while the other bones derive from domestic animals the male is a feral goat. However, Noddle (1974: 201) also presents interesting information in relation to the metacarpals. The metacarpal of the intact male is short and broad, with that of the female being a little longer and more slender, while that of the castrate was long and more heavily built than the female one.

The goat metacarpal bones from Turku can be formed into three groups based on greatest length. In Bp and Bd the two smallest groups are within the limits set out by Klein and Reichstein (1977: 34) and defined as female goats in their material, though their animals are larger than the Finnish goats. Examining the short metacarpals that cluster together in Bd and Bp it can be seen that the cluster spreads when SD is used. Thus, some of the short metacarpals are clearly more heavily built than others.

The form and size of the metacarpals were studied further by plotting the Bd / GL x 100 index against the SD / GL x 100 index (compare with cattle metacarpal sexing) (figure 79). Here three groups emerge, which could be interpreted as females, castrates and intact males. When the Bd / GL x100 value is plotted against greatest length, it becomes clear that bones with a low Bd /GL index are the longest in the assemblage (figure 80). The distal breath alone does not form any clear bimodal curve (figure 81). In the material from Turku it is difficult to separate different sexes using the goat metacarpals, as no differences to equate with those described by Klein and Reichstein (1977) or Noddle (1974) are clearly present. However, it seems possible that the long metacarpals do indeed represent castrated males.

4.2.4 Size and shape of small bovids

4.2.4.1 Sheep

Comparisons of the sheep measurements with the withers height data reveals that there is a decrease in the size of sheep bones from the earliest phases to the latest (table 22). This change can be seen in most of the skeletal elements (exception: calcaneus in phases 1 and 2 at Åbo Akademi), in both excavation areas and in the withers height estimations measurements. The size differences cannot be explained by larger numbers of female animals in the later phases. In fact, the frequency of males seems to increase. The results imply that the size of sheep was diminishing in Turku from the medieval to post-medieval periods.

The form of the sheep metacarpals in Turku was examined in order to explore possible changes in animal robustness (table 23). The minimum medio-lateral shaft width (SD) was plotted against the greatest length of the bone (GL). The breath measurement was chosen because its growth seems to indicate the development away from "unimproved" breeds (O'Connor 1995: 87) In Åbo Akademi there seems to be an increasing robustness in sheep metacarpals, while that in Aboa Vetus decreases.

The size range of the withers height estimations is particularly interesting (table 24). The size range of the sheep in phases 1 and 2 at Åbo Akademi is notably broad, with the animals that have withers heights of over 64,5 cm only being found here. It also seems that in the medieval phases the small animals are present, and it is the influence of the larger animals that raises the average withers heights. Phase 3 at Aboa Vetus, dating to the 18th-19th centuries, shows a slight increase in the average withers heights. However, the sample size is too small to draw further conclusions about the size development of the sheep in this period.

4.2.4.2 Goat

Goats withers heights in the Åbo Akademi and Aboa Vetus medieval material is approximately 60 cm (table 25). Not enough measurable goat bones were found from the post-medieval contexts for comparisons. In fact, only one goat bone is available for withers heights calculations from this period (phase 3 at Åbo Akademi), giving the value of 57,5 cm. Interestingly, the withers heights distribution reveals few larger individuals. If these animals are male or castrated goats, or if they represent some larger stock remains unclear, although the former explanation seems the most likely.

4.2.4.3 Sheep horns

The frequency of polledness among the sheep in Turku is revealed in phase 1 at Åbo Akademi and in phase 2 at Aboa Vetus, as both include sheep horns but do not show clear signs of horn working. The number of polled animals was counted, as well as the number of cranium fragments with signs of horns: in this study the number of horn cores themselves were not used in order to eliminate transported loose horn cores. It has to be recognised that some of the horn cores found in these contexts can still be related to horn working activities. Moreover, the animals slaughtered in Turku may not represent an equal proportion of the whole population. It is even possible that even some ewes had horns in Turku as some horn cores were very small and fragile (cf. Hatting 1983).

Only horn cores with attached pieces of cranium were counted. In phase 1 at Åbo Akademi 46% of the observed crania were polled (rudimentary horns included) and 54% horned (n = 35). In phase 2 at Aboa Vetus the percentages were 54 % polled animals and 46 % horned animals (n = 13), i.e. approximately half of the sheep were polled. Thus it seems possible that the number of polled animals increased from the medieval to post-medieval period.

There is one probable polycerated horn core of a sheep. A fragment from a base of a large horn core probably once had another, smaller horn core attached to the side (figure 82). This is comparable with a horn core from Birka (Wigh 2001: 92), although in the Turku specimen the two horn cores lie more closely together.

4.2.5 Pathologies

4.2.5.1 Arthropathies

In contrast to the cattle, arthropathies were rare among the sheep and goat bones. Only 16 bones with this type of condition were observed. Most of the joint-related pathologies found in the small bovid bones were mild. For example, three sheep humeri had similar distal additional bone growth in the distal epiphyses, two of them situated on the lateral side and one on the medial side. In two goat first phalanges (probably from the same individual) the sesamoid bones were fused near the proximal end of the bones. Some scapulae, pelvic bones and femora of small bovids showed tracks of mild arthritic changes like eburnation or exostosis. Two pairs of lumbar vertebrae could not be separated from each other due to the changes in the articular processes.

A few more severe conditions were noted in Turku. One small bovid pelvis showed dislocation of the femoral head (figure 83). In the original acetabulum the articular surfaces were destroyed and exostosis had developed. The femur had hollowed a new acetabulum in a cranio-lateral direction from the original one. The new acetabulum showed large exostoses and severe eburnation. One small bovid femur displayed rather severe eburnation and pitting in its head and neck area, an indication of osteoarthritis.

4.2.5.2 Trauma

Several broken ribs were found among the small ungulate category, some of which evidently belong to small bovids. The most common type of trauma observed in sheep bones was a characteristic small lesion in the shaft of the metacarpals or -tarsals, apparently caused by a puncturing wound, which had damaged the periosteum. These wounds (in 5 metapodials) manifested as a minor swelling or as a small wart-like extra bone growth. In addition, one goat metacarpal displayed a similar kind of lesion, which showed signs of an acute infection.

Besides these pathological changes the sheep metapodials also showed a number of broken and healed fractures. One small bovid femur exhibited a large bone formation at the distal end near the *fossa plantaris,* which could have been caused by traumatic injury to the attached muscles. One sheep tibia exhibited abnormal bone growth at the distal end. The bone formed a loop which was probably also traumatic in origin, though not necessarily a fracture since the rest of the diaphysis seemed unaffected.

A small bovid radius from the previously analysed assemblage from Åbo Akademi displayed a well healed fracture, where the proximal end of the radius had shifted forward and down (Tourunen 2002a: 57). The fusing of the proximal part of the bone several centimetres down from its original location would have make this leg shorter than the others.

4.2.5.3 Other pathologies

Tooth rotation and impaction are fairly common features in the dentition of the small bovid assemblage. In one small bovid mandible a piece of pd 4 had been stuck between PM 4 and M 1.

4.2.6 Small ungulates

The small ungulates group includes specimens from sheep, goat and pig, but because pig is less abundant than sheep and goat, the small ungulate anatomical distribution mostly reflects (but not entirely) small bovids. One difference in the anatomical distribution between the contexts is notable between the contexts is notable. The largest variation in anatomical representation is seen in contexts from phases 1 and 2 at Åbo Akademi (appendices 8-11). The other phases exhibit less variation. Throughout the phases at Åbo Akademi small ungulates exhibit a similar pattern in anatomical distribution to the large ungulates: there is an increase of high utility skeletal elements in phase 3. This is not the case at Aboa Vetus. In phase 1 at Aboa Vetus there is a high number of large ungulate high utility skeletal parts, but lower numbers of small ungulate high utility skeletal parts. This situation is reversed in phase 3 at Aboa Vetus, where a high number of small ungulate high utility skeletal parts are found. At Åbo Akademi and at Aboa Vetus the number of small ungulate high utility parts increases during the centuries.

4.3 Pig

4.3.1 Anatomical distribution

The pig anatomical distribution is not affected by the craft activities. The variation in the number of high and low utility skeletal elements between different contexts most likely reflects differential distribution of the slaughter- and food waste.

In pig MAU-data the mandibles and cranium are the most common elements (figures 84-85, appendix 29). Again, the vertebrae, ribs and small bones of the foot are scarce. In phase 1 at Åbo Akademi there is a larger difference between the highest MAU and the rest of the values than in phase 2 and 3 at Åbo Akademi. There seems to be an increased number of high utility elements as one progresses through the different periods. In phase 1 at Aboa Vetus the distribution of different elements is rather even, in contrast to phase 2, where the difference between the highest values (cranium and mandible) and the rest of the elements is larger. Again, it seems that in phase 3 at Aboa Vetus there is plenty of high utility skeletal parts, although the number of observations is low.

In the Aboa Vetus cellars whole animals have a clear effect on the abundance of low and high utility body parts (appendices 7 and 9). When all the bones are considered, 80% of the pig bones from cellar K 94:8 come from high utility body parts. After the removal of the articulated skeletons and the infant bones, only 62% of the bones are from this group. The same pattern can be found from all the cellars that contain whole pig skeletons. Thus, the bone debris around the whole pig skeletons seems to contain less high value parts than the complete skeletons (compare also with K 94:11 (AV) sheep bones and M 147 (ÅA) pig bones).

4.3.2 Age

Pig mandibles in phases 1-2 at Åbo Akademi show peaks in age groups SA 1 and A 1-2 (figures 86-89, appendix 30). However, in phase 2 there is also a peak in juvenile animals. Conversely, phase 1 at Aboa Vetus shows only one mandible peak, that of the age group A 1. Phase 2 shows a major peak in age group SA 1. Animals belonging the Neonatal or Juvenile age categories probably do not represent household waste. The cellars at Aboa Vetus contained an abundance of articulated skeletons, which also included several pig skeletons. The high number of Neonatal and Juvenile mandibles is therefore not surprising in phase 2 at Aboa Vetus, which only consists of three cellars. The specific depositional patterns in this context are reflected in the age structure. A pig belonging to the adult age group and buried in the cellars also retained its mandible. From the younger layers there are too few mandibles to draw any further conclusions. From phase 3 at Åbo

Akademi there is one mandible in groups J, I 1, SA 1, SA 2 and A 1, and from phase 3 at Aboa Vetus there is one mandible in SA 1 and two in SA 2. There seems to be a more even distribution of different age groups at Åbo Akademi than at Aboa Vetus. There also seems to be fewer mandibles from the older categories in Aboa Vetus, thus indicating the presence of younger animals.

The pig epiphyseal fusion data shows similar patterns in phases 1 and 2 at Åbo Akademi, where most of the epiphyses in the early fusing group are fused, followed by approximately 30% in the middle group (figures 90-94, appendix 31). In phase 3 at Åbo Akademi there are more open epiphyses in the first two groups. There are more open epiphyses present in the first group at phase 1 of Aboa Vetus than at either phase 1 or 2 of Åbo Akademi, but the other groups are similar. In phase 2 at Aboa Vetus there is a marked decrease in the number of fused epiphyses between the first and the subsequent two groups. In all phases most of the pigs have been slaughtered when young. Phase 1 and 2 at Åbo Akademi and phase 1 at Aboa Vetus show more fused epiphyses than the two post-medieval phases.

Most of the pig vertebral epiphyses are unfused, but there are some closing and fused lumbar vertebrae in phase 2 at Åbo Akademi and in phase 2 at Aboa Vetus. In phase 2 at Aboa Vetus 87 % of the lumbar vertebrae were open, with 7% closing and 7% fused, while in phase 2 at Åbo Akademi 90 % of the cervical vertebrae were open and 10 % closing. According to Habermehl (1975: 150) the vertebrae of pig fuse between 4-7 years, and the rarity of the fused epiphyses in vertebrae is not surprising when other age data is considered.

4.3.3 Sex

The mandibular canine was chosen for the evaluation of the sex distribution of the pigs. Due to the small number of pig mandibles and loose teeth the material was divided into three part where enough material for comparison was available; medieval Åbo Akademi, medieval Aboa Vetus and post-medieval Aboa Vetus (figure 95). Post-medieval Åbo Akademi (ÅA phase 3) included only four canines, two females and three males. A predominance of male animals is clear in all three sections. This is especially true for the post-medieval Aboa Vetus section, which in practice means the cellars. Only approximately 13% of the canines located here were from females. Unfortunately mandibles were too scarce and fragmented for meaningful sex distribution comparison between the different age groups.

4.3.4 Size

No significant differences in size between the phases can be found for pig (table 26). Measurable pig bones were rather scarce because most pig bones were derived from young individuals. Therefore, the material was divided in two to investigate any possible differences between the medieval and post-medieval phases. The medieval and post-medieval pig bones are of a remarkably similar size: 71,0 and 70,9 cm in withers heights (table 27). When examining pig bone measurement data it should be noted that most of the withers heights have been counted from the talus, in which no epiphyses are present. Therefore immature animals are also included in this data set, although all clearly juvenile (that is, with a porous structure) bones were excluded from the analyses. The average withers height counted from bones other than talus (thus, with the epiphysis) is 73,5 cm and from the talus alone 70,0 cm. Therefore it seems possible that the withers height is possibly too low and the adults may have been slightly larger.

4.3.5 Pathologies

Arthropathies were not common among the pig bones. A small fragment of a pig pelvis was found which exhibited a possible dislocation at the acetabulum. Some pigs had suffered from broken ribs, some of which are found among those identified as small ungulates. One young pig from Aboa Vetus had two fractures in the healing stage in its ribs. Healed fractures were found in a pig scapula (fractured over part of the blade), in two tibiae (where part of distal fibula had united with the distal tibia and another with a greenstick fracture in the diaphysis) and in one (possibly two) calcaneus, where the proximal part of the bone had fractured and formed an extensive exostosis extending on both sides of the original bone.

An interesting trauma-related pathology was found in one distal humerus. The medial condyle had been pressed into the *fossa olecranon* and fused to the bone at that location. No other modification was observed in this specimen. The possibility of a post-mortem origin for this condition was carefully examined, but the condyle seems to be tightly fastened and could not be removed. The pathology is probably related to a traumatic injury in the early stage of this pig's life, before the condyle was fused to the shaft, which would have left the joint immobile and perhaps in a permanently fixed position.

Some dental deformities caused by genetic or developmental factors were observed. Extra teeth were recorded in three pig maxilla, where double PM 1, PM 2 or PM 3 were recorded, all in different specimens.

One pig rib had a deformed proximal part indicating inflammation. The head of the bone exhibited a swelled, porous and round formation. The pathology might be related to inflammation in a vertebra which had spread to the rib. One pig lumbar vertebra had pits on its corpus, both in the articular discs as well as on the sides. Two exostoses had grown at the anterior margin of the epiphysis. One pig thoracic vertebra had an extra perforation in the left side of the neural arch, which is probably of congenital origin. A pair of ribs from a piglet showed a split in both the proximal and the distal end. It is possible that the two ribs had partially fused together.

4.4 Horse

Only 20 horse bones were found in the material. The osteological analysis confirms that horseflesh was not consumed in Turku. Most of the bones derive from the cranium, mandible or lower legs. Only one bone from a utility skeletal part was found, namely a whole scapula, which included carnivore teeth marks. It is possible that dogs were occasionally fed with horse flesh. However, horse bones were also used to produce bone artefacts. Many of the bone skates found in Turku are made of horse metapodials (Katajisto 2002). Horses were also skinned, as pieces of horsehides have been found among the leather finds in Turku (Jokela 2002: 27). Most of the horse bones derive from adult animals, but one mandible of a foal was found from M 104 (ÅA), with only slight wear to the milk molars.

4.5 Cat

Cat bones were found in all phases except in phase 3 at Aboa Vetus. There is no doubt that cats were present in the town during this period, and the absence of cat bones is probably due to the small sample size or the type of the deposits.

The life expectancy of the cats in Turku seems not to have been very high. The bones of infant or juvenile animals dominated the assemblage. The interpretation of the age profile of the cats was difficult, because the material consists (more or less) of whole skeletons, articulated elements and solitary bones. At Aboa Vetus the skeletons of at least one kitten and three adult or subadult cats were recovered in addition to solitary bones. At Åbo Akademi the skeletons of three kittens were found. It also seems that among the solitary cat bones the proportion of adult animals was higher at Aboa Vetus than at Åbo Akademi (see figures 96 and 97, the articulated skeletons are excluded. Note however the smaller number of observed epiphysis in Aboa Vetus). Even in Aboa Vetus infant and juvenile cat bones were abundant. Epiphyses have been identified and placed in the early group (distal humerus and proximal radius), in the middle group (proximal femur and ulna and distal tibia), and in the late group (proximal tibia and humerus and distal femur, radius and ulna) (Luff & Moreno 1995: 98; Smith 1969).

The anatomical distribution of the cat bones differs between the two excavation areas. At Aboa Vetus more small bones such as metapodials, phalanx, tarsi and sternum were found. However, this is due to the recovery technique and not as a result of the differential deposition of cats in different areas (cf. hare bones).

Some cutmarks were also present in the cat bone assemblage. At Aboa Vetus the frontal bone of an approximately half year-old cat was found with cutmarks to the forehead. This suggests that this kitten was skinned. At Åbo Akademi one cat femur with knife marks circulating both the proximal and the distal diaphysis just above and below the epiphyses was discovered (figure 98). There were also some cut marks on the shaft, probably due to the removal of soft tissue. The marks suggest that initially both epiphyses were meant to be cut off. A cat femur is round in cross-section and straight and would have produced a nice symmetrical bone tube.

One cat femur displayed an interesting pathological deformation, the aetiology of which is uncertain. The femur was abnormally short and bowed at the distal end. The diaphysis showed no signs of healed trauma or any other traits which could have caused the bowing. The *facies patellaris* was slightly deformed at the edges. This bowing could have been the result of a well-healed traumatic injury, rickets or it could even be of congenital origin. Obviously the cat limped during its lifetime. One of the cat skeletons found in the Aboa Vetus cellars showed abnormal frontal root development in both the right and left lower PM 4. In the right tooth the tip of the root was found in the bottom of the alveolus, but it was not connected to the rest of the tooth. The part of the root still attached to the tooth appeared to be splintery, this was also true of the left root. Because both sides were affected, congenital malformation is the most likely cause.

Juvenile cats are often found in high numbers in bone assemblages (Luff & Moreno 1995: 108; Hatting 1990; O´Connor 1982: 38; Thomas 2005: 58; in contrast see Wigh 2001: 120, where most of the cat specimens derived from adult individuals). This mortality pattern may be normal for feral or semi feral cats or those affected in one way or another by humans (Luff & Moreno 1995: 108-110). In assemblages clearly formed of skinning waste, young animals, even kittens, dominate (Hatting 1990; Luff & Moreno 1995). In Turku it seems that humans did have some control over the cat population and the mortality profile probably does not represent a natural age-of-death distribution. The presence of cut marks is an obvious sign that this was the case. In the previously mentioned context M 147 a minimum of three kittens were found together with other infant animals. These kittens were all of different sizes, and probably of different ages. The largest one had the distal humerus in a fusing stage, indicating an age of approximately 4 months (Smith 1969: 525). It seems unlikely that these animals, apparently not coming from the same litter, would have concentrated in this context by chance, but rather had been deliberately killed for their furs.

4.6 Dog

Dog bones are not very common in Turku. In Aboa Vetus the complete skeletons increases the overall number of dog specimens. In addition to 21 solitary dog specimens, three dog skeletons were found in the Aboa Vetus cellars and one partial skeleton of a puppy in context M 147 at Åbo Akademi. Dog specimens were present in all phases, however, their numbers were too small to investigate the age distribution of this species in detail. However, infant, juvenile and adult animals are present at Turku. In contrast to cat, most of the dogs represented in the material are adults.

Some dog specimens displayed tooth marks made by carnivores (unlikely to be pigs), which were most probably caused by other dogs. These chewed bones come from Åbo Akademi. Some of the dog carcasses were evidently disposed of in such a manner that other dogs had access to them. The dog specimens found at Åbo Akademi were either isolated finds or clusters of only a few bones. A dog skull found in M 513 B originates from the same animal as the mandibles found in M 513. A tibia found in M 513 could also belong to this individual.

One of the dog bones in Turku also bear cut marks. The bone in question is a pelvis found in phase 1 at Aboa Vetus. The cutmarks were located on the inner side of the bone at the area of the acetabulum. It seems unlikely that they were associated with skinning activities, and it is more likely that they represent butchering. Cut marks on dog bones have been observed in previous analyses. From Aboa Vetus there is one dog ulna, not included in this study, with cut marks on the diaphysis. From context 504 at Åbo Akademi one dog metacarpal with cutmarks at its distal end has been found (Tourunen 2002a: 103). In addition, one second phalanx of a large dog or wolf bears cutmarks typical of skinning. No cutmarks were found on the articulated skeletons. Almost all of the phalanges of these skeletons were missing, which might indicate that they were removed with the fur. It is also possible that these small bones could have been missed during the excavations.

The dog specimens exhibited signs of pathological changes. One dog humerus from a short-legged individual had a marked swelling on the diaphysis. The cause is possibly an ossified haematoma. This could have been caused by a blunt impact causing bleeding, which later gradually ossified (Baker & Brothwell 1980: 83). One of the articulated skeletons (Aboa Vetus dog 2) found at Aboa Vetus had healed fractures on the vertebrae and ribs. One rib had fused to the thoracic vertebra in the healing process. One rib had a well-healed fracture on the corpus. In one thoracic vertebra the spina was broken but not properly healed: a false joint had developed. All these fractures could be the result of the same accident

One of the dog skeletons found in Aboa Vetus (Aboa Vetus dog 1) was studied previously for the museum exhibition (Tourunen 2002b). It's left articular surface towards the pelvis, *facies auricularis*, was missing at the sacrum, and it had fused to the last lumbar vertebra (figure 99). A somewhat similar congenital malformation in the sacral area has been described by O'Connor (1982: 40). In the specimen from Turku the lower back had been loop-sided, probably affecting the composition of the body. There was also some amount of lipping in the *facies patellaris* in the femur and some asymmetry in the limb bones: all the bones from the right side were shorter than the adjacent left side bones. Moreover, the ridges forming the surface for muscular attachments were not symmetrical on each side. Thus, this animal probably limped during life.

The complete skeleton of a young dog from the Aboa Vetus cellars (Aboa Vetus dog 3) had both milk and permanent canines present (figure 100). The milk teeth had been retained in the upper jaw even after the corresponding permanent ones had erupted.

4.6.1 Big and small, long and short

The dog skeletons found in the Aboa Vetus excavations represent different types of animals (table 28). One of the skeletons belongs to an adult short-legged (brachymel) individual, with an estimated shoulder height of 25 cm, counted as an average from all the bones (height estimated according to Harcourt (1974)). Using the withers height formula for brachymel dogs may not produce the most reliable of results (von den Driesch & Boessneck 1973: 343). The Swedish Vallhund skeleton, a modern brachymel dog at the Aboa Vetus museum, had a known withers height of 33 cm. Harcourt's (1974) formula gives withers height estimates between 29-33 cm, with an average of 31 cm. The resulting withers heights are usually lower than the real one (counted from the humerus, radius, ulna and tibia but mostly for the femur). The Aboa Vetus dog 1 exhibited the highest estimated withers height from the femur (26,3 and 26,7 cm) which probably lies closer to the real wither height than the average estimation. The other skeleton derives from a young individual, which was aged at approximately one year based on epiphyseal closure (Silver 1969). This animal was also rather small, with a withers height of ca. 32 cm, but with normal body proportions. The skull of this animal was damaged, most likely caused the excavation rather than ante-mortem. The third skeleton is that of a large dog. This animal, with a height of 59 cm, is at the moment the largest dog found in Turku. It is a male animal with the baculum bone present. One solitary humerus from phase 3 at Åbo Akademi originates from an animal with a withers height of 54 cm.

In addition, the solitary dog bones are also derived from different dog types. No measurable dog bones were found in the oldest contexts, but even without metrical data it is evident that different types of dogs were also present in the medieval layers. One dog tibia found in phase 1 at Åbo Akademi represents a short-legged individual, but unfortunately this specimen could not be measured as the epiphyses had been completely gnawed off. The humerus of a short-legged dog was present in phase 1 at Åbo Akademi. A pelvis found in phase 1 at Aboa Vetus has proportions similar to those of short – legged dogs. A fragmentary dog tibia and fragmentary ulna from phase 1 at Åbo Akademi represent middle-sized dogs with normally proportioned legs. Thus, short-legged individuals as well as middle-sized dogs were present in the Middle Ages in Turku. In addition to these dog types, somewhat larger and smaller individuals have been found in the post-medieval layers.

4.6.2 Comparison of the dog bones to modern breeds

One way to outline the outer appearance of dogs found in archaeological material is to compare the bones with those of modern breeds. Even if this helps to visualize the morphological and size variation of past dog populations some words of caution are necessary. Modern dog breeds are a result of conscious breeding aimed to produce inheritable characters which distinguish one breed from another (e.g. Clutton-Brock 1987: 26-33). Even if some studies present the possibility of very old breeds (Wayne & Ostrander 1999), in the past the animals were not necessarily bred with such deliberate caution, and the outer appearance of a dog was probably rather unimportant compared to its performance as a hunting,- guardian,- or herder (Coppinger 2005: 33; Thurston 1996). Even if some selective breeding of, for example, short-legged individuals or high performing hunting dogs occurred, it must have been difficult to avoid the uncontrolled breeding of dogs which obviously enjoyed some degree of freedom in the town area. Indeed, this level of control proves difficult even in a modern environment. It is also possible that some of the dogs in Turku were strays, living without direct human interference (Coppinger 2005). Therefore it is impossible to know if a certain type of dog skeleton recovered from an archaeological context is the result of conscious breeding with uniform genetic properties, or a coincidental combination of genes from various parents. Establishing evidence for certain dog “breeds” is therefore difficult, and requires a large assemblage or supporting information from historical sources (e.g. Azúa 2000). However, the study of the physical properties of dogs can reveal the different types present. The physical properties and the form of the skeleton are connected with the types of activities dogs were utilised for (Boëthius 2004: 28). The presence of very large or small individuals is likely to be connected with conscious breeding and development of these traits.

Only three dog skulls from Turku could be investigated osteometrically. Two of them derive from the articulated skeletons found in Aboa Vetus, while the other one came from phase 1 at Åbo Akademi and was found with its mandible intact. The skulls were measured and compared against each other and against modern examples. The aim of this study was not to specifically identify any 'breeds' among the material, but simply to compare the shape of the specimens. Indices by Harcourt (1974) were used for this purpose (figures 101-103) (Definitions made by von den Driesch (1976) were used for the measurements. Cephalic index: (Zygomatic breadth x 100) / Total length, Snout index: (Viscerocranium length x 100) / Total length, Snout width index: (Breadth at the canine alveoli x 100) / Viscerocranium length). The three skulls cluster rather closely to one another, although one of them has a broader snout then the other two. The skulls do not closely resemble any of the modern breeds used for comparative purposes. Their form falls in between the modern breed which have long snouts (Dobermann, Swedish Vallhund) and those with medium snouts (Finnish Spitz, Fox terrier, Papillon).

Apart from skull form and withers heights, the limb proportions were also studied. This was achieved by counting the slenderness index (SD x 100/ GL) (table 29) (Harcourt 1974: 153 "mid-shaft index"; Mazzorin & Tagliacozzo 2000: 155-156). The overall form of the dogs was studied by plotting the slenderness index against the withers heights (figure 104) (Mazzorin & Tagliacozzo 2000: 156-157). Here three types of dogs are evident: small and robust (short-legged), small and slender and large (or perhaps medium) and slender. However, the number of specimens examined is small and drawing any conclusions based on their size and form is difficult.

4.7 Wild fauna

A rather small proportion of bones from non-domesticated mammals were found in Turku (table 3). The bones represent only approximately 1 % of the whole material (according to NISP). Most of them represent animals that were utilized by humans, while some bones probably belong to species that used Turku as their habitat, and were either ignored or rejected by humans.

4.7.1 Elk (*Alces alces*)

The only bones identified as elk were bone artefacts. No elk bones other than antler fragments have been found in previous studies in Turku, and at that even the antler examples are rare (Kylänen 2001: 22). Only one specimen of an unidentified cervid has been reported from the excavations of Raatihuone (Poutiainen 1999: 82). However, elk has been identified in the late Iron Age-Early medieval site in Raisio, near Turku (Tupala 1999: 49). Thus, the elk had only been a part of the local fauna for approximately a hundred years prior to the earliest layers in Turku, from which it is absent.

Historical sources report that elk was present in the neighbouring provinces of Finland Proper. The hunting of elk was not restricted to the upper classes in Finland, although apparently hunting was sometimes forbidden (Alhonen et al. 1996: 196; Melander 1920: 6). An exception was the Åland Islands, which was declared a Royal hunting park in the 17th century (Melander 1920: 8). The hunting or harming of elks on the island was strictly forbidden, and was punishable by death (Melander 1920: 15-16). Orphan elk calves on Åland were occasionally nursed with cow milk, not an especially economic task but one which underlines the high status of these animals (Melander 1920: 16). In addition to the hides that were acquired from hunting parks (which were not many), the Crown received elk hides from Finland via trade and confiscations, an example being hides of animals killed between Shrovetide and the end of July, when the hunting of elk was forbidden (Melander 1920: 12; Melander 1952: 162-164). Elk was hunted to extinction on the Åland

Islands in the 18th century, partly as a result of the needs of the Swedish and Russian armies (Melander 1920: 28). Elk meat was included in tithe: for every animal one shoulder part was to be given to the priest (Pirinen 1962: 105).

Elk hides were exported from Turku, with in 1579 as many as 278 pieces going abroad (Grotenfelt 1887: 32-33). The value of one elk hide was comparable to five cowhides (Grotenfelt 1887: 152). An elk hide jacket is mentioned in the estate inventory lists from Turku in the 17th century (Utdrag ur Åbo Stads Dombok 1638: 317). Unfortunately the hides could have been transported to Turku from some distance, and they do not prove that elk was present in Finland Proper at that time. However, elk was still present in Northern Satakunta and Häme in the 18th century (Gadd 1751: 76-77; Herkepaeus 1756: 18-19). In 1757 one elk hide and elk antlers were exported from Western Uusimaa to Stockholm (Bergman 1760: 53).

Elk bones have been found in Swedish medieval contexts, though they are neither abundant or common (Vretemark 1997: 148-149). Antler fragments left over from the comb making industry are exceptions to this rule (Vretemark 1990). It is surprising that there seems to be more elk bones in Swedish town layers than in Finland. Aside from the few examples in Turku, elk bones have not been found in other urban excavations in Finland. No signs of any professional or large-scale comb making trade has been found in Turku or in other Finnish towns, and these two facts could be connected. In Skara practically all the antler fragments are from elk, and of them 25% were derived from hunted animals – the antlers were still attached to the skulls (Vretemark 1990: 139-40). Perhaps this connection to elk hunting provided some elk meat to the towns, but in Finland these connections were weak. The elk was probably extinct in Finland Proper from at least the 16th century onwards (when historical sources appear) but it would seem likely that they had already disappeared by the Middle Ages. Some rural osteological assemblages should be analysed to confirm the absence of these animals, as well as the date of their disappearance. If some elk meat was brought to Turku (with hides, for example) they were either boneless pieces or only included vertebrae and ribs- which are difficult to separate from those of cattle.

4.7.2 Forest reindeer (*Rangifer tarandus fennicus*)

No reindeer specimens were identified at Åbo Akademi or Aboa Vetus. In previous studies only a few reindeer antler fragments, probably derived from a single antler, have been found (Kylänen 2001: 22). Forest reindeer were extinct in Finland by the beginning of the 20th century (Jensen 1994: 301; Melander 1920: 29-30). They were possibly present in Finland Proper in the 11th century, and still existed in Satakunta in the 17th and the 18th centuries, but its distribution was restricted to the eastern regions before finally becoming completely extinct in Finland (Gadd 1751: 76-77; Melander 1920: 32; Talve 1990: 83). A deer hide was found in a grave dated to the 11th century in Kaarina Kirkkomäki (located inside the modern town of Turku's limits) (Kirjavainen & Riikonen 2005: 33), but it could have been a trade item. Forest reindeer is separated from the tame mountain reindeer by its larger, longer and more slender skull (Siivonen & Sulkava 1999: 71-72, 190-191). However, male forest reindeer bones are of a similar size to those of medieval and post medieval cattle, and the bones may have been identified as large ungulate. In the 17th century estate inventory lists for Turku reindeer hides and antler are mentioned (Utdrag ur Åbo Stads Dombok 1638: 304, 307, 311). Forest reindeer was probably already extinct in Finland Proper by the medieval period, and the hides and antlers most probably belong to imported animals from other provinces.

4.7.3 Red deer (*Cervus elaphus*) and Roe deer (*Capreolus capreolus*)

No evidence for these two cervid-species has been found in the Turku osteological material. Red deer are not indigenous to Finland, and there are reasons to expect that the same applies to roe deer (Lepiksaar 1986: 58; Ukkonen 2001: 26). However, red deer was introduced to Turku in the 16th century, when Juhana herttua founded a hunting park in Ruissalo, an island in the Turku archipelago (Melander 1920: 40). These animals did not succeed very well at Ruissalo, perhaps due the climate or improper care, and the herd never exceeded 22 animals (Melander 1920: 40-43). The hunting of these animals never gained any significance for the castle's economy, and finding a red deer bone in Turku, or even in Turku castle, would be a surprise.

The absence of roe deer in Finnish osteological material is perhaps more surprising than the absence of red deer. Roe deer has spread into Finland in the past few decades, and has been successful in our climate. Roe deer was present in the Åland Islands in the 16th century but obviously never spread to the mainland- there are no records at all of its presence in historical sources (Melander 1920: 56-57). It is possible that they were indigenous in origin, but already by 1623 there were plans to import roe deer to the Åland Islands from Sweden- perhaps as a consequence of diminishing numbers (Melander 1920: 58). There is one roe deer bone from the medieval Kuusisto castle, which is located near Turku (Mutikainen 1989: 11). The historical sources mention some roe deer carcasses being brought from the Åland Islands to Turku castle (Melander 1920: 58). It might be expected that roe deer would be present only as a curiosity or as imported carcasses.

4.7.4 Brown bear (*Ursus arctos*)

Nine specimens of brown bear were present in the medieval phases at Åbo Akademi, the first thus far discovered in Turku. At Aboa Vetus no bear bones were identified among the investigated sample, although in a recent excavation (2005) one bear claw was found. The bear bones at Åbo Akademi derive from both low- and high utility body parts and are probably related to both skin processing and meat utilisation (figure 105).

Bears held a special place in ancient Finnish religion and bear hunting was highly ritualised. The bear spirit was released back to heaven, its original home, by means of a ritual entitled "peijaiset", which was an imitation of a wedding (Pentikäinen 2005: 16-17). People's relationship with bears changed when they adopted agriculture and older religious beliefs were superseded by Christianity (Sarmela 1994: 38, 40-42). Increasing numbers of domestic animals were killed by bears as agriculture spread, but bear continued to be regarded as special when compared with other animals. In 1640 the bishop of Turk still found it necessary to preach against the ceremonies practiced after a successful bear hunt (Pentikäinen 2005: 107-109). During the 17th-19th centuries the bear became increasingly feared as a symbol of pagan faith, during the 19th century it was almost hunted to extinction (Pentikäinen 2005: 116-117).

The anatomical distribution of the bear bones indicates that bear meat was consumed in Turku. The Catholic Church was not opposed to the consumption of bear meat in Finland, even though the consumption of carnivore meat was forbidden in the Bible (Old Testament, 3. Mos. 11:27; also Egardt 1962: 96). On the contrary, one ham was to be given to priests from every hunted animal (Pirinen 1962: 105). This tax is not mentioned in Finland Proper, but it was common in areas where hunting formed an important part of peoples subsistence (Pirinen 1962: 105). There were some parts of Eastern Finland where bear meat was not consumed (Pentikäinen 2005: 18; Sallinen-Gimpl 1985: 222).

According to the historical sources, bears were common animals in Finland in the post-medieval period, and this is most likely true for the medieval period as well. The presence of these animals is generally recorded in the historical sources as a result of the damage they inflicted on livestock. For example, in 1544 wolves and bears caused the loss of 50 animals at Häme Castle (Vilkuna 2003: 53). In the 17th century a bear mauled an ox in a neighbouring parish to Turku (Vilkuna 1935: 4). In the 18th century bears sometimes wandered near to the city of Helsinki (Forsius 1757: 9). As late as 1780, 27 bearskins were imported into Turku from the surrounding rural area (Gadd 1783: 111). Some bearskins can be found in the 17th century Turku estate lists; one was used as bed cover (Fi: välly) (Hästesko 1905: 298, 310).

In traditional bear rituals all the bones were collected after the ceremony and buried, with the skull being hung on a pine (Pentikäinen 2005: 58-59). The bones found in Turku indicate that the bear was no longer treated in a traditional fashion during the medieval period. It should be mentioned that in Raisio Mulli and Sysmä Ihananiemi (the late Iron age or early medieval sites) only the teeth or metatarsal bones of bears were found (Mannermaa 2002; Tupala 1999), which could indicate the redeposition of bones other than those attached to skin.

4.7.5 Wolf (*Canis lupus*)

Two bones from the Åbo Akademi excavations were judged to derive from wolf. The potential for these bones deriving from a large dog were excluded due to their great size and characteristics, established following comparison with modern examples of wolf and large dog skeletons. The most reliable method for identifying wolf bones is obtained by measuring the teeth and parts of the skull (Pluskowski 2006: 280). All the recovered wolf bones were post-cranial. The largest dog found from Turku measured 59 cm in withers height, while modern wolves have withers heights of 70-90 cm (Siivonen & Sulkava 1999: 166). No complete wolf long bones have been recovered, but one calcaneus could be measured, producing a GL of 61 mm. No certain large dog bones were recovered in the material, but all the large canid bones were identified as wolves (either definite or probable). A number of bones were identified as"dog or wolf"; three phalanges that could derive from either a large dog or wolf, and one suspiciously large juvenile ulna.

Wolves were present in Finland Proper during the medieval period, although the historical sources only describe them in the 17th century. From the 17th and the 18th century we have some records for wolf hunting in Raisio, a neighbouring parish of Turku. In every household a wolf net was to be kept and a collective wolf trap maintained (Mäntylä 1960: 285). A hunting bailiff was to be assisted with wolf hunts (Mäntylä 1960: 285). These regulations were enforced, as fines were imposed on households for neglecting a wolf trap in Raisio in 1687, and for neglecting a wolf net in Lieto in 1629 (Hiltunen 1988: 371-372; Mäntylä 1960: 285). In Sauvo wolves were hunted an average of six times a year in the mid 18th century (Vilkuna 1935: 8).

Wolves were feared beasts: they killed livestock, dogs and sometimes even people (e.g. Vilkuna 1935: 4-5). For example wolves killed a cow and a young ox in Lieto in 1685 (Hiltunen 1988: 371). The damage bears and wolves caused to livestock varied depending on the time and place; an unlucky farmer could loose all his animals to these predators, and the devastation was sometimes considerable (Soininen 1974: 221). In Pieksämäki in 1761, 55 households lost 198 of their 486 animals to the carnivores - 41 % of their livestock (Soininen 1974: 219). Efraim Carenius reported in 1759 that a total of 907 animals (30 horses, 15 oxes, 27 cows, 25 young cattle, 25 calves, 280 sheep, 325 goats and 180 pigs: 6 % of the livestock) were lost to wolves and bears in the previous year in the parish of Huittinen, and he also claims that the losses in some other years were worse (Carenius 1759: 55). However, these figures should be viewed with some caution, as the authors may have exaggerated the losses due in order to obtain increased compensation or to gain publicity.

Wolf hunting was apparently practiced by both authorities and common folk. One record of wolf hunting is found in the Turku court books for 1635 (Utdrag ur Åbo Stads Dombok 1635: 3). Three Crown hunters were tracking a wolf and succeeded in injuring it, but they were unable to follow the animal. One servant found the bloody tracks and followed them with a dog, only managed to scare the wolf away by shooting at it. Some days later the three unlucky and angry hunters beat the servant up, stole his gun and hat and tried to steal his dog.

Wolf skins were valued at approximately the same level as bear skins (Grotenfelt 1887: 152). However, as with the dog bones, the wolf bones also show cut marks which are not necessarily the result of skinning. Two lumbar vertebrae found in a previous study from Åbo Akademi M 504 exhibit cutmarks to the upper articular surface, indicating dismemberment rather than skinning (Tourunen 2002a). In addition, the lateral processes had been cut. A wolf ulna from Åbo Akademi M 513 B has been cut through the olecranon and a calcaneus from Åbo Akademi M 164 B had cutmarks and had been cut through. The presence of wolf vertebrae and an ulna in the town indicates that the animals were, at least occasionally, brought into the town whole. The consumption of wolf flesh would explain both the anatomical presentation and the cutmarks. Unlike the situation with bear, there are no historical sources to confirm or deny the idea of wolf flesh consumption. Wolf flesh or fat might have been used for other purposes aside from consumption, such as for medicinal needs.

4.7.6 Seal (Ringed seal, *Phoca hispida* and Grey seal, *Halichoerus grypus*)

Both ringed seal and grey seal have been identified in the material. As most of the seal bones cannot be identified to species, the finds are here dealt with as one group.

Most of the seal specimens derive from high utility body parts. Only a few bones from lower limbs has been recovered, and none from the cranium or mandible. Some of the bones contain cut marks. Seal meat was obviously consumed to some extent in Turku. According to Olaus Magnus (946) seal meat could be eaten during the fast, because it was an aquatic animal (see also Ylimaunu 2000: 331-332).

Seals are seldom mentioned in the historical sources. It is only in 18th century travel books that some descriptions can be found (Acerbi 1799: 12-13, 89; von Linné 1732: 193). The seal products- train oil and skins- were exported from Finland and train oil is mentioned in the oldest surviving sources dating to the 15th century (Grotenfelt 1887: 32-35; Kallioinen 2000: 190, 323). Von Linné (1732: 199) mentions shoes made of seal skin and this is borne out by the discovery of a shoe partly made of seal skin from the early 14th century at Aboa Vetus (Jokela 2005: 8-9).

The distribution of seal bones is rather interesting, both as regards dating and location. In the oldest deposits at Åbo Akademi seal bones are not present (except one os baculum) and they are also scarce in the medieval deposits. In the layers dating to the 17th -18th centuries seal bones are more frequent. No seal bones have been found from earlier investigations at Åbo Akademi (Kylänen 2001: 22; Tourunen 2002a). At Aboa Vetus the situation is different, with seal bones present in both the medieval and post-medieval phases. It is difficult to explain why the seal bones are absent from the oldest Åbo Akademi deposits. Seals were surely present and hunted, and the bones from the Aboa Vetus deposits indicate that they were also eaten. The reason for this difference is likely to indicate that the occupants of the two sites had different associations with the marine environment.

4.7.7 Squirrel (*Sciurus vulgaris*)

In the historical sources squirrel skins are important tax products and exports (for example Grönros et al. 2003: 107). The trading importance of the fur ceased during the 15th century, probably because Furs were no longer available in the same quantities as previously (Kallioinen 2000: 190). In 1558, 826 *kiihtelys* (33040 pieces) of squirrel skins were exported from Finland (Grotenfelt 1887: 149). This figure can be compared to the 5018 *kiihtelys* (200720 pieces) of squirrel skin one merchant alone exported from Turku to Tallinn in 1391 (Grönros et al. 2003: 107). In the 16th century a good squirrel skin was worth almost 4 times more than one hare skin (Grotenfelt 1887: 152). The best quality squirrel was worth 7 mark per *kiihtelys* or about 40 pieces, with hare worth only 2-1 ½ mark per *kiihtelys.*

The tradition of consuming squirrel meat is known in Finland (Sirelius 1919: 305; Talve 1973: 43) and a dish called "oravakukko" ("squirrel pie") was still being prepared in Eastern Finland at the beginning of the last century. Even if no cut marks were found on the squirrel bones these animals could have been consumed to some degree. Von Linné (1732, 53) mentions that in Sweden squirrel meat was eaten. Thomas (2005: 25) also presents some information about the keeping of squirrels as pets, but this seems unlikely in Finland, unless perhaps among wealthier families.

Squirrel bones were found at both Åbo Akademi and Aboa Vetus, in both the medieval and post-medieval layers. The abundance of squirrel cannot be estimated with proper precision, as bones of this size would have been regularly missed during excavation. However, in one context, M 159, so many squirrel bones were found that with the other evidence for tanning or fur processing from the same context, it could be speculated that squirrels were processed at this site for their fur. All bones which could be recognized considering the recovery methods used (being the skull, mandible, and long bones), are represented.

Squirrel bones can originate from animals that were actually living on site. However, this seems unlikely when one takes into consideration the abundance of squirrel bones, the probably treeless environment around Turku and the pressure on the species due to hunting. Thus, these animals were deliberately brought to Turku. However, the anatomical distribution indicates that the squirrel bones derive from whole carcasses and not only from the skins. From Birka 1001 squirrel specimens were found (Wigh 2001: 124).

Here almost all of the bones derive from the tail, paws and the distal ends of radii, ulnae and tibiae (Wigh 2001: 123-124). Even if the sieving method used in the Turku excavations had left all these bones undiscovered, the presence of skulls, upper limb parts and proximal parts of ulnae and tibiae indicate a different utilisation or curation strategy in Turku as opposed to Birka, where the pelts of different animals were processed in great quantities (Wigh 2001: 121-123). In addition, the scarcity of the bones of other fur-bearing animals in Turku supports this view. There are other important differences to note between the squirrel assemblages from Birka and Turku. Wigh (2001: 124) reports that the young animals are missing from his assemblage. In contrast, the Turku assemblage displays plenty of open epiphyses among the squirrel bones.

As the presence of squirrel paws and tails cannot be confirmed or denied due to the sieving methods employed, the question as to whether or not squirrel pelts were processed at the site has to be left somewhat open. However, it is likely that squirrel furs were processed to some extent. The squirrel bones found from Åbo Akademi M 159 are probably derived from carcasses as well, but because there are other signs of fur processing from this context, the squirrel bones probably derive from animals brought as whole carcasses to Turku in order to be skinned on site. The squirrel bones from the Åbo Akademi and Aboa Vetus excavations probably only represent a small proportion of the bones originally deposited. Therefore, the information retrievable regarding the squirrel's anatomical distribution is limited. However, one detail is highlighted in the data set. Most of the tibiae found contain only the proximal portion of the bone. As a result, the squirrel bones from Turku could be interpreted as representing the initial stage of the fur removing process. It is also possible that these animals were consumed to some degree.

4.7.8 Arctic hare (*Lepus timidus*)

All the various hare body parts represented in the research material. The small bones are missing or under-represented due to the recovery methods employed. However, hare is present in every larger context and in the majority of the smaller ones. 27 hare bones presented cut marks, most of them in the pelvis and scapula.

Some prejudices in the past caused the consumption of hare meat to be frowned upon. Hare eating was even forbidden by the Catholic Church in 8th century Europe (Egard 1962: 88). One reason for this prohibition can be found in the Bible, where hare eating is banned (Egard 1962: 66). These regulations may have affected attitudes towards the hare and consumption habits regarding hare meat. In Norway and among the Saami hare meat was still being avoided in the 16th century (Vuorela 1975: 55). Some prejudices have also been noted in Finland, especially in the south-east (Vuorela 1975: 54; Sirelius 1919: 27). Despite this, hare was used as tax good (Seppälä 2000: 125; Vilkuna 1998: 63; Vuorela 1975: 54) and hunted by the town dwellers in their rural farms in the 17th century (Ranta 1975: 519-520). Olaus Magnus (821-2) mentions that hare meat was commonly consumed in the

Northern countries, but also mentions that pregnant women should avoid hare meat in order to insure their child did not have a cleft lip, "a harelip". It seems that common folk had more reservations regarding the consumption of hare meat than the upper classes (cf. Talve 1973: 43). Hare skins were also exported from Finland; in 1558, 366 kiihtelys, or 14640 pieces (Grotenfelt 1887: 149). Hare skins were used for commodities such as bed covers (Fi: välly) (Utdrag ur Åbo Stads Dombok 1638: 310, 318).

Whatever prejudices there were against hare meat in Finland, it was consumed in Turku constantly throughout the centuries. Hares were brought into the town as whole carcasses and were probably also skinned there. Some of the hares were most likely hunted by the town dwellers themselves, with others brought in by rural inhabitants.

4.7.9 Rat (Black rat, *Rattus rattus* and Brown rat, *Rattus norvegicus*)

Both of these rats are represented in the material. The two species were identified from crania according to guidelines presented by Bergquist (1957). One brown rat cranium was discovered in layers dating to the 18th-19th centuries (in Aboa Vetus R 12, LU 93). The other identifiable cranium was that of a black rat, coming from the medieval layers (M 56 M, RA 60 G, well). The exact dating of the rat bones is difficult, because rats can be intrusive and the bones could be derived from later periods. Rats are present in the oldest deposits from Åbo Akademi and Aboa Vetus, and rat bones have also be found at the Late Iron Age-Early medieval settlement in Raisio near Turku (Tupala 1999: 47). The brown rat is supposed to have spread to Finland in the early 19th century displacing the black rat, which is now extinct (Jensen 1994: 131, 135). Therefore, most of the rat bones in the material are assumed to derive from black rats.

Besides destroying foodstuff, rats could also have other more serious negative effects on the human population. Fleas living in rats have been identified as carriers of plague and as being responsible for the transmission of the disease to humans (Vuorinen 2002: 102). No evidence for plague has been found in Finland before 1420, but several epidemics raged in the 15th-18th centuries (Vuorinen 2002: 117).

The rats have left other traces apart from their bones. Approximately 0,4% of the Åbo Akademi material and 0,5 % of the Aboa Vetus material specimens show rodent gnawing marks, most of which are likely derived from rat teeth. The distribution of gnawed specimens is not even. In some contexts the number of gnawed bones is high (up to 17 % of all specimens), and in some no gnawed bones have been identified. The highest numbers of rodent teeth marks are found in small, closed contexts such as the Aboa Vetus well (R 50, n = 12) and feature K 28:3 (n = 44). Here 17 % and 14 % of the specimens respectively show gnawing marks. These features are of course exceptionally small. Of the larger ones M 75 has 4,3 % gnawed specimens (n = 161). The largest context with no gnawed bones is M 60 C (n = 2716). The presence or absence of rodent teeth marks can reveal information about the nature of the deposit. For example, M 75 and M128 F were both found inside abandoned large wooden vessels. They both included high numbers of gnawed bones, 4,3% and 2,6% respectively. It seems probable that these contexts had provided sheltered places for rodents to feed.

4.7.10 Red fox (*Vulpes vulpes*) and other fur-bearing carnivores

Only eight red fox bones were identified in the material. All the bones come from the Aboa Vetus excavations. One of these bones can be dated to the medieval period while the others derive from layers not precisely dated, but evidently post-medieval. Among the bones identified as "canidae" was small canid bone which could be derived from a fox, but is more likely from a small dog. The fox bones present an interesting anatomical picture. The medieval bone is part of a mandible, while in the post-medieval layers a collection of metapodials and cranial fragments were found. These bones are most likely derived from the paws and the cranium attached to a skin. Two fox tibiae, apparently a pair, were also recovered in the post-medieval layers (figure 106). One of these bones has a pathological lesion in the distal end. The whole articular surface was affected and pitted with holes. In addition, the epiphyseal margins were involved. The other tibia found in the same context had no pathological lesions. Fox bones are rare in Turku and the two tibiae were found in the same small contexts (R 19 A, LU 385 from pit 40) containing only 103 specimens. These two specimens probably belong to the same individual. The size of the bones was similar, but the pathological one was more slender. This might indicate that the leg could not be used properly.

In earlier studies only a few fox bones have been found in Turku. These specimens come from Åbo Akademi and the Mätäjärvi area (Kylänen 2001: 22; Vuorisalo & Virtanen 1985: 275). No other finds of fur bearing carnivores (others than bears and wolves) have been identified from the Turku excavations. The historical sources describe trade in the furs of stoat (*Mustela erminea*), European mink (*Mustela lutreola*), pine marten (*Martes martes*), wolverine (*Gulo gulo*), otter (*Lutra lutra*), polecat (*Mustela putorius*), arctic fox (*Alopex lagopus*) and lynx (*Lynx lynx*) (Grotenfelt 1887: 152; Jokipii 1953: 90-91; Melander 1952). Not all of these animals lived in Finland Proper and therefore the absence of their bones is not surprising. In Finland Proper the importance of hunting as a constituent part of subsistence, and by the 16th century furs, (although they were still to some extent exported), had lost their dominance in trade (Kallioinen 2000: 189-190). In the Late Iron Age-Early medieval site in Raisio the bones of fox, lynx and otter were found (Tupala 1999: 47).

4.7.11 Beaver (*Castor fiber*)

One humerus of a beaver was identified among the Aboa Vetus material in phase 1, dating to the medieval period. Beaver skins are mentioned in the historical sources, but they are not common. An example is the Silver tax rolls from Pori, where only one fourth of a beaver skin is mentioned (Suomen hopeaveroluettelot Satakunta). Beaver was hunted to extinction in Finland in the 19th century (Jensen 1994: 105). In the 16th century most of the beaver skins came from Northern Finland, so it is possible that beaver by this period beaver was already rare in Southern Finland (Melander 1952: 140). Beaver meat was also consumed (von Linné 1732: 53; Sirelius 1919: 27) and therefore it is possible that the beaver was brought to Turku for consumption.

4.7.12 Importance of birds and fish in Turku

In this study bird and fish bones were not analysed. Due to the 10 mm or 8 mm sieve used in the excavations most of the specimens were probably lost during recovery. This is especially true for fish, which in the material mostly comprise of large bones from large large fish, with pike (*Esox lucius*) jaws particularly well represented. Some analysis of bird bones from Åbo Akademi has already taken place (Kylänen 2001; Tourunen 2002a), the purpose of which was to investigate the importance of birds in Turku. For fish only one test sample (Tourunen 2004) was analysed, but the historical sources also shed some light on the matter.

The two studies on the bird bones from Åbo Akademi (Kylänen 2001; Tourunen 2002) have produced similar results. Domestic chicken is the most common species among the identified bones. Wild species from both aquatic and forest environments were also present (table 30). Some duck bones were identified as mallard or domestic duck (*Anas platyrhynchos*). The geese (*Anser anser*) bones might represent either domestic or wild forms. The historical sources do not mention birds very often. Moreover, when geese or eggs are mentioned, it is not always clear if domestic or wild animals (or eggs collected from wild birds) are meant. However, geese were evidently being raised in Turku castle by 1463 and 1464, when they were fed with oats (BFH I: 338,356). Domestic geese and chicken are mentioned in documents from the 16th and 17th centuries, (Säihke 1963: 64; Tornberg 1973: 69) and turkeys in the 17th and the 18th centuries (Kalm & Cavander 1753: 15; Tornberg 1973: 69). However, domestic ducks are not mentioned in any of these sources. The Finnish word (Fi: ankka) is mentioned in a vocabulary compiled by Schroderus in 1637 (Häkkinen 2004: 75). The Finnish word for duck is derived from Swedish. Olaus Magnus (876) mentions ducks in Sweden in the 16th century. It remains uncertain as to when the domestic duck was introduced to Finland, and how common they were. It seems that most, if not all, of the *Anas platyrhynchos* specimens recorded in Finland belong to the wild form, namely the mallard. In the 18th century it was claimed that inhabitants of the Turku archipelago occasionally captured wild geese and tamed them (Kalm & Cavander 1753: 15).

So far the importance of fish in Turku is difficult to properly evaluate. The importance of fish can be only be thoroughly investigated in well sieved assemblages. In the few thoroughly sieved samples examined from Turku (Tourunen 2004) it becomes clear that fish bones are very abundant in the soil. Samples of 10-15 litres included 45 – 276 fish specimens each. Even if pike is very abundant in the material sieved with a 8-10 mm screen, smaller fish such as perch (*Perca fluviatilis*) and cyprinids (Cyprinidae) dominate in the fine sieved samples. Fishing equipment like hooks, net weights and net floats were found in the medieval layers at Åbo Akademi, and are probably indicative of small- scale household fishing (Hietala 2004, 62-64). Among the Åbo Akademi material two interesting fish bones were found and identified as the proximal part of the rib of a wels catfish (*Silurus glanis*), a very large individual. The bones came from phase 3 at Åbo Akademi (M 60 and 60 C), dated to the 17th-18th century. Wels catfish became extinct in Finland in the 1860's (Koli 2001: 88).

Even if fish and fishing was likely to have been an important form of subsistence in Turku by the medieval period, the documentary information is only really available from the 17th and 18th centuries. In the 17th century Turku was fighting for fishing and fish trade privileges in the territorial waters around the town (Ranta 1975: 522-525). In the 18th century the inhabitants in Turku were suffering from a shortage of fresh fish, partly because fish catches from the Turku archipelago were being sold to meet the growing consumption needs in Stockholm (Nikula 1971: 398-402). Salted fish was delivered to Turku; an example being the period between 1719 and 1729 when ca. one thousand barrels of salted Baltic herring arrived (Ranta 1975: 523).

Bird and fish probably played a consistently important role in the subsistence of Turku. Both food resources were diversely explored. It was not only domestic birds which were exploited, as others were imported from marine and forested environments. The species representation for fish in Turku is suggestive of a similarly well developed and wide ranging exploitation.

5 EVIDENCE FOR CRAFTS IN TURKU

5.1 Indications of craftsmanship

The signs of craftsmanship can be identified through its effect on several properties of the material. As has already been discussed above, the concentration of certain elements can alter the proportion of different species in the contexts, as well as having an effect on the anatomical distribution within contexts and potentially even phases. However, because of the small number of bones relating to these activities and the large size of the contexts, this is not always the case. The most effected animal is goat, which is principally represented in the material through its metapodials and horn cores, deriving from goatskins imported into the town. In phase 1 and 2 at Aboa Vetus there is approximately the same proportion of goat specimens as there is sheep specimens, but the goats are represented by a different anatomical distribution, which is also indicative of a probable difference in importance.

However, signs of crafts also affect the potential to search for sex distribution and the size of the animals in material. Concentrations of horn cores and metapodials give adequate measurement samples, enabling sex and size analysis. Signs of comb-making or horn core sawing which could destroy these bones are almost absent in this material – only a few waste pieces have been recovered from the Åbo Akademi or Aboa Vetus sites. However, the sex and size distribution of animals destined for handicrafts can differ from those originating from ordinary household deposits.

Signs of craftsmanship were sought throughout the anatomical distribution (tables 31 and 32). The abundance of bone elements relating to craft activities was counted following the methods described in chapter 1. These values served as guidelines for the examination of the contexts.

The method of contextual excavation affects the potential to evaluate the anatomical distribution and species representation within each context. M 159 (ÅA), a large context (117,7 kg, n= 9411, at least 20 m²) contained high numbers of both sheep and goat metapodials, but no cattle metapodials or horn cores, and is an example of the weaknesses of the excavation method used at the Åbo Akademi site. It has the second highest frequency of sheep and goat metapodials, and a very interesting species representation. One bear claw, 28 specimens of squirrel (MNI 3) and one of the few horse bones (a tooth) were represented in the material. This context also contains bones from infant sheep and goat. Interpreting this context as a location for fur processing and a tannery for sheep and goat (maybe even the infant ones) seems sound, although it would have been valuable to have additional contextual information on the spatial distribution of the bones in these large contexts. In addition, more careful sieving could have added some information relating to the presence and anatomical distribution of the small fur bearing animals such as squirrel, weasel and stoat.

The excavation method used at Aboa Vetus offers the potential to more closely examine the spatial distribution of the horn cores in R 25 (table 33). The horn cores were found all around the area of R 25, but fewer horn cores were recovered from the middle section. No pit-like features were recognised in the profiles (maps 73, 76, 97, Aboa Vetus museum archive). It is possible that the corners of the area were more often used for the disposal of horn cores, or alternatively it is possible that trampling in the central area destroyed the horn cores located there. It seems that the horn cores were not discarded in an orderly fashion in one concentrated spot , but were distributed arbitrarily around the yard.

Context R 19 U (AV) also contained a high frequency of horn cores, as well as contexts M 114 D (ÅA) and M128 F (ÅA). M 128 F was found inside a barrel. It contained a small but interesting assemblage of 4 cattle horn cores and 5 horn sheaths. The presence of horn sheaths is worth considering; these were probably removed from the horn cores, as they were found separated. Context M 114 D contained plenty of horn cores and metapodials, and no other context exhibits a similar pattern. Context M 78 C (ÅA) also contains unusually high numbers of the anterior parts of lower cattle jaw and premaxilla (see below). Contexts M 66 (ÅA), M 66 B (ÅA), M 118 (ÅA) and M 118 B+C (ÅA) contain a lot of sheep metapodials but very few goat metapodials. M 66 also contained several hare bones, most of which come from the paws. Contexts M 90 E (ÅA) and M 163 (ÅA) both contain a high number of sheep horn cores. In M 163 there are significant numbers of cattle metapodials , and this is also the case with M 511 B (ÅA), M 73 (ÅA) and M 14 (ÅA). Contexts M 512 (ÅA) and M 503 M (ÅA) contain quite high quantities of cattle horn cores.

Two contexts, M 78 B (ÅA) and M 78 C (ÅA), display a different pattern of anatomical representation. M 78 B was found above M 78 C, and the main between them is the presence of a mineral fraction in the soil of M 78 B. Both exhibit remarkably high numbers of the anterior parts of cattle lower jaws and premaxillae. M 78 B also has the highest number of cattle metapodials and M 78 C has a high number of goat horn cores. M 78 B contained no cattle horn cores and M 78 C contained only a small number. In addition, M 60 (ÅA) and M 60 C (ÅA) contained a large amount of the anterior parts of mandible. These concentrations are most likely the result of craft activities.

Evidence other than that provided by the osteological material can be used for the evaluation of the evidence for craft activities in each context. Other signs of leather working, such as the presence of waste pieces or currying waste are indicative of craft activities in different locations. The historical sources claim that shoemakers tanned their own leather. Therefore, the presence of cattle metapodials, currying waste and waste pieces in one context might be expected. However, in those contexts where plenty of cattle metapodials have been found, no currying waste is present (pers. comm 26.1.2006 Lic. Phil. Janne Harjula, Archaeology, University of Turku. All the available information concerning the presence of currying waste, waste pieces and leather working equipment is from Harjula's e-mail, in the author's possession). Conversely, in M 118 (ÅA) and in M 66 (ÅA), which contain a high frequency of sheep metapodials some currying waste is present. Some contexts contain signs of leather working even if no signs of such activities were visible in the bone material, and sometimes the signs of leather working activity were absent even when its presence was indicated by the bone material.

6 DISCUSSION: ANIMALS IN AN URBAN CONTEXT

The combined data from the Turku osteological l material and historical sources presents us with a picture of animal husbandry practice, the utilisation of animal resources and the role of different species. The animal bones found in the Turku excavations originate from animals bred in the town and its hinterland. Therefore the results highlight animal husbandry strategies in Finland Proper. It should be remembered that the animals in Turku do not necessarily represent the productive stock in the rural area, but animals of a certain age and sex that may have been brought to town. Moreover, the social differences present in Turku may have had an effect on the observed animal consumption patterns. It is difficult to properly evaluate the variability in the social structures of the excavation areas in medieval and post medieval Turku. However, urban consumption and rural production were not independent of each other, as the urban consumption of meat was closely connected to the animal husbandry pattern practiced in the rural areas. Therefore changes in animal husbandry patterns are likely to be reflected in the urban material.

6.1 Crafts in Turku

The depositional patterns in Turku reveal that animal bones present in the material were deposited through several different activities, with some relating to craft activities, some to animal husbandry at the site, and some to food processing. "Normal" household waste forms the majority of the osteological material in Turku. As the historical sources reveal, the purchase of meat was of secondary importance to the inhabitants of 18th century Turku when it came to obtaining food, with the self- slaughtering of animals predominating (see chapter 1). The same pattern is supported by the anatomical distributions found in the osteological material. The household waste within the assemblage seems to contain all the body parts of the animals, as well as those related to craft processes.

The concentration of certain anatomical elements in a context can be caused by different activities and craft processes. There are a number of possible explanations for the concentration of horn cores. Horn sheaths were used as raw material and the horn cores were probably deposited in the location where sheaths were separated from the useless cores. A number of tradesmen could separate the sheaths from the cores, but if this was not carried out before the horn-workers received the material they separated them themselves (Dobney et al. 1996: 23). The separation of the sheaths could also have been carried out at an earlier stage by either the tanner or the butcher, who could then have sold the sheaths on to the horn-worker (Armitage 1990: 84). The butcher may have already separated the horn cores from the cranium in the primary butchering process. The cranium or horn cores and the metapodials could also have been left attached to the hide when the animal was skinned (Dobney et al. 1996: 23; Schibler 1989: 146; Serjeantson 1989: 136). The cranium could also have stayed with the skin for brain tanning (Eskelinen &

Frank 1999: 105, 116). Therefore horn cores can also be found in association with tannery activities.

If the horn cores were of no economic value economic value, they could have been left in the place of slaughter. As Serjeantson (1989: 139) points out, this might be the case if small quantities are recovered, but where greater numbers are discovered craft processing activity is the more likely explanation. On occasion horn cores with the sheath still attached are found in excavations, indicating that the sheaths were not separated and used. This can be see in Turku in context M 512 (ÅA). Horn cores with cutmarks can usually be associated with horn working. In such cases, horn cores sawn in cylindrical sections might be present (Schibler 1989:151). However, some types of horn working do not necessarily leave any cutmarks on the bones (MacGregor 1989: 117).

No actual pits or structures filled with horn cores have been recovered in Turku. Some cutmarks can be found on the horn cores from contexts that exhibit an over representation of this type of bone, but not in great quantities. Pieces of cores cut into cylindrical sections have not been recovered in Turku either. The historical sources do not mention any professional hornworkers or comb makers in medieval Turku (Grotenfelt 1887: 41; Kallioinen 2000, 216-217). Although evidence for horn- or antler working is scarce, it seems reasonable to assume that horn cores were, at least to a certain degree, used as a raw material, as is indicated by the presence of loose horn sheaths and concentrations of horn cores with cutmarks at their base. Indications of antler working are scarce in Turku and antler pieces are only present in a small number of contexts (Kylänen 2001:22).

Concentrations of metapodials can be created by tannery or slaughtering activities (see for example Serjeantson 1989). In Turku a surplus of goat horn cores and metapodials indicates that more goatskins than live animals were imported into the town. Therefore, concentrations of goat horn cores and metapodials are more likely to indicate skin or horn working rather than a place of slaughter. Linné (1732: 312) mentions that the lower parts of the animals legs were boiled and the separating grease was collected for use in coats and strings. The exact way in which this grease was used is unclear in the description. The grease from the lowest parts of the animal's legs produced neatsfoot oil which could be used for tanning (Eskelinen & Frank 1999; Serjeantson 1989: 141). Apart from grease extraction, an overrepresentation of metapodials can also be representative comb production (Vretemark 1983**:** 260). This kind of activity should leave behind sawn bone ends as waste pieces. However, no such specimens have been recorded in the Turku material.

The accumulation of horn cores and metapodials can be the result of several activities, which are sometimes difficult to separate from one and another. The historical sources claim that the tanning of cattle hides was usually separated from the tanning of other animal skins. The osteological evidence supports this view in the majority of cases, showing concentrations of metapodials from one species only. However, in many contexts there is one dominant species from which metapodials are found in great abundance, but high numbers from other species metapodials are also found in the same context. For example M 73 (ÅA) contains plenty of cattle metapodials but also a significant number of goat metapodials.

Currying waste and worked implements prove that shoemakers or other leather-related craftsmen were present in the Åbo Akademi area (pers.comm. 26.1.2006 Lic. Phil. Janne Harjula, Archaeology, University of Turku). Even where potential tannery waste and currying waste do not occur in the same contexts, there is no reason to assume that shoemakers could not tan their own leather. This could have been carried out by the river or by Lake Mätäjärvi. Furriers seem to have worked with their material in the Åbo Akademi area. They were mostly using the skins of sheep and goat, but also utilised the furs of hare and squirrel, which are the most abundant wild species present in the material. As the chamois-leather makers also used goat and sheep skins for raw material, these two occupations can be difficult to separate from each other, and it is by no means certain that a clear distinction is always possible when analysing bone assemblages. Cats were also used as fur animals to some extent Turku (see chapter 4). However, cat bones have not been found in large numbers in contexts which display other signs of furrier activity (M 66 (ÅA), M 118 (ÅA) or M 114 D (ÅA) and perhaps M 66 B (ÅA)). However, plenty of cat bones are found in M 159 discussed above, as well as in some other contexts (M 104 (ÅA), M 147 (ÅA)) and in the Aboa Vetus cellars. The utilisation of cat skins were not restricted to official furriers but could be treated and produced by anyone.

Bones other than metapodials could also be used for grease production. Some fragments of the diastema of the mandibular corpus from M 78 C (ÅA) show similar burn marks as Dobney et al. (1996: 25) have presented from the city of Lincoln, UK. These marks were interpreted as a result of heating the lower jaws for the extraction of the liquefied marrow (Dobney 1996: 25-26). Context M 78C also contains large numbers of premaxillae but almost no horn cores at all. It seems that at some stage of the butchery process the premaxilla was cut off from the rest of the cranium. Either the horn cores and the rest of the cranium (and potentially the brains) were brought from this location or the premaxillae were. The former explanation seems more reasonable, considering the anatomical representation and the importance of horn cores in crafts industry.

In addition, other craftsman occupations can sometimes be traced from the bones or waste pieces. Various artefacts are made of bone, and for example the production of combs or buttons leaves specific waste pieces behind. Some such bone pieces have been recovered from the Aboa Vetus site (Koskinen 2004: 38-39). However, these pieces are few, and so far no traces of professional or intensive production of bone artefacts has been detected in Turku. The presence of horse bones can perhaps be linked to bone artefact production. For example, eight specimens of horse were found in M 130 E (ÅA). They consist of five pieces of (probably a single) metacarpal, a second and third phalanx and one sesame bone. The metacarpal pieces were worked. It is probable that this assemblage of horse bones represents the residue of bone artefact production.

No context can be indisputably linked to tanning or slaughtering activities alone. Both activities could have been carried out to some degree at Åbo Akademi. The assemblage from M 78 B and C (ÅA) could represent both primary butchery and grease extraction activities. In the Turku material there is no evidence for intensive professional horn- antler or bone working. Perhaps horn and bone artefacts were produced in the households when needed, seasonally by semi-professionals or perhaps as by-products during other manufacture.

The small number of residual bones related to craft activities and the lack of organised waste disposal of craft waste is suggestive of only occasional or periodical craftsmanship. No pits or features filled with tanners waste or waste pieces of bone used in bone artefact production have so far been found in Turku. However, among the unstudied material such concentrations may yet be discovered. According to the excavation report, Structure RA 77 at Åbo Akademi included a pit full of large bones, probably from craft activities (Arkeologiset tutkimukset Åbo Akademin tontilla (Turku I/7/4) vuonna 1998). However, some of the bone material from this pit, M 68B, was not available for analysis.

There are some major points to consider, however. The excavation technique employed at Åbo Akademi, where large contexts were excavated as one entity may not allow us to recognise waste concentrations enable the recognition of waste concentrations. Sometimes bone and antler working was carried out in specific areas (Riddler 2004). Tanning is an activity that is usually situated outside towns near rivers or lakes because of the its water requirements, but also as a result of the strong smell associated with the work but also due to the smelly character of the profession (MacKinnon 2004: 222; Serjeantson 1989: 135; Vretemark 1997: 59). In Turku some tanneries are mentioned near the bridge and river in the 18th century (Nikula 1971: 547). The Åbo Akademi area was not situated by the river or lake in the Middle Ages (Pihlman 2003: 70). A more suitable place for tannery activities- in other words skinners, shoemakers and tanners- was the riverside and strand beside Lake Mätäjärvi ("Rotten lake"), situated approximately 100 metres east of the Åbo Akademi excavation area (Pihlman 2003: 70). No osteological analysis has been carried out on the material from the riverside, but bone material excavated from Lake Mätäjärvi has been analysed. Here, the medieval material revealed a great number of horn cores as well as a large amount of low utility skeletal parts (Vuorisalo &Virtanen 1985: 278-279). Therefore it needs to be considered that the lack of clear indications of craft in the urban Turku material is not necessarily a sign of the lack of intensive and professional tannery in Turku, but rather is a reflection on the areas selected for this study. This may also be the case for the other craftsmanship activities associated with cattle

Naturally, not all craft activities are evident in the osteological material. Some craftsmen were clearly operating in the Åbo Akademi area. The archaeological material from Åbo

Akademi exhibits evidence for leather working and textile manufacture (Kirjavainen 2002; pers.comm. 26.1.2006 Lic. Phil. Janne Harjula, Archaeology, University of Turku). The majority of shoes found in Turku have been made from cattle leather (Jokela 2002: 28), and are most likely of local production.

There seem to be some differences in craft activities between Åbo Akademi and Aboa Vetus through the centuries. Evidence for tannery or furrier activities was found at Åbo Akademi but not at Aboa Vetus. In both areas the frequency of horn cores seems to diminish through time. The most active crafts phase seems to be the phase 2 at Åbo Akademi, where the most clear, versatile and unequivocal signs of crafts are found.

6.2 Spatial and temporal differences

In Turku each phase seems to have a characteristic anatomical distribution pattern, representative of different species and age, sex and size data. Some of the patterns show changes from one phase to another, e.g. in relation to the size data of sheep. These trends can be found at both Åbo Akademi and Aboa Vetus. The patterns are related to large-scale changes in animal husbandry strategies in Turku and its surroundings. However some patterns are related to differences in the type of the deposits, such as the presence of craftsmanship activities.

The study shows that large-scale changes occurred in the utilisation of animal resources in Turku through the centuries. Several observations regarding species distribution, anatomical distribution, sex and size data show either an increase or a decrease through the centuries. However, even in such a large assemblage as the one included in this study, the quantitative analysis of e.g. the pathological changes between different phases, proved to be difficult. However, there does not seem to be any significant differences between the medieval and the post-medieval contexts. Similar types of pathologies are found in both periods.

The oldest phase, phase 1 at Åbo Akademi (though part of the material from phase 1 at Aboa Vetus is of an older date than phase 1 at Åbo Akademi), is characterised by the highest number of young cattle and old pigs. The sheep from this phase also exhibited the largest adult body size of the entire assemblage. Phase 2 at Åbo Akademi represents a rather “typical” medieval assemblage. Phase 3 at Åbo Akademi differs from the other phases due to the higher representation of goat as to sheep, and by the high frequency of high utility goat skeletal parts. Phase 1 at Aboa Vetus presented significant numbers of high utility cattle skeletal parts, but closely resembles the other medieval phases in some of the other features. Unfortunately, phase 3 at Aboa Vetus was small, and the material could be only be used for a small number of comparisons. However, no dramatic differences can be observed in the composition of the assemblage. This material includes the highest amounts of high utility body parts, young animals and a rather high frequency of male sheep.

Phase 2 at Aboa Vetus has the most deviating pattern. The bones originate from rather specific contexts or features. Some of the extraordinary features, such as those containing high numbers of complete skeletons have been discussed above, and this is partly due to the fact that this phase is made up of the material from the cellars at Aboa Vetus. Therefore, the contexts belonging to this phase were the most uniform and consistent of all the phases. It produced the highest number of small ungulates as compared to cattle (large ungulates), the greatest numbers of male cattle and pigs, the oldest cattle, but the youngest small bovids and pigs, and the smallest sheep. Thus, the contents of these cellars seem to include a large number of animals intended for meat production- young small bovids, male pigs and cattle. This material might represent a place where more specialised meat consumption took place, perhaps a wealthy household or tavern.

Some differences can be discerned between Åbo Akademi and Aboa Vetus. There are more small bovids at Aboa Vetus than at Åbo Akademi. This is probably at least partly due to the smaller sieve size used at Aboa Vetus; however it seems likely that the higher number of small bovids in Aboa Vetus is an actual difference. The medieval phases at Åbo Akademi contained some wolf and bear bones which were not found in phase 3 at Åbo Akademi or in any phases at Aboa Vetus. In a subsequent excavation at Aboa Vetus one third phalanx (claw) of a bear was found. It is most likely derived from a bear skin, and not from the preparation or consumption of a bear. The Åbo Akademi medieval phases contained horse bones, but the only one found at Aboa Vetus was from phase 2 (in KU 12, which was dug into K 94:12). The seal bones were concentrated in phase 3 of Åbo Akademi, but were also found in both the medieval and post-medieval layers at Aboa Vetus. There were also more carnivore chewing marks in the bones recovered at Åbo Akademi. This might reflect the more open and less controlled environment of Åbo Akademi when compared to that at Aboa Vetus.

There are some features common to all the medieval layers. The age distributions of all species in all phases resemble each other more closely than the age distributions in the post medieval phases. The pig sex ratios are similar in medieval phases of both Åbo Akademi and Aboa Vetus, i.e. with a dominance of males. There are also more female cattle in the medieval phases than in the one post medieval phase that produced enough material for comparative analysis. The amount of horn cores and cranial fragments of cattle, sheep and goat decreases through time at both Åbo Akademi and Aboa Vetus, with phase 3 exhibiting the lowest amounts. However, in Aboa Vetus phase 2 horn cores and cranial fragments (especially those of sheep) are still rather common. Generally, the amount of high utility skeletal parts increases through the centuries. This may indicate a more specialised use of animals or animal products. Bones relating to craftsmanship were not deposited among the household waste to the same extent, and meat was increasingly purchased in butchered cuts. In addition, the decreasing number of carnivore chewing marks from the medieval to the post-medieval period reflects a change in the control of the urban environment, with the access of dogs to refuse being more restricted. The changing pig age structure, showing less adult animals in post-medieval periods, could be related to more controlled pig breeding or more selective consumption. Perhaps pigs were bred in a more intensive and conscious way in the post-medieval period.

At Åbo Akademi changes through time in both animal consumption patterns and craftsmanship can be observed. Younger cattle meat seems to have held more favour in the older phases than in phase 3, while the consumption of younger sheep seems to increase in phase 3. There also seems to be a change in the role of goats, which became more important as meat animals in the latest phase. The importance of goat hides and horn cores as a raw material seems to decrease as the number of goat bones relating to these activities became scarce; however, this might be caused by the more controlled deposition of craft waste. In this area, the majority of craftsmanship observations come from phase 2. However, interpretations are complicated by the greater number of contexts in this phase. In phase 1 at Åbo Akademi only one context shows clear traces of craft activities, but in phase 3 this drops to none. According to the MAU-data, phase 3 at Åbo Akademi exhibits more high utility skeletal parts for small bovids especially, but also for cattle and pig. At Åbo Akademi there seems to be a decreasing trend in the disposal of cattle craniums and mandibles in the post-medieval period. The higher number of high utility skeletal parts could indicate more concentrated waste disposal and a less self-supporting pattern of meat consumption, when slaughtering and primary butchery were carried out at another location. However, the presence of slaughter waste indicates that part of the meat consumed was still raised or brought in as whole carcasses to the site. The low numbers of all horn cores in phase 3 indicates a change in the activities practiced at Åbo Akademi, shifting to a less professional use of animal resources and towards a higher dependence on imported meat, as seen in the more selective anatomical representation of all species.

At Aboa Vetus there seems to be similar changes in the pattern of cattle and sheep consumption. In addition, the importance of goat as a meat producer seems to increase in phase 2. Phase 2 at Aboa Vetus is contemporary to phase 3 at Åbo Akademi, where a similar change occurs. However, in the latest phase at Aboa Vetus goats seem to have lost their status as meat producers. As this phase dates partly to a later period than phase 3 at Åbo Akademi, it is possible that this reflects a more temporal rather than local trend. In phase 1 there is also a relatively high numbers of goats, but in this phase the finds were more related to craft activities. In phase 1 at Aboa Vetus high numbers of cattle high utility skeletal elements are present. In this area the number of small bovid high utility skeletal parts seems to be increasing towards the later periods. Cranium fragments of cattle and small bovids are abundant in phase 2 but scarce in phase 3. Phase 1 is the only phase at Aboa Vetus to show traces of craft activities, with high levels of horn cores. Horn cores derive from layers most likely deposited prior to the 15th century. They were found under structure R 25, with a dendrochronological date of AD 1400 at the latest (Zetterberg 1999).

This is contemporary (or even older) than phase 1 at Åbo Akademi, which shows little signs of horn working at that time.

What has created the differences between Åbo Akademi and Aboa Vetus? In the medieval phases the earliest signs of craft activities come from Aboa Vetus. It is possible that these activities were no longer practiced at Aboa Vetus in the 15th century, but without layers that could be precisely dated to this period it is difficult to interpret fully. R 19 U, which produced a large number of plenty of horn cores can only be broadly dated to pre 16th century. Moreover, the layers with horn cores have plenty of high utility skeletal parts. The stone and brick buildings were erected at Aboa Vetus in the late 14th century and first half of the 15th century, emphasising the prosperity of the area (Uotila 2003: 126-130). Phase 1 at Aboa Vetus, being partly older and partly contemporary with these buildings, shows a high proportion of cattle high utility skeletal parts. This could be the sign of a more specialised pattern of cattle utilisation, and perhaps indicates higher social status than Åbo Akademi. Phase 2 at Aboa Vetus also exhibits higher proportion of imported meat, perhaps also associated with a high social status or alternatively a specialised settlement. It seems that Aboa Vetus represents a more prosperous settlement than Åbo Akademi, which is characterized in the medieval period by craftsmanship activities.

6.3 Animals in Turku

6.3.1 Urban and rural production and consumption

To gain a picture of production and consumption of different animals inside and outside Turku, three different sources of information have been combined (figure 107). The abundance of the major domesticates was examined in three neighbouring parishes (Raisio, Maaria and Kaarina) of Turku through the silver tax rolls of 1571 (Oja 1944: 172; Oja 1946: 129; Oja 1960: 127). From Turku both osteological and written data is available. Here data from 1632 was chosen for comparative purposes, being the closest available list to the silver tax rolls. The osteological material does not cover both dates. The material from phase 2 at Åbo Akademi is older than the historical records while phase 2 at Aboa Vetus is probably a little younger. No osteological evidence is available from the farmsteads of Finland Proper: at present, excavations of the medieval or post-medieval farm sites in Finland are very rare. This is not a problem specific to Finland. The character of rural settlement is generally not well known. The historical sources are at the moment the only possible way to study the animals in the surrounding landscape.

6.3.2 Consumed cattle: age and sex structure

There are a number of different aspects to consider when interpreting the age and sex data from the cattle in the assemblage. As Vretemark (1997, 111-2) points out, the different bones represent different age categories. The pelvis is fused at approximately one year of age, while the metacarpus fuses at two and a half years of age. The measurable horn cores come from animals older than three years (Armitage 1982: 42). A deliberate culling of young male animals would lead to higher and higher proportions of female animals in every advancing age category, as is seen in Skara, Sweden (Vretemark 1997: 111). In Turku this seems to be the case in phases 1 and 2 at Åbo Akademi, but not in phase 2 at Aboa Vetus.

When interpreting the sex data the possibility of the different origin of the bones in question should be considered. As was described above, the horn cores, metapodials and pelves can derive from different activities: the former two from handicrafts and the latter from food processes. If the horn cores and the metacarpals derive from hides brought into town then the corresponding pelves are missing. If meat was brought to the site as readily cut pieces, then the low utility body parts as well as the metapodials and horn cores are missing.

Cattle provided most of the meat consumed in Turku. From the osteological material it is evident that the frequency of old cattle increased in Turku between the medieval and post-medieval periods. Animals under the age of two years are also rare in the medieval layers. Cattle aged between two and four years are more common in the medieval phases, where they represent up to half of the killed animals. In the post medieval phases these younger animals became uncommon. Elderly animals are rare at Åbo Akademi, but more common at Aboa Vetus. Thus, the consumption of meat from young cattle seems to decrease during the centuries. It is possible that cattle breeding in the Middle Ages was more targeted towards the breeding of young animals for the meat production only.

Historical sources which reveal information on cattle breeding strategies in the Middle Ages are almost absent. In post-medieval times the importance of manure, traction and milk is obvious. The arable field area in Finland Proper was increasing from the beginning of the 16th century, but it may be assumed that this was already happening prior to this date. The number of farms in Finland Proper nearly doubled between 1350 AD and 1540 AD (Nummela 2003: 142; Orrman 2003b: 84). Field cultivation required manure, and in areas of intensive field cultivation more cattle were kept than in other parts of the country (Nummela 2003: 155). According to some sources, the average number of cattle on individual farms in Finland Proper increased from three and half to five between 1543 and 1600, and the number of cattle was still rising in the 17th century (Nummela 2003: 154, 157). At the same time, the number of meadows was not increasing, and indeed the opposite is most likely true. A change in climate may have affected the availability of fodder. The 1490s saw the beginnings of a little Ice Age, characterised by long cold periods, and lasting into the late 17th century (Sartes & Uotila 1997: 124). This could have affected the productivity of the meadows and decreased the fodder available. Therefore a certain change in cattle breeding strategies should be expected. If more adult cattle were required for manure production and for traction as a result of increasing field cultivation, and there was no concurrent increase in fodder production, then less food resources were available for the young cattle kept only for meat production. Moreover, as the importance of adult cattle increased, a larger proportion of young cattle reached full maturity. It is likely that all the surplus calves that were not needed for stock renewal were slaughtered before their first winter. However, it seems that these animals did not reach Turku, as the mandibles of cattle under one year of age are scarce.

Another possibility for the changing age structure (in other words the increasing numbers of adult animals) for cattle through time in Turku could be a change in the meat purchasing system. As has been presented above, some of the inhabitants of Turku from the medieval period onwards owned farms outside the town and kept cattle, probably mainly milking cows, in the town as well. Because of the increasing professionalism of the tradesmen in Turku the town merchants and craftsmen (Nummela 2003: 157) probably increased the amount of meat they bought meat bought from professional meat mongers, reducing the number of cattle they raised themselves. This is to some extent supported by the increasing number of high utility anatomical parts in the material. The increase of male animals in the material from the medieval to the post-medieval period implies that a considerable proportion of the meat needed in Turku was obtained from adult oxen. In Sweden oxen were transported long distances for consumption during the late medieval period (Vretemark 2001, 47). The historical sources from 1729 mention an increase in the price of fattened bullocks or oxen (Fi: "syöttöhärkä"), which forced the slaughterers to raise the price of meat (Nikula 1971: 531-532). This supports the idea that in the post-medieval period male oxen were an important source of meat in Turku. However, the 18th century historical records, where only a small number of slaughterers in Turku are mentioned, do not support an interpretation that the inhabitants of Turku were relying solely on meat purchased from market. It seems that in the post medieval period animals were still kept in Turku, even if there were some changes in the meat purchasing system.

According to the historical sources draught oxen could have been used for traction from the age of 2-4 and onwards, with heifers also being utilised for this activity from the same age. Ethnological sources claim that draught oxen often reached the age of 8-12 (Vilkuna 1931: 27). Some Swedish sources claim that it was not unusual for a cow to reach the age of 14 (Björnhag 1998: 127). Cattle that had served for a long time in milk production or traction work, and of at least 8 years of age, would therefore be expected to be abundant in the osteological material. However, elderly animals, as indicated by closed spinal column epiphyses and extremely worn teeth, are relatively rare in Turku. Either the length of time cattle were used for milking or draught was short, or these older animals seldom reached the town.

The mild and uncommon pathologies found in the cattle metacarpals could be seen as signs of a relatively rapid circulation of draught animals. The pathologies found in cattle metapodials and phalanges are not very severe in the Turku material. Most of the phalanx 1 studied did not show any pathological changes, thus scoring 0 in the pathological index.

Only a few phalanges showed more advanced pathological changes. The distribution differs from other examined assemblages: the large amount of phalanges without pathological changes was observed in an assemblage of young modern Romanian bulls (De Cupere et al. 2000: 262). A sample from the medieval site of Koekelare, Belgium, which was interpreted as consisting of non-draught cattle, exhibited notably lower frequencies of phalanges with a pathological index of 0 (De Cupere et al. 2000: 262). Even if the number of pathology-free phalanges is higher in the Turku assemblage, three phalanges show higher pathological indices than in Koekelare. The different frequencies of the pathologies are unlikely to be caused by differences in age distribution. Both assemblages consist principally of adult animals. Another explanation for the rather mild pathologies could be the light nature of the traction work. Oxen were not especially useful in the winter or on slippery roads, and could get some rest during the wintertime when horses were used in their stead (Vilkuna 1931: 15-16).

Oxen destined for meat production could have been culled at a rather young age, following only a few years of draught use, which would ensure better quality meat: a similar pattern has been suggested by Bartosiewicz et al. (1997: 119) and Johannsen (2005: 47). In the parish of Maaria, Finland Proper 185 oxen and 63 "training oxen" were recorded in 1600 (Oja 1944: 174). If the training period did not last longer than one year, and the year in question represent typical year, the average oxen would spend four years in work: one as a trainee and three as a proper oxen. It seems likely that the old animals were not attractive for consumption purposes and therefore were not imported into Turku very often. It was younger adult animals, probably less suitable for traction or milking (for example barren, weak or ill- tempered animals) that were selected for the town markets.

6.3.3 Sheep breeding in the light of urban consumption waste

The age structure for sheep shows the dominance of two distinct age groups: one from approximately 1,5 years old animals and the other from adults, although the latter are not old animals. The later phases include more young animals than the earlier phases. Very few Elderly sheep mandibles are present in Turku. The quality of the mutton was better in animals not older than 4 years (Albarella 1997: 24) and it seems that only high quality meat was consumed in Turku. Some information about the age structure of the sheep stock is available from Kuusisto manor in 1557 (Hausen 1881). Here, 186 female sheep are reported, of which 33 are claimed to be "young". If the size of the stock was constant, then the whole flock would be renewed within a 4-5 year period. In Kuusisto manor this would give a somewhat higher average life expectation for the ewes than that demonstrated in the Turku osteological material.

All phases dated to the Middle Ages contained approximately 70% female and 30% male sheep. In Kuusisto manor in 1557 the proportion of live male and female animals was 34% adult males and 66% females (Hausen 1881). In the phases dating to the later periods there is a difference between the two excavation areas: at Åbo Akademi the proportion of female to male animals is the same; 70/30, but at Aboa Vetus there were more male animals; 45% on the basis of pelves. The Aboa Vetus material may represent more specialised consumption.

The age and sex structures for sheep indicate that sheep breeding in Turku's surroundings was not specialised towards one single goal. The high percentage of male animals in the living stock (see above) and the presence of castrates, imply that more male animals were kept than was necessary for reproduction: Ryder (1983a: 82) claims that 4 rams for each 100 ewes are required. Castrated sheep were used for meat and wool production. The culling of animals in their second autumn suggests that the meat was of primary interest; the absence of elderly animals may also be related to mutton quality. The historical sources claim that wool was also an important product; even if finer cloths required imported fine wool, in the cold Finnish climate there was a great need for coarser warm clothing in every household. Perhaps the culling of young animals not earlier than their second year was carried out in order to gain some additional wool from meat animals. Knowing the difficulties of winter feeding, the keeping of sheep for meat over one additional winter is otherwise difficult to understand, even if sheep could be fed with dried leaves, without (or with very little) hay. The milking of the ewes were probably not of great importance, otherwise additional males would have been slaughtered as lambs to concentrate all the winter feeding resources on females.

The present study has revealed that the size of sheep decreased in Turku between the Middle Ages and the post-medieval period. The reason for this change can be sought in the different utilisation of the sheep. The post-medieval phases include more young sheep than the medieval ones, and meat production possibly grew in importance in the 17th and 18th centuries. This, however, does not explain the body size decrease in the sheep. If mutton or lamb was the main sheep product main product of sheep, an increase in body size would be expected as larger animals would have been more attractive (Albarella 1997: 25). The decreasing size of sheep has been interpreted as a sign of the over grazing of meadows in Eketorp, Sweden (von den Driesch & Boessneck 1979: 106). In Sweden the size of sheep seems to diminish towards the north of the country and has been interpreted as a sign of less favourable feeding possibilities (Vretemark 1997: 132-136).

The explanation for the changes in culling age and size can perhaps be related to the growing importance of cattle in manure producing, and the difficulties in winter-feeding with scarce food resources. As has been shown above, the size of cattle did not diminish during the centuries in Turku. Perhaps the feeding resources were saved more specifically for cattle, with the sheep being increasingly neglected when it came to provision of hay and attention. The increasing number of young animals in the town material can possibly be explained by an increasing preference for lamb rather than young cattle, which were no longer being bred for meat production.

6.3.4 Goats as a part of the husbandry system

The importance of goats in Turku seems to vary in different contexts and phases. In some phases goats bones and horns were mainly utilised as a raw material. The consumption of goat meat seems to have risen in the post-medieval phases. According to the historical sources the number of goats in Turku was still low by the 17th century, although according to 18th century sources they were abundant shortly afterwards (see chapter 1). In the osteological material goats seem to become more abundant by the 17th century. This might be related to the difficulties in finding proper pasture for cows near the town. Some of the goat bones found in the town layers are likely to originate from female goats, kept for milk production. However, as it seems unlikely that adult male goats would have been specially bred in a town environment, it is likely that part of the bones, especially the horn cores and metapodials, are derived from animals raised in the countryside and transported to Turku.

As has been pointed out above, the role of goats in Finland has differed compared to the other domesticates. Goats were extremely rare in the Eastern parts of Finland, and their abundance varied locally in the rest of the country. Even their nomenclature is new and reflects prejudices towards the animals. The female goat, "kuttu" in Finnish, derives from the Swedish expression for female sexual organs. In addition, the names of male and young goats, "pukki" and "kili" are derived from Swedish (SSA 1992: 361,419, 455). The reasons as to why goats were not common in Eastern Finland have not been properly investigated. A cultural border divides Eastern and Western Finland, and these differences can be seen in agriculture by the early Middle Ages: the eastern area was the scene of slash-and-burn cultivation and while the western area saw field cultivation (Orrman 2003a: 91).

The large variation in the utilisation of goats in Finland Proper might be associated with animal husbandry and agricultural strategies. The most important animals were cattle and sheep. Most of the attention of animal breeding was concentrated on them. In addition, taxes claimed by the crown were tied to cattle and sheep. The limited keeping of goats might be related to the key role of butter production in animal husbandry. To what extent the sheep milking occurred is not known. Cow milk was important, not in and of itself but for the production of butter. Cheese was another milk product that was highly nutritious and could be stored for long periods (Ryder 1983b: 242). Cheese can be made as a by-product of butter- making from skimmed milk, but also from whole milk (Björnhag & Myrdal 1994: 82; Ryder 1983b: 242; Ränk 1966: 97). Cheese could be valued as highly as butter (Seppälä 2000: 119) and it could be used for paying different taxes (Seppälä 2000: 119; Vuorela 1975: 270). The production of butter and cheese from cattle was probably as competitive. Goat (and sheep) milk could be used for cheese making without skimming (Grotenfelt 1922: 23; Laurikkala 1953: 38; Ränk 1966: 93-96). Goat cheese could complement cheese made from skimmed cows milk because of the higher fat content. In addition, there would be no need to use whole cow milk for cheese making, as it could be saved for the production of valuable butter. As Tornberg (1973: 63) points out, goat keeping in the 17th century was concentrated in areas where animal husbandry played an important role in subsistence. Cheese making with curling has been practiced in Finland Proper, Åland, Satakunta and Ostrobothnia (Talve 1973: 92). In these areas, except in Ostrobothnia, goats were also kept. In Ostrobothnia there were good pastures and as a result the potential to produce plenty of milk without using goats. It is difficult to estimate whether goat keeping and cheese making with curling in the agricultural system of Western Finland had a connection or if they were indirectly linked. Goats in rural Finland Proper seem to have been animals kept in specialised farms or areas for cheese, but also in order to gain buck- skins for sale. Goats were later considered as "poor man's cows", and their keeping was associated with an inability to keep cows (see chapter 1).

6.3.5 Pig consumption

Pigs were kept for one main purpose only, to produce meat. However, pigs could also have been utilised for their skin: some pieces of pig leather have been found in Turku (Jokela 2002: 27), so evidently pigs were at least occasionally skinned. Some rare deciduous forests in Southern Finland could have had a local importance for pig husbandry, such as the island of Ruissalo in the Turku archipelago. Apart from this, there are no other large deciduous woods in Finland with the capability to support pig herds as existed in more southerly parts of Europe (Myrdal & Söderberg 1991: 88).

Pigs did not usually reach an old age in Turku. Most of the slaughtered animals were less than two years of age. However, the meat of immature animals was consumed rarely, if at all, and many of the animals less of than one year of age are most likely derived from piglets that perished in diseases or accidents rather than from food waste. The proportion of adult animals is higher in the medieval deposits than in the post medieval ones. Åbo Akademi seems to represent a self-sufficient pig-raising system, where parts of the animals were slaughtered when they reached a suitable weight, and part were saved a spared until a slightly older age to assist in reproduction. Aboa Vetus seems to exhibit a more concentrated kill-off pattern, perhaps due to a more focused and purpose-oriented utilisation of pigs.

The amount of human control over pig breeding in Turku probably varied. Pigs can breed at any time of the year and this has apparently happened in Finland (see chapter 1, also Lauwerier 1983). The presence of pig houses proves that some control and shelter was offered to them. An almost semi-feral life for pigs in the Finnish countryside, even spending the winter outside, is still being described in the ethnographic sources of the 19th century (Virtanen 1927). However, in the Finnish climate, the breeding of pigs all year round would have presented some problems, if additional shelter and fodder for piglets and the sow would not have been provided (Virtanen 1927: 72).

The pigs ran free to some extent in the town, and the females may have occasionally sought their own place to farrow. In archaeological excavations at the City Library site in Turku in 2004 the skeleton of a young sow was found under the floor of a wooden building (Tuovinen & työryhmä 2006). It was excavated carefully, and the remains of four piglets were found in its abdominal area. One of the piglets was situated in the sow's pelvic area. The sow had possibly made a nest under this building but died in labour. It is also possible that it had been discarded under the building after death, however the latter seems an impractical solution and is unlikely. The abundance of skeleton piglets found in the town layers indicates that many piglets were born and died, possibly partly because of the lack of human interest in their welfare and safety. In one approximately half-year-old piglet skeleton found at Aboa Vetus, a broken rib and a vertebra were noticed. These injuries were healing at the animals time of death.

The cellars at Aboa Vetus (phase 2) contained an impressive collection of more or less whole pig skeletons. At least two subadult animals, three juvenile ones and seven infant animals had been buried in the cellars. Assuming that the bones of individuals are not spread among different cellars, potentially up to five juvenile and ten infant animals are present. These bones are most likely derived from animals that had died due to either diseases or accidents. Animal diseases plagued the town as well as the countryside, and pigs were certainly among the affected animals (Indrenius 1753: 15; Tornberg 1973: 91-92). It is uncertain if the pigs that ended up in these layers died and were deposited over a long or short period of time. However, some of the animals share common osteological characters, which suggest that they might have been related. In a pigs distal humerus there is usually a natural hole called the *foramen supratrochleare.* It is present in most of the pig humeri found in Turku, but it is absent in both the humeri of the two subadult pig skeletons from the Aboa Vetus cellars, as well as in one of the young piglets. At least two of the infant humeri lack this trait, and two had only very small holes (figure 108). Usually this hole is well developed and already present in infancy. The possible genetic origin of this trait is interesting, and may be an indication that the pigs were related. The animals could be derived from one pig herd, perhaps perishing together in an epidemic. However, the animals are not derived from one concentrated spot, but are spread over different parts of the cellars. Therefore they are more likely to derive from animals discarded into the cellars by the same household (or at least from a closely related population) over several different events.

The age profile for the pigs in phase 2 at Aboa Vetus displaying a large number of young animals, indicates a slaughter pattern typical of specialised consumption. However, the presence of infant and juvenile skeletons indicates pig breeding on the site. Therefore it is possible that the household waste and buried skeletons derive from different sources.

6.3.6 Horses outside consumption

The main reason for the scarcity of horse bones is that horseflesh was not consumed in either medieval or post-medieval Turku. The Catholic Church did not allow horsemeat to be consumed (Egart 1962: 109). There are signs of horseflesh consumption in Finland in earlier periods (Mannermaa 2002: 4-5; Tupala 1999: 47-49). However, there are no signs of horsemeat consumption in medieval or post-medieval Turku. Horse bones are scarce and the bones found derive mostly from the cranium and metapodials, which might be associated with craft activities (Tourunen 2005). Actions taken by 'enlightened' 18th century citizens to remove the inhabitants prejudice towards horsemeat met with little success (Egart 1962: 41-58; Tornberg 1973: 57-58). Indeed, individuals involved in the slaughter and skinning of horses, cats and dogs were also regarded with prejudice in Finland (Egart 1962: 1; Vilkuna 1935: 190). These "rakkarit" (Sw: rackaren) were hated and feared, and plates and cups used by them were even burned or thrown away (Vilkuna 1935: 159-160). In 1674 in Masku one man was adjudged not to be a valid witness in court, because he had skinned dogs and cats (Vilkuna 1935: 160).

6.3.7 Cats in Turku

Cats are seldom mentioned in the historical documents. In 1680 furriers charged two women for performing illegal craftsmanship with furs (Ranta 1975: 439). However, when the caps in question were examined in the court, they proved to be made of cat and sealskins. As these skins were not included in the furriers privileges, the women were cleared of the charges.

The primary function of cats in Turku was most probably controlling the number of rodents, although this activity is not mentioned in the historical sources and can only be indirectly interpreted from the bone material. Cats were also utilised in other ways. In the previously cited court report, the use of cats as fur animals is indicated. The evidence from the osteological material supports this usage. Cats were probably skinned occasionally and not specially bred for this purpose. The presence of a worked femur proves that the inhabitants saw cat bones as a source of raw material and were evidently aware of the anatomical properties of the cat skeleton. No butchery marks were found on cat bones from Turku, and there seems to be no reason to expect that these animals were consumed (Luff & Moreno 1995). There is no mention of cats serving as pets in the historical sources, and it is possible that these cats lived a semi- feral life rather than being 'owned' by individuals (cf. Thomas 2005: 59).

6.3.8 Dogs in Turku

Remarks on dogs are not abundant in the historical sources. Where dogs are mentioned in the documents, they are usually commented upon as an aside, for example when describing hunting or dog equipment (Alhonen et al. 1996: 197; BFH III: 304; FMU II: 1482; Utdrag ur Åbo Stads Dombok 1635: 3; Melander 1920: 8). Dogs and pigs are sometimes found together in the documents because of the freedom and food they shared (Utdrag ur Åbo Stads Dombok 1626-32: 34; Ruuth 1923: 176). Dog skinning and dog skins are mentioned in some documents (e.g. Vilkuna 1935: 160). The outer appearance of dogs is mentioned only few times and even then the description is superficial. In a document from the 18th century all the loose dogs, "both small and big ones" in Turku were ordered to be shot in order to prevent the transmission of the plague (Suolahti 1991: 299). Ulrik Rudenschöld (1738-41: 154-155) described the dogs in Central Finland as, being used for herding in the summer and hunting during the winter.

Dogs were evidently skinned and perhaps even butchered in Turku. This was also the case with the wolves found at Åbo Akademi. The historical sources also report dog skinning, but no references to the butchering of these animals can be found. In other medieval zooarchaeological assemblages butchered dogs have been interpreted as indications of dog meat consumption, with their meat being used to feed other dogs or even the use of dog fat for cosmetic purposes (Albarella 1999: 873), although no evidence for this is available from Finland.

What was the relationship between humans and dogs in Turku? We know from historical sources that dogs had an important role in hunting and herding, and it seems logical to assume that they were used for guarding as well. However, the occasional use of dogs for food in Turku cannot be ruled out. This use could be related to exceptional circumstances, such war or famine. However, dog consumption was not common and it was not a part of the normal diet.

It is evident that different kinds of dogs were present in Turku. Short-legged individuals are present from both medieval and post-medieval periods. The degree to which dogs were bred and their reproduction controlled is unclear. The presence of different size classes indicates that some breeding control was most likely practiced.

There is not much data available highlighting contemporary peoples attitudes towards dogs. However, some observations are of interest. Dogs are never mentioned in estate inventories, not even when animals of very small value like hens are listed (Oulun perunkirjoituksia). They were evidently not seen as the same kind of property as horses or cattle. Furthermore, the skeleton of a limping short-legged dog from Aboa Vetus shows that at least occasionally unfit animals were kept alive.

6.3.9 The importance of wild mammal resources in Turku

Wild mammals were of limited importance in term of consumption, craftsmanship or trade in Turku. Some furs and skins were exported from Turku, and this type of trade was probably of greater importance in the early Middle Ages than during the later periods (Kallioinen 2000: 189-190). The osteological finds do not bear much evidence that furs would have been prepared in Turku, the only possible exception to this being the squirrel. Neither the antlers or bones of wild mammals were utilised for large scale artefact manufacture. However it has to be remembered that evidence for such activities may yet be discovered in other parts of Turku. The seal was probably the most important wild mammals for merchants in Turku, being a source of train oil which they purchased from the archipelago (cf. Grotenfelt 1887: 32-33).

Most of the wild species identified in Turku probably lived near the town. Bears and wolves were still living close to human habitation areas in SW Finland in the 18th century in SW Finland. The absence of other fur-bearing carnivores indicate that hunting for furs was no longer an important form of subsistence, at least for the city dwellers, with the same being true for fur preparation. The main reason for the hunting of bear and wolf was the protection of domestic animals, and wolf or bear bones are not likely to be transported over a long distance or related to trade (even if the possibility that the origin of the wolf remains is connected with trade is suggested by Pluskowski 2006: 289-290). The inhabitants of Turku, who owned cattle and pastured them in the neighbouring parishes, were surely interested in keeping the number of such carnivores down. As the wolves were probably not consumed, the wolf carcases may have had both a ritual and practical function, because they were deliberately brought into the town and not skinned at the hunting place. Evidently wolf carcasses were cut up into pieces (cf. dog butchering). Perhaps the carcasses of such feared beasts were eagerly paraded by the hunters (cf. posing of modern hunters with their prey).

Hare meat probably formed a regular but rare proportion of the total meat consumption in Turku. Some of these animals might have been hunted by the city dwellers themselves, while others were brought to the town by local villagers. The regular occurrence of hare bones indicates that the acquisition of hare was not difficult, nor was it limited to certain sections of the population.

Apparently, the townsmen in Turku had vibrant contacts with the surrounding areas. Forest birds have been identified in Turku and these, as with some of the hare carcasses, could have been brought to the town by local villagers. The absence of elk and forest reindeer bones indicates that these animals were not part of the local fauna during this period, and that they were not imported from greater distances either. Sea bird and seals show that the inhabitants of Turku also had contacts with the coastal area and archipelago. These birds and seal flesh could also have come to Turku via local trade routes.

6.4 Animal utilization in Turku compared to other locations

6.4.1 Consumption patterns

All the evidence indicates that cattle were important in animal husbandry in Turku from the Middle Ages up to the 19th century. Especially, when taking into consideration the larger size of cattle carcasses when compared to that of sheep, the second most common species, the superiority of cattle meat consumption is clear even in those phases where sheep bones are more abundant. Pig is less abundant in the material than either cattle or sheep and their importance for subsistence was probably constant, though modest. In Turku goat bones are far rarer than those of cattle, sheep and pigs. Even if some of the goat bones have ended up in the 'sheep or goat' category and cannot be separated from the sheep specimens, goats were not abundant in the material. Most of the identified goat bones come from low utility body parts, but some amount of goat meat was also consumed. Wild species were of only minor importance for the consumption patterns in Turku.

The pattern of animal utilisation observed in Turku can be compared to several other assemblages from Finland, Sweden and Estonia. There are not many other zooarchaeological studies to use for comparative purposed in Finland, and those that are available are rather small (see chapter 1). However, some information regarding consumption patterns can be found from the towns of Pori, Helsinki, Tornio and Oulu (Puputti 2005; Puputti 2006; Tourunen 2000a; Tourunen 2000b). Pori and Helsinki are situated in Southern Finland within approximately 150 km of Turku, while Tornio and Oulu are located in Northern Finland. All the available material dates to the post-medieval period (16th-19th century). There are also some previous osteological studies from Turku (Peltonen 2002; Poutiainen 1999; Tourunen 2002; Vuorisalo & Virtanen 1985). In Helsinki the remains of the recovered building probably belonged to a merchant (Niukkanen 2002:21) but for the rest of the urban sites the social status of the unit is unknown. Some assemblages have been analysed from ecclesiastical contexts. Medieval material from the Bishop's castle in Kuusisto and medieval and post-medieval material from Franciscan Friary in Kökar have been analysed (Fisher 1996: Mutikainen 1989). Both are situated in a maritime environment in Finland Proper, with Kuusisto castle in a coastal area and Kökar Friary in the outer archipelago. The bone material from Kökar and Kuusisto represent large entities that obtained their meat partly from their own production and partly via tithes, taxes or purchase (cf. Fisher 1996: 61-62, 69). A large collection of cattle metapodials have been analysed from the manor of Suitia, Siuntio, dating to the early 16th century (Tourunen 2001).

In Sweden three large town assemblages were used for comparison, namely the medieval materials from Lund and Skara and the Viking Age material from Birka (Ekman 1973; Vretemark 1997; Wigh 2001). The material from Skara derives from six different excavation areas, both from the central and more remote areas of Skara (Vretemark 1997: 22). However, the Skara assemblage is treated as one entity although some age is data is presented separately from the two different areas. The sample from Birka was selected randomly from the total amount of material (Wigh 2001: 39). Craft activities like bronze casting and mercantile activities were practiced on this site during the different phases (Wigh 2001: 26-27). The material from Lund is also derived from two excavation areas, but these are of unknown social status (Ekman 1973: 10). From Estonia two medieval urban sites, situated in the towns of Pärnu and Tartu, were available for comparison (Maldre 1997 a & b). No detailed information about the contexts of these sites was available.

6.4.1.1 Finland

In all the materials used for comparative purposes domesticates dominate the assemblage and wild species are in minority. However, some differences can be observed in the wild fauna between the assemblages from Southern and Northern Finland. In Oulu and Tornio there are more wild mammals, and fox, seal and hare specimens are more abundant (Puputti 2005: 78; Puputti 2006: 19). In Tornio reindeer are also present (Puputti 2006: 19). Also in the bird material wild birds dominate over the domestic chicken (Puputti 2006: 19). The material from the Friary of Kökar, Finland Proper forms an exception to this pattern as seal bones were found in abundance (Fisher 1996: 77). This reflects the importance of seal hunting in the archipelago (Fisher 1996: 68-69). The two ecclesiastical sites also included one species not identified in the other assemblages: roe deer (Fisher 1996: 34; Mutikainen 1989: 11). As this species is likely to have been imported onto both sites (Fisher 1996: 72-73, see also chapter 4.7.3), the presence of roe deer reflects different trade or social connections than those found in the urban environments.

In all the assemblages cattle were the most abundant animal (NISP), followed by small ungulates and pig (figure 109) (Fisher 1996; Mutikainen 1989; Puputti 2005: 79; Puputti 2006: 19; Tourunen 2000a: 6; Tourunen 2000b: 3). The importance of pigs for subsistence seems to be higher in the small towns of Southern Finland (Pori and Helsinki) than in Turku or in Northern Finland. Goat is absent from Oulu and Tornio (Puputti 2005: 79; Puputti 2006: 21). In Pori there were a few goat bones and of these, most were from low utility anatomical parts (Tourunen 2000a: 25). In Helsinki goats formed 24% of sheep and goat specimens and 69% of the goat specimens derive from high utility anatomical parts (Tourunen 2000b: taulukko 13). Goat bones were also identified in Kökar and in Kuusisto. In Kökar only horn cores, crania and mandibles (milk teeth) were identified to species, so the role of goats as a meat animal is unknown (Fisher 1996: 14). In Kuusisto part of the goat bones were derived from high utility skeletal parts (Mutikainen 1989).

Comparisons of age and sex data and thus the overall animal exploitation pattern are difficult due to the small analysed samples. In Pori there are plenty of older cattle as is the case with the post-medieval deposits in Turku (Tourunen 2000a: 11). In Helsinki there seems to be more young cattle, especially when one concentrates on the mandibles, but the small bovid data is more difficult to interpret. However it seems that there are more young small bovids than in the medieval phases at Turku (Tourunen 2000b: kuva 6, 8). Most of the cattle were identified as females but in small bovids the distribution is more even between the different sexes (Tourunen 2000b: 5). In Tornio the cattle age pattern more closely resembles that of medieval Turku as opposed to post- medieval Turku, with more young cattle and older sheep (Puputti 2006: 20). In this assemblage the female cattle and sheep dominate (Puputti 2006: 18, 21). In Kökar the medieval and post-medieval age data have been combined. In this site most of the consumed cattle and sheep or goats were subadults and young adults, with mature animals being rare (Fisher 1996: 62-64). In contrast to Kökar, the cattle and small bovid bones from the Kuusisto castle assemblage are principally derived from mature animals derives mostly from mature animals (Mutikainen 1989).

In all the assemblages cattle is the most abundant animal. This is likely to reflect not only the consumption patterns but the importance of cattle for crop cultivation and milk production in Southern Finland, and for milk production in the Northern Finland. This is also emphasised by the written sources. The higher number of pigs in Pori and Helsinki compared to Turku might be related to differences in social status and thus consumption patterns, but might also reflect, perhaps more plausibly that intensive pig breeding was practiced in smaller towns. The role of goat varies in different materials and is difficult to evaluate. In Helsinki goats seem to have been used for meat to some extent, a similar pattern to that seen in post medieval Turku. However, this is not the case in Pori. These differences might be related to differing social status between the sites, or of a different role for goats in Turku and Pori.

It seems that other areas of Finland did not necessarily experience a similar change in animal consumption patterns as is evidenced in the Turku material. At the very least any such changes did not appear at the same time as in Turku, i.e. between the medieval and post medieval periods. In the comparative sample only Pori exhibits more old cattle than Turku. The consumption patterns in Oulu, Tornio and Helsinki more closely resemble that of medieval Turku, with younger cattle, older sheep and a female dominance in the assemblage. However, in Helsinki there are more young small bovids and more males, indicating the importance for meat consumption of small bovids. This difference might be related to the more advanced stage of urbanisation in Turku and Pori when compared to other towns. However, the variations might also reflect different animal husbandry patterns practiced in different areas of Finland; Helsinki, Oulu and Tornio were situated outside the draught oxen area cattle breeding in Northern Finland might also have been slightly different, with the animals less bound to field cultivation.

In Northern Finland the importance of wild fauna was more pronounced than in Southern Finland. This difference is likely to reflect the greater importance of hunting and more abundant wild resources. Moreover, the urban dwellers in Northern Finland might also have had stronger contacts with hunters or may even have hunted themselves. The non-urban sites of Kuusisto and Kökar do not differ to any great extent from the urban assemblages, as they have the same main species; cattle, small bovids and pig. However, the high number of young animals consumed in Kökar is exceptional. Whether this principally reflects the cattle breeding strategies in the archipelago, social differences or different patterns of meat purchasing (e.g. via tithes) is unclear: a combination of these factors seems likely. The presence of roe deer in both Kökar and Kuusisto indicates the different status of these sites compared to urban sites.

6.4.1.2 Sweden and Estonia

All the assemblages from Sweden and Estonia consist mostly of domestic animals. In Lund cattle is the most abundant animal followed by pig and small ungulates (counted from NISP) (Ekman 1973: 79). In Skara cattle is the most common domesticate followed by pigs and small bovids. In the earlier periods pig is the second most abundant animal but in the latest phases small bovids become the second most common group (Vretemark 1997: 67). At Birka the situation is more complex. The earlier phases are dominated by small bovids and pig, while the later periods are dominated by cattle and pigs (Wigh 2001: 56). Cattle also seem to be the most important animal in Estonia, followed either by small bovids (Pärnu) or by pigs (Tartu) (Maldre 1997 a; Maldre 1997 b).

In Sweden older cattle (over 4 years of age) are the most common age group found in medieval towns while young animals are scarce (Ekman 1973: 16; Vretemark 1997: 85-87; also Viking age Birka, Wigh 2001: 62). These figures resemble the age structures found in post-medieval Turku. The Swedish medieval urban assemblages contain more young small bovids than medieval Turku (Ekman 1973: 27; Vretemark 1997: 88-90; also Viking age Birka, Wigh 2001: 90). Skara and Birka show a clear dominance of female cattle, but in Lund there seem to be only slightly more females than male cattle (Ekman 1973: 16-18; Vretemark 1997: 111; Wigh 2001: 69). There are some differences in the sex distribution for small bovids in the assemblages: females dominate in Skara while the distribution is more even in Lund and Birka (Ekman 1973: 93; Vretemark 1997: 116-117; Wigh 2001: 90-91).

In Pärnu there are plenty of cattle over 3 years of age and in Tartu there are more young cattle than in Turku (Maldre 1997 a; Maldre 1997 b). The age profile for small ungulates indicates the presence of young animals in Tartu. In Tartu older cattle dominate in the material which derives from cesspits (Maldre 1997 a tai b) but in Pärnu older small bovids dominate the sample (Maldre 1997 a; Maldre 1997 b).

There are not many studies concerning the importance of goats as meat producers, partly because of the identification of goats only by their horn cores and metapodials relating to crafts activities (Ekman 1973: 25; Vretemark 1997: 76). In Birka, where high utility skeletal parts are also used for identification, goats seem to be rare in general with only few high utility skeletal parts being found (Wigh 2001: 84-86). In Pärnu, 32 % of the sheep and goat specimens belong to goats, but the identified elements are not mentioned (Maldre 1997: 111).

It seems that cattle were of great importance for consumption as well as the economy of these Swedish and Estonian towns. Pork appears to be more important in the Swedish assemblages than the Finnish ones. This might indicate a difference in social status. However, it is more likely that this reflects a more suitable environment for pig breeding in the more southerly area.

6.4.2 Discussion

Western Finland represents the North-East corner of the West European Cultivation system (see chapter 1). Therefore similarities (but also differences) between animal husbandry strategies and consumption patterns in Turku and the rest of Central- and Northern Europe should be expected. Indeed, the importance of cattle is also obvious in Swedish and Estonian assemblages. Cattle were also important animals when it came to urban consumption patterns in Northern and Middle Europe during the medieval period followed by either pig or sheep (Benecke 1994: 208-211). The medieval period in these areas is defined as covering the 7th century to the 16th century (Benecke 1994: 182). In the early Middle Ages (7th-10th century) pig becomes a more important meat animal in the urban economy, but by the 14th-16th centuries cattle had become the dominant species (Benecke 1994: 195, 207).

There seems to be two possible factors which affected cattle abundance in Northern Europe. It seems that in the assemblages the number of cattle increases from the Viking age through to the medieval deposits and on into the post-medieval period. In Birka the proportion of cattle increases from the earlier phases to the later ones and in medieval towns the proportion of cattle also seems to increase through time (Vretemark 1997: 74-75; Wigh 2001: 100-101). This might reflect either a change in the agricultural system or in consumption patterns, possibly due to the advancing urbanisation process. In the late Iron Age / Early medieval rural site of Mulli in Raisio and in the late Iron Age site of Kohagen on the Åland Islands the sheep or goat are the dominant species followed by cattle (Storå & Lõugas 2005, 96-97; Tupala 1999:47), in contrast to the cattle dominated medieval Turku. However, sometimes urban sites exhibit a different species distribution pattern than the surrounding landscape (e.g. Landon 1997: 54-55). There is also the possibility that cattle grew more important in Finland Proper during the early medieval period. There does not seem to be any significant changes in the proportion of cattle from the medieval to the post-medieval period in Turku.

Apart from the alterations through the centuries, another pattern observed is the higher proportions of cattle in more Northern regions. As all the other assemblages from Finland apart from Turku are post-medieval, and all the assemblages used for comparison from Sweden and Estonia are medieval or older, the effect of time and location cannot be properly investigated. However, the difference might be due to adaptations forced on agricultural practice due to the harsh conditions in more northerly climes. In more northerly and more sparsely populated areas the winter-feeding of cattle was probably easier, even if the animals had to be kept stalled for a longer period of time.

The consumption of older cattle and younger sheep seems to be occurring in Swedish towns by the Viking age and medieval period. Similar patterns do not emerge in Turku until the post medieval period (figures 110 and 111). The age distribution in Northern and Central European urban assemblages indicate that adult cattle and young sheep were the most regularly consumed (Benecke 1994: 208, 211). Unfortunately no osteological assemblages from farmsteads in Finland can be used for a detailed urban-rural or production/consumption comparison. As Vretemark (1997: 86-87) points out, there is a difference in the age structure of cattle and sheep in urban and rural contexts in Sweden. In rural assemblages a more even age distribution of cattle is seen- thus more young cattle are present than in the urban assemblages. The cattle age structure of medieval phases in Turku seems to fall between the rural and urban patterns evident in Sweden. This might indicate that the urbanisation process had not proceeded as far in Turku as in the Swedish towns.

According to Benecke (1994: 207) the reason for the increasing number of cattle in the Middle Ages is a result of the higher importance placed on crop cultivation for subsistence. A similar cause is most likely responsible for the dominance of cattle in Turku. Intensification in cultivation increased the number of cattle in Finland, but as discussed earlier this probably caused a shortage of fodder. The written sources support view that increasing numbers of cattle were being bred in Finland Proper, at least during the 16th century (Nummela 2003: 154, 157). A similar change has been suggested in Sweden between 1350 AD – 1450 AD, when the number of cattle per person rose and less fodder per cow was available (Sten 1994: 39). The proportion of cattle does not increase in the urban environment of Turku between the medieval and post-medieval periods even though the number of cattle being bred in the rural area probably rose. However, such an increase would be difficult to estimate on the basis of osteological finds. The higher numbers of cattle available might have affected the urban environments consumption patterns by increasing the consumption of selected oxen, rather that as a result of an increase in the overall number of cattle consumed. Cattle meat in Turku probably arrived more often as butchered pieces, as is indicated by the higher numbers of high utility skeletal elements of cattle in the post-medieval phases. It is therefore possible that the NISP comparisons fail to reveal the increasing levels of cattle consumption; the same amount of meat produced less bone waste as the low utility elements were not deposited in the town layers.

6.5 Local adaptations

Comparisons of different breeding strategies in the assemblages in Finland and Sweden are difficult due to the small size of the studied materials and thus a lack of sufficient levels of comparative data.

6.5.1 Cattle

The metrical data indicates that there is no discernible change in the size of cattle from Turku between the medieval and post medieval period. The mean withers height of cows was approximately 106 cm (with a variation between the different phases of 106,5 cm - 104,3 cm). Two other studies from Finnish osteological assemblages have yielded enough measurements to allow comparison. In the large body of material from Åbo Akademi examined earlier (the dating of which corresponds to ÅA phase 1 in this study) the average withers height of cows was 105 cm (Tourunen 2002a: 53). Another large assemblage from the manor of Suitia in Siuntio (dating to the first half of the 16th century) gives an average withers height for cows of 102 cm (Tourunen 2001: 7).

Compared to Swedish cattle from the same time period these values would appear to represent animals of medium height (Sten 1994). It should be noted that different factors have been used to obtain the withers heights estimates in Sten's (1994) study. The effect is minor, but in her study the resulting withers heights are slightly greater. Vretemark (1997) does not give withers heights for cattle. However, the average greatest lateral length for the talus is in the Skara material 58-60 mm (Vretemark 1997: 127), and 56-59 mm in Turku depending on the phase. The average withers height of cows in Birka is 110,5 cm (Wigh 2001: 75). In addition, the male withers heights seem to be constant in Turku, at approximately 108 cm. This corresponds well with the withers heights of Swedish bulls, while Swedish oxen seem to be taller (Sten 1994: 44-45). Fock's (1966) factor for oxen, used by Sten (1994), gives slightly smaller withers heights estimates than that produced by Matolsci’s (1970) formula, which was used for the present study. The average male withers heights in Turku the average withers heights for bulls in Turku is 107cm when Fock’s formula is applied.

In Estonia the withers heights for cattle in the Middle Ages varied between 100-120 cm (Maldre 2003: 166). In Pärnu the average withers height was 104 cm for cows, and 107 cm for bulls and oxen (Maldre 1997: 108). Fock's (1966) formula was used in this study.

Cattle grew larger in England from the 15th century onwards (Albarella 1997: 19-21), with the same occurring in Germany during the Middle Ages (Benecke 1994: 218; Doll 2003: 55). In Sweden the withers heights of cattle was decreasing until the 15th century, when a possible turn towards taller animals took place (Myrdal 1999: 136). In Turku no such change in cattle size seems to occur.

Cattle horn lengths seems to be rather similar in Turku, Skara and Pärnu, with short horns (96-150mm long) being the most abundant (Vretemark 1997: 104, 130; Maldre 1997 a: 108). This also seems to be the case with the Swedish medieval material generally (Vretemark 1997: 130-131), but in the Birka material (dating to an earlier period), longer horns were observed (Wigh 2001: 73). There are few polled animals in medieval Sweden, with only isolated finds being discovered (Vretemark 1997: 130). Von Linné (1732: 38,43) mentions some (naturally) polled cattle in Middle Sweden, in Ångermanland. In the Oulu estate inventory lists (145) one polled white cow is present. Polled cattle were obviously not common before the 19th- 20th centuries. The lack of clear differences may be related to the lack of selective breeding. However, it is possible that horn types were not a major consideration for breeders at this time.

6.5.2 Sheep and goat

Unlike cattle, there seems to be a change in the withers heights of sheep in Turku from an average of 58 cm in the medieval period to 54 cm in the post-medieval period. The variation in average withers heights from other Finnish assemblages is 56,4 cm (Kuusisto castle, medieval, n=3) to 60,7 cm (Old Great Market Turku, 1275-1330, n = 11) (Mutikainen 1989: 20,30; Poutiainen 1999: 78). The average withers height in Sweden was a little higher, 59-61 cm in the medieval period and 57 cm in the post-medieval period (Sten 1994: 46). In Birka the average withers heights of sheep was 62 cm (Wigh 2001: 95). In Eastern Sweden sheep withers heights were decreasing from the late Iron Age to the early medieval period (Sten 1994: 40). In Estonia the withers height was approximately 60 cm in both prehistoric and medieval sheep (Maldre 2003: 167). In Pärnu the average 14th- 15th century sheep withers height was 58,2 cm (Maldre 1997: 113). Finnish sheep seem to have been of a similar size or a little smaller than the sheep found in neighbouring areas. In Sweden the size of sheep diminished from south to north (Vretemark 1997: 134-136). The smaller size of Finnish sheep compared to the more southerly regions might be related to environmental factors, affecting the most profitable size of animals compared to the natural resources available.

The body size of sheep was increasing in the post-medieval period in England, a trend which reach its peak in the early 19th century (Albarella 1997: 19-21; O'Connor 1995: 89). However, it is not until the 19th century that sheep became more robust, indicating breeding favouring meat production (O'Connor 1995: 90). The case is more complex in Central Europe, with very diverse types of sheep being observed in different regions, although during the Middle Ages at some regions display a decrease in the withers heights (Benecke 1994: 221).

Sheep horn shape varied a lot in neighbouring areas. In Sweden there is strong variation in the Middle Ages: in some assemblages both ewes and rams are usually horned while in others both sexes were usually polled (Vretemark 1997: 136). This has been interpreted as an indicator of the development of regional breeds (Vretemark 1997: 137). In Estonia ewes were usually hornless and rams horned (Maldre 2003: 167). In Turku both polled and horned ewes were present, with the rams being horned.

Due to the scarcity of goat bones in the excavations, no proper information relating to the size of the goats in neighbouring areas exists. In Birka, Sweden, one goat with a withers height of 64,5 cm was discovered, although only one bone was measurable (Wigh 2000: 96). The absence of measurable goat bones might be related to a lack of skin working activities. It is also possible that the metacarpals are those of young goats.

6.5.3 Pig

Wild boar was apparently not indigenous to Finland, unlike in Sweden and in Estonia (Lepiksaar 1986: 58; Ukkonen 2001: 26). In Sweden wild boar had become locally extinct by the 12th -13th century, but it probably persisted in some regions until the 17th century (Vretemark 1997: 140-141). The larger animals found in some Swedish osteological assemblages have been interpreted as wild boars or bastards, i.e. crosses between wild and domesticated stock (Vretemark 1997: 140-141). No signs of wild boar have been found in Turku. The pig bones are all rather small and no diverging values have been noted.

In Turku the withers heights of pigs ranged between 62 cm and 80 cm. This is approximately similar to the remains from 11th century Lund, but some larger pigs were also found there found (Ekman 1972: 23). Modern wild boar exhibits a withers heights of 85-100 cm, or 110 cm (Siivonen & Sulkava 1999: 185). In Sweden the size of the pigs decreased (at least in Eastern Central Sweden) during the 12th -13th century (Vretemark 1997: 138). Comparison of the mandibular M 3 lengths with the Swedish values reveals that the Finnish lengths are of a lower range than Swedish ones, however most of the Swedish sites dates to earlier periods (Vretemark 1997: 138-139). This is to be expected, since wild and domestic pig did not crossbreed in Finland.

6.5.4 Cats

The skinning of cats, which was practiced in Turku according to the historical sources and osteological material, has also been noted in other osteological studies. The Birka assemblage also included cat bones but lacks any evidence of cat fur utilisation (Wigh 2001: 119-120). Luff and Moreno García (1995) reported an assemblage a minimum of 79 cats found in a well in Cambridge, England. These animals had been skinned as well as butchered. In Viking Age Odense, the deliberate killing, skinning and perhaps even breeding of cats was practiced (Hatting 1990). Occasional signs of skinning have also been found (e.g. Doll 2003: 266-267; O'Connor 1989:186; Thomas 2005: 58-59).

6.5.5 Dogs

Indications of dog butchering are present in other osteological assemblages. In Germany evidence for the eating of dogs, cynophagie, can be found in both osteological assemblages and in written sources (Doll 2003: 262-266). Dogs were still being slaughtered and eaten in an organised manner in Germany in the 20th century (Geppert 1990). A large number of butchered dog remains have also been recovered in 15th century deposits from Uppsala, Sweden (Ehn & Gustafsson 1984: 93).

A great variation in size and body dimensions are found in dogs from the Middle Ages and earlier in Europe (e.g. Benecke 1994: 226-228; von den Driesch & Boessneck 1979: 143-157; Doll 2003: 106-107; Harcourt 1974). In the Middle Ages different types of dogs, short-legged, small and large, were present in Sweden (von den Driesch & Boessneck 1979: 156-157; Ehn & Gustafsson 1984: 93; Ekman 1973: 42). The different types of dogs found in Turku are thus in line with the results from other assemblages.

6.6 Animal husbandry in SW Finland

In this chapter some central issues concerning animal breeding in Turku and in SW Finland are discussed in more detail. The question of cattle castration practices in Finland is a complex one and will be examined in detail. The presence of local breeds in the past and the connection between the medieval animal population and modern landraces will also be discussed

6.6.1 Castration practices

6.6.1.1 Castration of oxen in Finland Proper

Oxen were common in the Turku from at least the medieval period onwards. This is reflected in the medieval and post-medieval documents. One of the earliest references to oxen in Finland Proper is a document dated to 1355 AD, where a pair of draught oxen are mentioned (Vilkuna 1936: 58). In fact, Turku and the surrounding areas were considered to be a centre of Finnish draught ox culture, with typical features including the use of a pair of oxen instead of one, and with a low number of horses in the livestock population (Luukko 1958: 105- 108: Vilkuna 1936: 57, 70-71). The utilisation of the draught ox in Finland can be seen as a part of the wider Nordic ox culture, which included the Baltic countries and parts of Sweden (Viires 1973: 443; Vilkuna 1936: 77-80).

There are a large number of cattle bones of uncertain sex in Turku, exhibiting the measurements of which bridge the demarcation point between probable male and probable female. It would seem likely that these bones are derived from oxen, as their bones tend to fall between the clear females and clear males. However, because most of the oxen bones are not particularly morphologically distinct when compared to those of bulls, a late castration age has to be considered. This is not in full agreement with the historical records, which would seem to suggest an early castration age. The separation of oxen and bull bones is sometimes difficult. The historical sources separate the different cattle groups in great detail, but are not always clear when it comes to differentiating between bulls and bullocks.

Bulls are not commonly mentioned in Finnish historical sources. As they were not used for traction work they were not utilised for anything other than breeding prior to slaughter. Not every farm had their own bull, but it was common to have one collective bull in a village for the wealthier households to support one (Tornberg 1973: 105-106; Virtanen 1938: 139-140). In the silver tax rolls of 1571 bulls are not mentioned. This is rather interesting, because otherwise the list of taxed animals is quite detailed. The lists vary in detail across the country as does the amount of tax on each animal group. Perhaps bulls were not taxed because they were considered to be "useless", i.e. not productive animals. However, bulls are included in later tax rolls from the 17th century which cover all of Finland (e.g. Luukko 1958). Another possibility is that the bulls were included in a different cattle category. As oxen were extremely rare outside the traditional draught oxen area, occurring almost exclusively in rectories, it seems that bulls were not listed as oxen (at least not outside the draught oxen area).

Bulls are still rare in the 1620s tax lists for Eastern Finland. According to Luukko (1958: 100-101) only 164 bulls were registered in Savo and only 16 in the whole of Vyborg Karelia (table 34). For one bull there was 56 and 499 cows accordingly. This can be compared to one bull for every 17 cows in the parish of Maaria, Finland Proper (Oja 1944: 174). Initially these figures would seem to be unreliable, and the first impression is that there must be an error in the estimates, perhaps due to differential practices in the compilation of the animal lists in different regions. In the same regions, there are either none or only a small number of oxen, and a small number of young male cattle. In fact, when examining the data for all of Finland, there are some discernible patterns in the estimates of the number of oxen, bulls and bullocks. A high frequency of oxen correlates with high numbers of bulls and bullocks, but not with high numbers of heifers. The latter is quite constant throughout Finland (with the exception of the Åland Islands). As the differences are obvious, the figures are not errors in the tax records but rather an indication of different cattle breeding strategies. The definition of ox and bull is most likely correct, but the "bullocks" i.e. a group of young males, is more uncertain. Are these "bullocks", as they are presented in the tax rolls, always castrated males?

The answer might lie in the differences between breeding strategies in the two areas. Where castration was the rule entire males were exceptional, unlike while the opposite was true in areas where castration was the exception, if indeed it was practiced at all. In draught oxen areas only a few special male animals were left for breeding; all other male calves were routinely castrated, and the extra ones not needed for draught purposes were culled after having gained sufficient slaughter weights. Therefore in draught oxen areas there were probably plenty of young males (castrates) waiting for a working career, and some bulls kept for breeding purposes only. Outside the draught oxen area there was not much use for adult male animals. It is possible that all the young males in these regions were bulls which were utilised for breeding purposes before being culled at a young age. In Estonia young bulls were used for breeding purposes before castration, which occurred at the age of two or three years (Viires 1973: 440). There is information from 19th century Finland which indicates that the bulls were 1 ½ or 2 years of age when utilisation for breeding began (Virtanen 1938: 139). A similar practice is described by Grotenfelt (1916: 38) in the 19th century.

When counting the young males from Savo and Vyborg Karelia together, we get the more reasonable numbers of 15 and 25 cows for each bull/bullock, respectively. The small number of young male animals reflects the limited use of adult male cattle, and most probably the majority of male calves were killed early with just a few left for breeding and meat purposes. The constant number of heifers in Finland (except the Åland Islands) shows that the need for female animals was similar in all areas and indicates that the young animals were not neglected when it came to taxing. The lack of young male cattle in the historical records outside of the draught oxen area is apparently a truism. The particular need for bulls in the draught oxen area is indicative of early castration, as otherwise the "bullocks" could have been used for mating prior to castration, and there would have been no need to separate these two categories of male animals with such care as was displayed outside the draught oxen area.

Thus it seems that the osteological material and historical sources point to different castration practices in Finland. The historical sources imply that early castration was practiced in Finland Proper, but the osteological material points towards later castration.

6.6.1.2 Castration in the neighbouring areas

Some differences can found between the cattle breeding strategies in Sweden, Estonia and Finland. One specific topic is the castration age of bulls. The data about the timing of castration in Sweden is not consistent. Some sources claim that bulls were castrated as calves, when just a few weeks or months old (Granlund 1969, 108). However, others suggest later ages, up to two years of age (Rålamb 1690: 54). In Estonia castration occurred when the animals were adults, generally after two or three years but occasionally as late as five (Viires 1973: 440; Vilkuna 1936: 95-96). This information dates back to the 16th and 17th centuries. According to Finnish ethnographic data (mainly from the 19th century) calves were castrated at a young age, and oxen produced this way were seen to be better draught animals than bulls that were castrated as adults (Vilkuna 1936: 59-60). The habit of adult castration was known in Finland and was used occasionally if a draught animal was needed at short notice (Vilkuna 1936: 60). In Estonia oxen castrated young were seen weak (Viires 1973: 440-441).

As has been discussed above, the age of castration influences the form of metacarpal bones and horn cores. Early castration should produce more slender and longer bones. In late castration the bones are likely to remain rather bull-like. In fact, in Sweden the ox metacarpal bones are longer than bull metacarpal bones (Ekman 1973: 85; Sten 1994: 44-45) while in Estonia bull and oxen metacarpals are of equal length (Maldre 1997: 108). In Turku the separation of bulls and oxen was not achievable as the oxen bones resembles those of bulls, but were not longer, thus linking the Finnish tradition to Estonia.

Linguistic and other evidence indicates that cattle breeding, castration knowledge and castration vocabulary share the same origins between Estonia and Finland (SSA 1992; Vilkuna 1936: 93-98). However, the historical sources give an impression that in Finland oxen were castrated as calves. It becomes clear that most of the adult male cattle present in Southwest Finland were in fact castrated ones. Most of the adult male bones recovered from Turku more closely resemble bulls. However, some of the bones did resemble those of oxen which had been castrated early. This dichotomy is probably the result of a flexible castration pattern, perhaps similar to that described in Estonia. Animals castrated around the age of two years evolved differently to those that were castrated when full adults.

The apparent contradiction between the historical records and the osteological data may be caused by the different cultural background of the administration and the local farmers. It could be possible that in both Finland and Estonia late castration was originally used, but after Finland became a part of Sweden early castration could have been gradually adapted. The first documents describing early castration appear in the 16th century. However, there does not seem to be a change in the metacarpal shapes between the medieval and post medieval deposits; long and short oxen metacarpals are present during both periods. It seems that the practice of late castration persisted in Finland into the post medieval period, even though the historical sources describe early castration as the preferred method.

6.6.1.3 Castration of sheep and goat

Evidently, sheep were castrated in Finland Proper. Oja (1944:176, 387) uses a Finnish term "*oinas*" to describe a category of male sheep or goat in the 16th- 17th centuries in the parish of Maaria. The original Swedish term is not known, but both entire bucks and rams are mentioned separately in the tax lists. *Oinas* is an old Finnish word for a castrated ram or a ram (SSA 1992: 261). Castration increases wool production, and the presence of castrated animals has been considered an indication of the importance of this trade (Clutton-Brock 1976: 382; Ryder 1983a: 452, 465). In Turku, where young animals destined for meat production were not slaughtered before their second year, sexually mature males were abundant. The castration of the males not needed for breeding would have kept the flock in check and prevented excessive male fighting. It should also be noted that no cervical vertebrae damage such as that described by Clutton-Brock (et al. 1990: 8, 12) and interpreted as having been caused by fighting were found in Turku.

Goats were probably castrated as well. They were kept for milk, skin and horns. Since buck skins were more highly valued than female skins, the keeping of male goats until they had fully developed hides was more profitable. Most of the goat mandibles from phase 2 at Aboa Vetus come from animals aged between one and half to two years old i.e. from subadults. The culling of bucks (or castrates) might have occurred at this age, when the animals had grown to adult proportions, in order to obtain full sized hides and horn cores.

The castration of sheep (and goats) is indicative of the breeding strategies employed. Considering the difficult winter fodder situation, the keeping of surplus males after their first grazing season was a significant investment, but was apparently profitable. Therefore, lamb meat and milk were probably not regarded as the principal products of sheep breeding; wool and mutton seem to have been regarded as more important. This is also supported by the sheep age structure. Male goats were bred for their horn and skin rather than for their meat.

6.6.2 State of the health of the domesticated animals

A total of 422 pathological lesions were recognized in the Turku material (table 35). The most common types of pathology were diseases of the joints, followed by oral pathologies and traumas. No neoplasias were recognised, nor were there any diseases visible on the immature skeletons. Different types of pathologies occur in different species, with arthopathies being most common in cattle, while traumatic injuries and oral pathologies are the most common among small ungulates.

There is variation in the location of traumas for different species. Some of the variation observed with the pathological types can be due to due to factors such as differing life spans or the use of cattle for traction (Baker & Brothwell 1980: 117; Murphy 2005: 21). In addition, broken limbs were not necessarily noticed if animals were allowed to roam free and without constant supervision. In cattle (including large ungulates) the trunk is the most often affected, with broken ribs being common. Conversely, healed broken limb bones, almost absent in cattle, are present in small bovid bones. This can be due to the more fragile nature of the smaller animals (cf. Murphy 2005: 21). One would expect the size of the animals to effect the healing process, so that large animals such as cattle or horses would probably be slaughtered if they sustained an injury such as a broken leg, with the result that the fracture can subsequently be difficult to identify as a result of marrow extraction.

Different types of pathological changes are distributed unevenly among the species. Arthropathies are most common in cattle, probably due to draught activities. The concentration of metacarpal pathologies in male individuals implies that draught activities probably played a significant role in their formation. However, alterations in other joints can also be the result other factors, as some arthritic changes were also found in female cattle.

Most of the cattle in the material would have spent the winter enclosed in a cool, dark and probably crowded shelter, and while the summers were spent wandering the forest in search of pasture. Some of the observed pathologies, such as a crushed elbow joint in cattle, are evidence that in some cases sever lameness was accepted. In the summertime the milk cow was so valuable that the keeping of an almost lame animal was considered worthwhile. The animals were not required to move a great deal during the winter, although it would have been difficult to ensure the proper feeding of such a lame animal during this period. Well-healed minor fractures which would not have hindered movement were rare in the cattle bones. This indicates that the selection of meat markets may not be the reason for the low abundance of cattle fractures in the material. In some other assemblages in the UK minor fractures on cattle metapodials were common (Brothwell 1995: 211; Luff & Brothwell: 122).

In contrast to cattle, where injuries to the lower legs are completely absent, the small bovid bones display a large number of both healed fractures and minor injuries to the metapodials. There was also more severe limb and joint injuries present than among the cattle bones, such as a dislocated hip, deformed cavitas in the scapula and trauma-related injuries on the femur and tibia.

Keeping the sheep in summer pasture on the islands unsupervised would have forced any animals who became injured to survive on their own. On the other hand, there was an abundance of food available in the summertime and without predators, the healing of such injuries was possible. During the winter they could be nursed and fed by humans.

Fractured pig metapodials, which have been found to be common in animal bone assemblages in Britain, were not observed in Turku material (Brothwell 1995: 211; Luff & Brothwell 1993: 112). However, injuries to the lower parts of the hind limb, namely the tibia, fibula and tarsal area, which also seem to be common in addition to the metapodial injuries, were found in Turku. Pigs were probably roaming rather freely in the town area and surroundings. Therefore, they were vulnerable to accidents and broken bones should be expected. Most of the fractures would not have caused permanent lameness in the animals.

Considering the number of dogs in Turku the pathological bones seem to be rather abundant. All three dogs found at Aboa Vetus had either trauma or developmental abnormalities in their skeletons. Traumas in the dog bones should not be unexpected, and fractured dog bones have regularly been reported in other towns (e.g. Baker and Brothwell 1980: 91-94; Brothwell 1995: 213ff; Luff & Brothwell 1993: 112; O'Connor 1982: 39).

Some protection and care was obviously provided to some injured animals and lameness was, to some degree, tolerated. The material did not include any fractured cat or hare bones (though the aetiology of the abnormal cat femur is an uncertain one) indicating a rare occurrence of traumas on these species.

6.6.3 Past and present- the question of local breeds?

6.6.3.1 Cattle

Modern Finncattle, the descendants of past animal populations, are divided into three breeds: Northern Finncattle, Eastern Finncattle and Western Finncattle. Northern Finncattle are white with a pigmented muzzle and ears, Eastern Finncattle are red-white with red sides and a white back and belly while Western Finncattle are solid red (Grotenfelt 1916: 14-16; Kantanen 1999: 9). All these colour types were already present in 18th century Oulu. Nowadays all three breeds are polled but horned Eastern and Western Finncattle were still to be seen at the beginning of the 20th century, when only Northern Finncattle were usually hornless (Grotenfelt 1916: 14-16; Kantanen 1999: 9). Genetic data shows that Northern Finncattle are more closely related to other North Scandinavian cattle breeds than with Western and Eastern Finncattle (Kantanen 1999: 21). Modern Finncattle have an average withers height approximately of 118-123 cm and an average live weight of 470-480 kg (Kantanen 1991: 55, 70). Even the smallest animals weigh around 300 kg (Kantanen 1991: 70). Compared to these figures the cattle in the medieval and post-medieval period appear both small and lean.

From the description of cattle available from the 18th century it is evident that a variety of colours existed (see chapter 1). In Oulu the earlier cited documents describe three kinds of animals, the colouring of which could represent the three modern breeds of Finncattle: one polled white, one red and one red-flecked (Oulun kaupungin perunkirjoituksia: 145). The oxen from Western Finland displayed a large variety of colours in the 18th and 19th centuries ranging from white to black (Vilkuna 1936: 67-68). According to these historical documents, animals with a certain colouring were not restricted to a certain area of

Finland. However, a more extensive study would be needed to more closely examine this question. Indeed, Clarke (1997: 227) mentions that in the parish of Ylitornio, Lapland in 1799 all the cattle were alike, being small and white.

No naturally or artificially polled crania were found in Turku. As the oxen were harnessed by the horns, polled animals were probably not desirable in the draught oxen area (Vilkuna 1936). Both small and long horns are represented in Turku, but most of the horn cores fall into the "short" category (according to Armitage & Clutton-Brock 1976: 331). This sample only represents medieval cattle, because measurable horn cores from the post-medieval phases are scarce. The sex of the animal had an affect on the length of the horn core; therefore different lengths may also represent sexual variation as well as different cattle horn types. However, among the cows both short and long horned individuals are represented. There is also some variation in the form and curvature of the horn cores. Most of horns point to the sides and slightly upwards. A similar shape was also the most typical in medieval and Viking age Sweden (Vretemark 1997: 13; Wigh 2001: 73). Some short horns point straight to the sides and even slightly downwards.

A large variation in the horn core lengths and types has been interpreted as potentially indicating different breeds or types of cattle (Armitage 1990: 88-89; O´Connor 1982: 22-23; Wigh 2001: 73-74). Local variants can evolve as a result of natural or artificial selection, responding to the demands of the natural and the cultural environment (Hall 1993: 102-103). The historical sources do not mention any local breeds in Finland (in contrast to England, see for example Armitage 1990). The physical properties mentioned in the written sources that could be associated with different breeds are the colour and horns of the cattle. The cattle in Turku were small and lean and may sometimes even have resembled the animals seem by von Linne in Northern Sweden (1732: 90-91). He tells of the cattle there being so lean that it was hard to believe they could walk, although they were capable of running to escape the warble flies, *Hypoderma bovis.* There was variation in size with the smallest animals having a withers height of less than 1 metre, while the largest ones were 20 cm higher. The presence of different cattle breeds in the assemblage studied is uncertain. It is likely that no definite cattle breeds existed in Finland Proper prior to the 19th century, but the cattle stock was heterogeneous in origin.

6.6.3.2 Sheep

The historical sources show that the slaughter weight of sheep was low. Although some sources of error are possible, it is evident from both the historical sources and the osteological analysis that the sheep were indeed small. The withers height of sheep varies in Turku from 48 cm to 69 cm, with most falling between 51-62 cm. The average withers heights decreases from 58 cm to 54 cm from the medieval to the post-medieval period. Hornless animals are rare in wild sheep, but emerged early in domesticated stock (Clutton-Brock 1987: 54, 57). In Turku both horned and hornless sheep occur. In addition, scurred or stunted animals are present. It is difficult to estimate the proportion of polled animals since sheep horns could have been used as a raw material, and therefore brought to the town separately or attached to skins.

In Finland, three landraces have survived into the modern day. The most common variety, Finn sheep, are usually white (brown and black animals also occur) and have no horns. Modern Finn sheep were created in the early 20th century, principally from northeastern sheep which were smaller than the southwestern stock and were therefore seen to be free from the influence of foreign breeds (Maijala 1988: 451-452). Finn sheep are famous for their fertility (Ryder 1983a: 12). The two other varieties, Grey Finnsheep and Åland sheep are rare (Tapio et al. 2003: 2046). Both horned and hornless Åland sheep ewes occur. They are believed to have been introduced to the islands during the 17th century (Tapio et al 2003: 2046).

It is uncertain as to how closely medieval or post-medieval Turku sheep are related to modern Finn sheep. If modern Finn sheep originate principally from animals outside South-West Finland, and if there were two separate sheep populations in Finland in the early 20th century (Maijala 1988: 451-452), then the descendants of the Turku sheep may possibly be extinct. Probably the most obvious difference between medieval sheep and modern Finn sheep are the horns; polled animals are dominant nowadays while up to 50% of the sheep in the Turku osteological material had horns. In addition, the fleece structure has changed: in medieval samples of wool some of the fibres were plucked, not sheared (Kirjavainen & Riikonen 2005: 37). Medieval sheep apparently had a more primitive fleece structure and may have shed part of the wool annually.

6.6.3.2.1 Wool

The historical sources claim that the wool of Finnish sheep was so coarse that it could not be used as raw material for finer clothing. The archaeological evidence would seem to bear this out. Medieval textiles found at Åbo Akademi include fabrics believed to be of local production. These were made of wool from a double-coated primitive type of sheep (Kirjavainen 2005: 140-142). The wool had originated from white, brown, grey and black sheep (Kirjavainen & Riikonen 2005: 37-38, pers.com. 11.4.2006 MA Heini Kirjavainen, University of Turku). The historical sources do not usually mention the colour of the sheep. However, in 1539 white and black sheep are mentioned in the flock of the late Anna Tott at the Nynäs estate (BFH III: 233). Finer, probably imported fabrics have been found in Turku, the fibre structure of which resembled medieval English wool (Kirjavainen 2005: 143). It is interesting that the wool of Swedish sheep also seems to be of a better quality than that of Finnish ones, because it was considered suitable for making broadcloth (Säihke 1963: 62). Even so, foreign sheep were also imported into Sweden to improve the stock quality (Sten 1994: 40).

In the 16th century the difference in the amount of wool produced by domestic and foreign sheep was probably partly due to the wool properties themselves, and partly to the greater size of the foreign sheep (Säihke 1963: 62). Some large individuals with different attributes to the other animals have been recovered in 16th century Swedish osteological assemblages and interpreted as foreign sheep (Sten 1994: 40). No signs of larger stock can be seen in Turku. A few larger individuals are present in the medieval phases at Åbo Akademi, which could be derived from different breeds. There are, however, no historical sources confirming the importation of foreign sheep into Finland by the 15th century. In addition, the size of the sheep in Finland seems to be larger in the medieval period than the later periods, which could also explain the single large animals. In the later phases there are no signs of larger sheep. This is not surprising, because the breeding of foreign stock was restricted to castles and manors and the bones of these animals are not likely to be found in the town layers. The effect the foreign animals had on the Finnish landrace gene pool is thought to be minimal (Tapio & Kantanen 2000: 22).

6.6.3.3 Goats

No information on the colour, coat texture or size of goats is available from the historical sources. In the osteological material only horned animals are present. The Modern Finn goat occurs in a range of colours, both polled and horned and with varying coat length (Einola 2004: 132; Grotenfelt 1922: 31). At the beginning of the 20th century the average withers heights of female goats was 60,7 cm and male goats 64,9 cm. This relates to animals of one to three years of age, so some immature animals are probably included in the results. It seems that no significant change in the withers height of goats has occurred during the centuries (approximately 60 cm).

6.6.3.4 Pig

The original Finnish pig breed, the Landrace, is nowadays extinct (Kantanen 2004: 42). It has been described as a small, slender, black-, brown- or white- flecked animal, having a coarse bristle on the back (Sirelius 1919: 221; Vuorela 1975: 199). According to ethnological sources, it was sometimes even kept alive up to the age of 6- 8 years because of their slow growth rate (Vuorela 1975; 199). However, in Turku such old animals were scarce or absent from the material and the pigs were slaughtered when young.

7 CONCLUDING REMARKS

Osteological analyses combined with scrutiny of historical sources has revealed new information on the human – animal relationships and complexity of the depositional patterns in medieval and post-medieval Turku. The studied material reflects the different roles of animals in subsistence and in culture.

The osteological analysis clearly shows that at an early stage in its development Turku was already solely dependant on the products available from domesticated animals. Cattle were the most important animals in the economy throughout the medieval and post-medieval periods. They were the main meat producers and central animals in agriculture, trade and craftsmanship. Sheep and pigs were less important but remained a key element of basic subsistence of the basic subsistence: goats served as supplementary animals for special needs. This study has also clarified the role of animals that occur less often in the osteological material or in the written sources. Cats lived semi-feral lives and they were utilised for their fur and bones. Dogs were cared for and controlled more than cats; however, this did not prevent them from occasionally been skinned and consumed as well. Fish and fishing probably played an important part in the subsistence of the town. In contrast, hunting played an insignificant role in the subsistence of the inhabitants – although bears and wolves were hunted during the medieval period. Various wild resources around the town were still utilised. Wild birds were consumed in town, probably brought in by rural dwellers. Train oil also played a significant part of trade, and hides, skins and furs of wild animals were exported from Turku. Elk or forest reindeer played no role in subsistence and a local extinction of these species is likely.

Some of the animal exploitation patterns had their roots in cultural practices instead of mere maximisation of production. The refusal to consume horse meat was deeply rooted in the culture of the Western cultivation area; the present study indicates that it was strictly obeyed in Turku. Although in the later periods at least horse carcasses were avoided, it did not prevent horse hides, hair and bones being used for craft activities. Attitude towards goats were also probably tied with cultural beliefs, and the peoples disdain for them perhaps not always justified. The utilisation of dog and cat fur, and even meat or fat, is evidently also seen elsewhere in Europe. In addition, the large variation in dog sizes is common in other assemblages. It is possible that some local dog types were created but their identification in the osteological material is problematic.

Different animal breeding strategies and consumption patterns form a complex network. Animal husbandry in the Turku's surroundings seems to have been closely bounded to agriculture. Cultivation practices controlled much of the animal breeding, by limiting feeding possibilities and by controlling the size of the animal stock and their age and sex structure. However, the society was able to adapt its strategies in order to fulfil their needs for meat, butter and commercial production. This is seen in the moderate culling age of sheep and oxen and in the selective and specialised utilization of goats.

Turku formed a centre of consumption, in which the need for meat was partly satisfied by animals raised inside the town boundaries and partly by imported stock. The different animals living inside the town boundaries were destined to satisfy a variety of purposes such as milk and meat production as well as traction. Extra meat acquired from the rural area came from surplus animals, either young animals that were not needed for breeding or older ones at the end of their (rural) work career. Some of the oxen transported to Turku might even have been specially raised for meat purposes, as the signs of active draught careers in the form of pathological changes in the bones are scarce. The animals consumed in Turku seemed to be of good quality as very old sheep and cattle were rare. The oldest animals were probably not transported to Turku but consumed elsewhere.

There was a change in the age structure the animals consumed between the medieval and post-medieval periods: the proportion of older cattle and younger sheep increases. The size decrease in sheep during the post-medieval period is likely also connected. This pattern reflects a change in the animal husbandry patterns of Finland Proper and the difficulties in meeting the needs of both animal husbandry and agriculture. This is in turn was related to a wider pattern reflecting a more pronounced importance of cattle though the intensification of crop cultivation seen in the North- and Central Europe. This change seems to merge this change seems to have occurred in Finland later than in the more Southerly regions, and even then it did not take hold in all parts of the country.

This study has revealed patterns in the osteological material characteristic of these different areas of Turku as well as different types of deposits. These patterns are reflections of the activities and therefore of the lifestyles practiced in Turku. The results emphasise the importance of context- awareness in studies of material culture from archaeological sites. Some conclusions can be drawn from the different social structures and development of the two areas examined in Turku. Craft activities were only practiced at Aboa Vetus during the early medieval periods. At Åbo Akademi craft activities played a more important role throughout the Middle Ages. Other attributes, such as the number of high utility skeletal parts, point towards the possibility that Aboa Vetus was a more prosperous area than Åbo Akademi. A change occurred in the deposition processes and consumption patterns between medieval and post-medieval Turku. Post-medieval Turku seems to have been more controlled and more urbanised. Despite of this, the signs of strict specialisation in crafts, butchery and household waste are absent.

The osteological material from Turku reflects the many sides of the towns economy from its international contacts to local markets. This study has revealed how versatile and complex the formation of the faunal assemblage is. This complexity represents the importance of animals in the past society of Turku.

BIBLIOGRAPHY

Archival Sources

TMA: Turun maistraatin arkisto, Archive of Turku administrative court.

Unpublished

Arkeologiset tutkimukset Åbo Akademin tontilla (Turku I/7/4) vuonna 1998. Unpublished excavation report, Turku Provincial Museum 2000.

Boëthius, A. 2004. *Med Hunden i Fokus- en metod att identifiera hundarnas användningsområde utifrån det postkraniala skelettet.* Seminar paper in Historical Osteology, University of Lund.

Fisher, T. 1996. *A Zooarchaeological Analysis of the Mammal Remains from the Late Medieval Franciscan Friary / Early Historical Parsonage Site on Kökar, Åland.* MA-thesis in Archaeology, University of Turku.

Jokela, S. 2002. *Turun Rettigin tontin eli Aboa Vetus-museon nahkalöydöt*. MA-thesis in Archaeology, University of Turku.

Katajisto, J. 2002. *Turun kaupunkialueen luuluistimet. Tarkasteltuna osteologiselta ja historialliselta kannalta.* Seminar paper in Archaeology, University of Turku.

Kivistö, T. 1999. *Kruununverotus Turun linnaläänissä vuosina 1470-1530.* MA-thesis in Finnish History, University of Turku.

Koskinen, M. 2004. *Historiallisen ajan luuesineet, Luuesineistä, luumateriaalin työstämisestä, käsityöläisistä ja käsityöläisyydestä Aboa Vetus–museon löytöjen valossa*. MA-thesis in Archaeology, University of Turku.

Kylänen, I. 2001. *Riista ja seuralaiseläinten luulöydöt Turun ympäristössä keskiajalta uudelle ajalle.* MA-thesis in Biology, University of Turku.

Mannermaa, K. 2002. *Sysmä 21 Ihananiemi KM 32291/Hannu Poutiainen. Luuanalyysi.* Unpublished report, Lahti Provincial museum.

Mutikainen, M. 1989. *Djurben från Kustö slott. En osteologisk analys av djurben från Kustö, S:t Karins sn., Finland.* Seminar paper in Osteo-Archaeology, Stockholm University.

Peltonen, N. 2002. *Karjaeläinten hyödyntäminen kaupunkikulttuurissa - esimerkkiaineistona Åbo Akademin tontin luulöydöt*. MA-thesis, Archaelogy, University of Helsinki.

Poutiainen, H. 1995. *Aboa Vetus-kaivausten eläintenluut ja luuesineet. Arkeo-osteologinen analyysi.* Unpublished report. Aboa Vetus-museum.

Poutiainen, H. 1999. *Eläinten luita ja luuesineitä Turun Vanhan Suurtorin kaivauksilta.* MA-thesis in Archaeology, University of Turku.

Seppälä, S. 2000. *Kruunun veronkantoyksiköt ja vuotuiset veroparselit Suomen linnalääneissä vuosina 1539-1609*. Licenciate thesis in Finnish History, University of Turku.

Söderholm, N. 1997. Helsinki, Presidentinlinna –97, Kellari Luut 1. Niukkanen, M.: *Helsinki, Presidentinlinna, Historiallisen ajan kaupunkikaivaus 1.-22.8. ja 29.9.-3.10. 1997. Liite XII.* Unpublished excavation report, Finnish National Board of Antiquity.

Tornberg, M. 1973. V*arsinais-Suomen karjatalous 1600-luvulla*. Licenciate thesis in Finnish History, University of Turku.

Tourunen, A. 2000a. *En arkeoosteologisk analys av 1500 - 1800-tals djurbensmaterialet från Björneborg, Finland.* Seminar paper in Osteo-Archaeology, Stockholm University.

Tourunen, A. 2000b. *Helsinki, Suomen Pankki (Snellmaninkatu 4-6). Osteologinen raportti.* Unpublished report, Finnish National Board of Antiquity.

Tourunen, A. 2001. *Suitian kartanon lehmät, härät ja sonnit- osteometrinen analyysi naudan kämmen- ja jalkapöydänluista.* Seminar paper in Archaeology, Univeristy of Turku.

Tourunen, A. 2002a. *Karjanhoito keskiajan Turussa. Arkeo-osteologinen analyysi Åbo Akademin tontin eläinluuaineistosta.* MA-thesis in Archaeology, University of Turku.

Tourunen, A, 2002b. *Koiran elämää- arkeo-osteologinen analyysi Turun Aboa Vetus-museon kaivauksilta löydetystä koiran luurangosta.* Unpublished report, Aboa Vetus-museum.

Tuovinen, T. & työryhmä 2006. *Kaupunkiarkeologinen kaivaus II-vaihe: kirjastotalon kellarikerros ja uudisrakennusosa 2004-2005*. Unpublished excavation report, Turku Provincial Museum.

Tupala, U. 1999. *Eläinuhreja vai teurasjätteitä. Euran Luistarin rautakautisen ruumiskalmiston eläinluumateriaalin lähdekriittistä tarkastelua.* MA-thesis in Archaeology, University of Turku.

Zetterberg, P. 1999. Turun Aboa Vetus-kaivausten puulöytöjen iänmääritys, dendrokronologiset ajoitukset FIT4801-FIT4884 (käsikirjoitus "Aboa Vetus-kaivauksen dendrokronologisesti ajoitetut puulöydöt keskiajan tietoarkistona" teokseen " Aboa Vetus-kaupunkikorttelin tutkittuja tarinoita. Turun kaupungin kaupunginosan II tontin II korttelin 3 tutkimuksia"). *Dendrokronologian laboratorion ajoitusseloste 162*:1-21, University of Joensuu.

Zetterberg, P. 2000. Åbo Akademin päärakennuksen tontin (Turku I/7/4) arkeologisen kaivauksen puulöytöjen dendrokronologinen iänmääritys, osa I: ajoitusnäytteet FIT 6601-FIT 6625. Ajoitusseloste 175, dendrokronologinen laboratorio, ekologian osasto, Karjalan tutkimuslaitos, Joensuun yliopisto. *Arkeologiset tutkimukset Åbo Akademin tontilla (Turku I/7/4) vuonna 1998. Kaivauskertomus*, *Liite 19.* Turku Provincial Museum..

Printed Sources

Acerbi, G. 1799. *Matka halki Suomen v. 1799*. Part of book: Travels through Sweden, Finland and Lapland to the North Cape. WSOY:n graafiset laitokset, Porvoo 1983.

Arwidsson, A. I. 1851. *Handlingar till upplysning af Finlands Häfder. Fjerde delen*. Stockholm.

Bergman, C. 1760. *Historisk och oeconomisk beskrifning över sjö-staden Ekenäs*. Faksimiluppl, Ekenäs tryckeri 1972.

BFH. *Bidrag till Finlands Historia I,III,IV* . Ed. Hausen, R. Helsinki 1881-1912.

Bouppteckningar i Helsingfors stad 1679-1808. Ed. Åkerman, B. *Suomen sukututkimusseuran julkaisuja XIII.* 1937.

Carenius, E. 1759. Efraim Careniuksen esitys Huittisten pitäjästä. Suomeksi muodostellut ja selityksillä varustanut Arvo Inkilä. *Kansanvalistusseuran kotiseutukuvauksia 7-10.*1910.

Clarke, E. D. 1799. *Matka Lapin perukoille 1799*. Kirjapaino Raamattutalo, Pieksämäki.1997.

Eerik Flemingin maakirjat. Ed. Oja, A. *Lisiä Suomen historiaan VII*. 1964.

Finlands Medeltidsurkunder II (FMU). Ed. Hausen, R. Helsinki 1915.

Forsius, H. 1757. Historisk och oeconomisk beskrifning öfwer stapel-staden Helsingfors : uti Nyland, sednare delen, med wederbörandes samtycke, under oeconomiae professorens, Kongl. Svenska Vettenskaps Academiens och Upsala Vettenskaps Societ. ledamots, samt nu varande acad. rectors hr. Pehr Kalms inseende, för lager-krantsen utgifwen oc til almänt ompröfwande framstält i Åbo Acad. öfre lärosal på wanlig tid f. m. den 21. Maji 1757. Af Henric Forsius, Nyländninge. Åbo.

Forssell, H. 1884. *Anteckningar om Sveriges jordbruksnäring i sextonde seklet*. Stockholm.

Gadd, P. A. 1751. *Ylä-Satakunnan oloja 1700-luvun puolivälissä*. Tampere 1946.

Gadd, P. A. 1769. Beskrifning, huru en finsk ko blifvit anfad och skött, at hon gifvit 9 til 10 pung smör om året. *Konliga vetenskaps akademiens handlingar för år 1769, vol. XXX.*

Gadd, P. A. 1783. Pietari Adrian Gaddin kertomus Turun ja Porin Läänin sekä Ahvenanmaan maalaiselinkeinoista v. 1783. Ed. Laurikkala, S. *Turun Historiallinen Arkisto V*: 94-127. 1936.

Grotenfelt, K. 1897. Muutamia asiakirjoja maatilus-oloista Suomessa, ja erittäinkin n.s. Vaasa-tiluksista, 1500-luvun keskivaiheilla. *Historiallinen arkisto XV*: 88-107.

Hausen, R. 1881. *Kuustö slott. Historisk-arkeologisk beskrifning. Förra häftet*. Helsingfors.

Herkepaeus, C. 1756. *Historiallinen ja ekonominen selonteko Hauhon pitäjästä Hämeessä*. Suom. Tuulikki Tenho. Helsinki, Markkinointi-instituutti 1981.

Iivar Flemingin maakirja. Ed. Roos, J. E. *Lisiä Suomen historiaan VI*. 1958.

Indrenius, A. 1753. *Kuvaus Keuruun pitäjästä.* Suomentanut Aulis Oja. Keuruun seurakunta 1953.

Kalm, P. & Cavander, C. 1753. *Historisk och oeconomisk beskrifning öfwer Sagu sochn : i Åbo lähn, med wederbörandes tilstädielse, under oeconomiae professorens, och Kongl. Swensk. Wettensk. Academ. ledamots, herr Pehr Kalms inseende, för lager krantsens ärhållande, til allmän undersökning utgifwen. I Åbo Acad: nedre sal d. 22 Decembr. Af Christian Cavander, Söder-Finne*. Turku.

von Linné, C. 1732. *Lapinmatka 1732.* Karisto, Hämeenlinna 1993.

Olaus Magnus. *Historia om de nordiska folken. Commented by Mats Rehnberg*. Nørhaven a/s, Danmark 2001.

Oulun kaupungin perunkirjoituksia 1653-1800. Ed. Brenner, A. *Suomen sukututkimusseuran julkaisuja XXV I-III*. 1963-66.

Rudenschöld, U. 1738-1741. Ulrik Rudenschöldin kertomus taloudellisista ym. oloista Suomessa 1738-1741. *Todistuskappaleita Suomen historiaan VI*,1899.

Rålamb, Å.C 1690. Adelig Öfning. T.13. Stockholm.

Suomen hopeaveroluettelot 1571:
Finlands sölfskattsegister af år 1571. Första häftet: Egentliga Finlands sölfskattregister. Ed. Fontell, A. G. Helsinki 1892.
Uudenmaan hopeavero ja hopeaveroluettelo v. 1571. Ed. Soikkeli, K. Helsinki 1912.
III Häme. Ed. Roos, J. E. *Suomen historian lähteitä V, 3.* Helsinki 1944.
IV Satakunta. Ed. Jokipii, M.. *Suomen historian lähteitä V,4*. Helsinki 1953.
V Ahvenanmaa. Ed. Kerkkonen, G. *Suomen historian lähteitä V, 5*. Helsinki 1965.
VI Pohjanmaa. Ed. Walta, M. *Suomen historian lähteitä V, 6*. Helsinki 1985.
VII Karjala. ed. Walta, M. *Suomen historian lähteitä V,7*. Helsinki, 1987.
Savo. Ed. Walta, M. *Suomen historian lähteitä V:8*. Helsinki 1996.

Tornion kaupungin pesäluetteloja 1666-1800. Ed. Tamelander, E. *Peräpohjolan ja Lapin kotiseutuyhdistysten julkaisuja IV*. 1941.

Utdrag ur Åbo Stads Dombok 1626-1632. Ed. von Bonsdorff, C. *Bidrag till Åbo Stads Historia IV*. 1887.

Utdrag ur Åbo Stads Dombok 1635. Ed. Hartman, T. *Bidrag till Åbo Stads Historia VII*.1891.

Utdrag ur Åbo Stads Dombok 1638. Ed. Hästesko, A. *Bidrag till Åbo Stads Historia XIII*. 1905.

Published

Alasuutari, S. & Syrjälä-Qvist, L. 1998. Lammastutkimukset Muddusjärven opetus- ja tutkimustilalla vuosina 1889-1993. *Helsingin yliopiston kotieläintieteen laitoksen julkaisuja 32*.

Albarella, U. 1997. Size, power, wool and veal: zooarchaeological evidence for late medieval innovations. In: Boe, G. De & Verhaeghe, F. (eds.). *Environment and Subsistence in Medieval Europe. Papers of the "Medieval Brugge 1997" Conference, Volume 9*: 19-30.

Albarella, U. 1999. "The mystery of husbandry": medieval animals and the problem of interating historical and archaeological evidence. *Antiquity 73*: 867-875.

Alhonen, P., Papunen, P. & Sarkki-Isomaa, S. 1996. *Ikaalisten entisen emäpitäjän historia I. Vuoteen 1640*. Vammala.

Armitage, P. 1982. A system for ageing and sexing the horn cores of cattle from British post-medieval sites (17th to early 18th century) with special reference to unimproved British Longhorn cattle. In: Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series* 109: 37-54.

Armitage, P. L. 1990. Post-Medieval cattle horn cores from the Grwyfriars site, Chichester, West-Sussex, England. *Circaea 7 (2)*: 81-90.

Armitage, P. L & Clutton-Brock, J. 1976. A system for classification and description of the horn cores of cattle from archaeological sites. *Journal of Archaeological Science, Vol. 3*: 329-348.

Azúa, R. V. 2000. Prehispanic dog types in Middle America. In: Crockford, S. J. (ed). Dogs Through Time: An Archaeological Perspective. *BAR International Series 889*: 193-204.

Backe, M. 1995. Osteologisk analys av benmaterial från G:a Kyrkbyn. Wallerström, T. 1995: Norrbotten, Sverige och medeltiden. Problem kring makt och bosättning i en europeisk periferi. Del 2-Bilagor. *Lund Studies in Medieval Archaeology 15:2*: 81-96.

Baker, J.R. & Brothwell, D.R 1980. *Animal Diseases in Archaeology*. London.

Bartosiewicz, L. 1999. The role of sheep versus goat in meat consumption at archaeological sites. In: Bartosiewicz, L. & Greenfield, H. J.: *Transhumant pastoralism in Southern Europe. Recent Perspectives from Archaeology, History and Ethnology*: 47-60.

Bartosiewicz, L., Van Neer, W. & Lentacker, A. 1997. Draught Cattle: Their Osteological Identification and History. *Annalen Zoölogische Wetenschappen/Annales Sciences Zoologiques Vol. 281.*

Baxter, I. L. 2002. Occipital perforations in a Late Neolithic probable aurochs (*Bos primigenius Bojanus)* cranium from Letchwoth, Hertfordshire, UK. *International Journal of Osteoarchaeology 12*: 142-143.

Benecke, N. 1988. *Archäozoologische Untersuchungen an Tierknochen aus der frühmittelalterlichen Siedlung von Menzlin. Materialhefte zur Ur- und Frühgeschichte Meklenburgs. Band 3*.

Benecke, N. 1994. *Archäozoologische Studien zur Entwicklung der Haustierhaltung in Mitteleuropa und Südskandinavien von den Anfängen bis zum ausgehenden Mittelalter*. Berlin.

Bergquist, H. 1957. Skeletal finds of Black Rat from the Early Middle Ages. *Archaleology of Lund 1*: 98-103.

Binford, L.R. 1978. *Nunamiut Ethnoarchaeology*. New York, Academic Press.

Björnhag, G. 1998. De svenska husdjursrasernas historia. In: Larsson, B. M. P., Morell, M. & Myrdal, J. (eds.). *Agrarhistoria.* Lts Förlag, Stockholm.

Björnhag, G. & Myrdal, J. 1994. Nötkreaturens produktion och utfodring enligt 1500-talets kungsgårdräkenskaper. Myrdal, J. & Sten, S (eds.). Svenska husdjur från medeltid till våra dagar. *Skrifter om Skogs- och lantbrukshistoria 5* :75-96.

Boessneck, J. 1956. Ein Beitrag zur Errechnung der Widerristhöhe nach Metapodienmaβen bei Rindern. *Zeitschrift für Tierzüchtung und Züchtungsbiologie. Bd. 68*: 75-90.

Boessneck, J. 1969. Osteological differences between sheep (*Ovis aries Linne*) and goat (*Capra hircus Linne*). Brothwell, D.R. & Higgs, E. (eds.). *Science in Archaeology, 2nd ed.*: 331-358.

Boessneck, J & von den Driesch, A 1979. Die Tierknochenfunde mit Ausnahme der Fischknochen. In: *Eketorp. Befestigung und Siedlung auf Öland, Schweden. Die Fauna*. Stockholm.

Brothwell, D. 1995. The special animal pathology. In: Cunliffe, B. Danebury: an Iron Age Hillfort in Hampshire. Volume 6. A hillfort community in perspective. *CBA Research Report 102*: 207-233.

Brännäng, E. 1971. Studies on monozygous cattle twins, XXIII. The effect of castration and age of castration on the development of single muscles, bones and special sex characters. Part II. *Swedish Journal of Agricultural Research 1*: 69-78.

Bull, G. & Payne, S. 1982. Tooth eruption and epiphysial fusion in pigs and wild boar. Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 55-71.

Bullock, D. & Rackham, J. 1982. Epiphysial fusion and tooth eruption of feral goats from Moffatdale, Dumfries and Galloway, Scotland. In: Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 73-80.

Clutton-Brock, J. 1976. The animal resources. In: Wilson, D.M.: *The Archaeology of Anglo-Saxon England*: 373-392.

Clutton-Brock, J. 1987. *A Natural History of Domesticated Mammals.* Cambridge University Press, Cambridge.

Clutton-Brock, J., Dennis-Bryan, K. & Armitage P. L. 1990. Osteology of the Soay sheep. *Bulletin British Museum (Natural History), Zoology Series,Vol. 56 Nb 1*: 1-56.

Coppinger, L. & R. 2005. *Koira? Ihmisen paras ystävä biologin näkökulmasta.* Vantaa 2005.

De Cupere, B., Lentacker, A., Van Neer, W., Waelkens, M. & Verslype, L. 2000. Osteological evidence for the draught exploitation of cattle: first applications of a new methodology. *International Journal of Osteoarchaeology 10*: 254-267.

Dahlbäck, G. 1987. I medeltidens Stockholm. *Monografier utgivna av Stockholms stad 81*.

Davis, S. J. M. 1987. *The Archaeology of Animals*. Butler & Tanner, London.

Davis, S. J. M. 2000. The effect of castration and age on the development of the Shetland Sheep skeleton and a metric comparison between bones of males, females and castrates. *Journal of Archaeological Science 27*: 373-390.

Dobney, K.M., Jaques S.D. & Irwing B.G. 1996. Of Butchers and Breeds. Report on Vertebrate Remains from Various Sites in the City of Lincoln. *Lincoln Archaeological Studies: No 5*.

Doll, M. 2003. Haustierhaltung und Schlachtsitten des Mittelalters und der Neuzeit. Eine Synthese aus archäozoologischen, schriftlichen und bildlichen Quellen Mitteleuropas. *Internationale Archäologie 78*

Driesch, A. von den 1976. *A Guide to Measurements of Animal Bones from Archaeological Sites*. Peabody Museum of Archaeology and Ethnology. Harvard University.

Driesch von den, A. & Boessneck, J. 1973. Kritische Anmerkungen zur Widerristhöhenberechnung aus Längenmaβen vor- und frühgeschichtlicher Tierknochen. *Säugetierkundliche Mitteilung 22*: 325-348.

Egardt, B. 1962. Hästslakt och rackarskam: En etnologisk undersökning av folkliga fördomar. *Brumme Nordiska Museets Handlingar* 57.

Ehn, O. & Gustafsson, J. H. (eds.) 1984. *Kransen. Ett medeltida kvarter i Uppsala*. Almqvist & Wiksell, Uppsala.

Einola, J. 2004. V*uohieläimet. Luonnonvaraiset sekä kesyt lampaat ja vuohet*. Pilot-kustannus Oy.

Ekman, J. 1973. Early Medieval Lund - the Fauna and the Landscape. *Archaeologica Lundensia V.*

Eskelinen, J. & Franck, K. 1999. *Harrastajanahkurin käsikirja I*. Länsipohjan kirjapaino Oy, Kemi.

Fabiš, M. 2005. Pathological alteration of cattle skeletons- evidence for the draught exploitation of animals? In: J. Davies et. al. (eds.). *Diet and Health in Past Animal Populations : Current Research and Future Directions: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*: 58-62.

Fock, J. 1966. *Metrische Untersuchungen an Metapodien einiger europäischer Rinderrassen*. Dissertation, München.

Gifford-Gonzales, D. 1991. Bones are not enough: analogues, knowledge and interpretive strategies in zooarchaeology. *Journal of Anthropological Archaeology 10*: 215-254.

Geppert, P. 1990. *Hundeschlachtungen in Deutschland im 19. and 20. Jahrhundert unter besonderer Berücksichtigung der Välhältnisse in München*. München.

Gardberg, C. J. 1971. Turun kaupungin historia 1100-luvun puolivälistä vuoteen 1366. In: Kivikoski, E. & Gardberg, C. J.(eds.): *Turun kaupungin historia kivikaudesta vuoteen 1366*. Turku.

Gardberg, C.J., Heininen, S. & Welin, P.O. 2000. *Kansallispyhättö. Turun Tuomiokirkko 1300-2000*. Hämeenlinna.

Granlund, J. 1969. Rinderanspannung und Joche in Schweden. *Národopiský věstnik Československý. Boénik III-IV. Brno-Praha*: 99-118.

Grant, A. 1982. The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 91-108.

Grayson, D. K. 1979. On the Quantification of Vertebrate Archaeofaunas. *Advances in Archaeological Method and Theory, Vol 2*: 199-237.

Grigson, C. 1982a. Sex and age determination of some bones and teeth of domestic cattle: a review of some literature. In: Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 7-24.

Grigson, C 1982b. Sexing neolithic domestic cattle skulls and horncores. In: Wilson, B., Grigson, C. & Payne, S. (eds.). Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 25-35.

Groot, M. 2005. Palaeopathological evidence for draught cattle on a Roman site in the Netherlands. In: J. Davies et. al. (eds.). *Diet and Health in Past Animal Populations : Current Research and Future directions: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*: 52-57.

Grotenfelt, K. 1887. *Suomen kaupasta ja kaupungeista ensimmäisten Vaasa-kuninkaiden aikoina*. J.C. Frenckell'in ja pojan kirjapaino, Helsinki.

Grotenfelt, G. 1918. *Vanhanaikainen suomalainen maitotalous*. Kustannusosakeyhtiö Otava, Helsinki.

Grotenfelt, G. 1922. *Suomen vuohikirja. Lyhyt opas*. Werner Söderström oy, Porvoo.

Grönros, J., Hyvönen, A., Järvi, P., Kostet, J. & Väärä, S. 2003. Tiima, tiu, tynnyri. Miten ennen mitattiiin. *Turun maakuntamuseo, näyttelyesite 32*.

Habermehl, K-H. 1975. *Die Altersbestimmung bei Haus- und Labortieren*. Verlag Paul Parey, Berlin.

Haggren, G. 2000. *Väitöskirja Turun porvarisyhteisöstä*. SKAS 3: 39-41.

Hall, S. J .G. 1993. Why are there so many breeds of livestock? In: Clason, A., Payne, S. & Uerpmann, H-P. (eds.). Skeletons in her Cupboard. Festschrift for Juliet Clutton-Brock. *Oxbow Monograph 34*: 99-107.

Hammond, J. 1962. Some changes in the form of sheep and pigs under domestication. *Zeitschrift für Tierzüchtung und Züctungsbiologie 77*:156-158.

Harcourt, R.A. 1974. The dog in prehistoric and early historic Britain. *Journal of Archaeological Science 1*: 151-175.

Harjula, J. 2005. Sheaths, scabbards and grip coverings. The use of leather for portable personal objects in the 14^{th}-16^{th} century Turku. *Archaeologia Medii Aevi Finlandiae X*.

Harris, E. C. 1979. *Principles of Archaeological Stratigraphy*. Academic Press.

Hatting, T. 1983. Osteological investigations on *Ovis Aries* L. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening. Bind 144*: 115-135.

Hatting, T. 1990. Cats from Viking Age Odense. *Journal of Danish Archaeology vol. 9*: 179-193.

Hatting, T. 1995. Sex-related characters in the pelvic bone of domesticated sheep (*Ovis aries* L.) *Archaeofauna 4*: 71-76.

Hellichius, S. 1986. Yrkesbeteckningar inom hud-, skinn- och läderhantverken i Sverige. En ordhistorisk undersökning. With a summary: Occupational Terms in the Hide, Fur and Leather Crafts in Sweden. A Study in Word-History. *Skrifter utgivna av institutionen för nordiska språk vid Uppsala universitet 18*.

Hiekkanen, M. 2003. Turun kaupungin perustaminen. Tulkintayritys uusien arkeologisten tutkimusten pohjalta. In: Seppänen, L. (ed). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 42-52.

Hietala, E. 2004. Åbo Akademin tontin keskiaikaisista kalastusvälineistä. In: Hietala, E (ed). Launista lohipatoon. Jokikalastuksen historiaa. *Turun maakuntamuseon näyttelyesite 35*: 60-69.

Higham, C. F. W. 1969. The metrical attributes of two samples of bovine limb bones. *Journal of Zoology vol 157*, part 1: 63-74.

Hiltunen, E. 1988. Ruotsin vallan aika. In: Mansikkaniemi, H., Luoto, J. & Hiltunen, E.: *Liedon historia 1*. Grafia oy, Turku.

Howard, M. 1963. The Metrical Determination of the Metapodials and Skulls of Cattle. Mourant, A. E. & Zeuner, F. E. (eds.): Man and Cattle. Proceedings of a Symposium on Domestication at the Royal Anthropological Institute 24-26 May 1960. *Royal Anthropological Institute Occasional Paper No 18.*: 91- 101.

Hüster, H. 1990. Untersuchungen an Skelettresten von Rindern, Schafen, Ziegen and Schweinen aus dem mittelalterlichen Schleswig. *Ausgrabungen in Schleswig. Berichte und Studien 8.*

Häkkinen, K. 2004. *Linnun nimi*. Karisto oy, Hämeenlinna.

Ijzereef, G. F. 1989. Social differentiation from animal bone studies. In: Serjeanson, D. & Waldron, T.(eds.). Diet and Crafts in Towns. The Evidence of Animal Remains from the Roman to the Post-Medieval periods. *BAR British Series 199*: 41-53.

Jensen, B. 1994. *Suomen ja Pohjolan nisäkkäät*. WSOY, Porvoo.

Johannsen, N. N. 2005. Palaeopathology and neolithic cattle traction: methodological issues and archaeological perspectives. In: J. Davies et. al. (eds). *Diet and Health in Past Animal Populations: Current Research and Future directions: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*: 37-51.

Jokela, S. 2005. Nahkalöytöjä luostarikorttelista. Poimintoja Aboa Vetus-museon vanhimmista kerroksista. *SKAS 1*: 6-11.

Kantanen, J. 1991. Itä-, länsi- ja pohjoissuomenkarjan populaatiorakenne biokemiallisen ja polymorfismin ja rungon mittojen perusteella. *Kotieläinjalostuksen tiedote No. 93*.

Kantanen, J. 1999. Genetic Diversity of Domestic Cattle (Bos taurus) In North Europe. *University of Joensuu Publications in Sciences No: 52.*

Kantanen, J. 2004. Maatiaiseläinrodut. In: Tiainen, J., Kuussaari, M., Laurila, I. P. & Toivonen, T. (eds.). *Elämää pellossa. Suomen maatalousympäristön monimuotoisuus*. Edita, Helsinki.

Kallioinen, M. 2000. Kauppias, kaupunki, kruunu. Turun porvarisyhteisö ja talouden organisointi varhaiskeskiajalta 1570-luvulle. *Bibliotheca Historica 59.*

Kirjavainen, H. 2002. Medieval archaeological textiles in Turku. In: Helmig, G., Scholkmann, B. and Untermann, M.(eds.). *Centre, Region, Periphery. Medieval Europe Basel 2002. Vol 2: Sections 4 and 5*: 346-351.

Kirjavainen, H. 2003. Åbo Akademin tontin keskiaikaiset tekstiilityypit. *SKAS 1*: 4-18.

Kirjavainen, H. 2005. The fleece types of late medieval textiles and raw wool finds from the Åbo Akademi site. In: Mäntylä, S. (ed.). Rituals and Relations. Studies on the Society and Material Culture of the Baltic Finns. *Annales Academiae Scientiarum Fennicae Ser Humaniora 336*.

Kirjavainen, H. & Riikonen, J. 2005. Tekstiilien valmistuksesta Turussa myöhäisrautakaudella ja keskiajalla. *Muinaistutkija 3*: 30-44.

Kivistö, T. 2000. Muuttuva yhteiskunta-muuttuva verotus. Keskiajan verotuksen vertailuongelmia. In: Lappalainen, J. T. (ed.). Verotushistoriaa 2. *Turun yliopiston historian laitoksen julkaisuja 58*, 73-90.

KL. *Kulturhistorisk lexikon för nordisk medeltid. Band I-XXII*. Helsinki.

Klein, P. & Reichstein, H. 1977. Metrische Untersuchungen an den Metapodien von Ziegen und Schafen aus der frühmittelalterlichen Siedlung Haithabu. *Schriften aus der Archäologisch-Zoologischen Arbeitsgruppen Schleswig-Kiel. Heft 2*.

Klein R. G. & Cruz-Uribe K. 1984. *The Analysis of Animal Bones From Archaeological Sites*. University of Chicago Press, Chicago.

Koli, L. 2001. *Suomen kalaopas*. Bookwell oy, Porvoo.

Korhonen, A. 1939. Hakkapeliittain historia. I osa 1617-1625. *Puolustusministeriön Sotahistoriallisen toimiston julkaisuja VI*.

Korhonen, T. 2003. Koneiden aika alkamassa. In: Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. (eds.). *Suomen maatalouden historia I. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle*. SKS, Helsinki: 461-479.

Kuujo, E. 1981. *Turun kaupungin historia 1366-1521.* Turku.

Kykyri, M. 2003. Puurakentaminen Turun kaupungissa. In: Seppänen, L. (ed). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 105- 120.

Landon, D.B 1997. Interpreting urban food supply and distribution systems from faunal assemblages: an example from Colonial Massachusetts. *International Journal of Osteoarchaeology vol 7*: 51-64.

Landon, D.B. 2005. Zooarchaeology and historical archaeology: progress and prospects. Journal of Archaeological Method and Theory, Vol 12, No 1: 1-36.

Laurikkala, S. 1953. Varsinais-Suomen talonpoikaisnaisten maitotalousastiat. *Varsinais-Suomen maakuntakirja 12*: 23-45.

Lauwerier, R. C. G. M. 1983. Pigs, piglets and determining the season of slaughtering. *Journal of Archaeological Science 10*: 483-488.

Lavento, M. & Haggren, G. 1999. Keskiajan tutkimista ja tuhoamista Turussa. *Muinaistutkija 1*: 59-62.

Legge, A.J. & Rowley-Conwy, P.A. 1991. "..Art made strong with bones": a review of some approaches to osteoarchaeology. *International Journal of Osteoarchaeology Vol. 1*: 3-15.

Lepiksaar, J. 1986. The holocene history of theriofauna in Fennoscandia and Baltic countries. In: Königsson, L.-K.(ed.). Nordic Late Quaternary Biology and Ecology. *Striae Vol. 24*: 51-70.

Lepiksaar, J. 1989. Om den tafonomiska förlustens betydelse vid kvantitativ analys av antropogena tanatocoenoser. In: Iregren, E. & Liljekvist, R. (eds.). Faunahistoriska studier tillägnade Johannes Lepiksaar. Symposium 26 maj 1988. *University of Lund, Institute of Archeaology. Report series no. 33*: 21-35.

Levitan, B. 1979. Excavations at West Hill, Uley, 1979: The Sieving and Sampling Programme. *Western Archaeological Trust. Occasional Papers No.10.*

Lindholm, A. J. 1892. *Bidrag till kännedom om Finlands ekonomiska tillstånd under tidskiftet 1634-1654*. Helsinki.

Luff, R-M. 1982. A Zooarchaeological Study of the Roman North-western Provinces. *BAR International Series 137*.

Luff, R. 1993. Animal Bones from Excavations in Colchester, 1971-85. *Colchester archaeological report*.

Luff, R. & Brothwell, D. 1993. Health and welfare. In: Luff, R. Animal Bones from Excavations in Colchester, 1971-85. *Colchester archaeological report*.

Luff, R-M. & Moreno García, M. 1995. Killing cats in the medieval period. An unusual episode in the history of Cambridge, England. *Archaeofauna 4*: 93-114.

Luukko, A. 1958. Suomen karjavarallisuus 1620-luvulla. *Historiallinen aikakauskirja 56*, 95-116.

Lyman, R. L. 1994. Vertebrate Taphonomy. *Cambridge manuals in Archaeology.* Cambridge University Press.

MacGregor, A. 1989. Bone, antler and horn industries in the urban context. In: Serjeanson, D. & Waldron, T.(eds). Diet and Crafts in Towns. The Evidence of Animal Remains from the Roman to the Post-Medieval periods. *BAR British Series 199*: 107-127.

MacKinnon, M. 2004. Production and Consumption in Roman Italy: Integrating the Zooarchaelogical and Textual Evidence. J*ournal of Roman Archaelogy, supplementary series number 54.*

Magnell, O. 2006. Tracking Wild Boar and Hunters. Osteology of Wild Boar in Mesolithic South Skandinavia. *Acta Archaeologica Lundaensia Series in 8°, No 51. Studies in Osteology 1.*

Maijala, K. 1988. History, recent development and uses of Finnsheep. *Journal of Agricultural Science in Finland.* Vol 60 N:o 6: 449-454.

Maldre, L. 1997a. Tartu VII kvartali IV kaevandi jäätmekastide archeozooloogilisest materjalist. In: Valk, H. (ed.). Arheoloogilisi uurimusi. *Tartu Ûlikooli arheoloogia kabineti toimetised 9*: 99-106.

Maldre, L. 1997b. Koduloomad keskaegses Pärnus. Toim. Aldruk Vunk:100 aastat Pärnu muinasuurimise seltsi. *Pärnumaa ajalugu, Vihik 1*: 99-122.

Maldre, L. 2003. Karjakasvatus Eestis. In: Mägi, M. (ed). *Eesti aastal 1200*. Kirjastus Argo , Tallinn: 163-172.

Maltby, M. 1979. The Animal Bones from Exeter 1971-1975. *Exeter Archaeological reports, volume 2*.

Maltby, J. M. 1982. The Variability of Faunal Samples and their Effects upon Ageing Data. Wilson, B., Grigson, C. & Payne, S. (eds.): Ageing and Sexing Animal Bones from Archaeological Sites. *BAR British Series 109*: 81-90.

Matolsci, J. 1970. Historische Erforschung der Körpergröβe des Rindes auf Grund von Ungarischem Knochenmaterialen. *Zeitschrift für Tierzüchtung und Züchtungsbiologie 87*: 89-137.

Mayer. J. J. & Brisbin, I. L. Jr. 1988. Sex identification of *Sus Scrofa* based on canine morphology. *Journal of Mammalogy 69 (2)*: 408-412.

Mazzorin, J. G. & Tagliacozzo, A. 2000. Morphological and osteological changes in the dog from the Neolithic to the Roman period in Italy. In: Crockford, S. J. (ed.): Dogs Through Time: An Archaeological Perspective. *BAR International Series 889*: 141-161.

Melander, K. R. 1896. Suomen ynnä Käkisalmen läänien ja Inkerin veroista vuosilta 1617-1634. *Historiallinen arkisto* XIV: 315-706.

Melander, K.R. 1897. Muutama tieto apu- eli viidennenkymmenennen rahan verosta Suomessa. *Historiallinen arkisto XV*: 204-213.

Melander, K.R. 1920. Hirvieläimistä Suomessa ynnä niitten pyytämisestä 16 ja 17 vuosisadalla. *Historiallinen arkisto 28:2*.

Melander, K.R. 1952. Riistaeläinten esiintyminen maassamme 1500- ja 1600-luvuilla. Suomen *Riista 7*: 120-168.

Mennerich, G. 1968. *Römerzeitliche Tierknochen aus Drei Fundorten des Niederrheingebiets*. Dissertation, München.

Metcalfe, D. & Jones, K.T. 1988. A reconsideration of animal body-part utility indices. *American Antiquity 53 (3)*: 486-504.

Moran, N.C. & O'Connor, T.P. 1994. Age attribution in domestic sheep by skeletal and dental maturation: a pilot study of available sources. *International Journal of Osteoarchaeology, Vol. 4*: 267-285.

Munson, P. J. 2000. Age-correlated differential destruction of bones and its effect on archaeological mortality profiles of domestic sheep and goats. *Journal of Archaeological Science* 27: 391-407.

Murphy, E. M. 2005. Animal paleopathology in prehistoric and historic Ireland: a review of the evidence. In: J. Davies et. al.(eds.). *Diet and Health in Past Animal Populations: Current Research and Future Directions: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*: 8-23.

Myrdal, J. 1987. Boskapens ålder och kön enlig medeltida skriftliga källor. META 3.

Myrdal, J. 1994. Bete och avel från 1500-tal till 1800-tal. In: Myrdal, J. & Sten, S (eds.). Svenska husdjur från medeltid till våra dagar. *Skrifter om Skogs- och lantbrukshistoria 5*: 14-34.

Myrdal, J. 1997. Medeltida boskap i Sverige. Diskussion kring en avhandling. *Fornvännen 3-4*: 209-220.

Myrdal, J. 1999. *Jordbruket under feodalismen 1000-1700. Det svenska jordbrukets historia*. Centraltryckeriet AB, Borås.

Myrdal, J. & Sten, S (eds.)1994. Svenska husdjur från medeltid till våra dagar. *Skrifter om Skogs- och lantbrukshistoria 5.*

Myrdal, J. & Söderberg, J. 1991. Kontinuitetens dynamik. Agrar ekonomi i 1500-talets Sverige. *Acta Universitatis Stockholmiensis. Stockholm Studies in Economic History 15*.

Müller, H-H. 1959. Die Tierreste von Alt-Hannover. *Hannoversche Geschichtsblätter Neue Folge Band 12, Heft ¾*: 179-259.

Mäntylä, R.A. 1960. Raision vaiheet 1600-luvun alusta Ison vihan päättymiseen. In: Kivikoski, E., Oja, A. & Mäntylä, R.A. *Raision Historia I.* Lounais-Suomen kirjapaino oy, Turku.

Noe-Nygaard, N. 1987. Taphonomy in archaeology with special emphasis on man as a biasing factor. *Journal of Danish Archaeology vol. 6*: 7-62.

Niemelä, J. 1996. *Lääninlampureista maaseutukeskuksiin. Maaseutukeskusten ja niiden edeltäjien maatalousneuvonta 1700-luvulta 1990-luvulle*. Suomen Historiallinen Seura, Maaseutukeskusten Liitto, Helsinki.

Niemelä, J. 1998. Vain hyödynkö tähden? Valistuksen ajan hyötyajattelun, luonnontieteen ja talouspolitiikan suhde Pehr Adrian Gaddin elämäntyön kautta tarkasteltuna. *Historiallisia tutkimuksia 199.*

Nikula, O. 1971. *Turun kaupungin historia 1721-1809. Toinen nide*. Oy Lounaisrannikko, Turku.

Nikula, O. 1987. *Åbo Stads Historia 1521-1600*. Åbo Stad, Åbo.

Niukkanen, M. 2002. Elias Mårtenssonin talo. In: Niukkanen, Marianna (ed): *Sirpaleita suurvalta-ajan Helsingistä.* Karisto Oy, Hämeenlinna: 20-25.

Noddle, B. 1974. Ages of epiphyseal closure in feral and domestic goats and ages of dental eruption. *Journal of Archaeological Science 1*: 195-204.

Norrman, E. 1998. Svensk husdjursskötsels historia. In: Larsson, Bengt M.P., Morell. Mats and Myrdal, Janken: *Agrarhistoria.* Lts Förlag, Stockholm.

Nummela, I. 2003. Asutus, pelto ja karja. In: Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. (eds.). *Suomen maatalouden historia 1. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle*. SKS, Helsinki.

Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. 2003. *Suomen maatalouden historia 1. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle*. SKS, Helsinki.

O'Connor, T. 1982. Animal Bones from Flaxengate, Lincoln c 870-1500. *Archaeology of Lincoln, Volume XVIII-1.*

O´Connor, T.P. 1989. Bones from Anglo-Scandinavian Levels at 16-22 Coppergate. *The Archaeology of York, Volume 15/3: The Animal Bones*.

O'Connor, T. P. 2003. The Analysis of Urban Animal Bone Assemblages: A Handbook for Archaeologist. *The Archaeology of York. Principles and Methods 19/2*.

Oja, A. 1944. Keskiajan ja 1500-luvun Maaria. In: *Maarian pitäjän historia, I osa*. Tampereen työväen kirjapaino 1944.

Oja, A.1946. Kaarina keskiajalla ja 1500-luvulla. In: *Kaarinan pitäjän historia, I osa.* Kirjapaino Polytypos, Turku.

Oja, A. 1960. Raision keskiaika ja 1500-luku. In: *Raision historia I.* Lounais-Suomen kirjapaino oy, Turku.

Orrman, E. 2003a. Keskiajan maatalous. In: Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. (eds.). *Suomen maatalouden historia I. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle.* SKS, Helsinki: 87-114.

Orrman, E. 2003b: Suomen keskiajan asutus. In: Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. (eds.). *Suomen maatalouden historia I. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle.* SKS, Helsinki: 67-86.

Payne, S. 1972. On the interpretation of bone samples from archaeological sites. Higgs, E.(ed.). *Papers in Economic Prehistory*: 65-81.

Payne, S. 1985. Morphological distinctions between the mandibular teeth of young sheep, *Ovis,* and goats, *Capra. Journal of Archaeological Science 12*: 139-147.

Pentikäinen, J. 2005. *Karhun kannoilla. Metsänpitäjä ja mies*. Yliopistopaino, Helsinki.

Perkins, D. Jr. 1973. A critique on the methods of quantifying faunal remains from archaeological sites. Matolsci, J.(ed.): *Domestikationforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*: 367-370

Perkins, D & Daly, P. 1968. A hunter's village in Neolithic Turkey. *Scientific American 219 (5)*: 96-106.

Pirinen, K. 1962. Kymmenysverotus Suomessa ennen kirkkoreduktiota*. Historiallisia tutkimuksia LV.*

Pihlman, A. 1989. Tutkimusalueet. Kostet, J. & Pihlman, A.(toim.): Turun Mätäjärvi*. Turun maakuntamuseo, raportteja 10*: 60-73.

Pihlman, A. 1999. Kaupunkiarkeologisista pelastuskaivauksista. *Muinaistutkija 2*: 40-42.

Pihlman, A. 2003. Åbo Akademin päärakennuksen tontin kaivaukset osana Turun kaupunkiarkeologiaa. In: Seppänen, L. (ed). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 69-76.

Pihlman, A. & Majantie, K. 2006. Varhainen Turku- uutta tietoa Turun varhaisista vaiheista. *SKAS 1*: 45-54.

Pluskowski, A. 2006. Where are the Wolves? Investigating the scarcity of European Grey Wolf (*Canis lupus lupus)* remains in Medieval archaeological contexts and its implications. International *Journal of Osteoarchaeology 16*: 279-295.

Prilloff, R-J. 2000. Tierknochen aus dem mittelalterlichen Konstanz. Eine archäeozoologische Studie zur Ernährungswirtschaft und zum Handwerk in Hoch- und Spätmittelalter. *Materialhefte zur Archäeologie in Baden-Württemberg. Heft 50*.

Prummel, W. & Frisch, H-J. 1986. A guide for the distinction of species, sex and body size in bones of sheep and goat. *Journal of Archaeological Science 13*: 567-577.

Prummel, W. & Frisch, H-J. 1988. Distinguishing features on postcranial skeletal elements of cattle, Bos primigenius f. Taurus, and red deer, Cervus elephus L. *Schriften aus der Archäologisch-Zoologischen Arbeitsgruppe Schleswig-Kiel. Heft 12:* 1-52.

Puputti, A-K. 2005. Eläinluututkimuksia 1600-luvun Oulusta. Kajaaninkadun ja Byströmin talon luulöydöt. In: Kallio, T. & Lipponen, S. (eds.). Historiaa kaupungin alla. Kaupunkiarkeologisia tutkimuksia Oulussa. *Pohjois-Pohjanmaan museon julkaisuja 16:* 77-83.

Puputti, A-K. 2006. A zooarchaeological study on animal husbandry and game exploitation in the 17th century Tornio, Northern Finland. *Meta 1*: 13-28.

Ranta, R. 1975. *Turun kaupungin historia 1600-1721.* Oy Lounaisrannikko, Turku.

Rasila, V. 2003. Mitä talossa tarvittiin? In: Rasila, V., Jutikkala, E. & Mäkelä-Alitalo, A. (eds.). *Suomen maatalouden historia I. Perinteisen maatalouden aika. Esihistoriasta 1870-luvulle*. SKS, Helsinki: 420-421.

Ratilainen, T. & Tourunen, A. 2003. Luita ja muureja- tutkimukset Hämeenkosken Pyhän Laurin kirkolla kesällä 2002. *SKAS 1*: 19-28.

Reitz, E. J. & Wing, E. S. 1999. Zooarchaeology. *Cambridge manuals in Archaeology*. Cambridge University Press.

Riddler, I. 2004. The spatial organisation of bone-working at *Hamwic.* In: Cambell, J (ed). Wics: The Early Medieval trading centres of Northern Europe. *The English Historical Review vol 119, nro 480*: 61-66.

Ruuth, J.W. 1923. *Åbo stads historia under medeltiden och 1500-talet* . Åbo : Bestyrelsen för Åbo stads historiska museum .

Ruuth, J.W. 1958. *Porin kaupungin historia II 1558-1809.* New edition by Jokipii, M. (ed.). Satakunnan kirjateollisuus Oy:n kirjapaino, Pori.

Ryder, M.L. 1983a. *Sheep & Man*. London.

Ryder, M.L. 1983b. Milk products. In: Jones, M. (ed.). Integrating the Subsistence Economy. Symposia of the Association for Environmental Archaeology No. 4. *BAR International Series 181*: 239-250.

Ränk, G. 1966. Från mjölk till ost. Drag ur den äldre mjölkhushållningen i Sverige. *Nordiska museets handlingar 66.*

Sallinen-Gimpl, P. 1985. Ruokatalous. In: *Sukupolvien perintö 2. Talonpoikaiskulttuurin kasvu*. Karisto oy, Hämeenlinna: 219-246.

Saloranta, E. 1999. Krooppien välinen Turku- tontin kehitys keskiajalta 1800-luvun alkuun. *SKAS 4*: 15-25.

Saloranta, E. 2003. Kulttuurimaan kerrostuneisuus (stratigrafia), dokumentointi ja tulkinta. In: Seppänen, L. (ed.) Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 55-68.

Sarmela, M. 1994. Suomen perinneatlas. Suomen kansankulttuurin kartasto 2. *Suomalaisen Kirjallisuuden seuran toimituksia 587*.

Sartes, M. 2003. Rettigin palatsin tontista tuli Aboa Vetus museo. In: Seppänen, L. (ed.). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 77-86.

Sartes, M. & Uotila, K. 1997. Unioniajan säätila. In : Pohjolan suurvalta ja heräävä leijona. *Turun maakuntamuseon näyttelyesite 24*: 123-125.

Savolainen, U. 2000. Lammastarkkailutulokset 1999. *Lammas ja vuohi 2/2000*: 21-28.

Schibler, J. 1989. Tierknochen als Informationsquelle zu Handwerk, Ernährung und Wirtschaftsweise im Mittelalter der Nordwest-schweiz. In: Tauber, J. (ed.). *Methoden und Perspektiven der Archäologie des Mittelalters. Tagungsberichte zum interdisziplinären Kolloquium vom 27.-30. September 1989 in Liestal (Schweiz)*: 145-156.

Schmölcke, U. 2004. Nutztierhaltung, Jagd und Fischfang. Zur Nahrungsmittelwirtschaft des frühgeschichtlichen Handelsplatzens von Gross Strömkendorf, Landkreis Nordwestmecklenburg. *Beiträge zur Ur- und Frühgeschichte Mecklenburg-Vorpommerns. Band 43.*

Schramm, Z. 1967. Szczatki kostne wczesnosredniowiecznej owcy i kozy z wykopalisk polnocno-zachodniej polski. *Roczniki Wyzszej Szkoly Rolniczej ro Poznaniu XXXVI*: 135-174.

Seppälä, S. 2002. Porin kuninkaankartanon arkipäivää Juhana-Herttuan aikaan. In: Kivistö, T. (ed). Arki ja läheisyys. Juhlakirja Ulla Heinon täyttäessä 60 vuotta. *Turun historiallinen arkisto 55*: 127-150.

Seppänen, L. 1999. Keskiaikaiset puurakennukset ja – rakenteet. *SKAS 4*: 26-33.

Seppänen, L. 2003. Salvoksista sosiaalisiin systeemeihin- rakennustutkimuksen menetelmät ja mahdollisuudet. In: Seppänen, L. (ed). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 89-104.

Serjeantson, D. 1989. Animal remains and the tanning trade. In Serjeanson, D. & Waldron, T.(eds.). Diet and Crafts in Towns. The Evidence of Animal Remains from the Roman to the Post-Medieval Periods. *BAR British Series 199*:129-146.

Siivonen, L. & Sulkava, S. 1999. *Pohjolan nisäkkäät*. Otavan kirjapaino Oy, Keuruu.

Silver, I. A. 1969. The ageing of domestic animals. In: Brothwell, D.R. & Higgs, E. (eds). *Science in Archaeology, 2nd ed.*: 283-309.

Sirelius, U.T. 1919. *Suomen kansanomaista kulttuuria I. Esineellisen kansatieteen tuloksia*. Vammalan kirjapaino 1989.

SKKK. *Suomen kansankulttuurin kartasto 1. Aineellinen kulttuuri. (Atlas of Finnish Folk Culture*).Helsinki 1976.

Smith, R.N. 1969. Fusion of ossification centres in the cat. *Journal of Small Animal Practice, vol 10*: 523-530.

Soininen, A.M. 1974. Vanha maataloutemme. Maatalous ja maatalousväestö Suomessa perinnäisen maatalouden loppukaudella 1720-luvulta 1870-luvulle. *Historiallisia tutkimuksia 96*.

SSA. *Suomen sanojen alkuperä. Etymologinen sanakirja 1-3.*1992 Gummerus, Jyväskylä.

Sten, S. 1994. Storleksvariationer hos medeltida och nyare tids nötkreatur och får. In: Myrdal, J. & Sten, S. (eds.). Svenska husdjur från medeltid till våra dagar. *Skrifter om Skogs- och lantbrukshistoria 5*: 35-50.

Sten, S. 2004. Bovine Teeth in Age Assessment, from Medieval Cattle to Belgian Blue. *Methodology, Possibilities and Limitations. Theses and Papers in Osteoarchaeology No. 1.*, Stockholm University.

Storå, J. 2001. Reading Bones. Stone Age Hunters and Seals in the Baltic. *Stockholm Studies in Archaeology 21*.

Storå, J. & Lõugas, L. 2005. Human exploitation and history of seals in the Baltic during the Late Holocene. In: Monks, G.G (ed.). *The Exploitation and Cultural Importance of Sea Mammals. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002:* 95-106.

Suhonen, M. 1999. Kaivaus- ja dokumentaatiomenetelmistä- tosiasioita ja kritiikkiä. *SKAS 4*: 4-33.

Suolahti, G. 1991. Elämää Suomessa 1700-luvulla. *Suomalaisen kirjallisuuden seuran toimituksia 544*.

Szabó, M. 1970. Herdar och husdjur. En etnologisk studie över Skandinaviens och Mellaneuropas beteskultur och vallningsorganisation. *Nordiska museets Handlingar 73*.

Säihke, I. 1963. Varsinais-Suomen maanviljelys ja karjanhoito 1500-luvulla. *Varsinais-Suomen historia V, 5-6*: 7-69.

Talve, I. 1973. Suomen kansanomaisesta ruokataloudesta. *Turun yliopiston kansatieteen laitoksen toimituksia 2.*

Talve, I. 1990. Suomen kansankulttuuri. *Suomalaisen kirjallisuuden seuran toimituksia 514*.

Tapio, M. & Kantanen, J. 2000. Mitä perinnöllinen muuntelu kertoo suomenlampaan historiasta? *Lammas ja Vuohi 3*: 21-25.

Tapio, M., Miceikiené, I, Vilkki, J & Kantanen, J. 2003. Comparison of microsatellite and blood protein diversity in sheep: inconsistencies in fragmented breeds. *Molecular Ecology* 12: 2045-2056.

Teichert, M. 1969. Osteometrische Untersuchungen zur Berechnung der Wiederristhöhe bei vor- und frühgeschichtlichen Schweinen. *Ethnogr.-Archäol. Zeitschrift 10*: 517-525.

Teichert, M. 1975. Osteometrische Untersuchungen zur Berechnung der Widerristhöhe bei Schafen. Clason, A.T (ed.): *Archaeozoological studies*: 51-69.

Telldahl, Y. 2005. Can paleopathology be used as evidence for draught animals? In: J. Davies et. al. (eds.). *Diet and Health in Past Animal Populations: Current Research and Future Directions: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*: 63-67.

Thomas, R. 2005. Animals, Economy and Status: Integrating Zooarchaeological and Historical Data in the Study of Dudley Castle, West Midlands (c. 1100-1750). *BAR British Series 392*.

Thurston, M. E. 1996. *The Lost History of the Canine Race. Our 15,000-Year Love Affair with Dogs.* Andrews and McMeel, Kansas City.

Tourunen, A. 2002c. Eläimet kaupungissa. In: Niukkanen, M. (ed.). *Sirpaleita Suurvalta-ajan Helsingistä*. Karisto Oy, Hämeenlinna: 46-51.

Tourunen, A. 2004. Pienseulakokeilu Turun kaupunginkirjaston kaivauksilla. *SKAS 2*: 42-49.

Uerpmann, H-P. 1973. Animal bone finds and economic archaeology: a critical study of \`osteo-archaeological\` method. *World Archaeology Vol 4, No 3*: 307-322.

Ukkonen, P. 2001. *Shaped by the Ice Age. Reconstructing the History of Mammals in Finland during the Late Pleistocene and Early Holocene.* University Printing House, Helsinki.

Uotila, K. 2003. Kivitaloja keskiajan Turussa. In: Seppänen, L. (ed). Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan. *Archaeologia Medii Aevi Finlandiae IX*: 121-134.

Vappula, J. 1999. *Ikaalisten entisen emäpitäjän historia II.* 1641-1721. Vammala.

Vennola, J.H. 1901. Pohjois-Suomen maalaisvarallisuus 16:lla ja 17:llä vuosisadalla. *Tutkimuksia Suomen taloudellisesta historiasta*. Helsinki.

Viires, A. 1973. Draught oxen and horses in the Baltic countries. In: Fenton, A., Podolák, J. & Rasmussen, H. (eds.). Land Transport in Europe. *Folkelivs studier 4*: 428-456.

Vilkuna, A.-M. 1998. Kruunun taloudenpito Hämeen Linnassa 1500-luvun puolivälissä. *Bibliotheca Historica 31*.

Vilkuna, A-M. 2003. Financial management at Häme Castle in the mid-sixteenth century (1539 - about 1570). In: Mikkola, T. & Vilkuna, A-M. (eds.). At Home Within the Stone Walls: Life in the Late Medieval Häme Castle. *Archaeologia Medii Aevi Finlandiae VIII*: 15-132.

Vilkuna, K. 1931. Suomen vetohäristä. *Lisiä Varsinais-Suomen historiaan 1*. Turku.

Vilkuna, K. 1935. *Varsinaissuomalaisten kansanomaisesta taloudesta: kansatieteellinen tutkimus.*

Vilkuna, K. 1936. Verwendung von Zugochsen in Finnland. *Studia Fennica II*: 55-98.

Vilkuna, K. 1967. Zur Geschichte des finnischen Pferdes. *Studia Fennica XIII*: 5-49.

Vilkuna, K. 1992. *Vuotuinen ajantieto*. Otava, Helsinki.

Virtanen, E. A. 1927. Huomioita suomalaisten talvisikataloudesta. *SM XXXIV*: 61-74.

Virtanen, E.A. 1938. Varsinais-Suomen yhteiskunnallista kansankulttuuria. *Varsinais-Suomen historia II,2*.

Vretemark, M. 1982. Vad stod på madsedeln? In: Dahlbäck, G. (ed.). *Helgeandsholmen : 1000 år i Stockholms ström*: 276-297.

Vretemark, M. 1983: Hantverksavfall och hushållssopor - livet i kvarteret Sparbanken i Skara för 700 år sedan. *Västergötlands Fornminnesförenings tidskrift 1983-1984* : 247-264.

Vretemark, M. 1990. Medeltida kammakerier i Skara- en råvaruanalys. *Västergötlands Fornminnesförenings tidskrift 1989-1990* : 133-144.

Vretemark, M. 1997. Från ben till boskap. Kosthåll och djurhållning med utgångspunkt i medeltida benmaterial från Skara. Del 1. *Skrifter från Länsmuseet Skara nr 25*.

Vretemark, M. 2001. Om nyttan av nötdjur. In: Andrén, A., Ersgård, L. & Wienberg, J. (eds.): Från stad till land. En medeltidsarkeologisk resa tillägnad Hans Andersson. *Lund Studies in Medieval Archaeology 29:* 45-50.

Vuorela, T. 1975. *Suomalainen kansankulttuuri*. WSOY, Porvoo.

Vuorinen, H. S. 2002. *Tautinen historia*. Vastapaino, Tampere.

Vuorisalo, T. & Virtanen, T. 1985. Osteological material from the Lake Mätäjärvi. *Iskos 5*: 272-281.

Wayne, R.K. & Ostrander, E.A. 1999. Origin, genetic diversity, and genome structure of the domestic dog. *BioEssays 21*: 247-257.

Wigh, B. 2001. Animal Husbandry in the Viking Age Town of Birka and its Hinterland. Excavations in the Black Earth 1990-95. *Birka Studies 7*.

Wiig, Ø. 1981. Faunal remains from medieval Bergen. *Fauna Norvegica 5*: 34-40.

White, T. D. 1992. *Prehistoric Cannibalism at Mancos 5MTUMR-2346*. Princeton University Press, Oxford.

Wijngaarden-Bakker van, L. H. 1984. Faunal analysis and historical record: meat preservation and the faunal remains at Smeerenburg, Spitsbergen. In: Grigson, C. & Clutton-Brock, J. (eds.). Animals and Archaeology: 4. Husbandry in Europe. *BAR International Series 227*: 195-204.

Ylimaunu, J. 2000. Itämeren hylkeenpyyntikulttuurit ja ihminen-hylje-suhde. *SKS 773*.

Östman, A.-C. 2004. Mekanisoinnin ensimmäinen aalto. In: Peltonen, M. (ed.). *Suomen maatalouden historia osa 2. Kasvun ja kriisien aika 1870-luvulta 1950-luvulle*. SKS, Helsinki: 19-76.

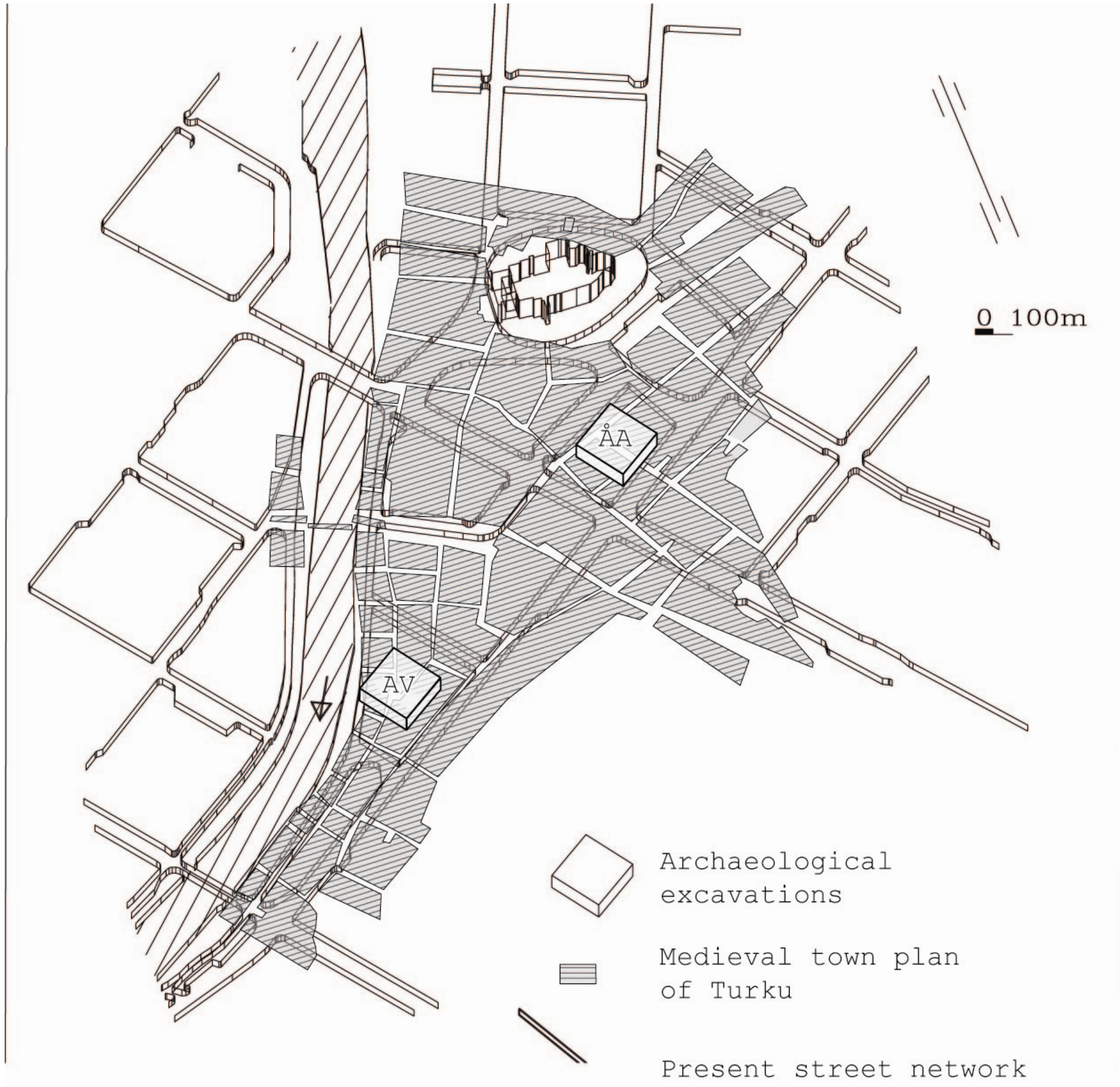

Figure 1. Location of the Åbo Akademi and Aboa Vetus sites in Turku. Original map by Kari Uotila Muuritutkimus Ky, adapted by Sara Nylund.

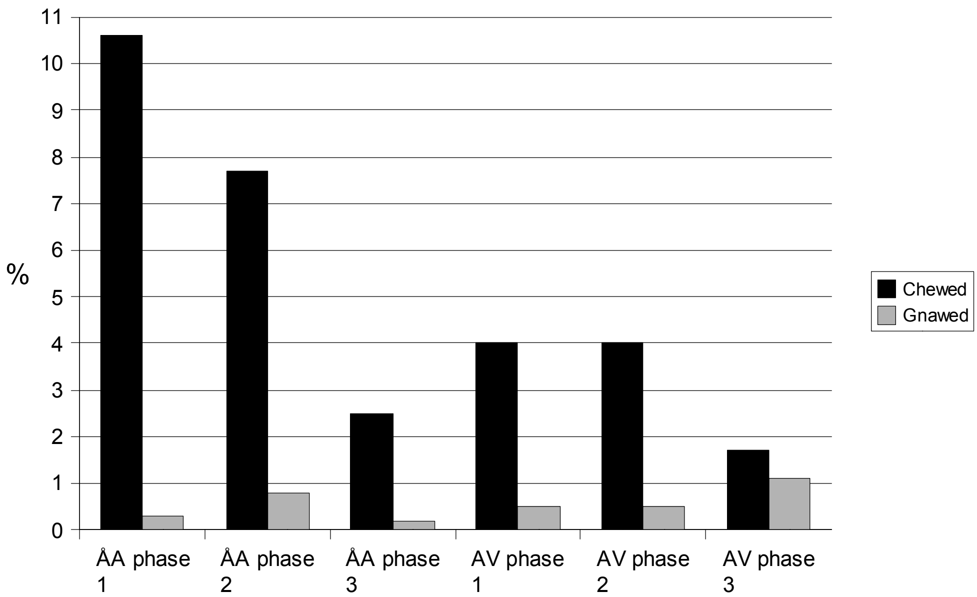

Figure 2. Total proporitions of chewed and gnawed specimens at Abo Akademi and Aboa Vetus counted from the whole material (NISP).

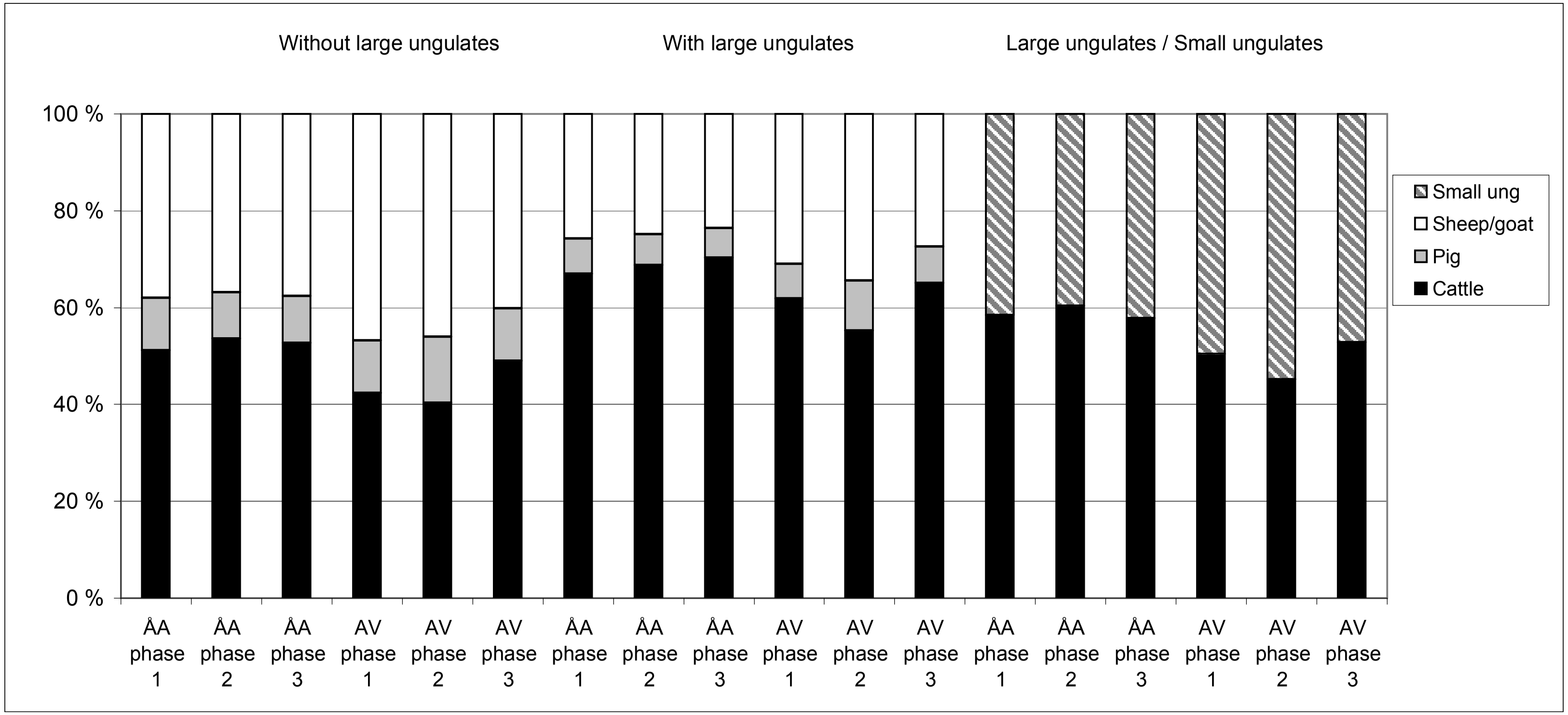

Figure 3.The relative abundance of major domestic species in different phases (NISP). The first figure in each phase represents cattle without large ungulates, the second with large ungulates and the third total amount of small ungulates compared to large ones. For closer definition see text, data in appendices 6-7.

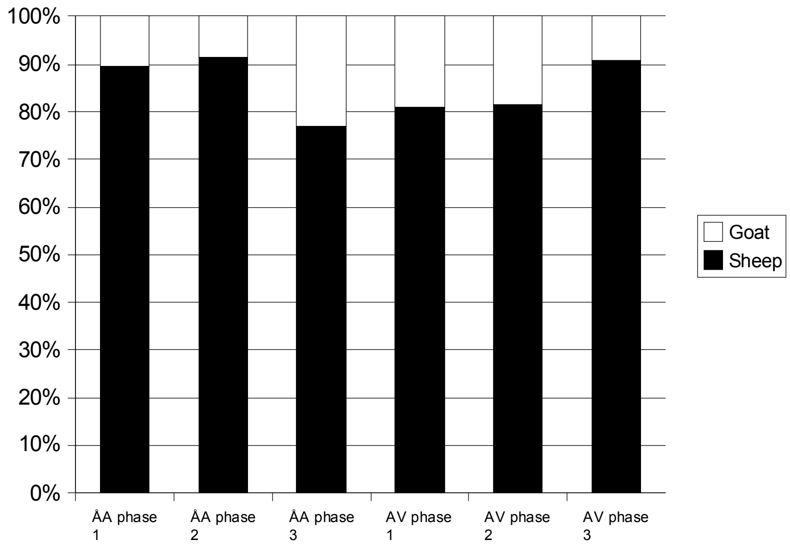

Figure 4. The relative abundance of sheep and goat specimens in different phases. Counted from all specimens (data in appendix 16).

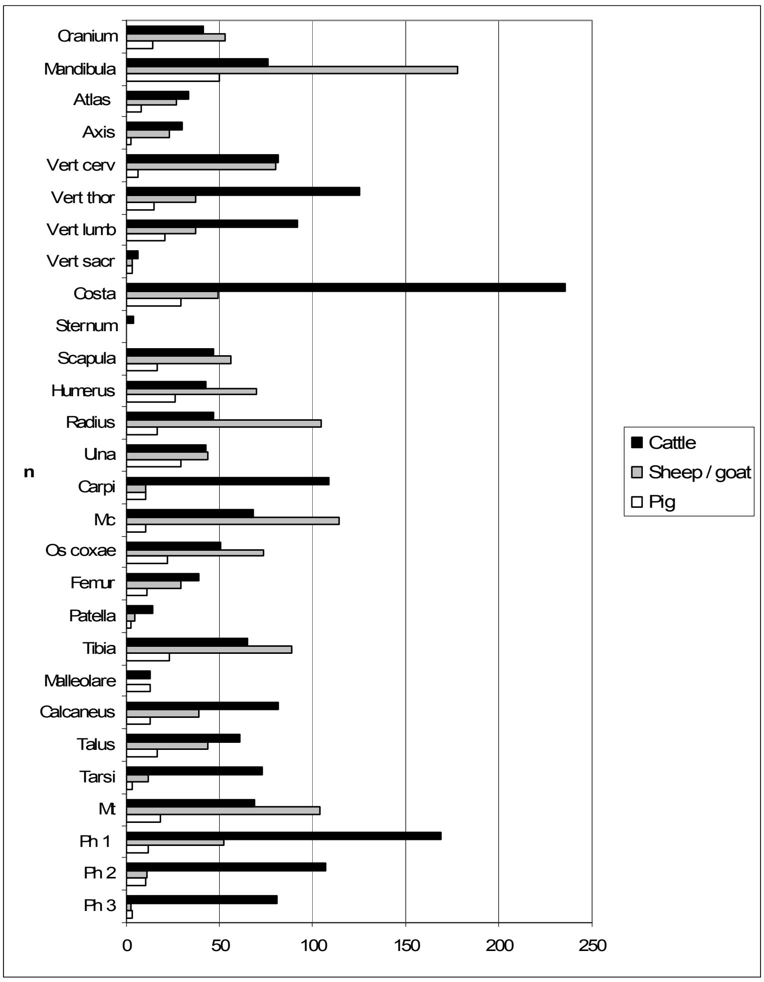

Figure 5. MNE values of cattle, small bovids and pigs in phase 1 at Åbo Akademi.

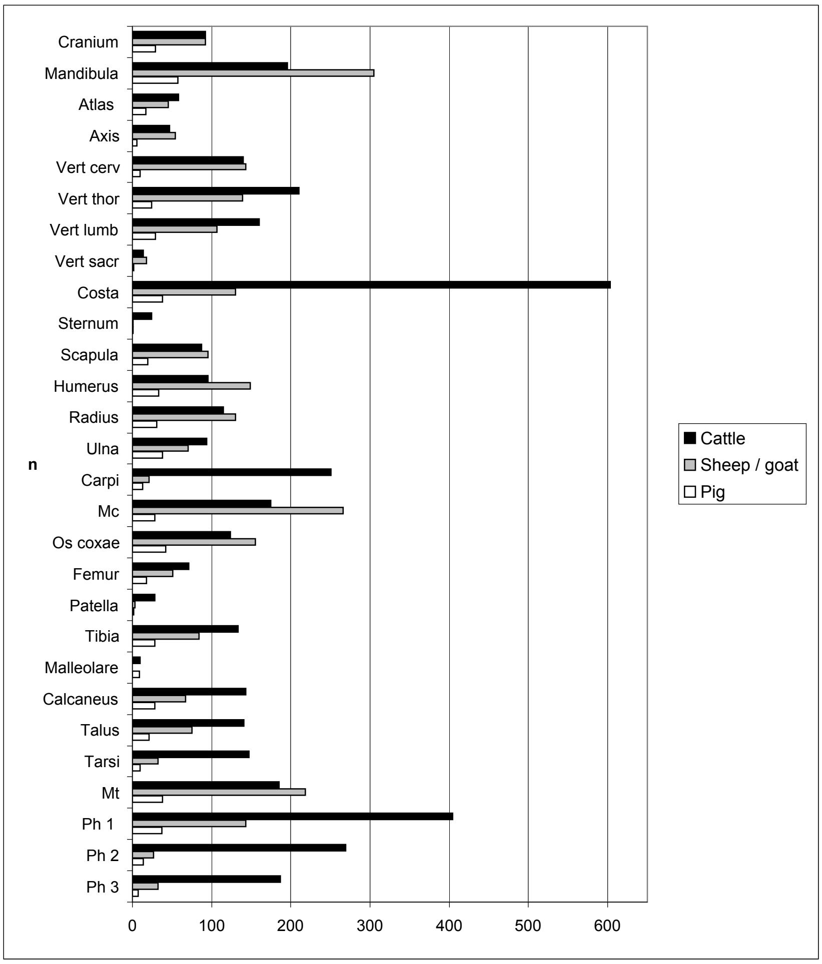

Figure 6. MNE values of cattle, small bovids and pigs in phase 2 at Åbo Akademi.

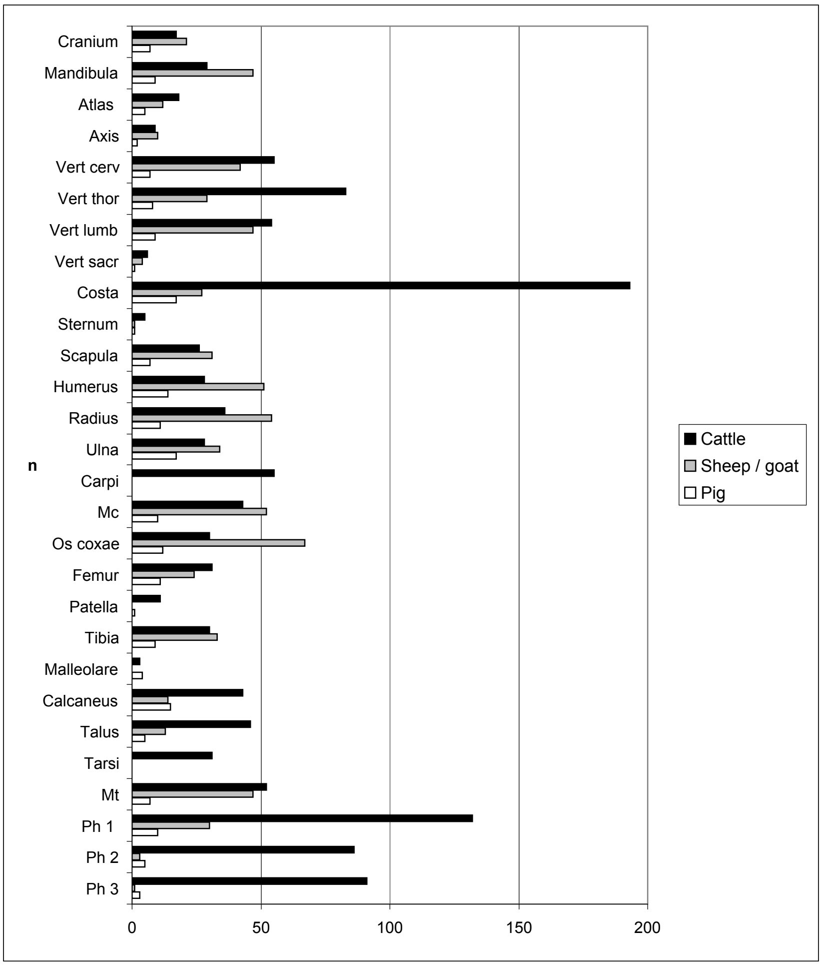

Figure 7. MNE values of cattle, small bovids and pigs in phase 3 at Åbo Akademi.

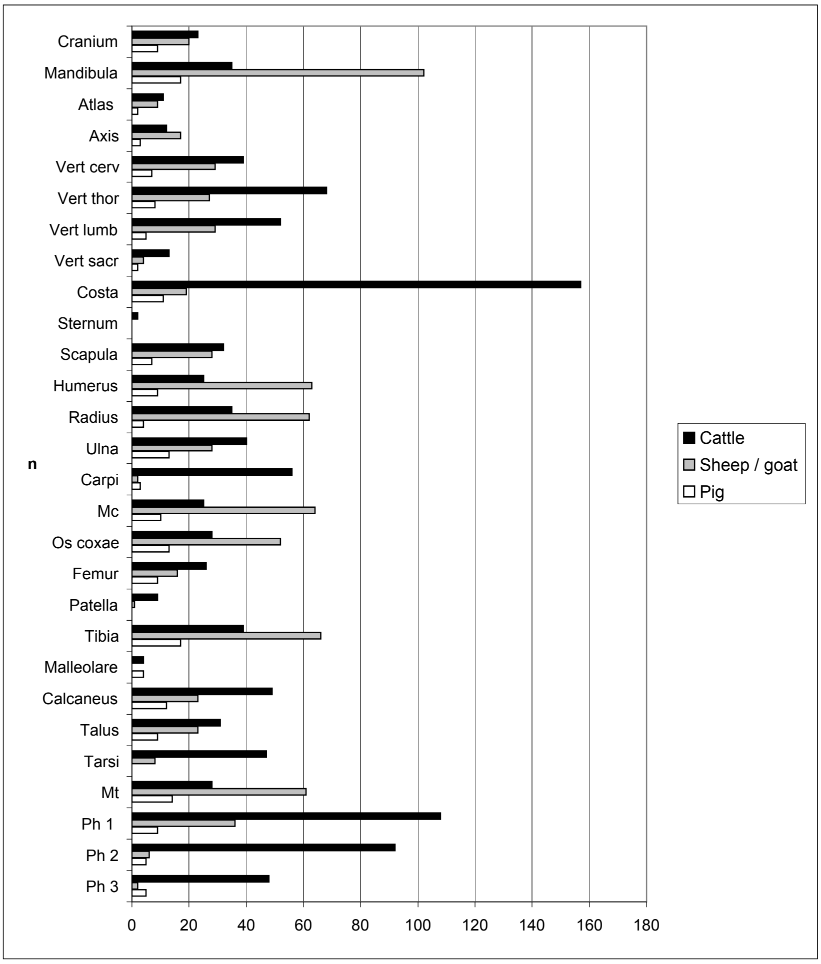

Figure 8. MNE values of cattle, small bovids and pigs in phase 1 at Aboa Vetus.

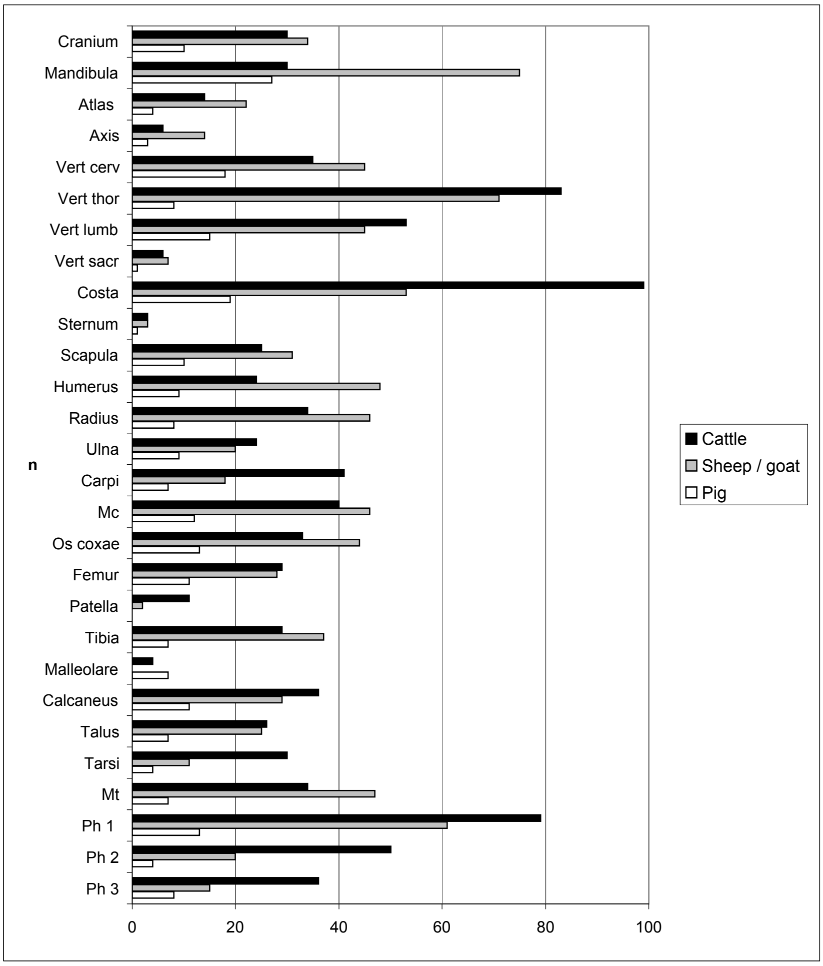

Figure 9. MNE values of cattle, small bovids and pigs in phase 2 at Aboa Vetus.

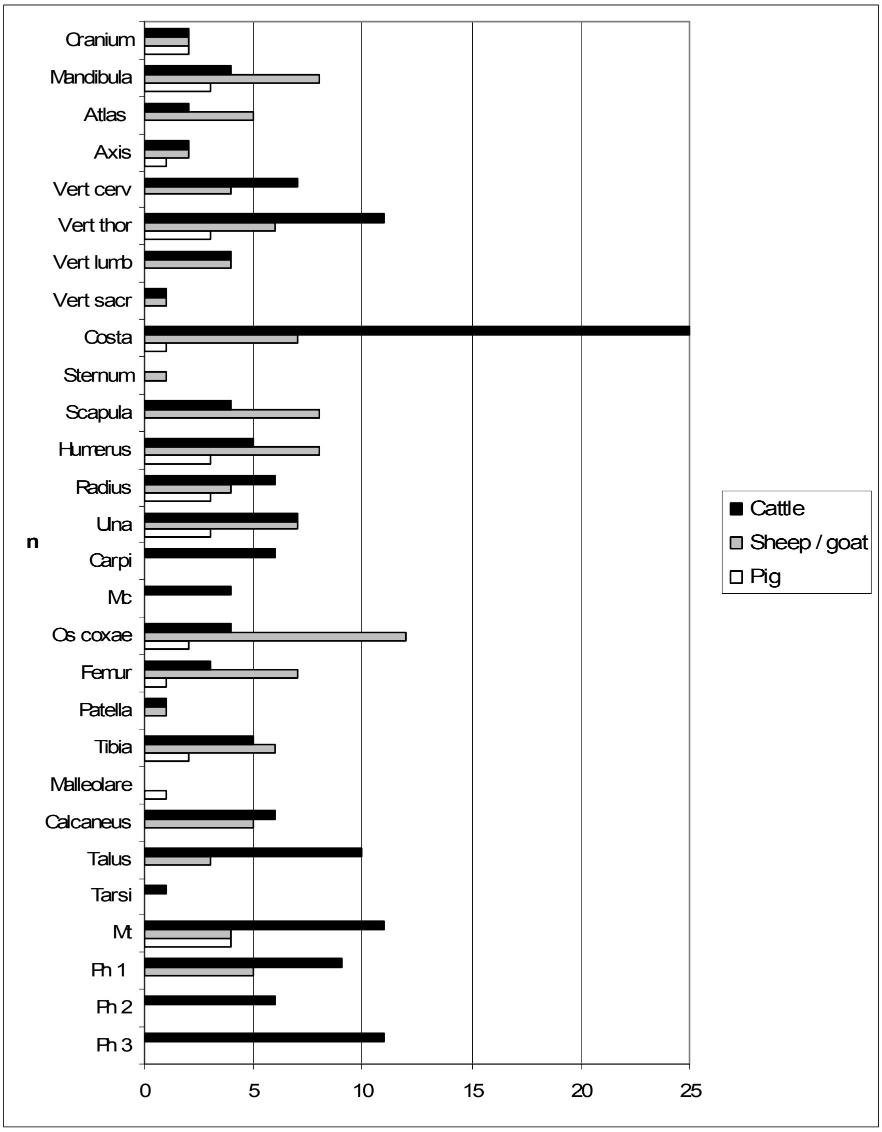

Figure 10. MNE values of cattle, small bovids and pigs in phase 3 at Aboa Vetus

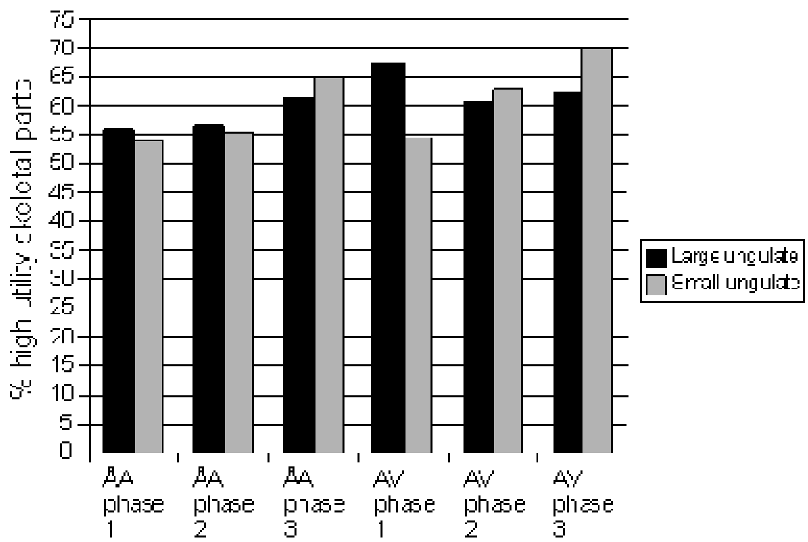

Figure 11. Proportion of high utility skeletal parts of large and small ungulates in different phases (NISP).

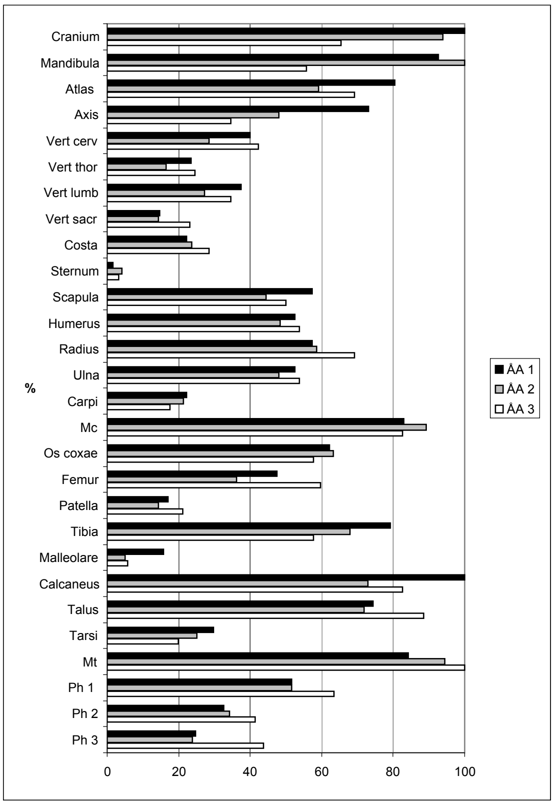

Figure 12. Anatomical distribution of cattle in phases 1, 2 and 3 at Åbo Akademi, based on MNE figures. Presented as %MAU.

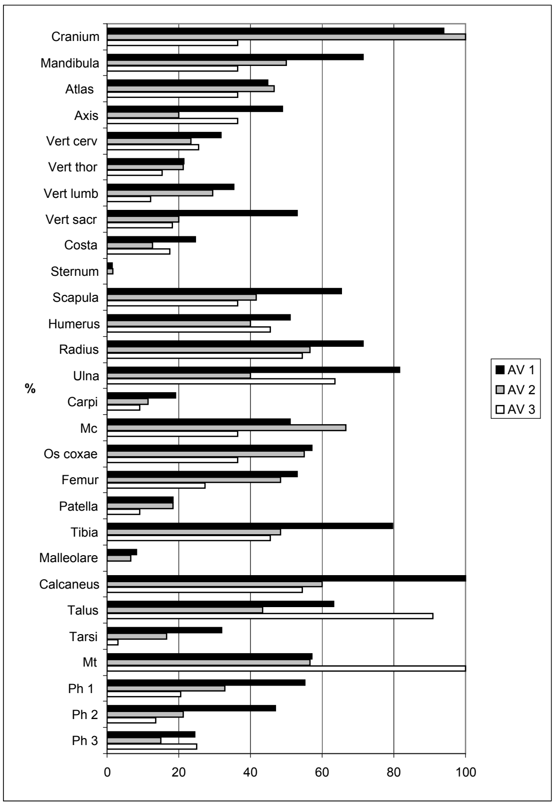

Figure 13. Anatomical distribution of cattle in phases 1, 2 and 3 at Aboa Vetus, based on MNE figures. Presented as %MAU.

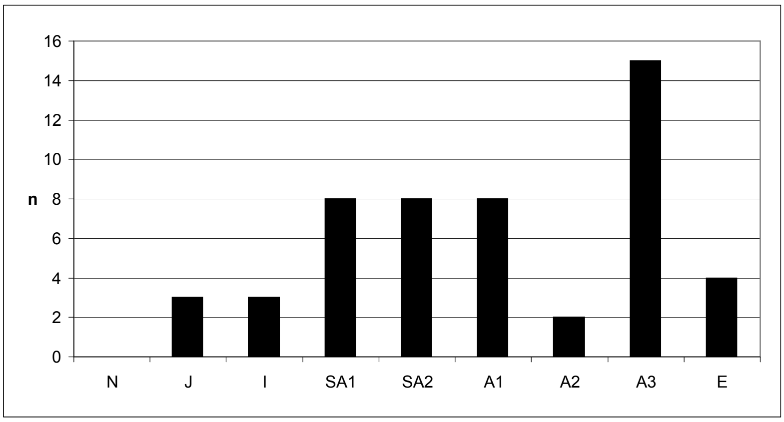

Figure 14. Cattle mandibles from phase 1 at Åbo Akademi divided into age groups according to O´Connor (2003).

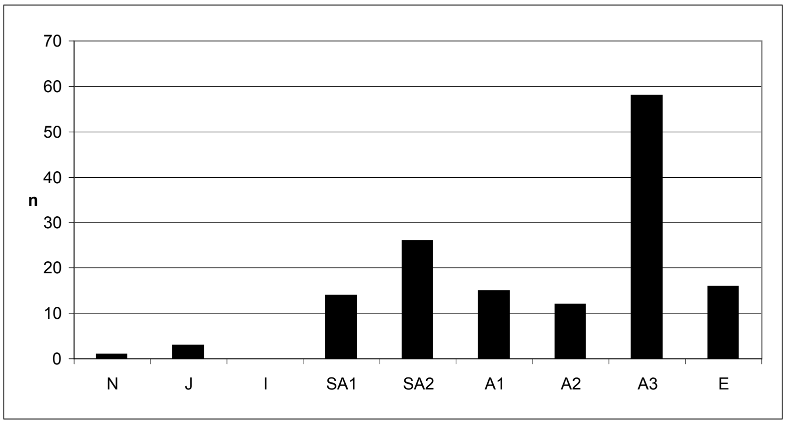

Figure 15. Cattle mandibles from phase 2 at Åbo Akademi divided into age groups according to O´Connor (2003).

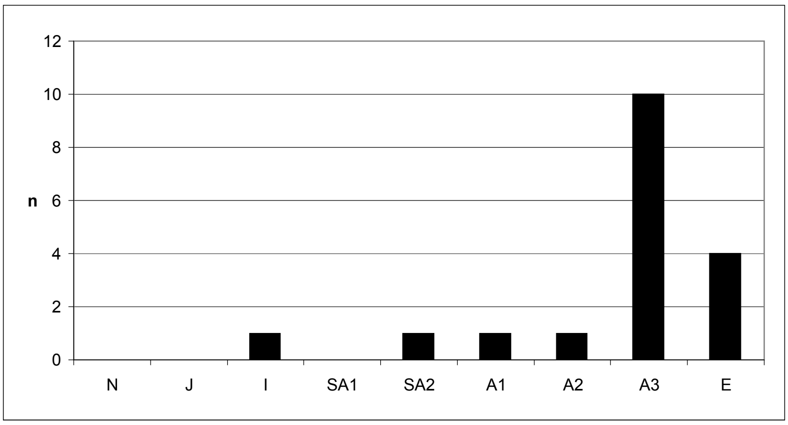

Figure 16. Cattle mandibles from phase 3 at Åbo Akademi divided into age groups according to O´Connor (2003).

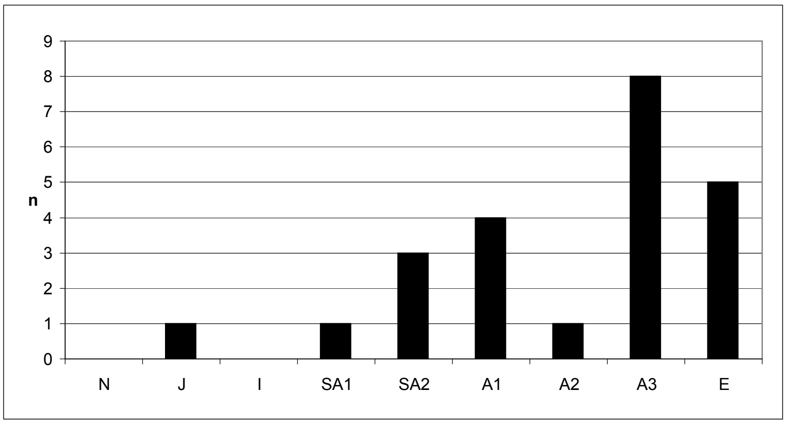

Figure 17. Cattle mandibles from phase 1 at Aboa Vetus divided into age groups according to O´Connor (2003).

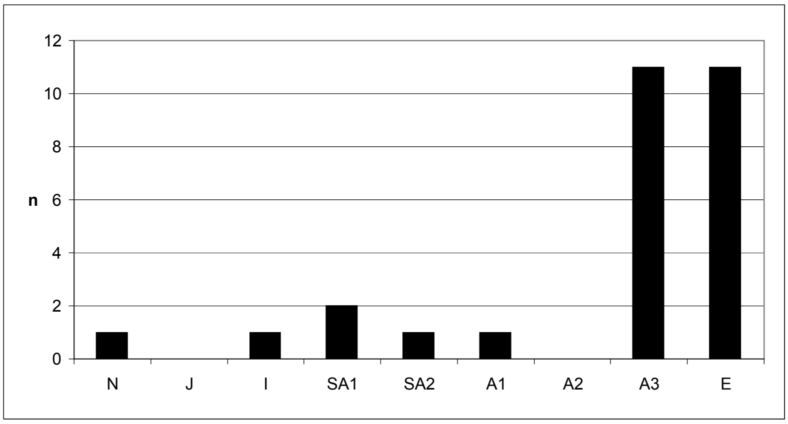

Figure 18. Cattle mandibles from phase 2 at Aboa Vetus divided into age groups according to O´Connor (2003).

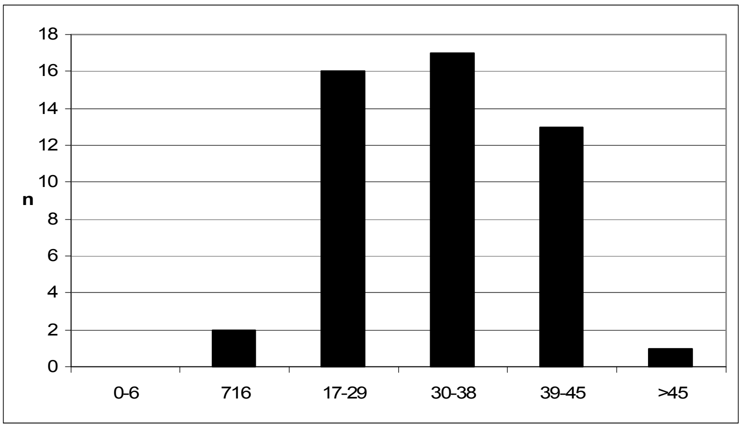

Figure 19. Cattle mandibles from phase 1 at Åbo Akademi divided into age groups by MSW (Grant 1982, Vretemark 1997).

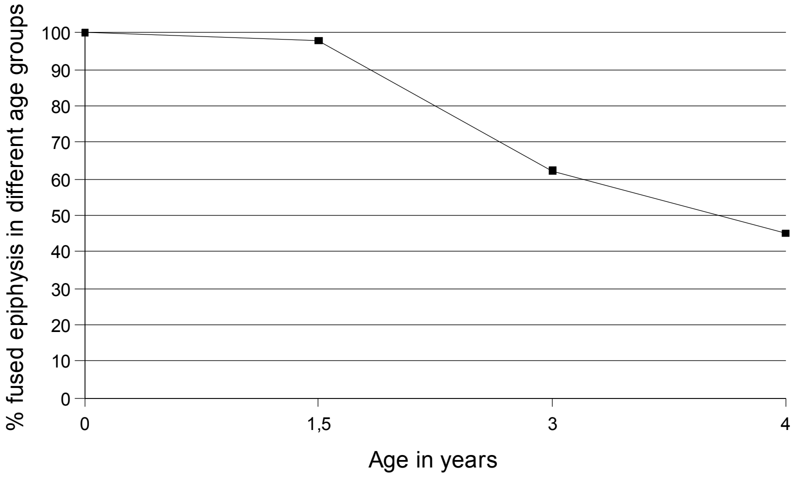

Figure 20. Age distribution of cattle based on epihyseal data in phase 1 at Åbo Akademi.

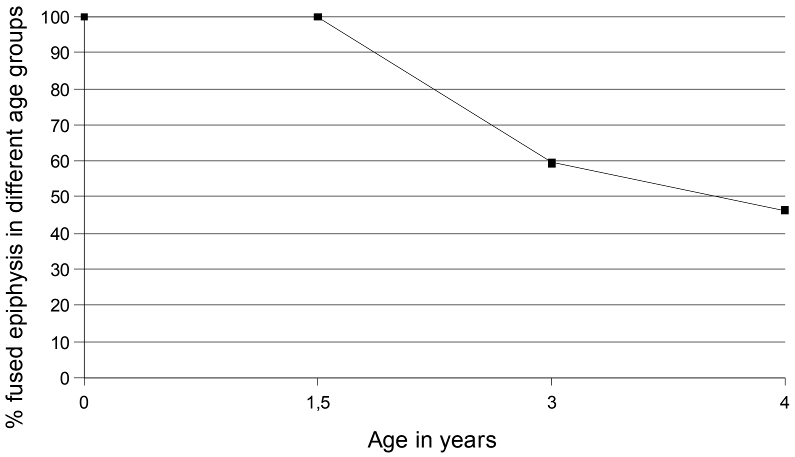

Figure 21. Age distribution of cattle based on epihyseal data in phase 2 at Åbo Akademi.

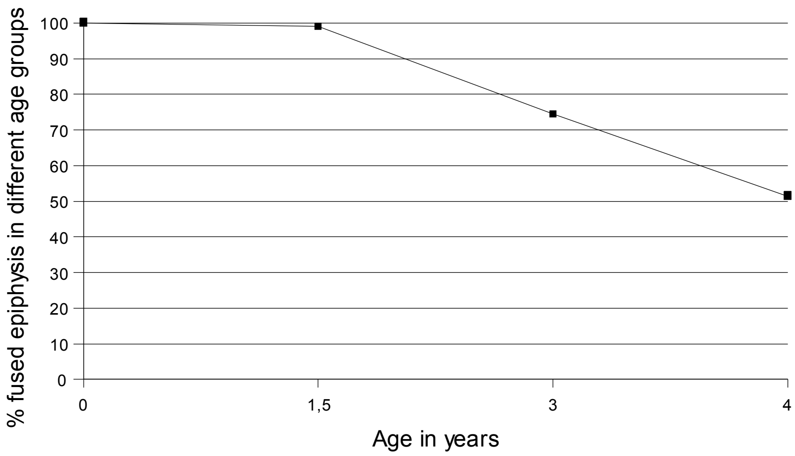

Figure 22. Age distribution of cattle based on epihyseal data in phase 3 at Åbo Akademi.

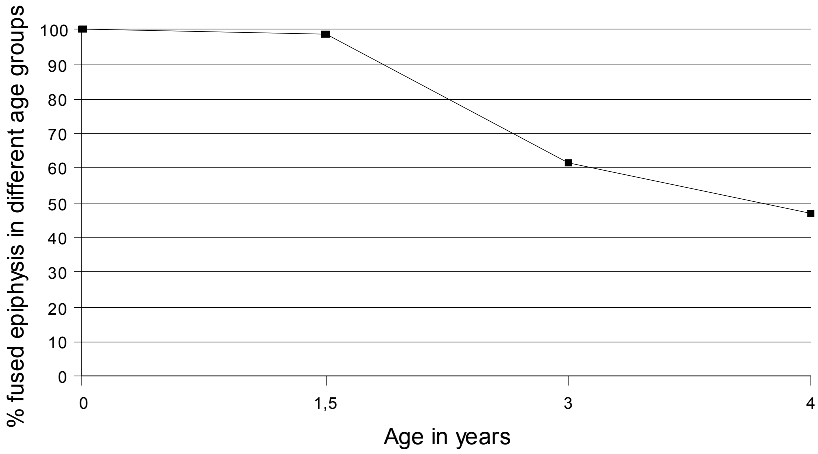

Figure 23. Age distribution of cattle based on epihyseal data in phase 1 at Aboa Vetus.

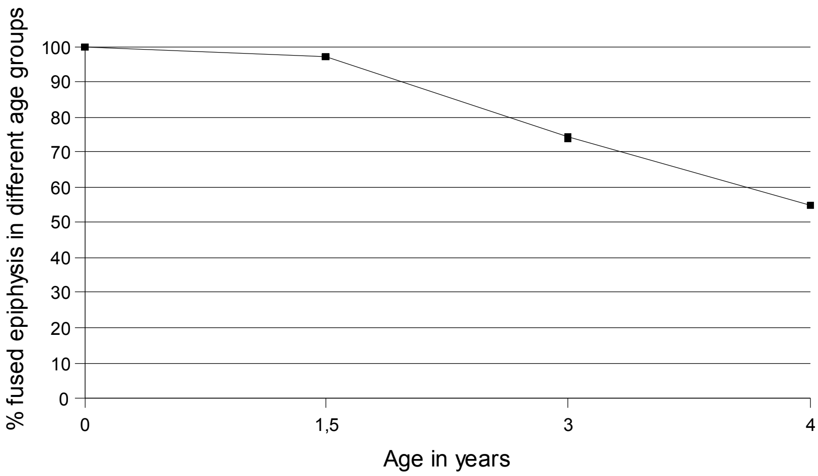

Figure 24. Age distribution of cattle based on epihyseal data in phase 2 at Aboa Vetus.

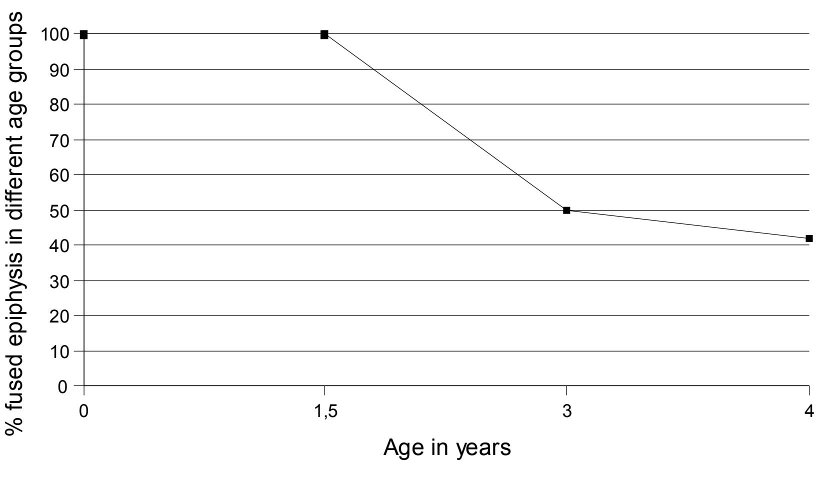

Figure 25. Age distribution of cattle based on epihyseal data in phase 3 at Aboa Vetus.

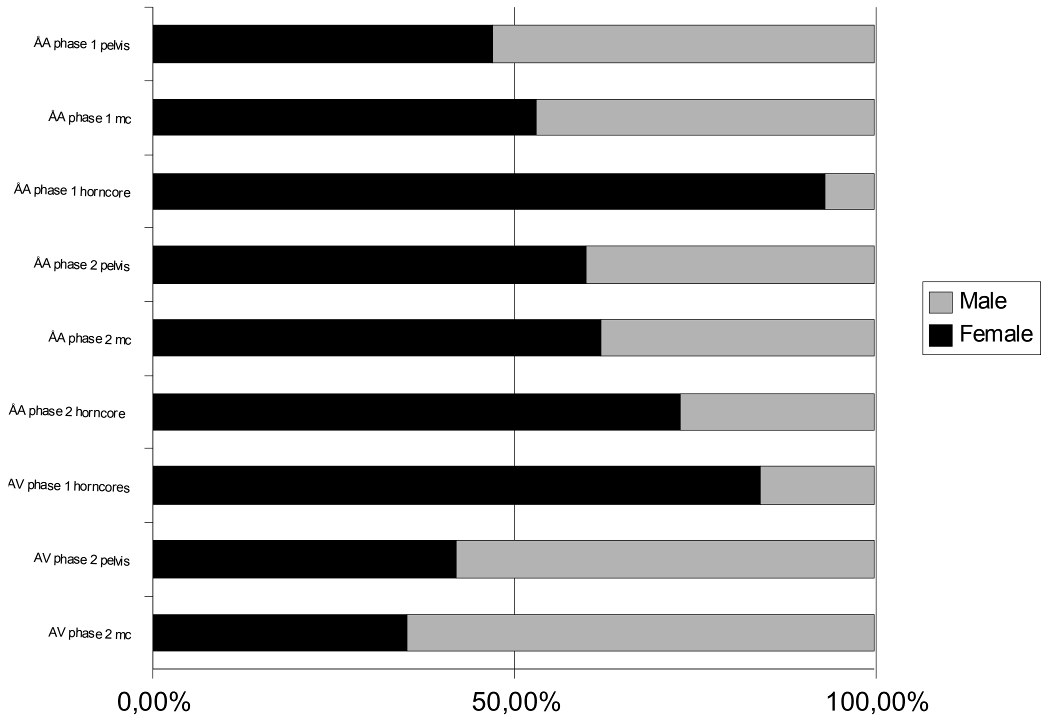

Figure 26. Summary of cattle sex data in different phases obtained from pelves, metacarpals and horn cores. Measurable metacarpals: ÅA phase 3 n = 7, AV phase 1, n = 5 and AV phase 3 n = 1. Measurable horn cores: ÅA phase 3 n = 0, AV phase 2, n = 1 and in AV phase 3 n = 0.

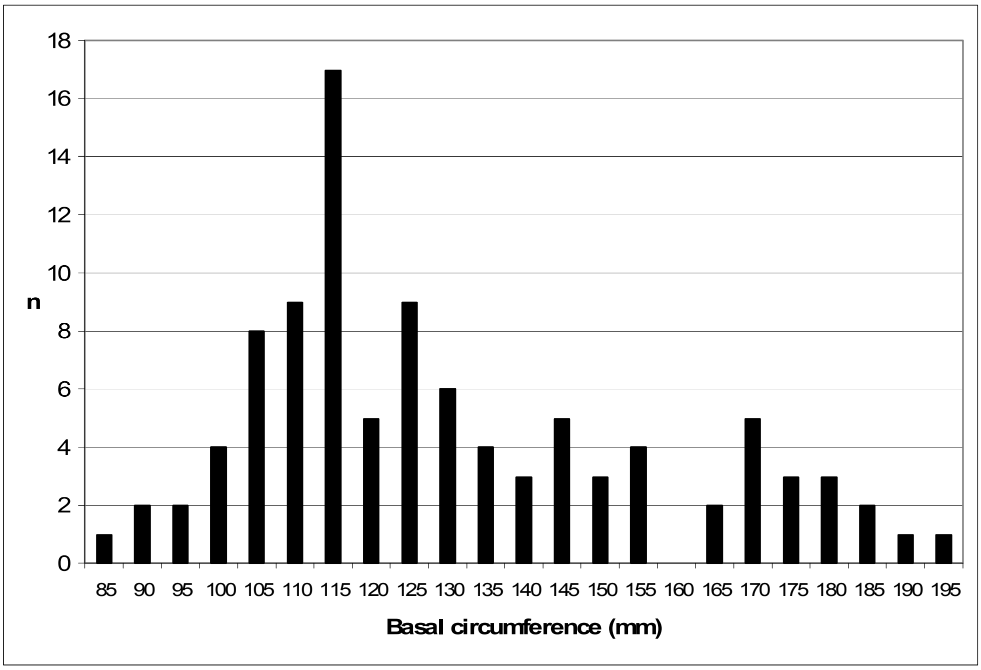

Figure 27. Distribution of basal circumference measurements of horn cores in medieval phases (Åbo Akademi: phases 1 and 2, Aboa Vetus: phase 1).

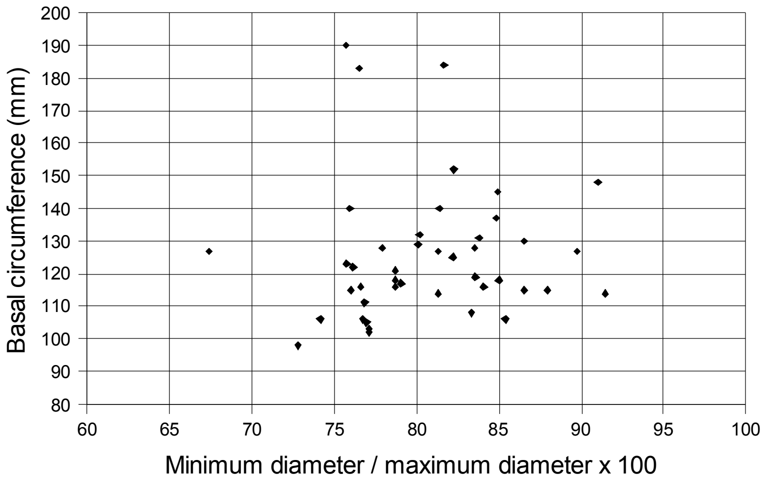

Figure 28. Cattle horn core measurements in phase 1 at Åbo Akademi, according to Benecke (1988). n = 43.

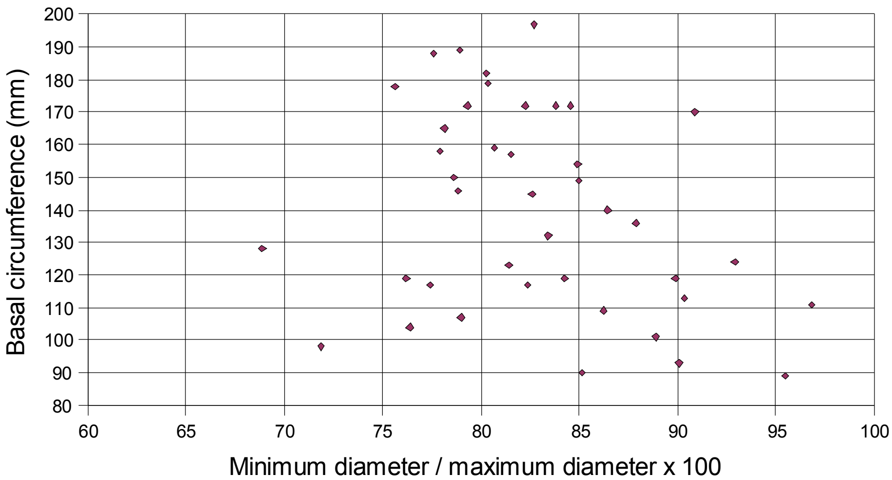

Figure 29. Cattle horn core measurements in phase 2 at Åbo Akademi, according to Benecke (1988). n = 41.

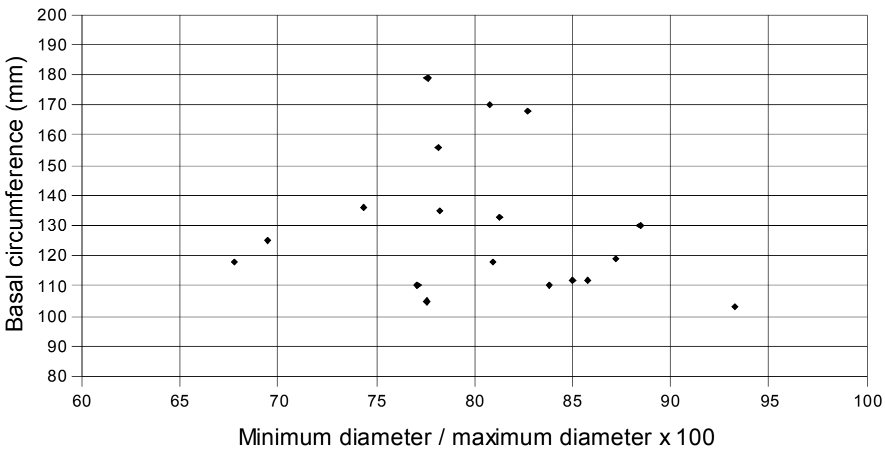

Figure 30. Cattle horn core measurements in phase 1 at Aboa Vetus, according to Benecke (1988). n = 18.

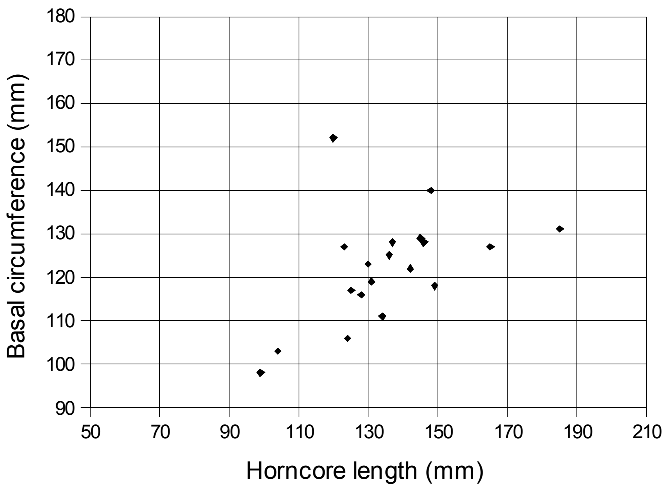

Figure 31. Cattle horn core length and basal circumference in phase 1 at Åbo Akademi, according to Müller (1959). n

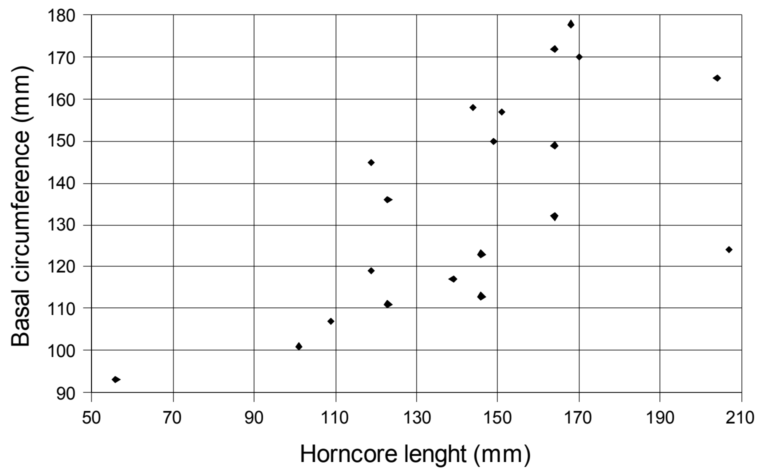

Figure 32. Cattle horn core length and basal circumference in phase 2 at Åbo Akademi, according to Müller (1959). n

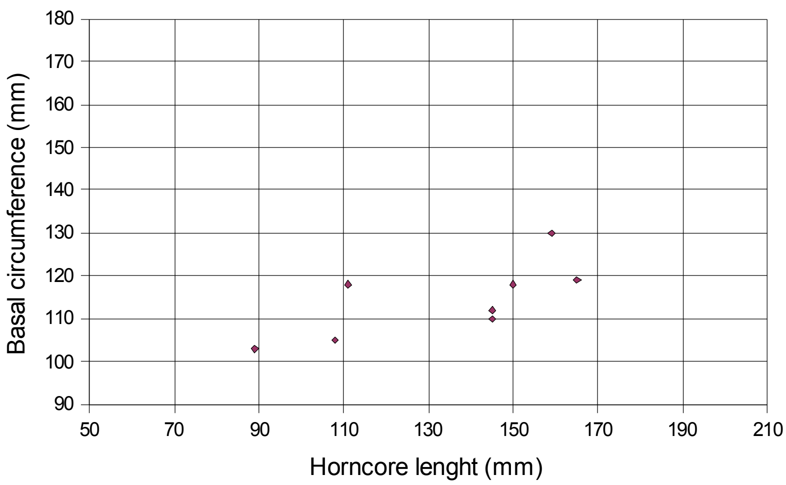

Figure 33. Cattle horn core length and basal circumference in phase 1 at Aboa Vetus, according to Müller (1959). n = 8.

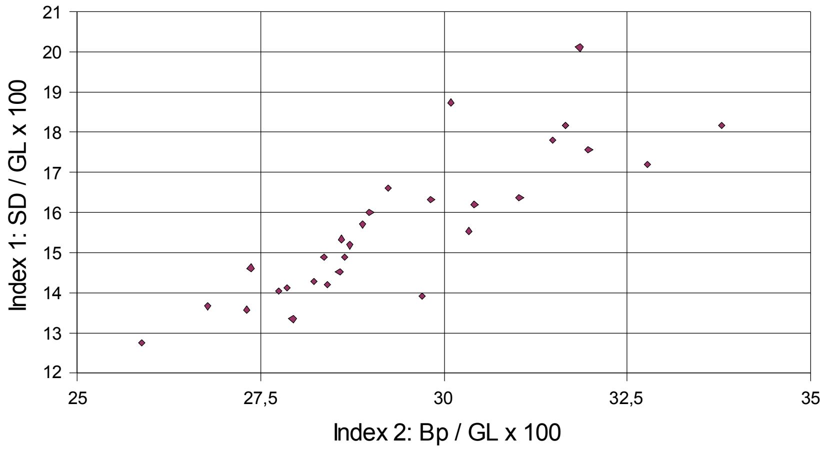

Figure 34. Distribution of cattle metacarpals according to Mennerich's (1968) indexes in phase 1 at Åbo Akademi. Thresholds separating males and females: index 1 16,5, index 2 29,5.

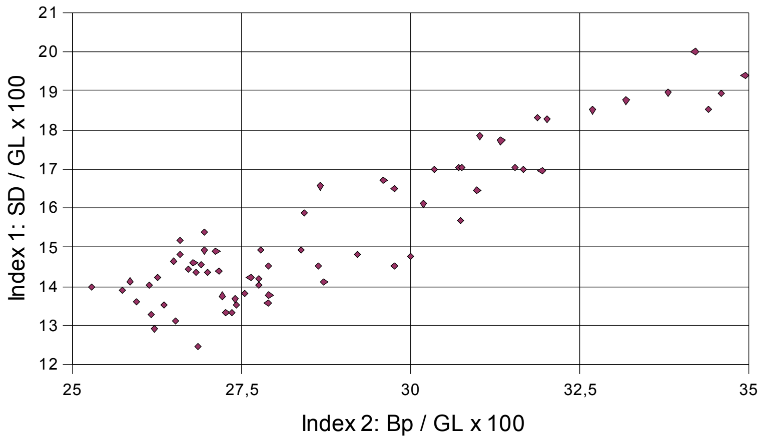

Figure 35. Distribution of cattle metacarpals according to Mennerich's (1968) indexes in phase 2 at Åbo Akademi. Thresholds separating males and females: index 1 16,5, index 2 29,5.

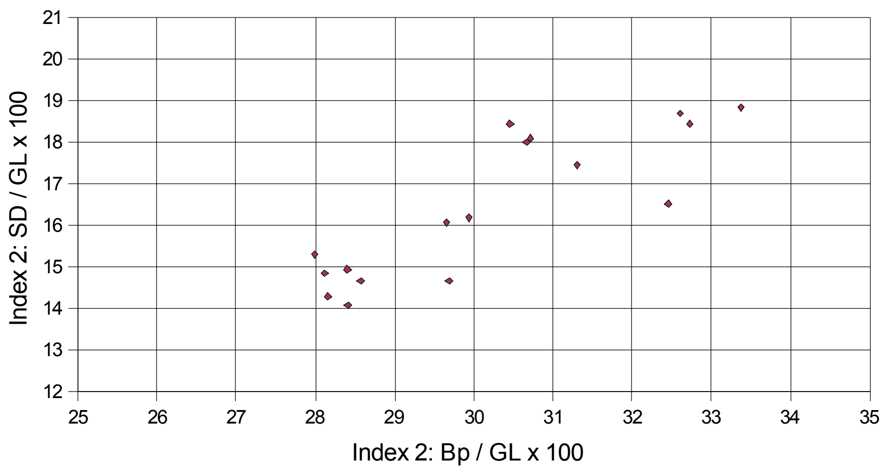

Figure 36. Distribution of cattle metacarpals according to Mennerich's (1968) indexes in phase 2 at Aboa Vetus. Thresholds separating males and females: index 1 16,5, index 2 29,5.

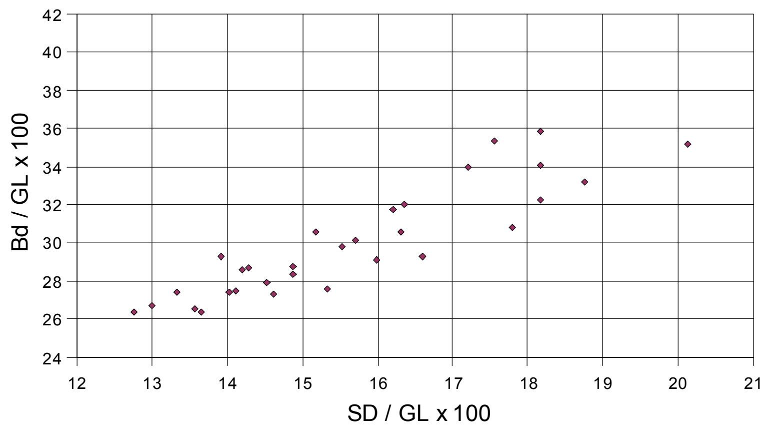

Figure 37. Distribution of cattle metacarpals in phase 1 at Åbo Akademi, according to Howard (1963).

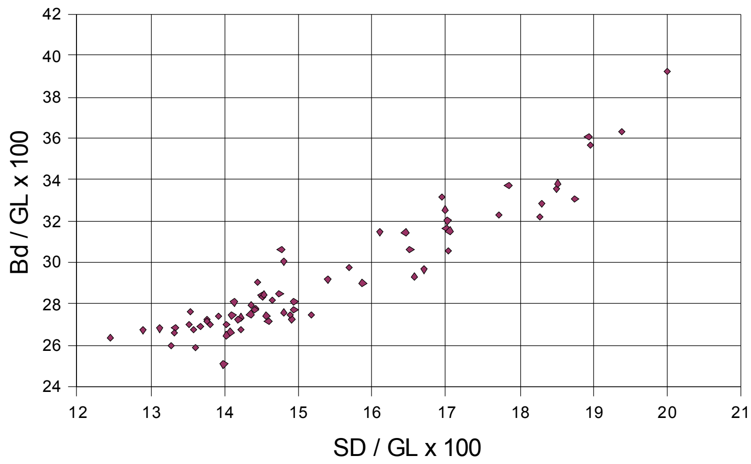

Figure 38. Distribution of cattle metacarpals in phase 2 at Åbo Akademi, according to Howard (1963).

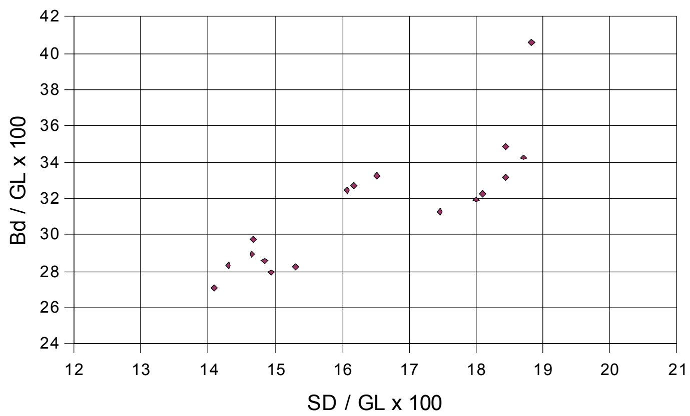

Figure 39. Distribution of cattle metacarpals in phase 2, Aboa Vetus, according to Howard (1963).

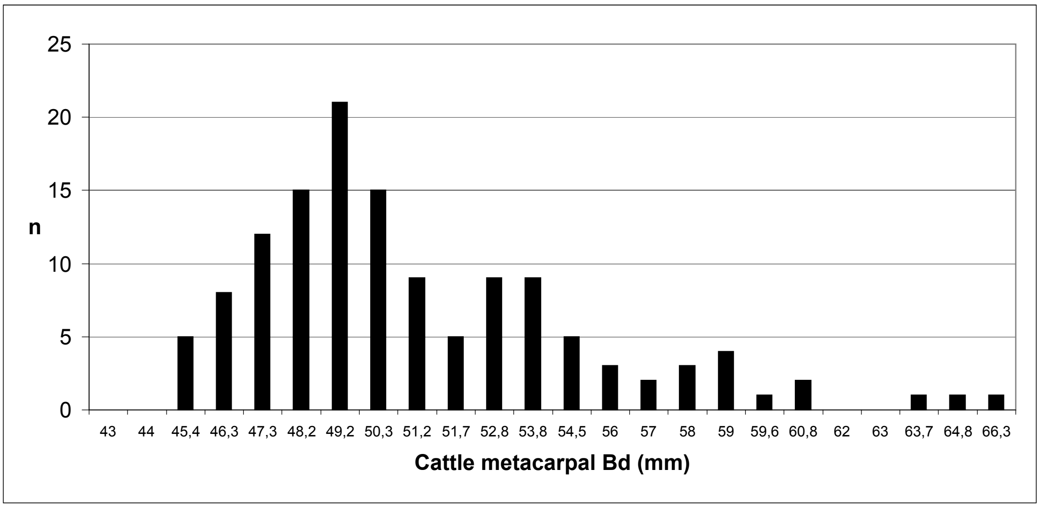

Figure 40. Distribution of distal breath measurements of cattle metacarpals in the medieval phases.

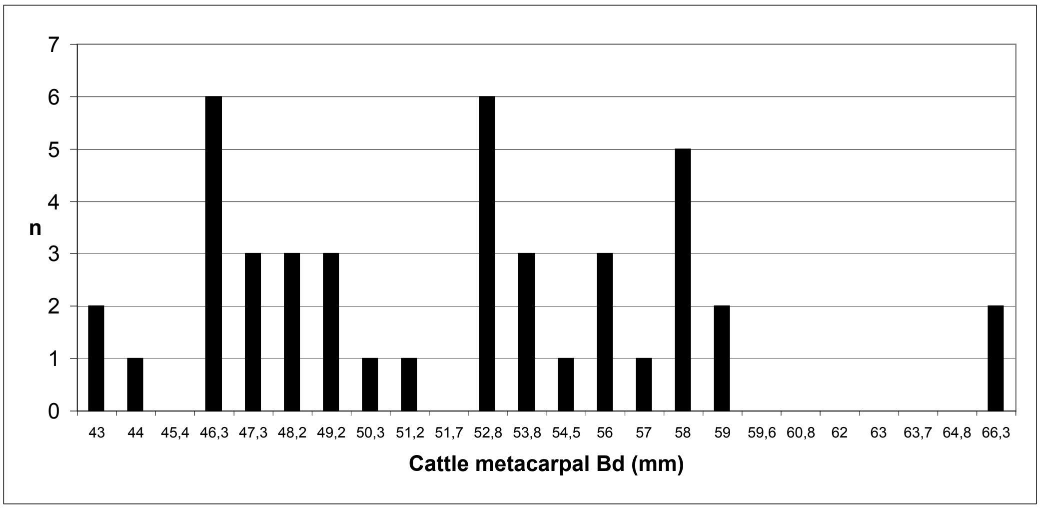

Figure 41. Distribution of distal breath measurements of cattle metacarpals in the post-medieval phases.

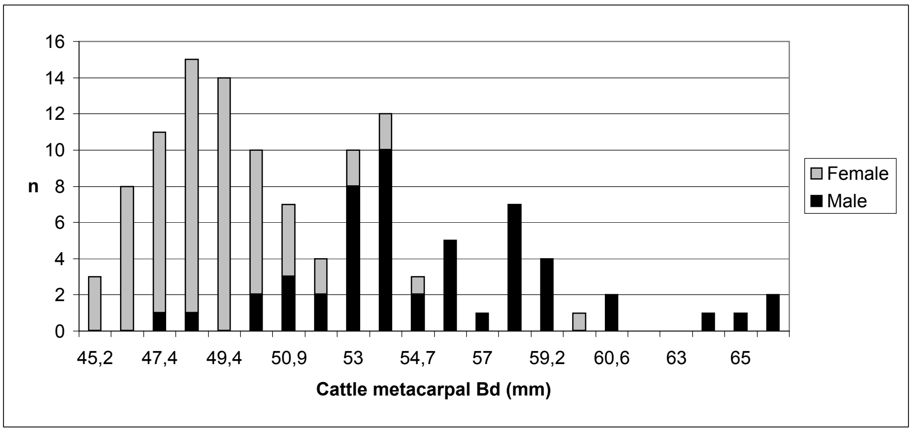

Figure 42. Distribution of distal breath measurements of cattle metacarpals sexed using Mennerich's (1968) method.

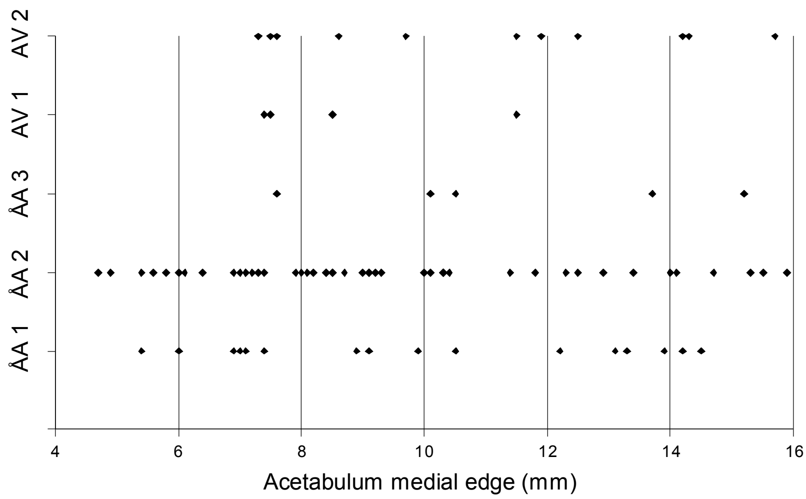

Figure 43. Distribution of acetabulum medial edge thickness of cattle pelves in the different phases.
Threshold separating male and female animals is set to 9,5 mm.
n = ÅA 1: 17, ÅA 2: 48, ÅA 3: 5, AV 1: 5 and AV 2: 12.

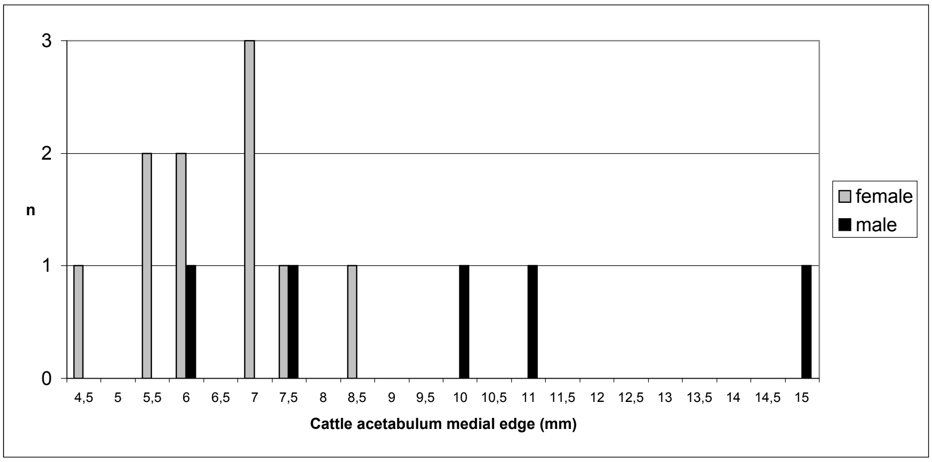

Figure 44. Distribution of acetabulum medial edge measurements of cattle pelves sexed with morphological criteria.

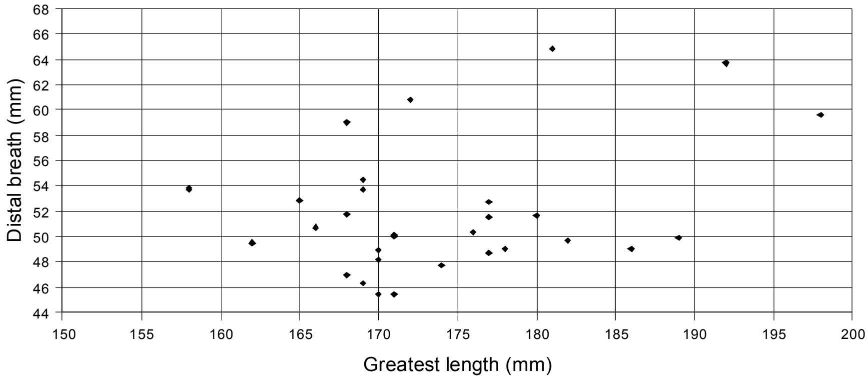

Figure 45. Cattle metacarpal greatest length and distal breath in phase 1 at Åbo Akademi. n = 31.

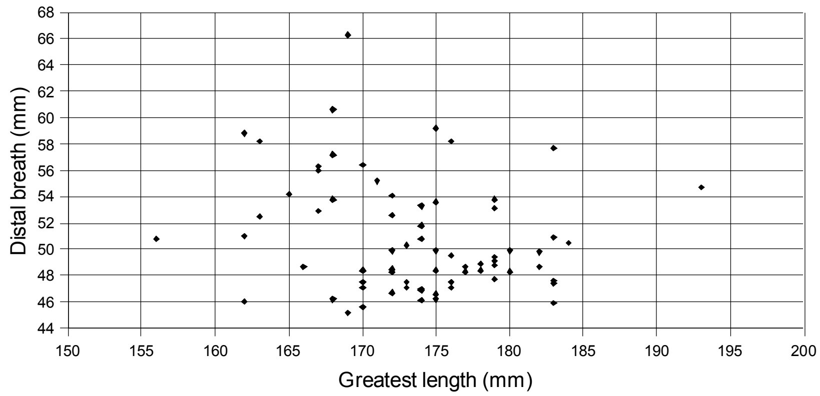

Figure 46. Cattle metacarpal greatest length and distal breath in phase 2 at Åbo Akademi. n = 71.

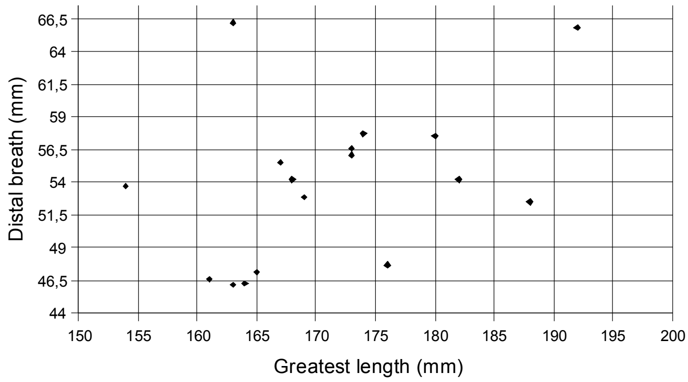

Figure 47. Cattle metacarpal greatest length and distal breath in phase 2 at Aboa Vetus. n = 17.

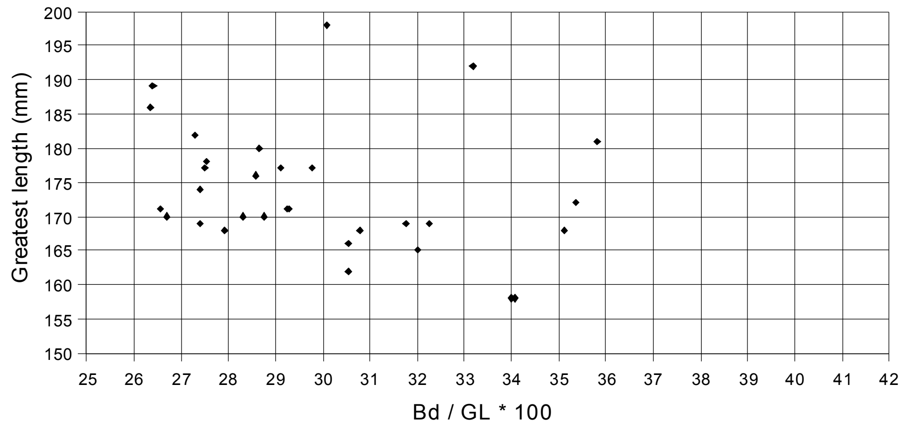

Figure 48. Size and shape of cattle metacarpals in phase 1 at Åbo Akademi. n = 31.

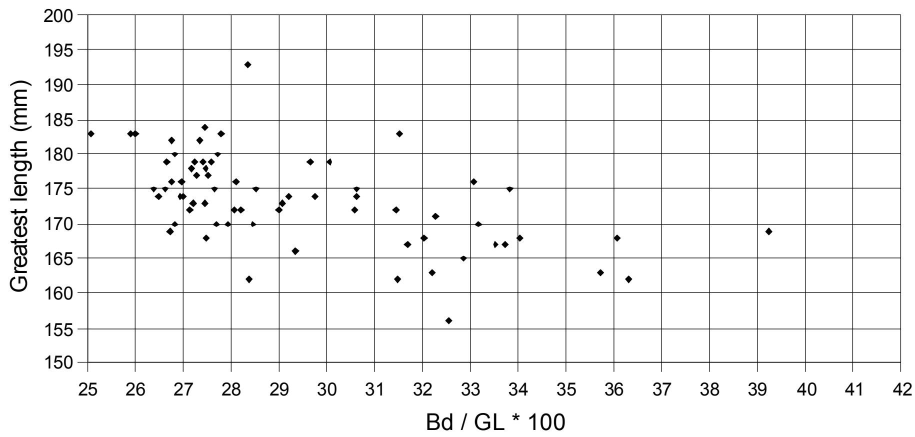

Figure 49. Size and shape of cattle metacarpals in phase 2 at Åbo Akademi. n = 71.

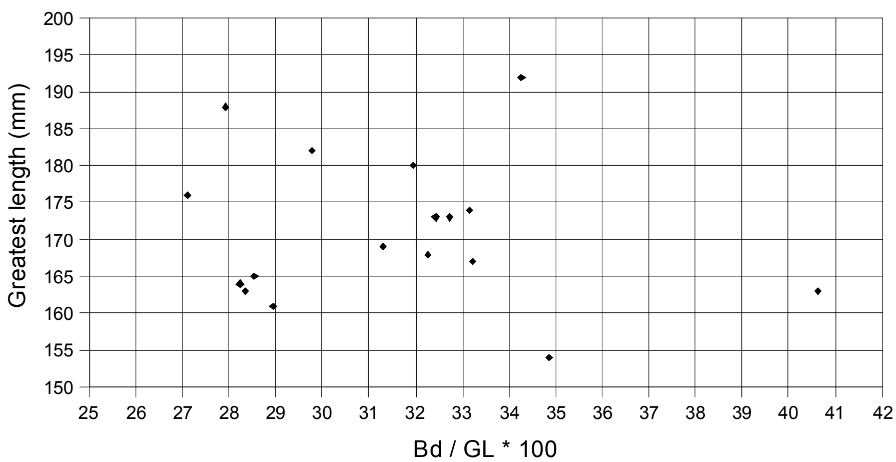

Figure 50. Size and shape of cattle metacarpals in phase 2 at Aboa Vetus. n = 17.

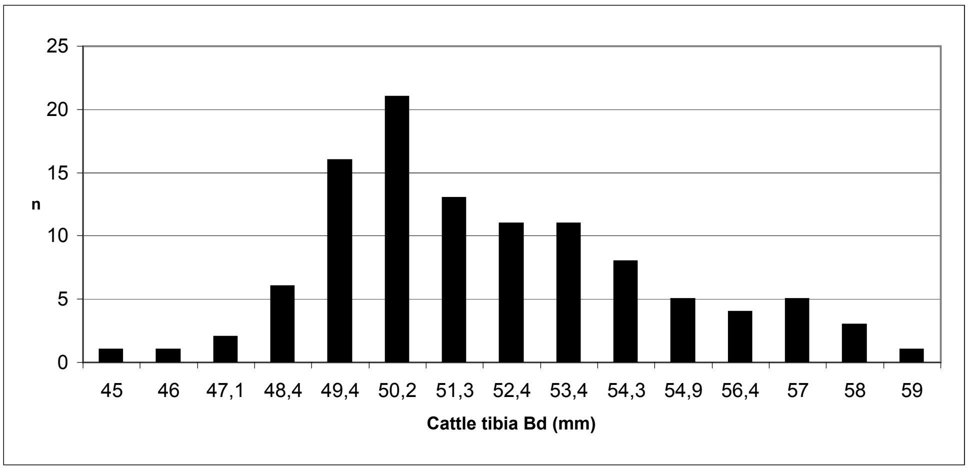

Figure 51. Distribution of cattle tibia distal breath measurements from the medieval phases in Turku.

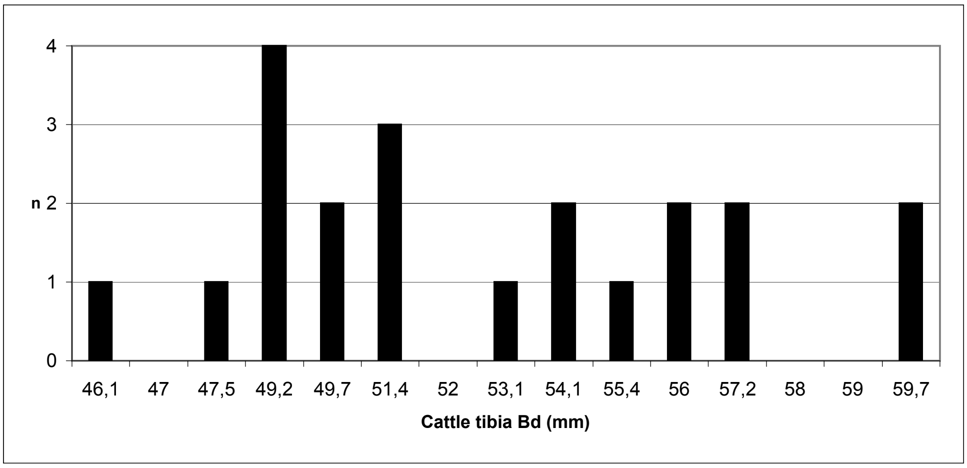

Figure 52. Distribution of cattle tibia distal breath measurements from the post-medieval phases in Turku.

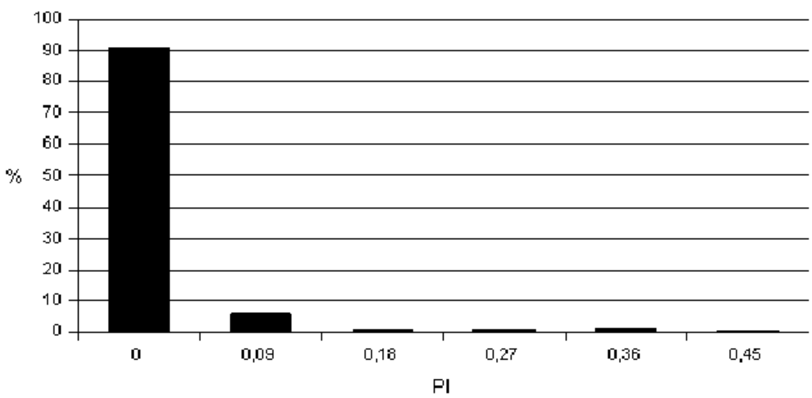

Figure 53. Distribution of cattle phalanx 1 PI- values in Turku (n=757). PI value counted according to Bartosiewicz e.al. 199

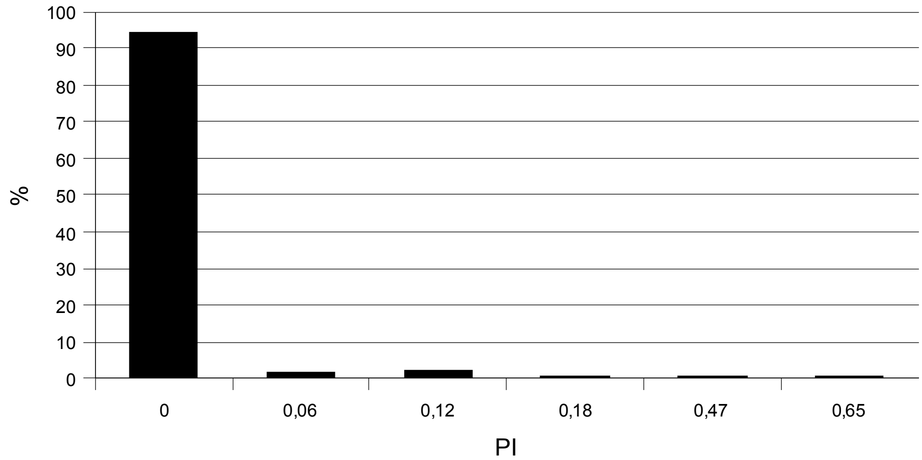

Figure 54. Distribution of cattle metacarpal PI- values in Turku (n=172).
PI value counted according to Bartosiewicz et al. 1997.

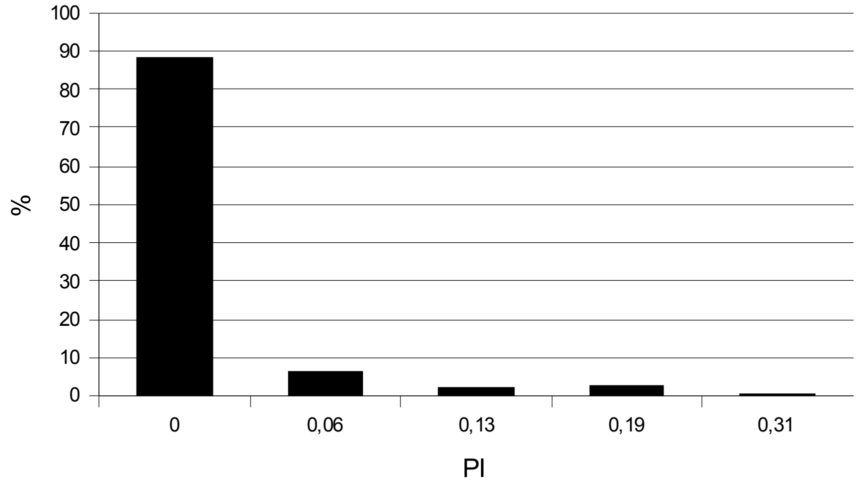

Figure 55. Distribution of cattle metatarsal PI- values in Turku (n= 147).
PI value counted according to Bartosiewicz et al. 1997.

Figure 56. Thoracic vertebrate of cattle (large ungulate) with fractured spina. Photo Auli Tourunen. Turku Provincial Museum.

Figure 57. Cattle (large ungulate) rib showing sings of extensive but healed inflammation. Photo Auli Tourunen. Aboa Vetus Museum.

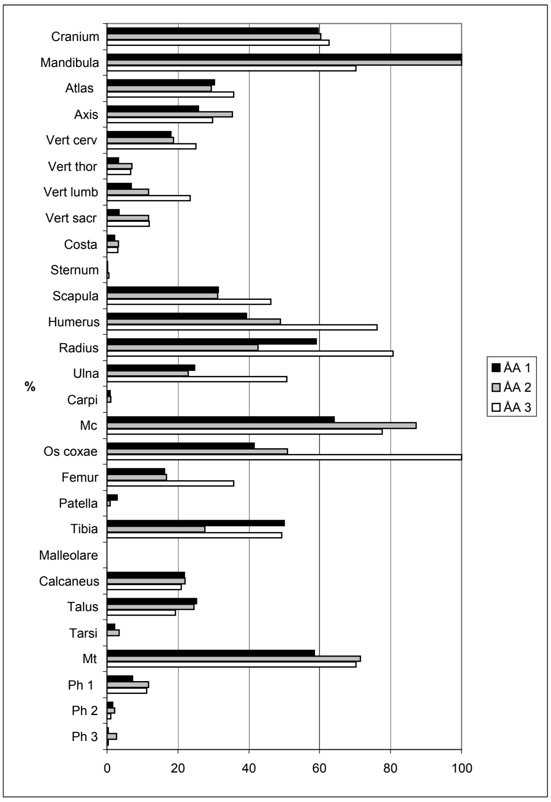

Figure 58. Anatomical distribution of small bovids in phases 1, 2 and 3 at Åbo Akademi, based on MNE figures. Presented as %MAU.

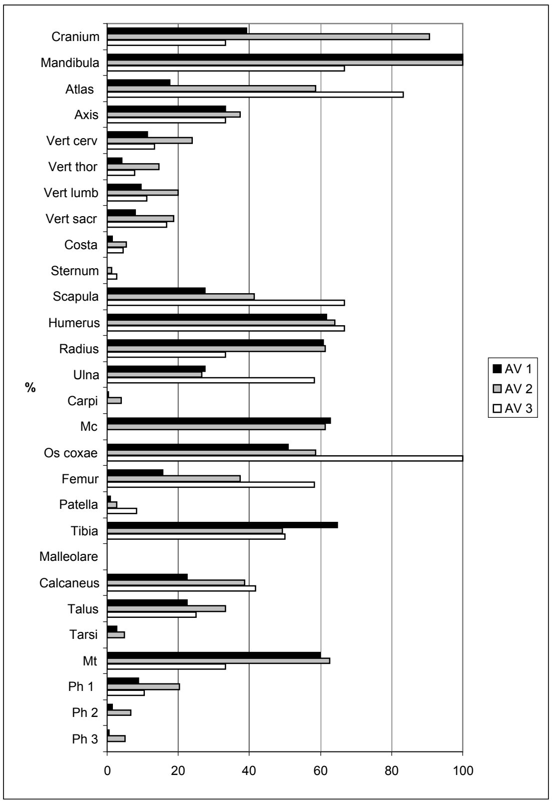

Figure 59. Anatomical distribution of small bovids in phases 1, 2 and 3 at Aboa Vetus, based on MNE figures. Presented as %MAU.

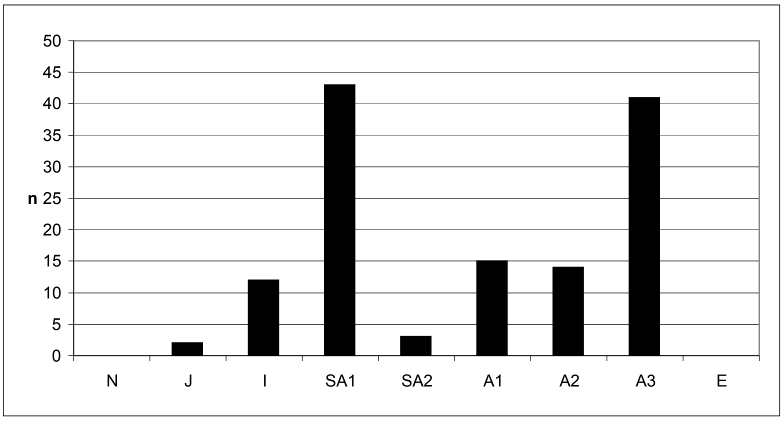

Figure 60. Small bovid mandibles from phase 1 at Åbo Akademi divided in age groups according to O´Connor (2003).

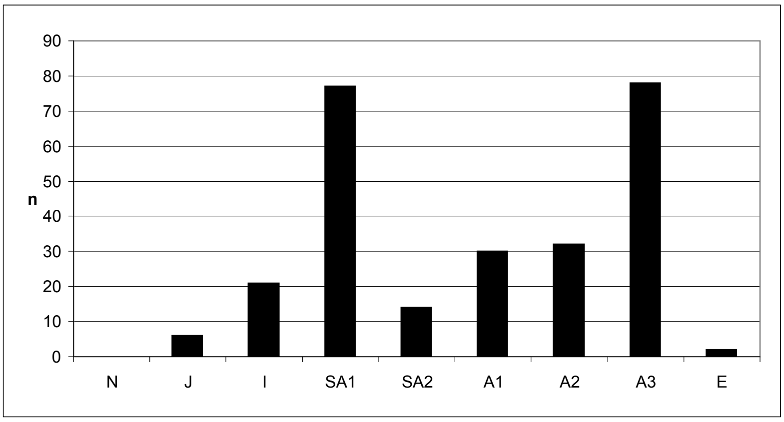

Figure 61. Small bovid mandibles from phase 2 at Åbo Akademi divided in age groups according to O´Connor (2003).

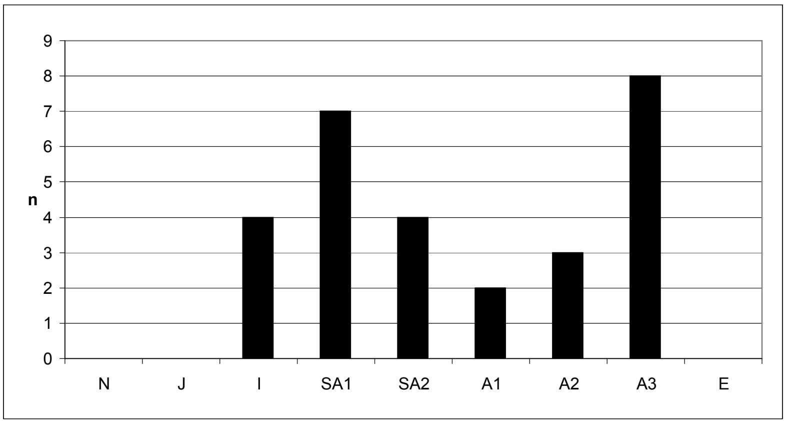

Figure 62. Small bovid mandibles from phase 3 at Åbo Akademi divided in age groups according to O´Connor (2003).

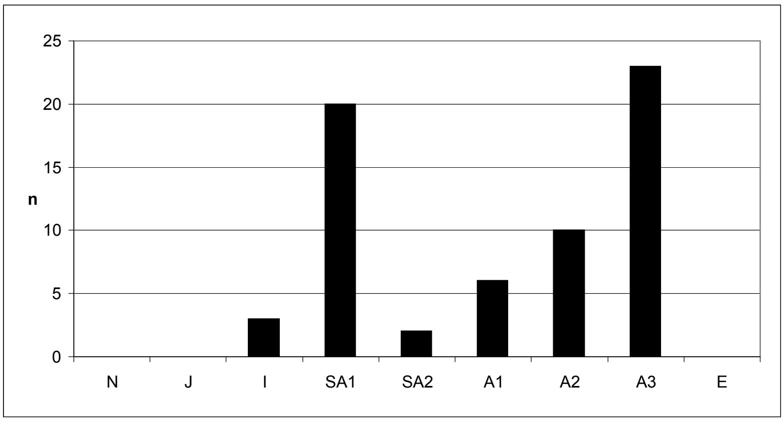

Figure 63. Small bovid mandibles from phase 1 at Aboa Vetus divided in age groups according to O´Connor (2003)

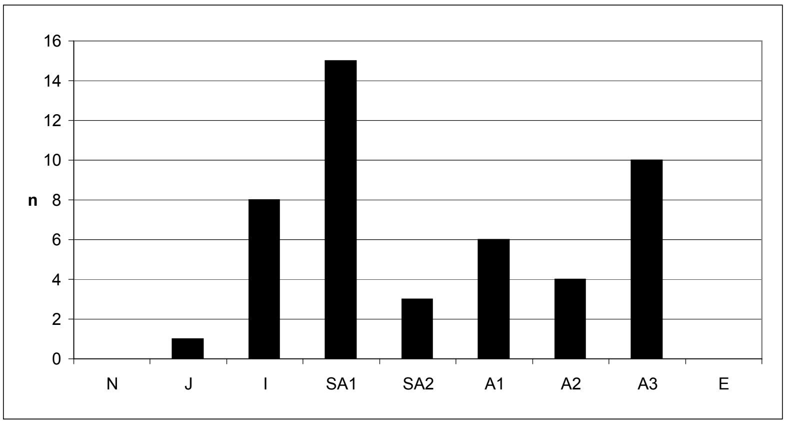

Figure 64. Small bovid mandibles from phase 2 at Aboa Vetus divided in age groups according to O´Connor (2003)

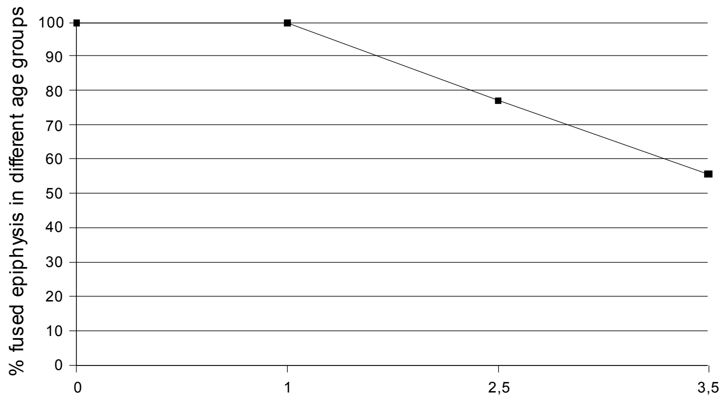

Figure 65. Age distribution of small bovids based on epihyseal data in phase 1 at Åbo Akademi .

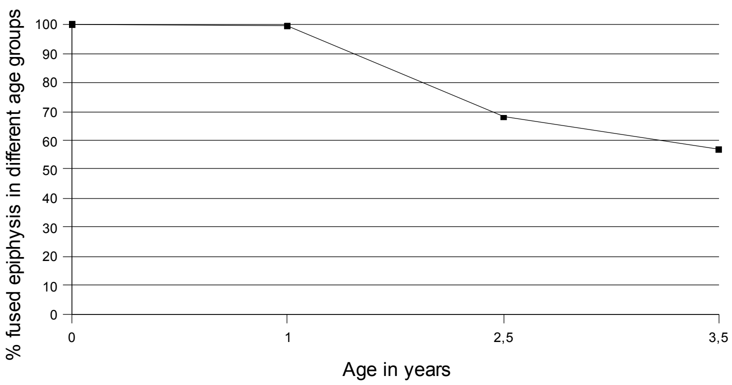

Figure 66. Age distribution of small bovids based on epihyseal data in phase 2 at Åbo Akademi .

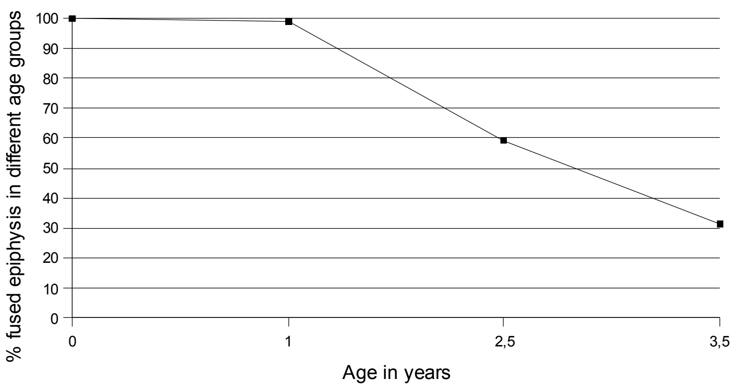

Figure 67. Age distribution of small bovids based on epihyseal data in phase 3 at Åbo Akademi

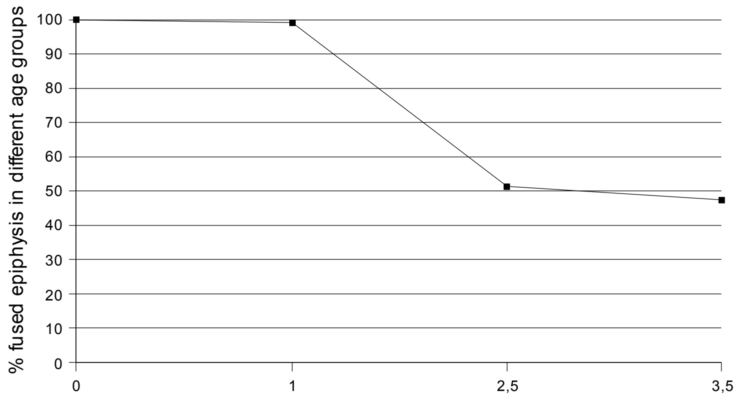

Figure 68. Age distribution of small bovids based on epihyseal data in phase 1 at Aboa Vetus

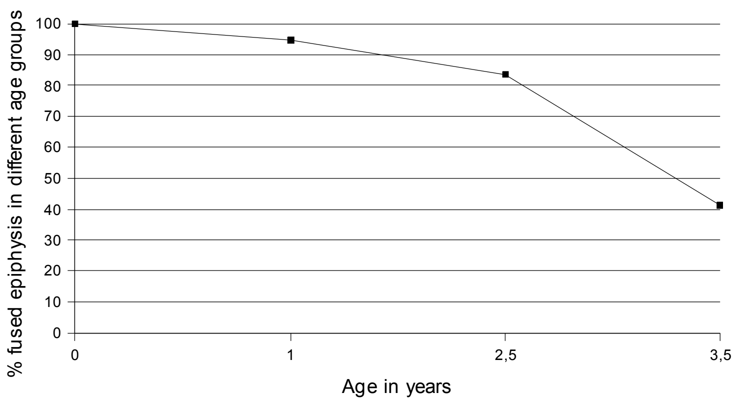

Figure 69. Age distribution of small bovids based on epihyseal data in phase 2 at Aboa Vetus

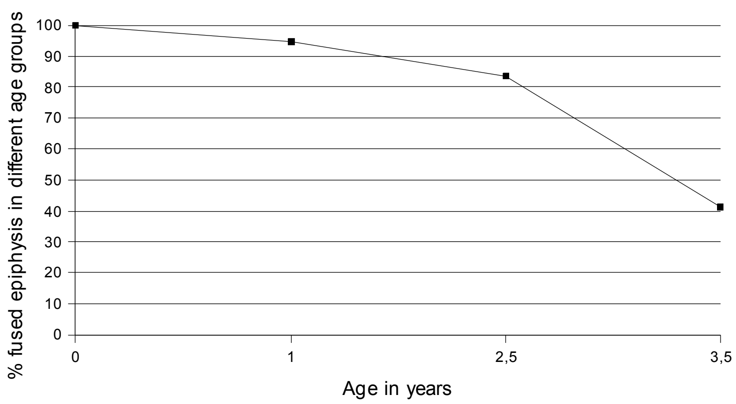

Figure 70. Age distribution of small bovids based on epihyseal data in phase 3 at Aboa Vetus

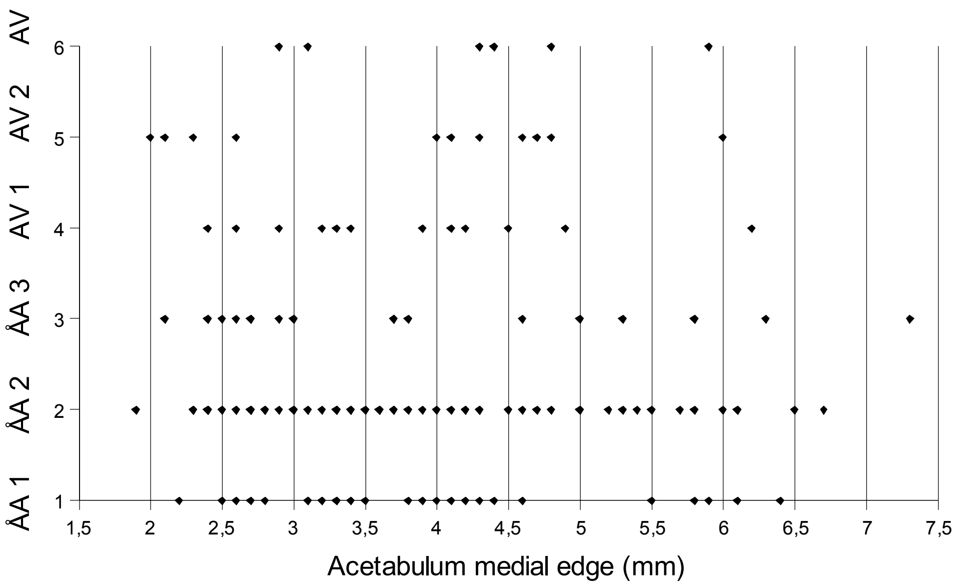

Figure 71. Distribution of acetabulum medial edge thickness of sheep pelves in different phases.
Values under 3,5 represent females, over 4.5 males. n = ÅA 1 37, ÅA 2 79, ÅA 3 21. AV 1 13, AV 2 11, AV 3 6.

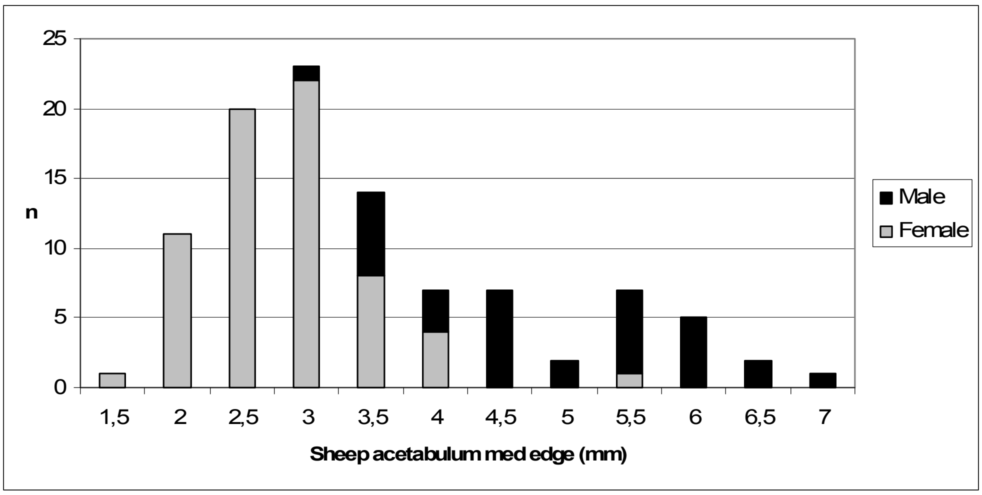

Figure 72. Distribution of acetabulum medial edge measurements of sheep pelves sexed with morphological criteria. n = 67 females, n = 33 males.

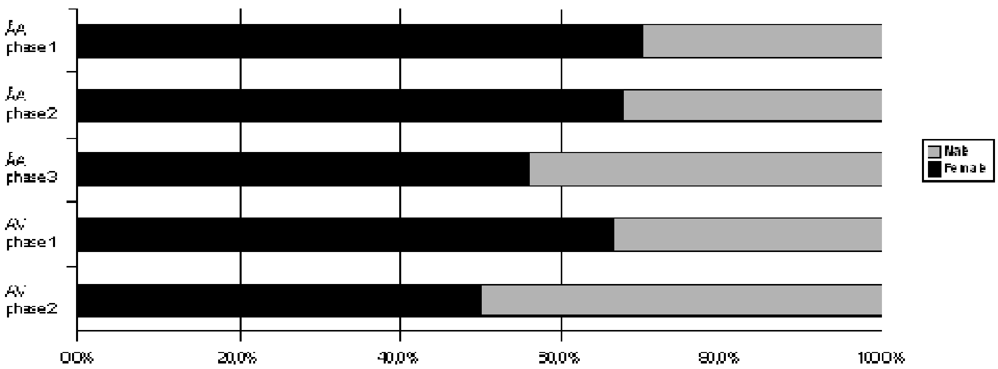

Figure 73. Summary of sheep sex data in different phases obtained from pelves medial edge measurements (female < 3.5 mm, male > 4,5).

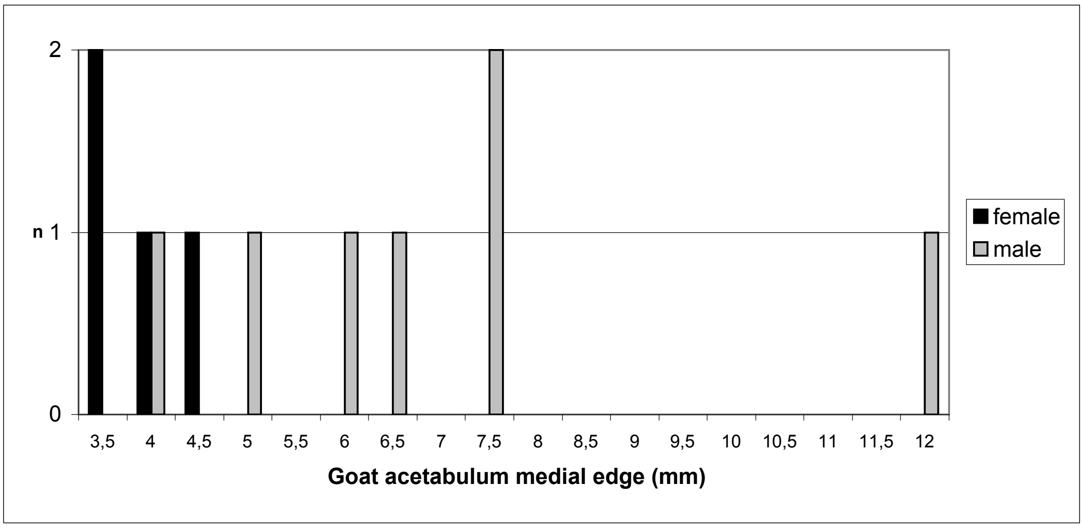

Figure 74. Distribution of acetabulum medial edge measurements of goat pelves sexed with morphological criteria.

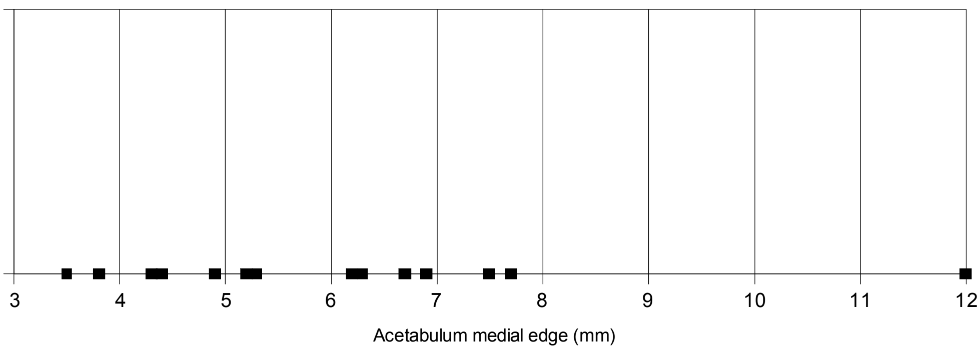

Figure 75. Distribution of acetabulum medial edge thickness of goat pelves. Threshold separating sexes is placed between 4,4 mm- 4,9 mm (see text). n = 14.

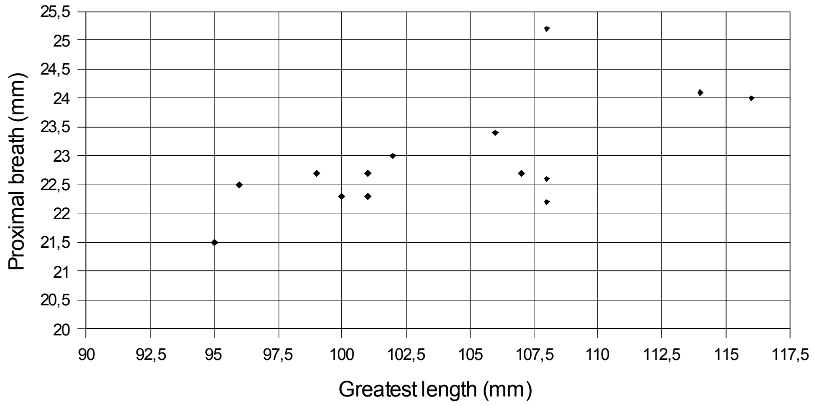

Figure 76. Goat metacarpal greatest length and proximal breath measurements in Turku. n = 14.

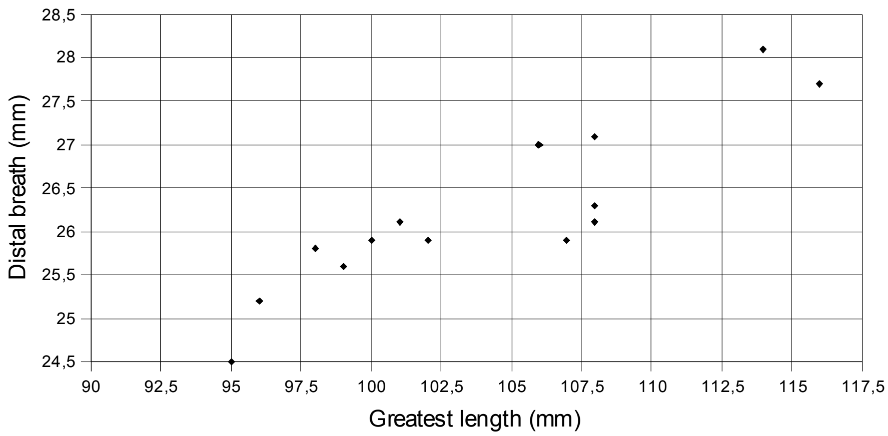

Figure 77. Goat metacarpal greatest length and distal breath measurements in Turku. n = 14.

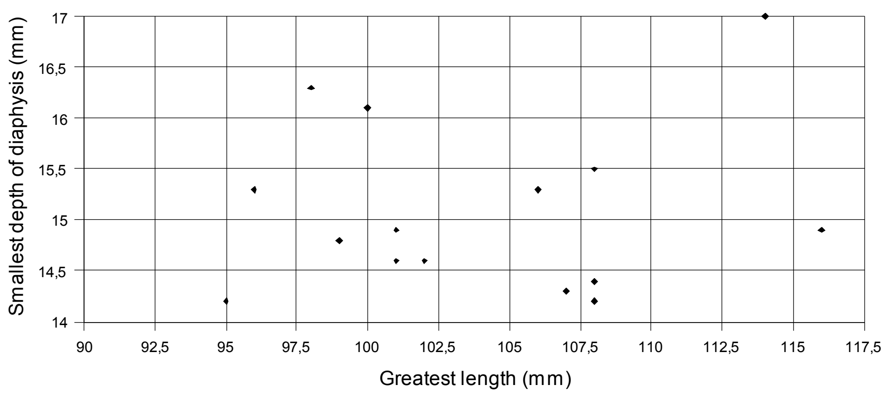

Figure 78. Goat metacarpal greatest length and smallest depth of the diaphysis measurements. n = 15.

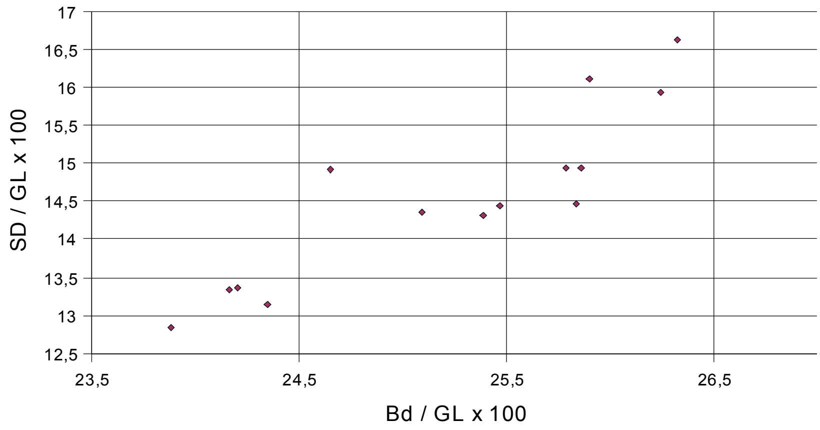

Figure 79. Goat metacarpal indexes counted from smallest depth of the diaphysis, distal breath and greatest length in Turku. n = 14.

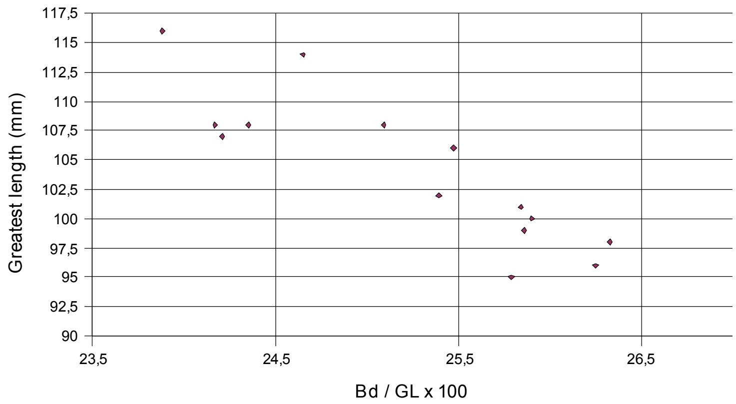

Figure 80. Goat metacarpal distal breath and greatest length index set against greatest length measurements in Turku. n = 14.

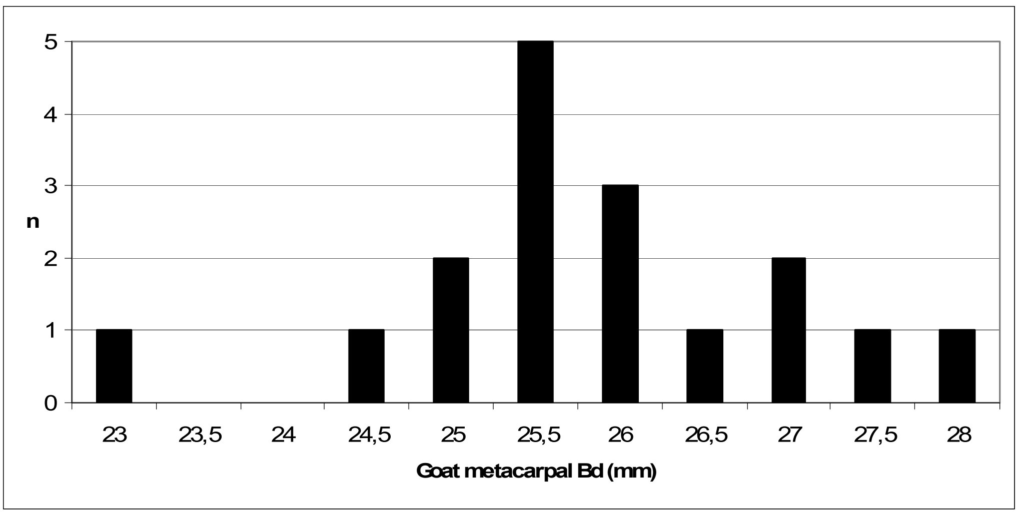

Figure 81. Distribution of distal breath measurements of goat metacarpals in Turku.

Figure 82. Polycerated horn core of sheep. Photo Auli Tourunen. Aboa Vetus Museum.

Figure 83. Badly deformed pelvis of small bovid due to dislocation of femur. Note the secondary joint formation above the original. Photo Auli Tourunen. Turku Provincial Museum.

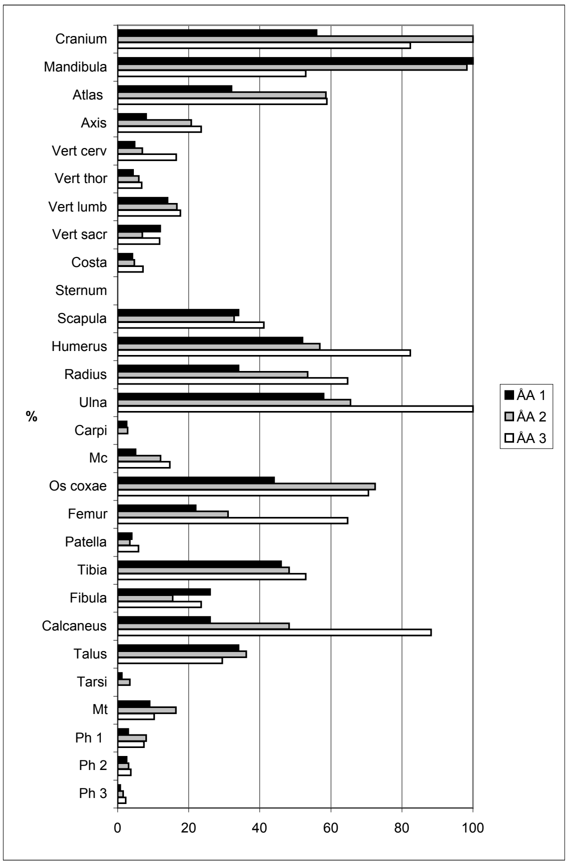

Figure 84. Anatomical distribution of pigs in phases 1, 2 and 3 at Åbo Akademi, based on MNE figures. Presented as %MAU.

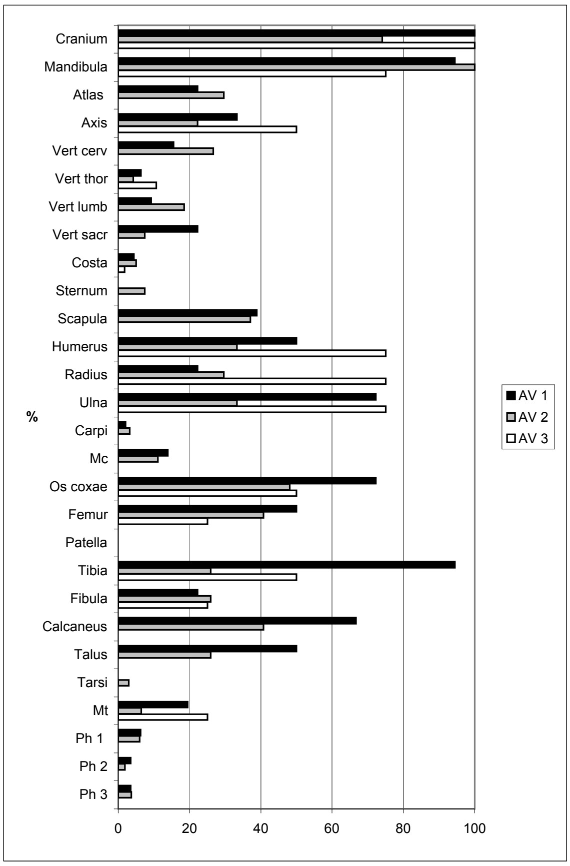

Figure 85. Anatomical distribution of pigs in phases 1, 2 and 3 at Aboa Vetus, based on MNE figures. Presented as %MAU.

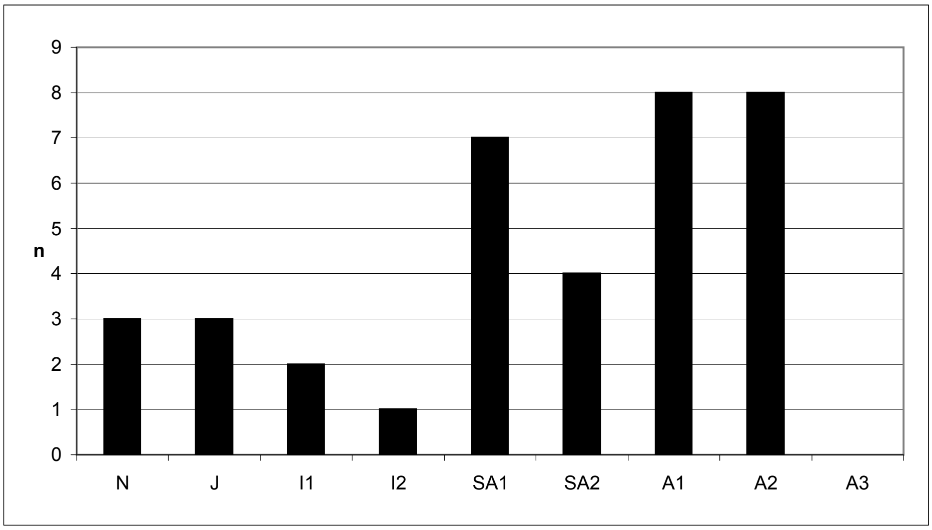

Figure 86. Pig mandibles from phase 1 at Åbo Akademi divided in age groups according to O´Connor (2003).

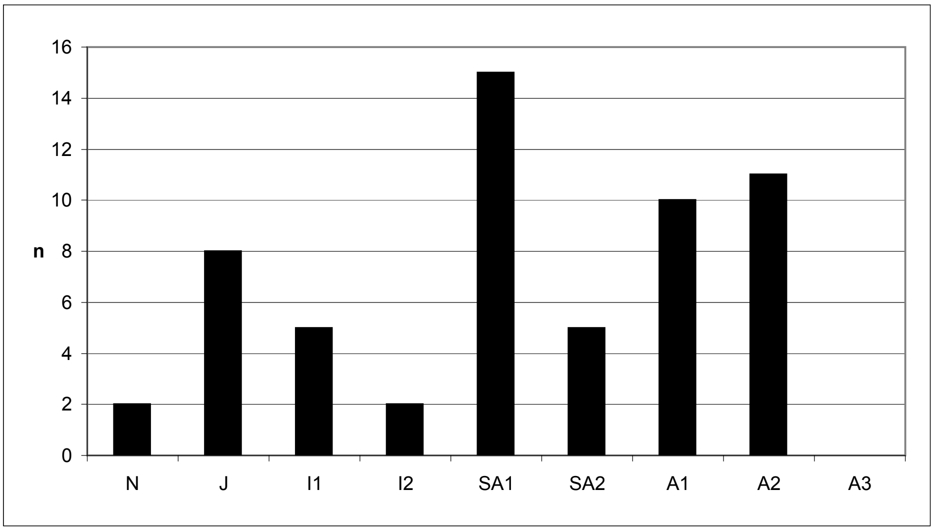

Figure 87. Pig mandibles from phase 2 at Åbo Akademi divided in age groups according to O´Connor (2003).

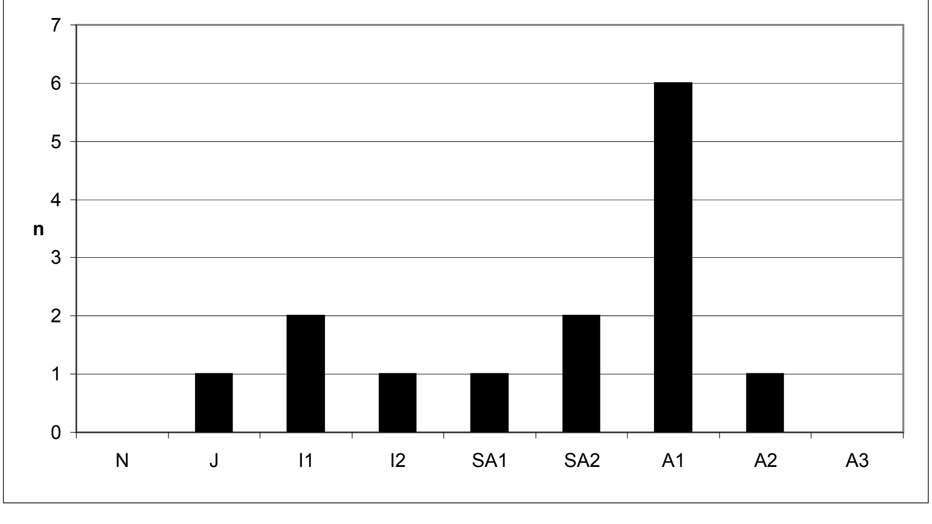

Figure 88. Pig mandibles from phase 1 at Aboa Vetus divided in age groups according to O´Connor (2003).

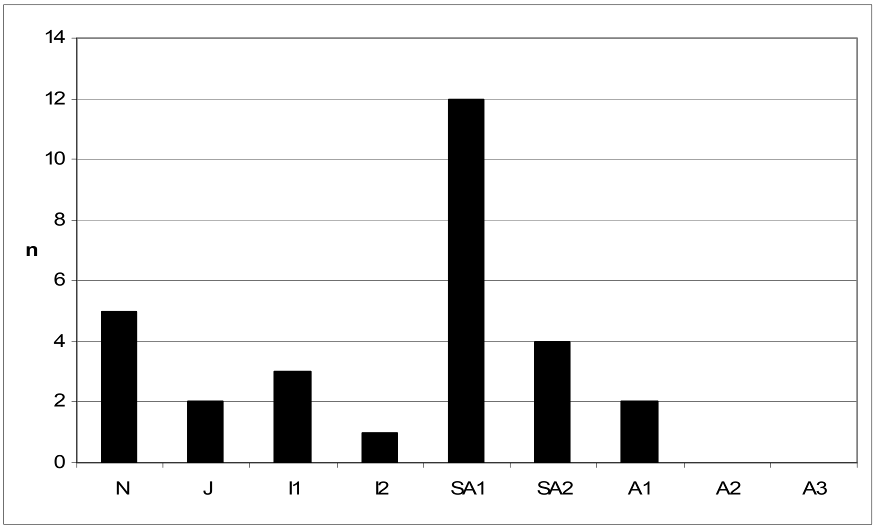

Figure 89. Pig mandibles from phase 2 at Aboa Vetus divided in age groups according to O´Connor (2003).

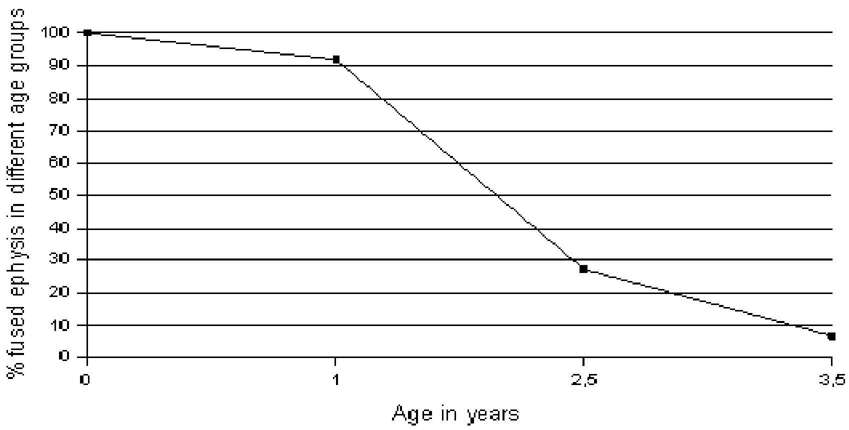

Figure 90. Age distribution of pig based on epihyseal data in phase 1 at Åbo Akademi

Figure 91. Age distribution of pig based on epihyseal data in phase 2 at Åbo Akademi

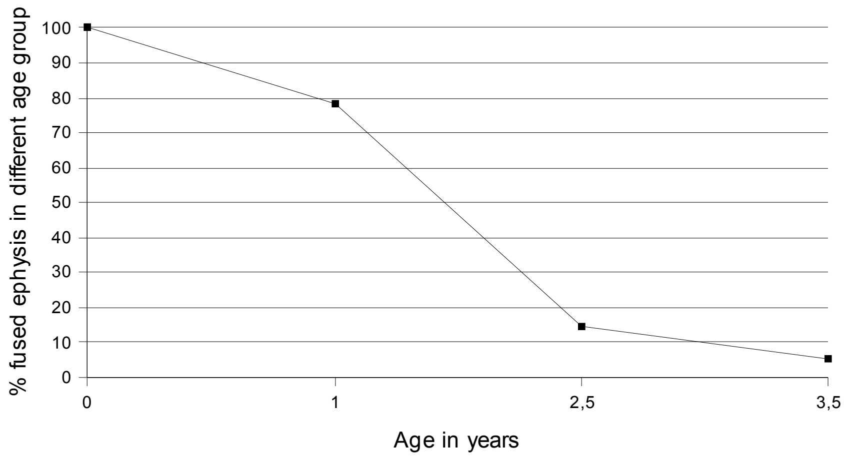

Figure 92. Age distribution of pig based on epihyseal data in phase 3 at Åbo Akademi

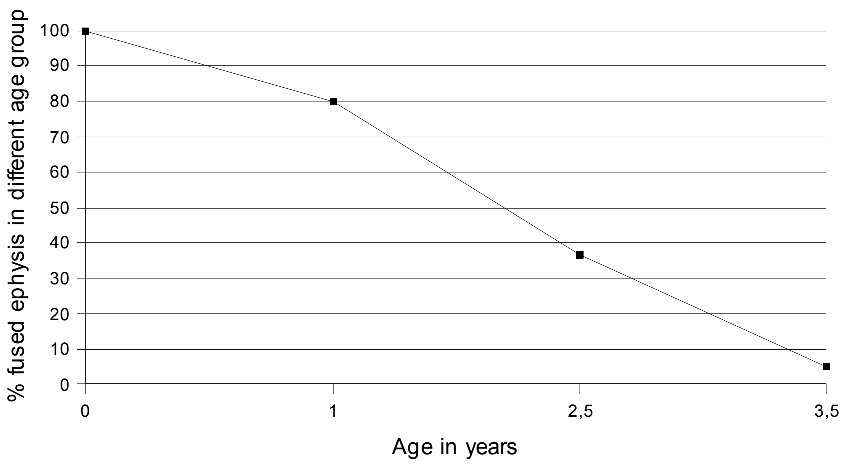

Figure 93. Age distribution of pig based on epihyseal data in phase 1 at Aboa Vetus

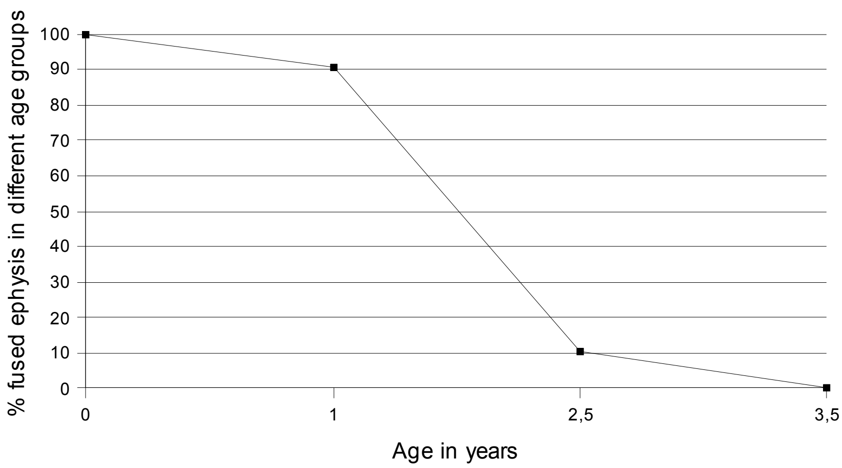

Figure 94. Age distribution of pig based on epihyseal data in phase 2 at Aboa Vetus

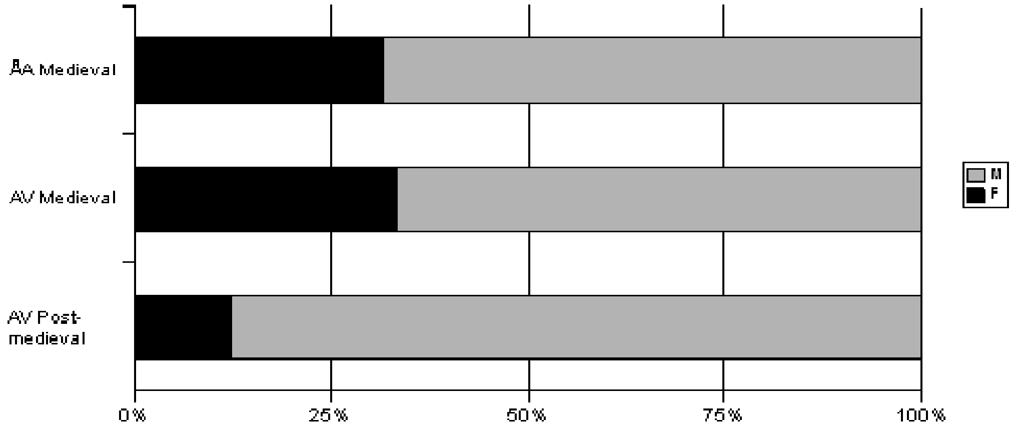

Figure 95. Pig sex data in material obtained from mandibular canines. n = ÅA medieval (phases 1-2)
AV medieval (phase 1) 12 and AV post-medieval (phases 2-3) 16.

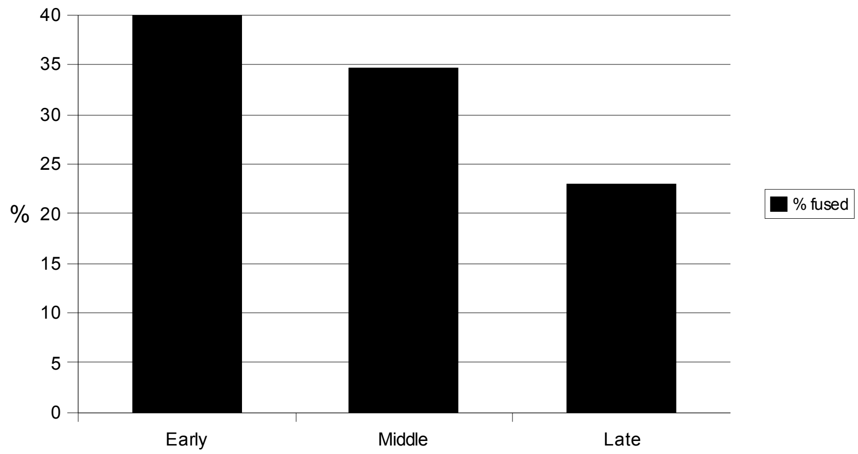

Figure 96. Proportion of fused cat bone epiphyses at Åbo Akademi. Division to early, middle and late fusing epiphysis according to Luff & Moreno 1995 and Smith 1969. n = 71.

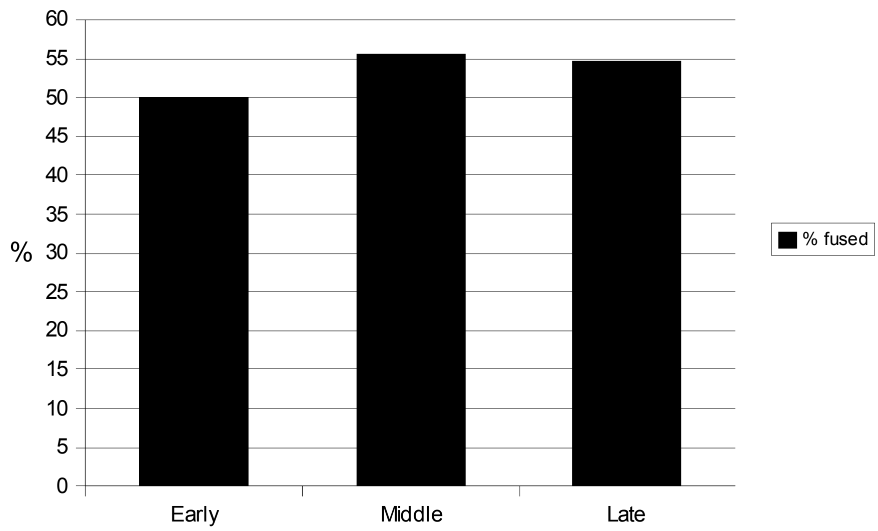

Figure 97. Proportion of fused cat bone epiphyses at Åbo Akademi. Division to early, middle and late fusing epiphysis according to Luff & Moreno 1995 and Smith 1969. n = 22.

Figure 98. Cat femur with cut marks below both epiphyses. The purpose of the cuts is most likely the initial step towards removal of the epiphyses. Photo Auli Tourunen. Turku Provincial Museum.

Figure 99. Deformed sacrum and last lumbar vertebrate from short-legged dog found in Aboa Vetus cellars (dog 1). Note the abnormal place of facies auricularis. Photo Ville Aakula. Aboa Vetus Museum.

Figure 100. Upper jaw of a young dog found in Aboa Vetus cellars (dog 3). Milk canine has retained in jaw even if permanent tooth has erupted. Photo Auli Tourunen. Aboa Vetus Museum.

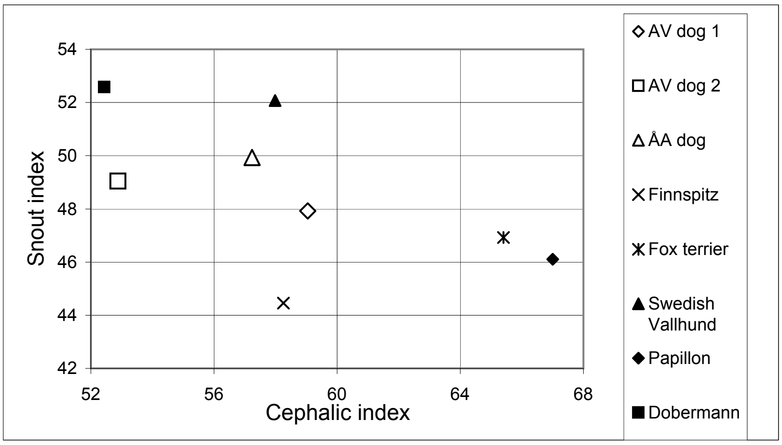

Figure 101. Dog skull index comparison, snout index against cephalic index.
Modern specimens: Finspitz, Fox terrier and Dobermann from Finnish Museum of Natural History, Swedish Vallhund from Aboa Vetus Museum, Papillon from author's collections.
Indices accordig to Hartcourt (1974), see text.

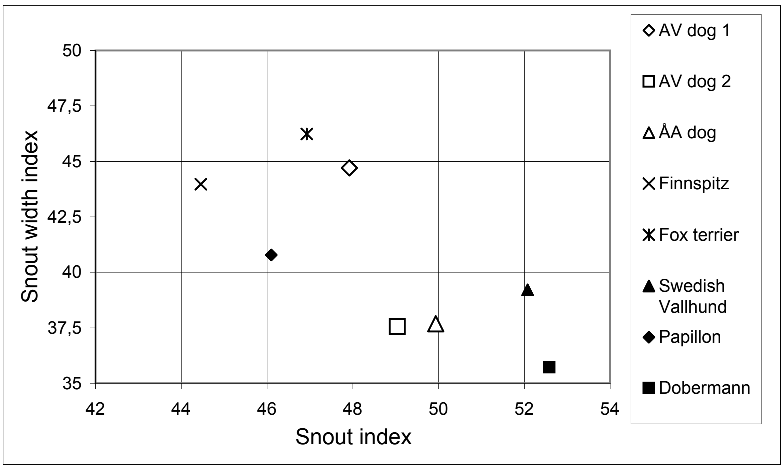

Figure 102. Dog skull index comparison, snout width index against snout index.
Modern specimens: Finspitz, Fox terrier and Dobermann from Finnish Museum of Natural History, Swedish Vallhund from Aboa Vetus Museum, Papillon from author's collections.
Indices accordig to Hartcourt (1974), see text.

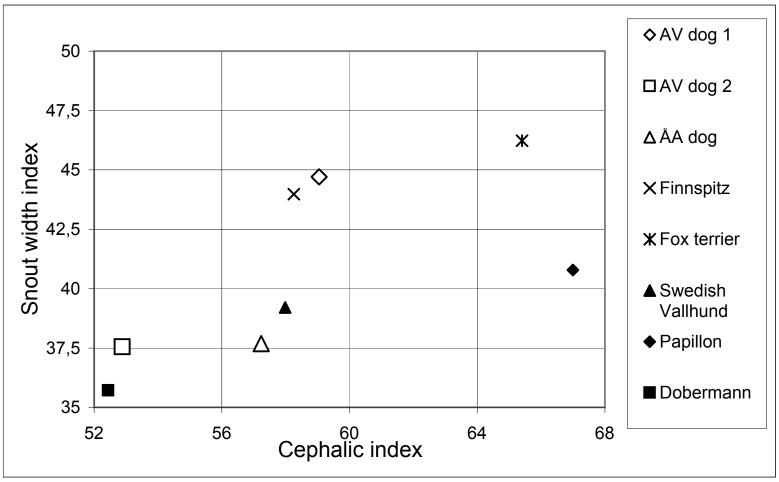

Figure 103. Dog skull index comparison, snout width index against cephalic index.
Modern specimens: Finspitz, Fox terrier and Dobermann from Finnish Museum of Natural History, Swedish Vallhund from Aboa Vetus Museum, Papillon from author's collections.
Indices accordig to Hartcourt (1974), see text.

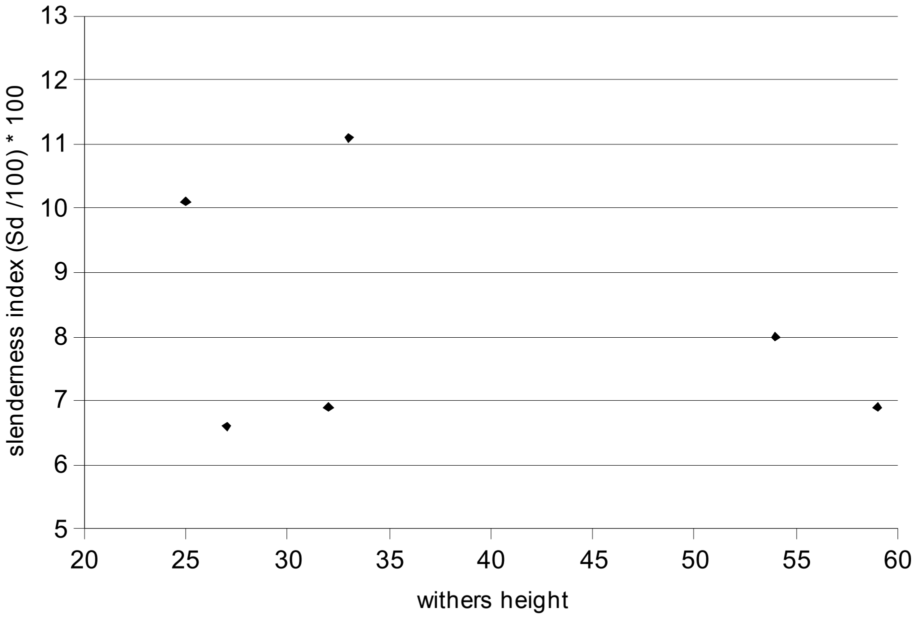

Figure 104. Dog slenderness index and withers heights.

Figure 105. Bear mandible from M 139 D (Åbo Akademi). Photo Auli Tourunen. Turku Provincial Museum.

Figure 106. Tibiae of red fox, probably from a single individual. Tibia on the right has infected lower joint and also appears also to be more slender than the healthy one. Photo Auli Tourunen. Aboa Vetus Museum.

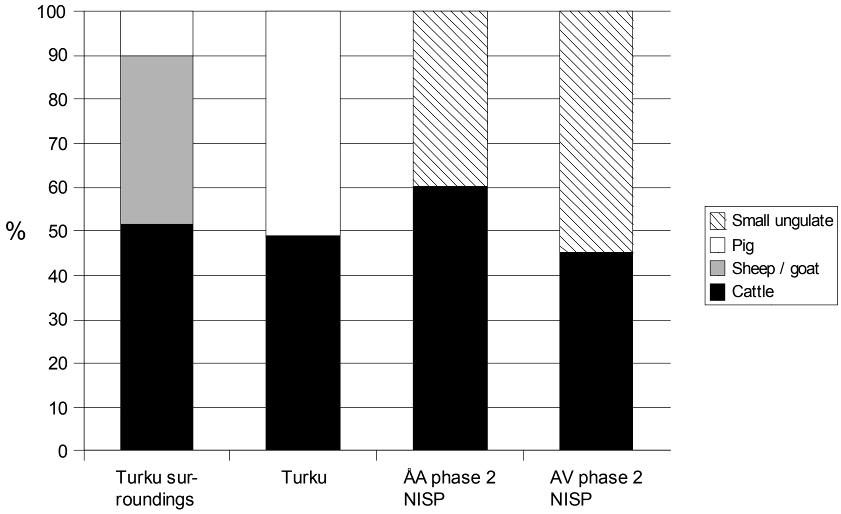

Figure 107. Proportion of cattle, small bovids and pigs in historical sources and in osteological mate
Turku surroundings counted from Silver tax rolls 1571, Turku from tax list year 1632, for closer defir

Figure 108. Presence and absence of foramen supratrochleare in infant pig humeri.
Photo Ville Aakula. Aboa Vetus Museum.

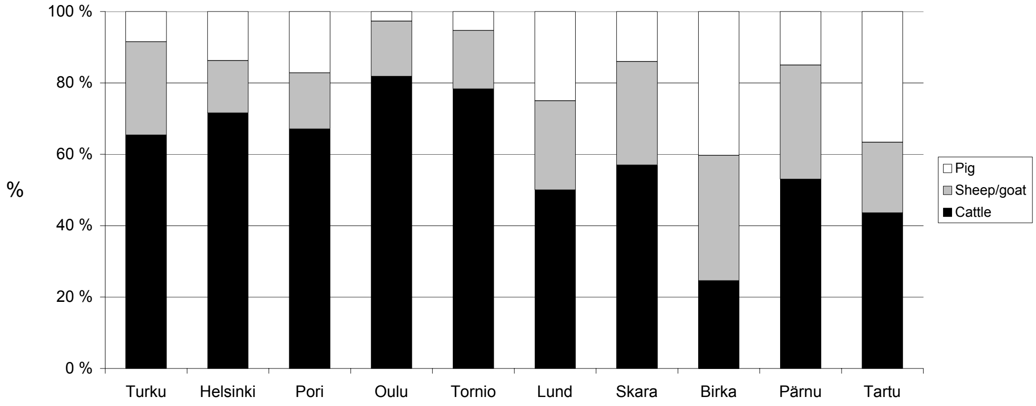

Figure 109. Abundance of major domesticates in different materials (NISP). Data and literature in appendix 32.

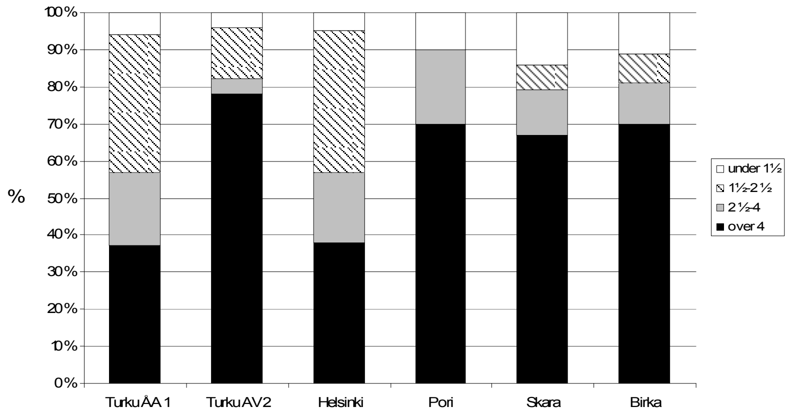

Figure 110. Comparison of cattle age profiles based on mandibular teeth eruption and wear. Data in appendix 33.

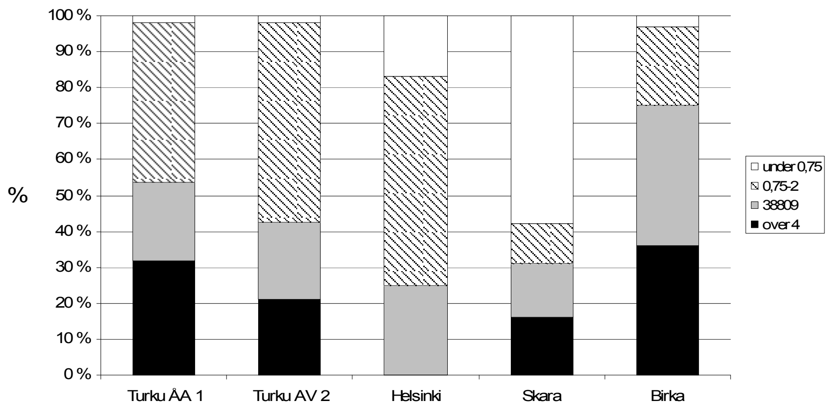

Figure 111. Comparison of small bovid age profiles based on mandibular teeth eruption and wear. Data in appendix 34.

Table 1. Sites used for comparison.* Identified specimens only. ** Specimens from cesspits only. Number of specimens from the cultural layer is not defined.

Country	Site	Dating	Number of specimens	Weight (kg)	Reference
Finland	Helsinki	17th-early 18th century	2937	61,7	Tourunen 2002 b
	Pori	16th to 19th century	4671	17,7	Tourunen 2002 a
	Tornio	17th century	659*	”few kg”	Puputti 2006
	Oulu	17th -early 18th century	8460	68,9	Puputti 2005
	Kökar, Friary	15th - 17th century	14953	135,6	Fisher 1996
	Kuusisto, Castle	13th -15th century	3627	30,0	Mutikainen 1989
Sweden	Skara	11th -15th century		ca. 800	Vretemark 1997
	Lund	11th century (some 13th-14th)	ca. 8000		Ekman 1973
	Birka	8th -10th century	33886*	571	Wigh 2001
Estonia	Pärnu	14th -15th century	1927		Maldre 1997 b
	Tartu	14th -16th century	1568**		Maldre 1997 a

Table 2. Specimens (NISP) found in 10 mm sieving or table sieving and specimens found from the same soil with 3 mm mesh from five samples collected from the Turku City Library excavations. Seven of twelve small ungulate specimens found in water sieving were vertebra or ribs, the rest of the fragments were long bone shafts.

Species	Basic sieving	Water sieving
Large ungulate	5	2
Small ungulate	1	12
Pig (*Sus scrofa*)	2	2
Sheep / goat (*Ovis/Capra*)	2	1
Dog (*Canis familiaris*)	1	1
Rat (*Rattus sp.*)		4
Red squirrel (*Sciurus vulgaris*)		1
Muridae		1
Mountain hare (*Lepus timidus*)		3
Bird (*Aves*)		3
Perciforme	1	49
Cyprinidae		22
Pike (*Esox lucius*)		9
Smelt (*Osmerus eperlanus*)		3
Clupeidae		12
Salmonidae		2
Total	12	127

Table 3. Number of specimens (NISP) and weight of bone fragments from the Åbo Akademi (ÅA) and Aboa Vetus (AV) excavations.
Large ungulate = cattle, horse, elk or forest reindeer, small ungulate = sheep, goat or pig, small animal = mammal smaller than cat, also bird.
* = artefacts made of elk antler.

Species	Weight ÅA	Weight AV	**Total (g)**	Specimens ÅA	Specimens AV	**Total (NISP)**
Cattle (*Bos taurus*)	543958,7	151444,6	695403,3	14693	3858	18551
Sheep (*Ovis aries*)	43271,1	10463,1	53734,2	3023	895	3918
Goat (*Capra hircus)*	7886,4	4535,5	12421,9	366	194	560
Sheep /Goat (*Ovis /capra)*	59008,1	22220,8	81228,9	6948	2999	9947
Pig (*Sus scrofa*)	42878,9	18909	61787,9	2916	1775	4691
Cat (*Felis catus*)	238,1	477,9	716	111	266	377
Dog (*Canis familiaris)*	269,1	1449,2	1718,3	20	279	299
Horse (*Equus caballus*)	949,8	11,2	961	19	1	20
Man (*Homo sapiens)*	22,1	45	67,1	2	1	3
Mountain hare (*Lepus timidus*)	940,1	235,4	1175,5	591	211	802
Red squirrel (*Sciurus vulgaris*)	22,2	2,6	24,8	57	6	63
Beaver (*Castor fiber*)		6,5	6,5		1	1
Water vole (*Arvicola terrestris)*	1,2		1,2	1		1
Rat (*Rattus sp.)*	7,2	8,8	16	20	30	50
Muridae	1,4	0,3	1,7	18	3	21
Wolf (*Canis lupus*)	48,7		48,7	2		2
Red fox (*Vulpes vulpes*)		23,8	23,8		8	8
Canidae	4,5	8,2	12,7	3	3	6
Brown bear (*Ursus arctor)*	402,3		402,3	9		9
Ringed seal (*Phoca hispida)*	45,9		45,9	2		2
Grey seal (*Halichoerus grypus)*	16,2		16,2	1		1
Phocidae	102,1	89,9	192	9	8	17
Elk (*Alces alces*) *	22,6		22,6	2		2
Large ungulate	216681,5	57910,6	274592,1	13792	3816	17608
Small ungulate	16264,3	6595,4	22859,7	6391	2867	9258
Small animal	79,8	61,9	141,7	139	118	257
Unidentified	50884,1	18656,5	69540,6	17970	9915	27885
Total	984006,4	293156,2	**1277162,6**	67105	27254	**94359**

Table 4. Description of contexts at the Åbo Akademi excavations. Dating: see text. Description of layers according to: Arkeologiset tutkimukset Åbo Akademin tontilla (Turku I/7/4) vuonna 1998, appendix 6.

	Context	Relating structure	Area	Weight of bone material	Description
Phase 1	M 503 M		Kosmo A	11,4	Layer of peat and manure
Latter half of the 14th century to	M 511 B		Kosmo A	11,7	Wooden chip layer with mineral fraction
beginning of the 15th century	M 512		Kosmo A	27,9	Layer of peat, just above natural clay
	M 513		Kosmo A	29,1	Wooden chip layer, in lower part plenty of manure
	M 513 B		Kosmo A	18,3	Wooden ship, clayey peat, just above natural clay
	M 173		Kosmo B	79,6	Wooden chip layer
	M 118		Kemicum	56,6	Wooden chip layer
	M 130 E		Kemicum	26,1	Wooden chip layer, plenty of manure
Phase 2	M 503 E		Kosmo A	15,1	Wooden chip layer
The 15th and 16th century	M 503 E+F		Kosmo A	3,4	
	M 503 F		Kosmo A	7,1	Organic mass consisting of wooden chips and manure
	M 503 G		Kosmo A	48,1	Wooden chip layer
	M 89 J+K	RA 143 B, lavatory	Kosmo A	8,5	Wooden chip layer, totally composted organic substance
	M 114 D		Kosmo B	10,1	Wooden chip layer with signs of burning
	M 139 D		Kosmo B	43,8	Clay with organic subsistence
	M 159		Kosmo B	117,9	Wooden chip layer whit some clay
	M 163		Kosmo B	7,3	Clayey wooden chip layer
	M 78 B		Kosmo B	17,8	Wooden chip layer with mineral fraction
	M 78 C		Kosmo B	56,8	Wooden chip layer
	M 90 E		Kosmo B	10,7	Wooden chip layer
	M 104		Kemicum	74,6	Wooden chip layer with manure
	M 118 B+C	RA 53 F, building	Kemicum	3,4	M 118 B manure, M 118 C clayey manure
	M 147		Kemicum	55,0	Wooden chip layer
	M 56 C-N	RA 60G, well	Kemicum	12,2	Variable: from totally composted organic to sand
	M 65 D		Kemicum	29,3	Wooden chip layer
	M 66		Kemicum	7,9	Totally composed organic layer
	M 75	RA 100, barrel	Kemicum	1,5	Clay with pieces of bricks and some wooden chips
	M 87 C+D		Kemicum	10,7	87 C Wooden chip layers, 87 D lenses of sand
Phase 3	M 60		Kosmo B	25,1	Clayey sand
The 17th- 18th century	M 60 C		Kosmo B	28,9	Clayey sand
	M 73		Kosmo B	19,3	Decayed wood: totally composted organic substance
	M 14		Kemicum	49,8	Mould with some sand
	M 36		Kemicum	8,2	Wooden chip layer, pieces of bricks
Other contexts	M 164 B	RA 190 lavatory	Kosmo B	4,1	Wooden chip layer
	M 113A, A+B, B, C, C+D, F	RA 68 C water container	Kemicum	12,8	Variable
	M 128 F	Kp 12857 barrel	Kemicum	5,2	Burned wooden chip
	M 146 A ja B	RA 60 H well	Kemicum	2,4	Manure
	M 66 B		Kemicum	18,7	Wooden chip layer, one layer of (horse -?) manure
	M 68 B	RA 77 building	Kemicum	0,3	Demolition layer
	M 96	RA 60G well	Kemicum	6,9	Mineral soil

Table 5. The dating of contexts and structures at the Aboa Vetus excavations. For description and dating; see text.

	Context (Structure)	Kg	Description of structure	Description of layers
Phase 1	K 94:7	0,03	Wooden floor	
From the late 13th century to	R 19 B (below)	62,3	Pavement	Under pavement
the early 16th century	R 1b	6,7	Wooden structures	Under structure
	R 25	41,5	Wooden floor	Under floor
	R 63	1,6	Wooden structures	Under structure
	R 75	13,4	Wooden structures	Under structure
Phase 2	K 94:8	10,9	Stone cellar	Inside cellar
The 17th century	K 94:9	4,8	Stone cellar	Inside cellar
	K 94:10	30,4	Stone cellar	Inside cellar
	K 94:11	24,6	Stone cellar	Inside cellar
	K 94:12	58,6	Stone cellar	Inside cellar
Phase 3	K 94:13	2,8	Stone cellar	Inside cellar
The 18-19th century	R 12	1,1	Wall	Relating to wall
	R 13	8,9	Wall	Relating to wall
	R 9	1,2	Street pavement	Relating to pavement
Other contexts	KU 12	6,3		Trial pit inside cellar K 94:12
	KU 12 extension	4,9		Trial pit inside cellar K 94:11
	R 19 A (above)	9,1		Above pavement
	R 28:3	1,1	Well/fridge	Inside well/fridge
	R 50	0,6	Well	Inside well
	Trial pits in cellars	2,3		Trial pit inside cellars K 94:8 & 9.

Table 6. Correlation between O'Connor's (2003: 160) mandibular age division and Vretemark's (1997: 82, 88, 95) mandibular age divisior
N = Neonatal, J = Juvenile, I = Immature, SA = Subadult, A = Adult and E = Elderly.

O'Connor	O'Connor criteria	Vretemark cattle	Vretemark small bovid	Vretemark pig
N & J	M1 not in wear	under 1 1/2 years	under 0,75 years	under 0,5 years
I, SA 1 & SA 2	M3 not in wear (can be erupting)	1 1/2 - 2 1/2 years	0,75 - 2 years	0,5-2 years
A1 & A2	M3 wear stage a-d	2 1/2 -4 years	2-4 years	2-5 years
A3 & E	M3 wear stage e or beyond	over 4 years	over 4 years	over 5 years

Table 7. Division of the epiphyses into early, intermediate and late age groups according to epiphyseal fusion. Vretemark (1997: 41) according to Silver (1969) and O'Connor (1982).

	Cattle	Small bovids	Pig
Early	1,5 year	1 year	1 year
	Scapula tuber	Scapula tuber	Scapula tuber
	Humerus distal epiphysis	Humerus distal epiphysis	Humerus distal epiphysis
	Radius proximal epiphysis	Radius proximal epiphysis	Radius proximal epiphysis
Intermediate	3 years	2,5 years	2,5 years
	Mc distal epiphysis	Mc distal epiphysis	Mc distal epiphysis
	Mt dist epiphysis	Mt dist epiphysis	Mt dist epiphysis
	Tibia dist epiphysis	Tibia dist epiphysis	Tibia dist epiphysis
			Calcaneus tuber
Late	4years	3,5 years	3,5 years
	Humerus proximal epiphysis	Humerus proximal epiphysis	Humerus proximal epiphysis
	Radius distal epiphysis	Radius distal epiphysis	Radius distal epiphysis
	Femur proximal epiphysis	Femur proximal epiphysis	Femur proximal epiphysis
	Femur distal epiphysis	Femur distal epiphysis	Femur distal epiphysis
	Tibia proximal epiphysis	Tibia proximal epiphysis	Tibia proximal epiphysis
	Ulna proximal epiphysis	Ulna proximal epiphysis	Ulna proximal epiphysis
	Calcaneus tuber	Calcaneus tuber	

Table 8. The proportion (%) of sheep specimens counted from sheep and goat specimens. Figures counted from all specimens and high and low utility skeletal parts (for definition see text). Aboa Vetus phase 3 excluded due to small sample size (goat NISP 5).

	ÅA Phase 1	ÅA phase 2	ÅA phase 3	AV phase 1	AV phase 2
All specimens	89,5	91,4	77,0	80,9	81,6
High utility	91,8	94,9	80,5	94,6	82,2
Low utility	88,2	90,1	74,7	75,5	79,1

Table 9. The presence of rare species at Åbo Akademi. X can represent more than one specimen. * = artefact made of antler. ** = os baculum.

	Context	Dog	Cat	Horse	Human	Squirrel	Rats	Rat/mouse	Wolf	Dog/wolf/fox	Bear	Seals	Elk
Phase 1	M 118		X		X	X					X	X**	
	M 130 E		X	X	X		X				X		X*
	M 173	X	X			X	X						
	M 503 M			X			X						
	M 511 B		X			X	X						
	M 512			X									
	M 513	X	X	X									
	M 513 B	X	X			X			X	X			
Phase 2	M 104		X	X		X					X	X	
	M 114 D		X										
	M 139 D		X	X		X					X		
	M 147	X	X			X				X			X*
	M 159		X	X		X	X				X		
	M 163		X								X		
	M 503 E					X							
	M 503 E+F												
	M 503 F											X**	
	M 503 G			X				X					
	M 56 C-N												
	M 65 D		X	X		X							
	M 66					X						X	
	M 68 B												
	M 78 B					X							
	M 78 C		X			X						X	
	M 87 C+D	X								X			
	M 90 E			X									
	M 96												
Phase 3	M 14	X	X			X						X	
	M 36		X			X	X					X	
	M 60												
	M 60 C					X						X	
	M 73	X	X									X	
Others	M 66 B										X		

Table 10. The presence of rare species at Aboa Vetus. X can represent more than one specimen.

	Context	Dog	Cat	Horse	Human	Squirrel	Beaver	Rats	Rat/mouse	Fox	Dog/wolf/fox	Seals
Phase 1	R 19 U	X	X		X	X	X			X	X	X
	R 1b6375											
	R 25		X					X				X
Phase 2	K 94:10	X	X					X				X
	K 94:11	X	X			X		X	X			
	K 94:12	X	X					X	X		X	X
	K 94:8	X	X									
	K 94:9	X	X			X		X				X
Phase 3	K 94:13											
	R91213											
Others	Ku 12 and extension	X	X	X								
	R 19 A	X	X					X		X	X	

Table 11. Comparison of MNE figures between cattle, small bovids and pig.

	ÅA phase 1 MNE N	ÅA phase 1 MNE %	ÅA phase 2 MNE N	ÅA phase 2 MNE %	ÅA phase 3 MNE N	ÅA phase 3 MNE %	AV phase 1 MNE N	AV phase 1 MNE %	AV phase 2 MNE N	AV phase 2 MNE %	AV phase 3 MNE N	AV phase 3 MNE %
cattle	1906	52	4203	56	1271	59	1134	53	944	45	157	53
sheep / goat	1348	37	2652	35	694	32	797	37	897	43	110	37
pig	404	11	629	8	207	10	207	10	253	12	29	10
total	3658		7484		2172		2138		2094		296	

Table 12. Comparison of MNE and NISP figures between cattle, small bovids and pig.

	ÅA phase 1 MNE %	ÅA phase 1 NISP %	ÅA phase 2 MNE %	ÅA phase 2 NISP %	ÅA phase 3 MNE %	ÅA phase 3 NISP %	AV phase 1 MNE %	AV phase 1 NISP %	AV phase 2 MNE %	AV phase 2 NISP %	AV phase 3 MNE %	AV phase 3 NISP %
cattle	52	67	56	69	59	70	53	62	45	55	53	65
sheep / goat	37	26	35	25	32	24	37	31	43	35	37	28
pig	11	7	8	6	10	6	10	7	12	10	10	8

Table 13. Level of fusion of vertebral epiphysis of cattle at Åbo Akademi and Aboa Vetus (MNE, %). O = open, C = closing and F = Fused.

		O	C	F			O	C	F
ÅA phase 1	Vert cerv	69,5	6,1	24,4	AV phase 1	Vert cerv	74,4	12,8	12,8
	Vert thor	72,8	5,6	21,6		Vert thor	76,5	4,4	19,1
	Vert lumb	63,0	3,3	33,7		Vert lumb	61,5	9,6	28,8
ÅA phase 2	Vert cerv	76,4	7,1	16,4	AV phase 2	Vert cerv	54,3	22,9	22,9
	Vert thor	78,9	6,0	15,0		Vert thor	77,1	6,0	16,9
	Vert lumb	69,4	5,6	25,0		Vert lumb	62,3	7,5	30,2
ÅA phase 3	Vert cerv	65,5	14,5	20,0	AV phase 3	Vert cerv	85,7	14,3	0,0
	Vert thor	75,9	8,4	15,7		Vert thor	72,7	9,1	18,2
	Vert lumb	79,6	7,4	13,0		Vert lumb	75,0	0,0	25,0

Table 14. Distribution of cattle horncore length measurements. According to Armitage & Clutton-Brock (1976).

Horncore length	n
small < 96 mm	2
short 96-150 mm	34
medium 150-200 mm	10
long > 200 mm	2

Table 15. Pathological cattle metacarpal measurements compared to other metacarpals from phase 2 at Åbo Akademi.

pathological mc	Bd	Bp	DD	SD	GL
M 159	57,1				
M 159	56,3	51,8	19,7	29,8	167
M 159	59,2	60,2	21,4	32,4	175
M 159	66,3	57,8	18,0	33,8	169
M 159	58,8	56,6	19,9	31,4	162
M 104	56,0	54,6	18,2	30,9	167
M 104	52,6	52,9	21,3	29,3	172
M 65 D	60,6	58,1	20,9	31,8	168
Average	56,0	56,0	18,0	31,3	169
other mc average males	53,7	52,7	19,3	28,7	170
other mc average females	48,3	47,8	18,2	25,0	176

Table 16. Average values of cattle bone measurements (mm).

	ÅA phase 1	n	ÅA phase 2	n	ÅA phase 3	n	AV phase 1	n	AV phase 2	n	AV phase 3	n
Calcaneus GL	**114,2**	21	**112,8**	44	**111,6**	11	**115,9**	15	**116,4**	11		
Talus GLl	**57,4**	48	**57,8**	114	**56,3**	25	**57,0**	25	**57,9**	15	**59,3**	4
Mc GL	**173,6**	31	**173,7**	70	**174,9**	7	**177,0**	5	**171,3**	17		
Mt GL	**200,4**	28	**198,4**	55	**195,0**	10	**199,0**	2	**195,3**	16	**199,0**	5
Tibia Bd	**51,2**	29	**51,8**	58	**54,8**	12	**52,1**	17	**52,8**	9		

Table 17. Withers heights of cattle. Counted from metacarpals according to Matolsci (1970).

	ÅA phase 1	n	ÅA phase 2	n	ÅA phase 3	n	AV phase 1	n	AV phase 2	n
female	**106,5**	16	**106,3**	41	**106,3**	4	**106,1**	3	**104,3**	6
male	**107,8**	14	**107,2**	26	**109,5**	3			**107,8**	11

Table 18. Minimum, maximum and average values and standard deviation of some cattle bone measurements (mm).

	Mc GL	average	min	max	st dev	n
ÅA phase 1		173,6	158	198	9,2	31
ÅA phase 2		173,7	162	193	6,5	70
ÅA phase 3		174,9	165	181	6,4	7
AV phase 1		177,0	168	186	6,9	5
AV phase 2		171,3	161	188	10,0	17
	Mt GL	average	min	max	st dev	n
ÅA phase 1		200,4	190	213	5,6	28
ÅA phase 2		198,4	182	220	7,3	55
ÅA phase 3		195,0	183	204	7,2	10
AV phase 1		195,3	172	213	10,1	2
AV phase 2		199,0	191	209	7,0	16
	Calcaneus GL	average	min	max	st dev	n
ÅA phase 1		114,2	106	124	4,4	21
ÅA phase 2		112,8	106	127	4,8	44
ÅA phase 3		111,6	103	128	7,2	11
AV phase 1		115,9	107	131	5,2	15
AV phase 2		116,4	107	125	7,5	11

Table 19. Level of fusion of vertebral epiphysis of small bovids at Åbo Akademi and Aboa Vetus (MNE, %). O = open, C = closing and F = Fused.

		O	C	F			O	C	F
ÅA phase 1	Vert cerv	47,5	23,8	28,8	AV phase 1	Vert cerv	44,8	24,1	31,0
	Vert thor	45,9	27,0	27,0		Vert thor	74,1	7,4	18,5
	Vert lumb	59,5	0,0	40,5		Vert lumb	55,2	6,9	37,9
ÅA phase 2	Vert cerv	56,6	28,0	15,4	AV phase 2	Vert cerv	71,1	13,3	15,6
	Vert thor	63,3	13,7	23,0		Vert thor	86,6	7,3	6,1
	Vert lumb	59,8	13,1	27,1		Vert lumb	75,6	6,7	17,8
ÅA phase 3	Vert cerv	61,9	9,5	28,6	AV phase 3	Vert cerv	75,0	0,0	25,0
	Vert thor	72,4	0,0	27,6		Vert thor	16,7	33,3	50,0
	Vert lumb	66,0	2,1	31,9		Vert lumb	75,0	0,0	25,0

Table 20. Number of sheep and goat mandibles in each phase and the number of mandibles which could be assigned to a certain age category (categories O'Connor 2003).

	ÅA 1	ÅA 2	ÅA 3	AV 1	AV 2	AV 3
n goat mandibles	4	4	3	5	10	-
Age category						
I		1				
SA 1	2	2	1	3	6	
n sheep mandibles	55	103	12	24	19	2
Age category						
J				1	1	
I	11	12	4	1	6	1
SA 1	22	46	1	9	3	
SA 2		3				

Table 21. Epiphyseal closure in goat metapodials, counted as MNE.
Stage C (closing) was not observed.

	O	F
ÅA 1	4	15
ÅA 2	26	13
ÅA 3	11	3
AV 1	9	11
AV 2	15	-

Table 22. Average values of sheep bone measurements (mm).

	ÅA phase 1	n	ÅA phase 2	n	ÅA phase 3	n	AV phase 1	n	AV phase 2	n	AV phase 3	n
Calcaneus GL	**49,8**	15	**50,4**	31			**50,8**	11	**47,3**	14		
Talus GLl	**25,6**	34	**25,3**	59	**24,5**	6	**24,7**	15	**24,6**	14		
Mc GL	**118,2**	34	**117,0**	69	**109,4**	11	**119,3**	12	**111,4**	9		
Mt GL	**128,6**	14	**126,9**	64	**120,8**	9	**124,9**	7	**116,0**	10		
Radius GL	**144,6**	11	**139,4**	13	**134,8**	4	**146,7**	3	**129,0**	14		
Tibia Bd	**23,4**	61	**23,1**	91	**21,9**	12	**23,0**	37	**22,1**	20	**22,8**	5

Table 23. Robustness of sheep metacarpals. According to O´Connor (1995).

	ÅA phase 1	ÅA phase 2	ÅA phase 3	AV phase 1	AV phase 2
SD / GL * 100	9,9	10,1	10,2	10,1	10,0

Table 24. Maximum, minimum and average values of withers heights of sheep (mm). Withers heights estimated according to Teichert (1975).

	ÅA phase 1	ÅA phase 2	ÅA phase 3	AV phase 1	AV phase 2	AV phase 3
min	51,4	48,1	50,0	50,1	49,9	50,1
max	69,1	67,4	59,7	64,2	61,2	60,1
average	57,8	57,3	54,4	57,6	54,1	54,2
n	107	242	31	20	48	4

Table 25. Withers heights of goat in medieval phases.

	Withers heigh	n
min	55,5	
max	66,7	
average	**60,1**	19

Table 26. Average values of pig bone measurements (mm).

	ÅA phase 1	n	ÅA phase 2	n	ÅA phase 3	n	AV phase 1	n	AV phase 2	n
M 3 mand L	**27,3**	8	**27,7**	14			**29,9**	6	**30,7**	3
M 3 max L	**27,9**	8	**27,7**	10	**29,4**	5	**29,1**	4		
Talus GLl	**38,7**	12	**39,6**	17	**38,8**	4	**38,9**	6	**38,4**	6

Table 27. Maximum, minimum and average values of withers heights of pig. Withers heights formula according to Teichert (1969).

	Medieval	Post-Medieval
min	62,3	64,8
max	79,7	80,4
average	71,0	70,9
n	49	13

Table 28. Estimated withers heights of dog bones, according to Harcourt (1974).

	Side	GL	Withers height	Average
AV dog 1				
humerus	dx	83,9	26,1	
humerus	si	84,1	26,2	
radius	dx	74,2	25,5	
radius	si	76,4	26,2	
femur	dx	87,8	26,3	
femur	si	89,5	26,8	
tibia	dx	82	24,9	
tibia	si	83,1	25,2	25,9
AV dog 2				
femur	sin	192	59,0	
femur	dx	191	58,7	
tibia	sin	201	59,6	
radius	sin	181	59,5	
humerus	dx	176	57,7	
humerus	sin	176	57,7	58,9
AV dog 3				
ulna	sin	112	31,8	
radius	sin	96	32,5	
radius	dx	96	32,5	32,1
ÅA M 73				
humerus	dx	164	53,6	

Table 29. Slenderness index (SD x 100)/GL of dog bones, according to Mazzorin & Tagliacozzo 2000.

	Side	GL	SD	Slenderness index	Average
AV dog 1					
humerus	dx	83,9	7,7	9,2	
humerus	si	84,1	7,7	9,2	
radius	dx	74,2	8,3	11,2	
radius	si	76,4	8,4	11,0	
femur	dx	87,8	8,5	9,7	
femur	si	89,5	8,7	9,7	
tibia	dx	82	8,6	10,5	
tibia	si	83,1	8,3	10,0	10,0
AV dog 2					
humerus	dx	176	11,7	6,6	
humerus	si	176	12,8	7,3	
radius	si	181	12,4	6,9	
femur	si	192	13,8	7,2	
tibia	si	201	13,3	6,6	6,9
AV dog 3					
radius	dx	96	6,6	6,9	
radius	si	96	6,6	6,9	6,9
ÅA M 73					
humerus	dx	164	13,1	8,0	

Table 30. Identified bird species in the Åbo Akademi material. According to Kylänen (2001)

Gallus gallus	Domestic chicken
Anas platyrhynchos	Mallard/ domestic duck
Anser anser	Graylag goose /domestic goose
Anas clypeata	Northern shoveler
Anas crecca	Teal
Anas penelope	Eurasian wigeon
Melanitta fusca	Velvet scooter
Melanitta nigra	Common scooter
Mergus merganser	Common merganser
Mergus serrator	Red-breasted merganser
Somateria mollissima	Eider
Lagopus lagopus	Willow grouse
Tetrao urogallus	Capercaillie
Tetrao tetrix	Black grouse
Bonasa bonasia	Hazel grouse
Numenius arquata	Curlew
Corvus corone	Crow
Corvus monedula	Jackdaw

Table 31.The abundance of chosen anatomical parts in the Åbo Akademi contexts. Horncores and premaxillae % of all the skull fragments, metapodials % of all the long bones, mandible frontal part % of mandible fragments. Infant bones are excluded from the comparisons.

ÅA	Context	Cattle horncores	Sheep horncores	Goat horncores	Cattle Mc/Mt	Sheep Mc/Mt	Goat Mc/Mt	Cattle Prem	Cattle mand front
Phase 1	M 512	21,2	7,7	2,3	23,6	16,7	10,9	1,4	17,4
	M 513	3,8	14,3	4,2	29,8	27,0	6,7	5,0	17,8
	M 513 B	15,6	14,9	2,7	38,1	35,0	4,3	2,2	13,6
	M 503 M	22,2	0	0	20,0	11,1	9,1	11,1	7,7
	M 511 B	11,1	6,5	6,7	47,6	25,4	2,6	0	0
	M 173	4,0	7,6	8,5	18,3	26,7	3,5	10,3	24,0
	M 118	8,0	17,7	7,2	26,4	42,8	4,9	4,6	22,4
	M 130 E	18,9	1,7	7,0	19,2	17,9	1,5	1,4	30,4
Phase 2	M 503 E	3,7	2,6	0	28,9	30,0	2,5	3,7	26,7
	M 503 F	0	0	0	26,5	7,0	0	25,0	0
	M 503 E+F	0	20,0	0	20,0	18,2	0	12,5	0
	M 503 G	5,6	4,5	1,4	23,8	30,5	4,5	4,3	25,9
	M 159	2,7	7,9	4,9	32,7	44,0	20,8	14,7	20,7
	M 147	15,1	11,4	7,0	19,9	28,2	1,2	3,5	12,5
	M 90 E	10,0	25,0	0	35,6	30,4	8,3	5,0	33,3
	M 114 D	22,2	28,6	25,0	25,8	40,0	27,3	3,7	16,7
	M 139 D	5,8	12,1	13,3	25,0	28,0	6,9	5,8	20,4
	M 163	3,7	23,1	0,0	41,7	14,8	5,3	14,8	25,0
	M 65 D	1,2	7,2	5,6	28,4	36,9	0	2,4	13,3
	M 87 C+D	4,7	14,3	0	18,0	14,3	6,3	2,3	0
	M 104	6,9	19,7	4,3	26,3	24,6	1,7	6,4	18,2
	M 78 B	0	9,3	5,3	69,5	30,2	0	35,5	40,6
	M 78 C	3,0	11,5	18,5	29,9	39,6	1,1	22,2	51,9
	M 66	0	13,8	17,2	23,1	48,7	0	16,7	17,6
Phase 3	M 73	0	0	0	43,5	26,0	11,8	10,5	30,0
	M 14	2,9	3,2	5,0	45,5	33,7	8,2	7,2	29,0
	M 60	4,7	8,3	0	32,0	12,9	7,8	9,3	44,0
	M 60 C	0	2,0	0	20,0	11,4	13,5	15,8	44,8
	M 36	4,1	10,0	11,1	40,5	15,2	0	4,0	0
Others	M 118 B+C				35,7	45,5			
	M 128 F	44,4							
	M 66 B	0	6,1	17,9	29,7	42,5	0	7,5	23,8

Table 32.The abundance of chosen anatomical parts in the Aboa Vetus contexts. Horncores and premaxillae % of all the skull fragments, metapodials % of all the long l
mandible frontal part % of mandible fragments. Infant bones are excluded from the comparisons

AV	Context	Cattle horncores	Sheep horncores	Goat horncores	Cattle Mc/Mt	Sheep Mc/Mt	Goat Mc/Mt	Cattle Prem	Cattle mand front
Phase 1	R 1b6375	10,0	0	2,9	11,1	16,1	6,1	14,0	4,3
	R 25	41,0	4,0	28,1	20,4	18,6	9,4	0	31,8
	R 19 U	19,8	11,8	15,6	22,9	23,2	8,8	6,6	21,4
Phase 2	K 94:8	3,3	33,3	0	23,3	12,5	4,5	3,2	25,0
	K 94:9	7,1	16,7	0	16,7	33,3	0	0	75,0
	K 94:10	4,7	18,9	3,7	18,7	22,3	5,7	11,6	31,6
	K 94:11	3,7	14,6	12,8	36,9	23,4	8,6	1,9	13,3
	K 94:12	1,4	5,4	2,3	26,1	16,3	11,2	2,8	13,2
Phase 3	K 94:13	0	0	33,3	33,3	20,0	0	0	100,0
	R91213	0	0	12,5	25,8	8,7	3,3	0	0
Others	Ku 12 and extension	0	18,2	0	25,9	20,5	3,7	4,3	30,8
	R 19 A	0	18,2	0	35,1	20,0	5,6	0	7,7

Table 33. Distribution of horncores in R 25, Aboa Vetus (NISP).

Square	Cattle	Goat	Sheep	Sheep / goat	**Total**
3	2			2	**4**
16		1			**1**
17	1			2	**3**
18	2				**2**
19	1			3	**4**
22	4	1			**5**
24		1	1		**2**
27		1		1	**2**
29	2	1		3	**6**
30	1	1		1	**3**
31	2	1		4	**7**
32	2		1	4	**7**
33		1		1	**2**
34		3			**3**
44					**0**
46	4	2		1	**7**
50					**0**
51					**0**
52			1		**1**
53					**0**
54					**0**
55					**0**
57				1	**1**
58	4	1		1	**6**

Table 34. The number of different types of cattle in the 1620's tax lists and ratio of different groups against to cows. Original data according to Luukko (1958: 100

Province	Oxen	Bulls	Bullocks	Cows	Heifers	Calves	Cow/Oxen	Cow/Bull	Cow/Bullock	Cow/Heifer
Finland Proper	8627	982	3705	19943	6642		2,3	20,3	5,4	3,0
Åland Islands	22	89	414	6551	445	4540	297,8	73,6	15,8	14,7
Satakunda	4203	884	2582	14571	7533		3,5	16,5	5,6	1,9
Hollola	120	92	240	4220	1800		35,2	45,9	17,6	2,3
Tavastland	2217	327	1928	12182	5425		5,5	37,3	6,3	2,2
Porvoo	106	179	340	4626	1674		43,6	25,8	13,6	2,8
Uusimaa	2557	706	2010	11682	4362		4,6	16,5	5,8	2,7
Kymenkartano	347	141	658	4233	1643		12,2	30,0	6,4	2,6
Vyborg Karelia	5	16	310	7985	2746		1597,0	499,1	25,8	2,9
Savo	0	164	435	9169	2352		-	55,9	21,1	3,9
Ostrobothnia	2190	1731	3840	36205	10489	4377	16,5	20,9	9,4	3,5

Table 35. Pathologies in the Åbo Akademi and the Aboa Vetus osteological material.

	Cattle	Large ungulate	Sheep / goat	Sheep	Goat	Pig	Small ungulate	Dog	Cat	Red fox	Unidentified	Total
Abnormalities	12			1		2		1				**16**
Inflammation	2	3			1	2				1		**9**
Traumatic injury	2	21	1	10		8	15	2			1	**60**
Arthropathy	213	7	6	8	2	1		1	1			**239**
Oral pathology	27		24	1	1	10			1			**64**
Unidentified	14	5	5			6	2		1		1	**34**
Total	**270**	**36**	**36**	**20**	**4**	**29**	**17**	**4**	**3**	**1**	**2**	**422**

Appendix 1. Number and average weight of unidentified specimens and their proportion in contexts.

ÅA	Context	N	%	Average weight (g)
Phase 1	M 512	256	16,6	18,11
	M 513	329	20,8	18,39
	M 513 B	243	20,6	15,55
	M 503 M	114	20,0	20,00
	M 511 B	309	34,0	12,87
	M 173	1345	24,6	14,55
	M 118	384	15,8	21,12
	M 130 E	479	24,2	13,16
	Total /average	*3459*	*22,1*	*16,31*
Phase 2	M 503 E	360	28,9	12,12
	M 503 F	96	18,6	13,73
	M 503 E+F	19	14,0	25,00
	M 503 G	702	24,7	16,90
	M 159	2855	30,3	12,51
	M 147	897	24,8	15,22
	M 90 E	100	20,2	21,66
	M 114 D	137	25,0	18,43
	M 139 D	292	14,5	21,76
	M 163	60	16,7	20,33
	M 65 D	387	24,7	18,70
	M 87 C+D	331	35,4	11,43
	M 104	865	23,0	19,98
	M 75	67	41,6	9,32
	M 89J+K	90	24,8	23,42
	M 118B+C	76	31,1	13,93
	M 78 B	915	42,6	8,29
	M 78 C	602	18,7	17,63
	M 66	172	29,2	13,39
	M 56 C-N	257	28,4	13,48
	Total /average	*9280*	*26,5*	*15,4*
Phase 3	M 73	460	30,3	12,70
	M 14	1057	28,3	13,38
	M 60	1202	35,1	7,30
	M 60 C	833	30,7	10,64
	M 36	534	49,3	7,56
	Total /average	*4086*	*32,7*	*10,52*
Others	M 113A-F	179	28,6	20,48
	M 68 B	9	37,5	12,50
	M 128F	30	15,3	26,53
	M 146A-B	17	11,8	16,67
	M 164B	45	18,1	16,47
	M 96	246	41,1	11,52
	M 68 B	9	37,5	12,50
	M 66 B	617	37,3	11,29
AV				
Phase 1	R 1b6375	284	22,6	13,8
	R 25	793	23,3	12,2
	R 19 U	1581	30,4	12,0
	Total /average	*2658*	*26,9*	*12,3*
Phase 2	K 94:8	125	23,7	20,7
	K 94:9	255	40,3	7,6
	K 94:10	459	19,0	12,6
	K 94:11	1606	52,5	8,0
	K 94:12	3885	52,0	7,8
	Total /average	*6330*	*44,9*	*9,2*
Phase 3	K 94:13	119	38,9	9,2
	R91213	158	20,1	14,2
	Total /average	*277*	*25,3*	*12,8*
Others	Ku 12 and extension	371	32,2	9,7
	R 19 A	139	24,7	16,0

Appendix 2. Properties of different contexts at Åbo Akademi. Consistence: Ma =manure, Mi =Mineral, O =Organic, W =Woodchip,V =Variable. Closed = deposited in a confined space inside a solid structure. Average weight of fragments and percentage of unidentified fragments. Signs of crafts:Y =yes, P =perhaps and N=no. Abundance of skeletons: X= ‰ over 10.
Abundance of species: contexts where highest percentages of species were present. C=cattle, S/G=sheep/goat, P=pig. Number indicates the order of abundance.

	Context	Area	Consistence	Closed/open	Average weight	% Unidentified	Signs of Crafts	Abundance of skeletons	Abundance of species
Phase 1	M 503 M	Kosmo A	O	open	20,00	20,0	P		P 2
	M 511 B	Kosmo A	W	open	12,87	34,0	P		S/G 1
	M 512	Kosmo A	O	open	18,11	16,6	P		P 1
	M 513	Kosmo A	Ma	open	18,39	20,8	N		
	M 513 B	Kosmo A	W	open	15,55	20,6	N		P 3
	M 173	Kosmo B	W	open	14,55	24,6	N		
	M 118	Kemicum	W	open	21,12	15,8	Y		
	M 130 E	Kemicum	Ma	open	13,16	24,2	N		
Phase 2	M 503 E	Kosmo A	W	open	12,12	28,9	N		
	M 503 E+F	Kosmo A	-	open	25,00	14,0	N		
	M 503 F	Kosmo A	Ma	open	13,73	18,6	N		
	M 503 G	Kosmo A	W	open	16,90	24,7	N		
	M 89 J+K	Kosmo A	W	closed	23,42	24,8			
	M 114 D	Kosmo B	W	open	18,43	25,0	Y		C 1
	M 139 D	Kosmo B	Mi	open	21,76	14,5	N		
	M 159	Kosmo B	W	open	12,51	30,3	P		S/G 3
	M 163	Kosmo B	W	open	20,33	16,7	P	X	
	M 78 B	Kosmo B	W	open	8,29	42,6	Y		C 2
	M 78 C	Kosmo B	W	open	17,63	18,7	Y		
	M 90 E	Kosmo B	W	open	21,66	20,2	P		
	M 104	Kemicum	Ma	open	19,98	23,0	N		C 3
	M 118 B+C	Kemicum	M	closed	13,93	31,1			
	M 147	Kemicum	W	open	15,22	24,8	N	X	
	M 56 C-N	Kemicum	V	closed	13,48	28,4		X	
	M 65 D	Kemicum	W	open	18,70	24,7	N		
	M 66	Kemicum	O	open	13,39	29,2	Y		S/G 2
	M 75	Kemicum	Mi	closed	9,32	41,6			
	M 87 C+D	Kemicum	W	open	11,43	35,4	N		
Phase 3	M 60	Kosmo B	Mi	open	7,30	35,1	P		
	M 60 C	Kosmo B	Mi	open	10,64	30,7	P		
	M 73	Kosmo B	O	open	12,70	30,3	P		
	M 14	Kemicum	Mi	open	13,38	28,3	P		
	M 36	Kemicum	W	open	7,56	49,3	N		
	M 128 F	Kemicum	W	closed	26,53	15,3	Y		
	M 113A-F	Kemicum	V	closed	20,48	28,6		X	
	M 146 A ja B	Kemicum	Ma	closed	16,67	11,8		X	
	M 164 B	Kosmo B	W	closed	16,47	18,1		X	
	M 66 B	Kemicum	Ma	open	11,29	37,3			
	M 68 B	Kemicum	Mi	closed	12,50	37,5			
	M 96	Kemicum	Mi	closed	11,52	41,1			

Appendix 3. Properties of different contexts at Aboa Vetus. Closed=deposited to limited space inside solid structure. Average weight of fragments and percentage of unidentified fragments. Signs of crafts=Y=yes, P=perhaps and N=no. Abundance of skeletons: X= ‰ over 10. Abundance of species: contexts where highest percentages of species. C=cattle, S/G=sheep/goat, P=pig.

	Context	Open/closed	% Unidentified	Average weight	Signs of Crafts	Abundance of skeletons	Abundance of species
Phase 1	R 1b6375	Open	22,6	13,8	N		
	R 25	Open	23,3	12,2	Y		
	R 19 U	Open	30,4	12,0	P		
Phase 2	K 94:10	Closed	19,0	12,6	N	X	
	K 94:11	Closed	52,5	8,0	N	X	
	K 94:12	Closed	52,0	7,8	N	X	P
	K 94:8	Closed	23,7	20,7	N	X	
	K 94:9	Closed	40,3	7,6	N	X	
Phase 3	R91213	Open	20,1	14,2	N	X	C, S/G
	K 94:13	Closed	38,9	9,2	N		
	Ku 12 and extension	Mostly closed	32,2	9,7	N	X	
	R 19 A	Open	24,7	16,0	N		

Appendix 4. Number of infant and articulated skeleton specimens (in italics) in the contexts at Åbo Akademi excavations.
The frequency of infant and articulated skeleton specimens is counted as per mil of the total number of specimens in each contexts.

ÅA	Context	Cattle	Pig	Sheep/goat	Sheep	Goat	Large ung	Small ung	Small animal	Dog	Cat	Unidentified	Total	‰ of the total number of specimens
Phase 1	M 118	9	3					2					**14**	**5,7**
	M 130E	1	6	4									**11**	**5,5**
	M 173	5	4		1		1				1		**12**	**2,2**
	M 503M	1	3										**4**	**7,0**
	M 511B	1	1										**2**	**2,2**
	M 512	7	5					2					**14**	**9,1**
	M 513	4	1	1									**6**	**3,8**
	M 513B	2	2	1			1						**6**	**5,1**
Phase 2	M 104	12	2	2				1			3	1	**21**	**5,6**
	M 114D		*5*										***5***	**9,1**
	M 118B+C												**0**	**0,0**
	M 139D	3	2										**5**	**2,5**
	M 147	4	42+*18*	4					1	6	31		**88+*18***	**29,3**
	M 159	5	20	7	3	4					5		**44**	**4,7**
	M 163			12	1						1		**14**	**39,0**
	M 503 E+F												**0**	**0,0**
	M 503E		3					1					**4**	**3,2**
	M 503F			1									**1**	**1,9**
	M 503G	4	3	2	1								**10**	**3,5**
	M 56C-N	6	3+*56*								*5*	2	**11+*61***	**74,0**
	M 65 D	1											**1**	**0,6**
	M 66												**0**	**0,0**
	M 75												**0**	**0,0**
	M 78B	1	2		1								**4**	**1,9**
	M 78C	1	1	1									**3**	**0,9**
	M 87 C+D	1	1				1					2	**5**	**5,3**
	M 89J+K	3											**3**	**8,3**
	M 90E												**0**	**0,0**
Phase 3	M 14	4	3									3	**10**	**2,7**
	M 36	1	6	2				1					**10**	**9,2**
	M 60	11	5	1			1					1	**19**	**5,5**
	M 60C	5	1										**6**	**2,2**
	M 73	2	2	1				1					**6**	**3,9**
Others	M 113A-F		*16*										***16***	**25,6**
	M 128F												**0**	**0,0**
	M 146A-B		11+*3*										**11+*3***	**97,2**
	M 164B		32										**32**	**128,5**
	M 66B		1		1								**2**	**3,9**
	M 68 B												**0**	**0,0**
	M 96												**0**	**0,0**

Appendix 5. Number of infant and articulated skeleton specimens (in italics) in the contexts at Aboa Vetus excavations.
The frequency of infant and articulated skeleton specimens is counted as per mil of the total number of specimens in each contexts.

AV	Context	Cattle	Pig	Sheep/goat	Sheep	Large ung.	Small ung	Dog	Cat	Unidentified	Total	‰ of the total number of specimens
Phase 1	R 1b6375		1								**1**	**0,8**
	R 25	6	5								**11**	**3,2**
	R 19 U	6	4	1							**11**	**2,1**
Phase 2	K 94:8	3	6+*32*						1		**10+*32***	**79,7**
	K 94:9		3	2			1		1+*62*		**7+*62***	**109,2**
	K 94:10	8	*25+167*	9				*52*			***42+219***	**108,1**
	K 94:11	10	6+*18*	*35*	*29*		*69*	*84*	3	1	**20+*235***	**83,4**
	K 94:12	1	167+*295*	2			1	*8*	49+*91*	1	**221+*394***	**82,4**
Phase 3	K 94:13										**0**	**0,0**
	R91213	8									**8**	**10,2**
Others	Ku 12 and extension	5	2					*115*	*26*		**7+*141***	**128,6**
	R 19 A	1	2						1		**4**	**7,1**
	R 50	1									**1**	**83,3**
	K 28:3					1					**1**	**22,7**

Appendix 6. Chewed (C) and gnawed (G) specimens at Åbo Akademi excavations.

	Context	C NISP	% C	G NISP	% G
Phase 1	M 118	310	12,7	14	0,6
	M 130 E	201	10,1	14	0,7
	M 173	411	7,5	29	0,5
	M 503 M	34	6,0	1	0,2
	M 511 B	115	12,7	1	0,1
	M 512	177	11,5	2	0,1
	M 513	220	13,9	7	0,4
	M 513 B	123	10,5	1	0,1
	Average		*10,6*		*0,3*
Phase 2	M 104	505	13,5	10	0,3
	M 114 D	36	6,6	0	0,0
	M 118 B+C	21	8,6	7	2,9
	M 139 D	156	7,7	11	0,5
	M 147	420	11,6	18	0,5
	M 159	383	4,1	96	1,0
	M 163	24	6,7	2	0,6
	M 503 E	236	18,9	7	0,6
	M 503 E+F	2	1,5	2	1,5
	M 503 F	34	6,6	9	1,7
	M 503 G	391	13,7	12	0,4
	M 56 C-N	38	4,2	3	0,3
	M 65 D	137	8,7	0	0,0
	M 66	40	6,8	2	0,3
	M 75	0	0,0	7	4,3
	M 78 B	44	2,0	3	0,1
	M 78 C	343	10,6	9	0,3
	M 87 C+D	43	4,6	0	0,0
	M 89 J+K	32	8,8	2	0,6
	M 90 E	42	8,5	1	0,2
	Average		*7,7*		*0,8*
Phase 3	M 14	107	2,9	8	0,2
	M 36	20	1,8	0	0,0
	M 60	61	1,8	6	0,2
	M 60 C	59	2,2	1	0,0
	M 73	58	3,8	2	0,1
	Average		*2,5*		*0,1*
Others	M 128 F	12	6,1	5	2,6
	M 113A- F	30	4,8	0	0,0
	M 146 A ja B	16	11,1	0	0,0
	M 164 B	17	6,8	2	0,8
	M 66 B	134	8,1	3	0,2
	M 68 B	0	0,0	0	0,0
	M 96	14	2,3	1	0,2

Appendix 7. Chewed (C) and gnawed (G) specimens at Aboa Vetus excavations.

	Context	C NISP	% C	G NISP	% G
Phase 1	R 19 U	140	2,7	14	0,3
	R 1b6375	59	4,7	6	0,5
	R 25	161	4,7	28	0,8
	Average		*4,0*		*0,5*
Phase 2	K 94:11	27	1,7	3	0,2
	K 94:12	97	2,5	7	0,2
	K 94:9	6	2,4	0	0,0
	K94:10	35	7,6	6	1,3
	K94:8	7	5,6	1	0,8
	Average		*4,0*		*0,5*
Phase 3	K 94:13	5	1,6	1	0,3
	R 91213	14	1,8	14	1,8
	Average		*1,7*		*1,1*
	K 28:3	0	0,0	6	13,6
	KU 12and extension	31	2,7	8	0,7
	R 19 A	6	1,1	1	0,2
	R 50	0	0,0	2	16,7

Appendix 8. Proportions of high and low utility body parts at Åbo Akademi contexts. LU= large ungulate, SU=small ungulate. For closer definition of high and low utility elements see chapter 1.

M 511 B	Cattle	Pig	Sheep/goat	Goat	Sheep	Large ungulate	Small ungulate	Cattle + LU	Sheep/goat + pig+ SU
High utility	28,7	47,1	55,1	40,0	30,8	88,8	74,5	56,7	59,3
Low utility	64,3	35,3	34,6	60,0	69,2	2,4	0,0	35,4	24,5
Other	7,0	17,6	10,3	0,0	0,0	8,8	25,5	7,8	16,1
M 503 M									
High utility	35,7	47,7	81,4	33,3	69,6	84,8	82,1	57,5	71,9
Low utility	56,4	43,2	14,3	66,7	30,4	6,3	0,0	34,1	19,4
Other	7,9	9,1	4,3	0,0	0,0	8,9	17,9	8,3	8,7
M 513 B									
High utility	30,6	27,8	51,2	42,9	23,3	81,2	69,1	52,8	48,2
Low utility	59,3	54,2	36,9	57,1	76,7	5,0	0,0	35,4	35,3
Other	10,1	18,1	11,9	0,0	0,0	13,9	30,9	11,7	16,4
M 513									
High utility	32,6	40,7	50,5	12,5	43,8	81,7	57,0	54,1	48,3
Low utility	57,0	40,7	35,6	87,5	56,3	6,9	0,0	35,1	33,9
Other	10,4	18,6	14,0	0,0	0,0	11,4	43,0	10,9	17,7
M 512									
High utility	34,7	45,5	54,4	27,3	55,6	85,4	81,5	59,8	58,1
Low utility	53,4	43,3	36,3	72,7	44,4	7,5	0,0	30,7	31,4
Other	11,9	11,2	9,3	0,0	0,0	7,0	18,5	9,5	10,5
M 173									
High utility	27,6	46,7	41,6	26,5	33,5	76,3	75,2	52,0	52,5
Low utility	55,1	37,7	40,2	73,5	66,5	11,8	2,1	33,4	30,9
Other	17,3	15,6	18,2	0,0	0,0	12,0	22,7	14,6	16,6
M 130 E									
High utility	33,8	50,5	53,8	36,8	46,3	91,6	70,6	62,4	58,2
Low utility	56,9	30,7	39,5	63,2	53,7	1,6	0,8	29,5	26,2
Other	9,4	18,8	6,7	0,0	0,0	6,9	28,7	8,1	15,6
M 118									
High utility	32,8	58,8	47,4	9,1	25,7	86,6	82,3	58,5	51,8
Low utility	58,4	32,8	37,4	90,9	74,3	4,6	0,0	32,7	37,2
Other	8,8	8,4	15,2	0,0	0,0	8,8	17,7	8,8	11,0
M 147									
High utility	38,0	47,8	47,3	21,4	33,1	84,8	70,5	60,5	51,3
Low utility	50,6	44,0	40,8	78,6	66,9	5,4	1,0	28,9	35,0
Other	11,4	8,1	11,9	0,0	0,0	9,8	28,4	10,6	13,7
M 159									
High utility	23,8	40,9	63,2	5,2	24,0	83,8	88,3	54,0	60,5
Low utility	59,1	48,8	30,5	94,8	76,0	5,3	1,1	32,0	32,6
Other	17,1	10,3	6,3	0,0	0,0	10,9	10,7	14,0	6,8
M 503 G									
High utility	32,6	37,1	49,0	40,0	26,8	80,1	61,7	52,1	45,5
Low utility	55,7	50,9	39,5	60,0	73,2	5,1	0,0	35,0	38,6
Other	11,7	11,9	11,5	0,0	0,0	14,8	38,3	12,9	15,9
M 503 F									
High utility	34,3	52,4	60,0	66,7	69,2	88,7	75,7	61,2	66,2
Low utility	50,9	28,6	28,8	33,3	30,8	0,0	2,7	25,7	19,6
Other	14,8	19,0	11,3	0,0	0,0	11,3	21,6	13,1	14,2
M 503 E+F									
High utility	24,5	100,0	44,4	100,0	54,5	93,5	100,0	51,3	72,2
Low utility	69,4	0,0	55,6	0,0	45,5	6,5	0,0	45,0	27,8
Other	6,1	0,0	0,0	0,0	0,0	0,0	0,0	3,8	0,0
M 503 E									
High utility	34,4	48,4	51,0	0,0	29,5	84,1	61,3	57,4	50,3
Low utility	53,8	43,5	36,2	100,0	70,5	4,4	0,8	30,9	32,1
Other	11,8	8,1	12,8	0,0	0,0	11,5	37,8	11,7	17,6
M 90 E									
High utility	38,4	68,2	42,9	50,0	25,0	86,6	82,5	61,9	55,5
Low utility	54,4	27,3	38,8	50,0	75,0	0,8	5,0	28,3	33,6
Other	7,2	4,5	18,4	0,0	0,0	12,6	12,5	9,8	10,9
M 87 C+D									
High utility	36,3	38,6	52,2	0,0	34,8	81,4	66,7	58,5	50,9
Low utility	52,8	36,4	31,5	100,0	65,2	3,7	7,0	28,6	30,3
Other	10,9	25,0	16,3	0,0	0,0	14,9	26,3	12,9	18,8
M 65 D									
High utility	27,7	40,3	30,5	0,0	26,8	87,8	82,1	55,8	44,6
Low utility	64,5	47,8	50,3	100,0	73,2	1,8	1,6	35,2	41,6
Other	7,7	11,9	19,3	0,0	0,0	10,3	16,3	8,9	13,8
M 163									
High utility	26,4	57,9	68,3	50,0	38,9	100,0	74,3	60,0	64,2
Low utility	67,8	26,3	26,7	50,0	61,1	0,0	0,0	36,9	24,6
Other	5,7	15,8	5,0	0,0	0,0	0,0	25,7	3,1	11,2
M 139									
High utility	35,4	42,4	56,2	21,4	49,6	84,1	83,9	60,5	60,9
Low utility	55,7	42,4	36,5	78,6	50,4	4,3	0,5	29,2	29,5
Other	8,9	15,2	7,4	0,0	0,0	11,7	15,6	10,3	9,6
M 114D									
High utility	30,8	52,6	53,6	0,0	31,0	85,6	75,9	60,9	55,6
Low utility	60,0	36,8	35,7	100,0	69,0	8,9	0,0	32,0	31,1
Other	9,2	10,5	10,7	0,0	0,0	5,5	24,1	7,1	13,3
M 104									
High utility	37,6	49,1	60,4	60,0	38,0	90,8	75,1	64,1	58,8
Low utility	54,8	37,9	28,8	40,0	62,0	1,0	0,7	28,0	28,1
Other	7,7	13,0	10,8	0,0	0,0	8,2	24,2	8,0	13,1
M 66									
High utility	29,5	30,0	39,1	0,0	16,7	95,6	86,0	56,6	43,4
Low utility	60,5	55,0	44,9	100,0	83,3	0,0	0,0	35,6	45,1
Other	10,1	15,0	15,9	0,0	0,0	4,4	14,0	7,8	11,4
M 78 C									
High utility	31,5	46,3	55,9	0,0	28,3	92,0	78,8	60,7	55,8
Low utility	57,4	43,5	33,7	100,0	71,7	2,5	0,3	30,9	32,7
Other	11,1	10,2	10,3	0,0	0,0	5,5	20,9	8,4	11,5
M 78 B									
High utility	12,8	33,3	37,9	0,0	34,5	78,1	69,3	34,7	47,3
Low utility	64,3	49,3	44,7	100,0	65,5	5,8	4,3	44,7	34,8
Other	22,9	17,4	17,4	0,0	0,0	16,1	26,4	20,6	17,9
M 60 C									
High utility	38,7	58,4	64,9	40,0	53,7	89,6	82,9	70,0	70,8
Low utility	51,5	31,2	28,0	60,0	46,3	1,5	0,0	20,8	18,0
Other	9,7	10,4	7,0	0,0	0,0	8,9	17,1	9,2	11,2
M 60									
High utility	34,6	66,7	63,1	25,0	42,2	87,5	76,1	64,3	68,5
Low utility	48,6	31,4	23,9	75,0	57,8	3,2	0,6	23,2	15,2
Other	16,7	1,9	13,0	0,0	0,0	9,3	23,3	12,6	16,3
M 36									
High utility	24,6	42,4	63,2	0,0	37,5	86,2	69,7	55,4	60,3
Low utility	59,4	33,3	16,8	100,0	62,5	3,6	0,0	31,5	17,1
Other	15,9	24,2	20,0	0,0	0,0	10,1	30,3	13,0	22,6
M 73									
High utility	35,2	45,5	63,5	40,0	42,3	80,6	79,0	58,0	60,7
Low utility	51,2	39,0	17,4	60,0	57,7	3,6	1,7	27,3	24,1
Other	13,6	15,6	19,2	0,0	0,0	15,8	19,3	14,7	15,2
M 14									
High utility	29,5	49,6	47,5	27,8	36,6	86,8	83,1	55,6	59,2
Low utility	57,3	40,0	31,6	72,2	63,4	2,6	4,4	32,3	27,5
Other	13,2	10,4	20,9	0,0	0,0	10,6	12,4	12,0	13,3

Appendix 9. Proportions of high and low utility body parts at Åbo Akademi contexts when infant bones and whole skeletons are removed from the material.
LU= large ungulate, SU=small ungulate. For closer definition of high and low utility elements see chap

M 511 B	Cattle	Pig	Sheep/goat	Goat	Sheep	Large ungulate	Small ungulate	Cattle + LU	Sheep/goat + pig+ SU
High utility	28,2	48,5	55,1	40,0	30,8	88,8	74,5	56,6	59,5
Low utility	64,8	33,3	34,6	60,0	69,2	2,4	0,0	35,6	24,3
Other	7,0	18,2	10,3	0,0	0,0	8,8	25,5	7,9	16,2
M 503 M									
High utility	36,0	46,3	81,4	33,3	69,6	84,8	82,1	57,8	72,0
Low utility	56,1	43,9	14,3	66,7	30,4	6,3	0,0	33,9	19,2
Other	7,9	9,8	4,3	0,0	0,0	8,9	17,9	8,4	8,8
M 513 B									
High utility	30,6	27,1	50,9	42,9	23,3	81,1	69,1	52,9	48,1
Low utility	59,2	54,3	37,1	57,1	76,7	5,0	0,0	35,3	35,3
Other	10,2	18,6	12,0	0,0	0,0	13,9	30,9	11,8	16,6
M 513									
High utility	32,6	41,2	50,7	12,5	43,8	81,7	57,0	54,2	48,5
Low utility	56,8	40,0	35,3	87,5	56,3	6,9	0,0	34,8	33,7
Other	10,5	18,8	14,0	0,0	0,0	11,4	43,0	10,9	17,8
M 512									
High utility	35,0	46,5	54,4	27,3	55,6	85,4	81,1	60,2	58,3
Low utility	52,8	41,9	36,3	72,7	44,4	7,5	0,0	30,2	31,0
Other	12,1	11,6	9,3	0,0	0,0	7,0	18,9	9,6	10,7
M 173									
High utility	27,5	46,6	41,6	26,5	33,7	76,2	75,2	51,9	52,6
Low utility	55,2	37,5	40,2	73,5	66,3	11,8	2,1	33,4	30,8
Other	17,4	15,9	18,2	0,0	0,0	12,0	22,7	14,7	16,6
M 130 E									
High utility	33,6	48,4	53,0	36,8	46,3	91,6	70,3	62,4	57,6
Low utility	57,0	31,6	40,2	63,2	53,7	1,6	0,8	29,5	26,5
Other	9,4	20,0	6,8	0,0	0,0	6,9	28,9	8,1	15,9
M 118									
High utility	32,3	59,4	47,4	9,1	25,7	86,6	82,3	58,3	51,8
Low utility	58,8	32,0	37,4	90,9	74,3	4,6	0,0	32,8	37,1
Other	8,9	8,6	15,2	0,0	0,0	8,8	17,7	8,9	11,0
M 147									
High utility	37,8	45,7	46,8	21,4	33,1	84,8	70,5	60,4	50,9
Low utility	50,7	43,0	41,2	78,6	66,9	5,4	1,0	28,9	34,5
Other	11,4	11,3	12,0	0,0	0,0	9,8	28,4	10,7	14,5
M 159									
High utility	23,8	39,5	63,4	5,5	24,2	83,8	88,3	54,0	60,7
Low utility	59,0	49,5	30,3	94,5	75,8	5,3	1,1	32,0	32,4
Other	17,2	11,0	6,3	0,0	0,0	10,9	10,7	14,0	6,9
M 503 G									
High utility	32,7	37,8	48,9	40,0	27,0	80,1	61,7	52,2	45,7
Low utility	55,6	50,0	39,4	60,0	73,0	5,1	0,0	34,9	38,2
Other	11,7	12,2	11,6	0,0	0,0	14,8	38,3	13,0	16,1
M 503 F									
High utility	34,3	52,4	59,5	66,7	69,2	88,7	75,7	61,2	66,0
Low utility	50,9	28,6	29,1	33,3	30,8	0,0	2,7	25,7	19,7
Other	14,8	19,0	11,4	0,0	0,0	11,3	21,6	13,1	14,3
M 503 E+F									
High utility	24,5	100,0	44,4	100,0	54,5	93,5	100,0	51,3	72,2
Low utility	69,4	0,0	55,6	0,0	45,5	6,5	0,0	45,0	27,8
Other	6,1	0,0	0,0	0,0	0,0	0,0	0,0	3,8	0,0
M 503 E									
High utility	34,4	49,2	51,0	0,0	29,5	84,1	61,0	57,4	50,3
Low utility	53,8	42,4	36,2	100,0	70,5	4,4	0,8	30,9	32,0
Other	11,8	8,5	12,8	0,0	0,0	11,5	38,1	11,7	17,8
M 90 E									
High utility	38,4	68,2	42,9	50,0	25,0	86,6	82,5	61,9	55,5
Low utility	54,4	27,3	38,8	50,0	75,0	0,8	5,0	28,3	33,6
Other	7,2	4,5	18,4	0,0	0,0	12,6	12,5	9,8	10,9
M 87 C+D									
High utility	35,9	37,2	52,2	0,0	34,8	81,3	66,7	58,3	50,7
Low utility	53,1	37,2	31,5	100,0	65,2	3,7	7,0	28,8	30,4
Other	10,9	25,6	16,3	0,0	0,0	15,0	26,3	12,9	18,9
M 65 D									
High utility	27,5	40,3	30,5	0,0	26,8	87,8	82,1	55,8	44,6
Low utility	64,7	47,8	50,3	100,0	73,2	1,8	1,6	35,3	41,6
Other	7,8	11,9	19,3	0,0	0,0	10,3	16,3	9,0	13,8
M 163									
High utility	26,4	57,9	62,5	50,0	41,2	100,0	74,3	60,0	62,0
Low utility	67,8	26,3	31,3	50,0	58,8	0,0	0,0	36,9	25,6
Other	5,7	15,8	6,3	0,0	0,0	0,0	25,7	3,1	12,4
M 139 D									
High utility	35,6	43,3	56,2	21,4	49,6	84,1	83,9	60,7	61,1
Low utility	55,4	41,2	36,5	78,6	50,4	4,3	0,5	29,0	29,3
Other	8,9	15,5	7,4	0,0	0,0	11,7	15,6	10,3	9,7
M 114D									
High utility	30,8	42,9	53,6	0,0	31,0	85,6	75,9	60,9	54,6
Low utility	60,0	42,9	35,7	100,0	69,0	8,9	0,0	32,0	31,5
Other	9,2	14,3	10,7	0,0	0,0	5,5	24,1	7,1	13,8
M 104									
High utility	37,5	49,1	60,1	60,0	38,0	90,8	75,0	64,2	58,7
Low utility	54,7	37,7	29,0	40,0	62,0	1,0	0,7	27,8	28,1
Other	7,8	13,2	10,9	0,0	0,0	8,2	24,3	8,0	13,2
M 66									
High utility	29,5	30,0	39,1	0,0	16,7	95,6	86,0	56,6	43,4
Low utility	60,5	55,0	44,9	100,0	83,3	0,0	0,0	35,6	45,1
Other	10,1	15,0	15,9	0,0	0,0	4,4	14,0	7,8	11,4
M 78 C									
High utility	31,4	45,8	55,8	0,0	28,3	92,0	78,8	60,7	55,7
Low utility	57,4	43,9	33,8	100,0	71,7	2,5	0,3	30,9	32,8
Other	11,2	10,3	10,4	0,0	0,0	5,5	20,9	8,4	11,5
M 78 B									
High utility	12,6	31,3	37,9	0,0	35,1	78,1	69,3	34,6	47,1
Low utility	64,4	50,7	44,7	100,0	64,9	5,8	4,3	44,7	34,8
Other	23,0	17,9	17,4	0,0	0,0	16,1	26,4	20,6	18,0
M 14									
High utility	29,1	48,5	47,5	27,8	36,6	86,8	83,1	55,6	59,2
Low utility	57,6	40,9	31,6	72,2	63,4	2,6	4,4	32,3	27,5
Other	13,3	10,6	20,9	0,0	0,0	10,6	12,4	12,0	13,3
M 73									
High utility	35,2	45,5	63,5	40,0	42,3	80,6	79,0	58,0	60,7
Low utility	51,2	39,0	17,4	60,0	57,7	3,6	1,7	27,3	24,1
Other	13,6	15,6	19,2	0,0	0,0	15,8	19,3	14,7	15,2
M 60 C									
High utility	38,2	57,9	64,9	40,0	53,7	89,6	82,9	69,9	70,7
Low utility	51,9	31,6	28,0	60,0	46,3	1,5	0,0	20,8	18,0
Other	9,9	10,5	7,0	0,0	0,0	8,9	17,1	9,3	11,2
M 60									
High utility	34,5	66,0	63,0	25,0	42,2	87,5	76,1	64,5	68,4
Low utility	48,4	32,0	23,9	75,0	57,8	3,2	0,6	22,8	15,2
Other	17,1	2,0	13,0	0,0	0,0	9,3	23,3	12,7	16,4
M 36									
High utility	24,8	37,0	62,4	0,0	37,5	86,2	69,4	55,6	59,7
Low utility	59,1	33,3	17,2	100,0	62,5	3,6	0,0	31,3	16,9
Other	16,1	29,6	20,4	0,0	0,0	10,1	30,6	13,1	23,5

Appendix 10. Proportions of high and low utility body parts at Aboa Vetus contexts. LU= large ungulate, SU=small ungulate. For closer definition of high and low utility elements see chapter 1.

R 25	Cattle	Pig	Sheep/goat	Goat	Sheep	Large ungulate	Small ungulate	Cattle + LU	Sheep/goat + pig+ SU
High utility	40,8	52,9	57,9	0,0	37,2	92,9	57,6	69,2	53,1
Low utility	51,0	32,6	27,8	100,0	62,8	1,5	0,4	24,0	25,5
Other	8,2	14,4	14,3	0,0	0,0	5,6	42,0	6,8	21,4
R 19 U									
High utility	36,1	40,0	52,1	7,9	29,3	87,2	65,0	63,0	52,3
Low utility	52,0	45,5	26,0	92,1	70,7	3,0	0,3	26,3	24,5
Other	11,8	14,5	21,9	0,0	0,0	9,7	34,7	10,7	23,2
R 1b7563									
High utility	36,2	34,3	47,8	50,0	39,3	91,0	75,5	69,8	58,3
Low utility	50,5	54,3	37,1	50,0	60,7	1,6	0,0	20,6	24,1
Other	13,3	11,4	15,1	0,0	0,0	7,4	24,5	9,7	17,7
K948									
High utility	39,0	79,7	72,7	50,0	41,7	81,8	75,0	55,8	70,6
Low utility	51,5	18,8	20,0	50,0	58,3	9,1	0,0	34,8	23,9
Other	9,6	1,6	7,3	0,0	0,0	9,1	25,0	9,4	5,5
K949									
High utility	33,3	26,9	56,4	50,0	13,3	79,0	83,7	52,7	55,8
Low utility	47,6	61,5	38,2	50,0	86,7	0,0	2,0	27,4	35,4
Other	19,0	11,5	5,5	0,0	0,0	21,0	14,3	19,9	8,8
K9410									
High utility	44,1	65,9	75,0	45,0	40,7	91,4	88,5	67,7	70,7
Low utility	50,9	31,5	19,8	55,0	59,3	1,7	0,0	26,4	24,0
Other	5,0	2,6	5,2	0,0	0,0	6,9	11,5	5,9	5,2
K9411									
High utility	33,7	45,4	57,5	19,0	28,0	88,1	93,4	57,7	63,7
Low utility	55,6	42,6	31,8	81,0	72,0	9,3	0,4	35,1	28,5
Other	10,8	12,0	10,6	0,0	0,0	2,6	6,3	7,2	7,8
K9412									
High utility	32,3	65,1	46,6	27,7	30,7	92,6	92,3	58,4	63,9
Low utility	56,3	30,6	36,2	72,3	69,3	2,3	0,2	32,9	27,4
Other	11,4	4,3	17,3	0,0	0,0	5,2	7,5	8,7	8,7
K9413									
High utility	35,1	57,1	35,3	0,0	44,4	91,5	89,5	60,6	66,7
Low utility	47,4	28,6	29,4	0,0	55,6	0,0	0,0	26,0	17,9
Other	17,5	14,3	35,3	0,0	0,0	8,5	10,5	13,5	15,4

Appendix 11. Proportions of high and low utility body parts at Aboa Vetus contexts when infant bones and whole skeletons are removed from the material. LU= large ungulate, SU=small ungulate. For closer definition of high and low utility elements see chapter 1.

R 25	Cattle	Pig	Sheep/goat	Goat	Sheep	Large ungulate	Small ungulate	Cattle + LU	Sheep/goat + pig+ SU
High utility	41,2	52,7	57,9	0,0	37,2	92,9	57,6	69,5	53,1
Low utility	50,6	32,4	27,8	100,0	62,8	1,5	0,4	23,7	25,4
Other	8,3	14,8	14,3	0,0	0,0	5,6	42,0	6,8	21,5
R 19 U									
High utility	36,3	38,8	52,0	7,9	29,3	87,2	65,0	63,2	52,1
Low utility	51,8	46,4	26,0	92,1	70,7	3,0	0,3	26,1	24,6
Other	11,9	14,8	21,9	0,0	0,0	9,7	34,7	10,8	23,3
R 1b7563									
High utility	36,2	35,3	47,8	50,0	39,3	91,0	75,5	69,8	58,4
Low utility	50,5	52,9	37,1	50,0	60,7	1,6	0,0	20,6	23,9
Other	13,3	11,8	15,1	0,0	0,0	7,4	24,5	9,7	17,7
K948									
High utility	39,8	61,5	72,7	50,0	41,7	81,8	75,0	56,6	64,0
Low utility	50,4	34,6	20,0	50,0	58,3	9,1	0,0	33,9	28,8
Other	9,8	3,8	7,3	0,0	0,0	9,1	25,0	9,5	7,2
K949									
High utility	33,3	21,7	56,6	50,0	13,3	79,0	83,3	52,7	55,3
Low utility	47,6	65,2	37,7	50,0	86,7	0,0	2,1	27,4	35,5
Other	19,0	13,0	5,7	0,0	0,0	21,0	14,6	19,9	9,2
K9410									
High utility	43,7	56,0	74,1	45,0	40,7	91,4	88,5	67,7	69,6
Low utility	51,2	40,3	20,5	55,0	59,3	1,7	0,0	26,3	24,3
Other	5,1	3,8	5,4	0,0	0,0	6,9	11,5	6,0	6,1
K9411									
High utility	33,9	35,7	52,1	19,0	31,7	88,1	91,1	58,0	59,3
Low utility	55,1	48,8	35,8	81,0	68,3	9,3	0,5	34,7	30,9
Other	11,0	15,5	12,1	0,0	0,0	2,6	8,4	7,3	9,7
K9412									
High utility	32,3	54,8	46,4	27,7	30,7	92,6	92,3	58,5	62,1
Low utility	56,3	34,1	36,3	72,3	69,3	2,3	0,2	32,8	27,1
Other	11,4	11,1	17,3	0,0	0,0	5,2	7,5	8,7	10,8
K9413									
High utility	35,1	57,1	35,3	0,0	44,4	91,5	89,5	60,6	66,7
Low utility	47,4	28,6	29,4	0,0	55,6	0,0	0,0	26,0	17,9
Other	17,5	14,3	35,3	0,0	0,0	8,5	10,5	13,5	15,4

Appendix 12. Number of all identified specimens of major domestic animals and their proportion at Åbo Akademi contexts. LU= large ungulate, SU=small ungulate. For closer description see text.

		NISP							%							
	Context	Cattle	LU	Sheep/goat	Sheep	Goat	Pig	SU	Cattle	Pig	Sheep/goat	Cattle+LU	Pig	Sheep/goat	Cattle+LU	Sheep/goat+pig+SU
Phase 1	M 512	378	371	182	72	11	134	124	48,6	17,2	34,1	65,2	11,7	23,1	58,9	41,1
	M 513	393	306	222	112	8	86	114	47,9	10,5	41,7	62,0	7,6	30,3	56,3	43,7
	M 513 B	258	202	168	73	7	72	136	44,6	12,5	42,9	59,0	9,2	31,8	50,2	49,8
	M 503 M	140	112	70	23	3	44	56	50,0	15,7	34,3	64,3	11,2	24,5	56,3	43,8
	M 511 B	143	125	107	39	5	34	137	43,6	10,4	46,0	59,2	7,5	33,3	45,4	54,6
	M 173	1272	1276	555	203	34	212	529	55,9	9,3	34,8	71,7	6,0	22,3	62,4	37,6
	M 118	795	725	329	214	11	131	215	53,7	8,9	37,4	68,9	5,9	25,1	62,8	37,2
	M 130 E	385	379	223	95	19	101	265	46,8	12,3	40,9	63,6	8,4	28,0	52,1	47,9
	Total /average	*3764*	*3496*	*1856*	*831*	*98*	*814*	*1576*	*51,1*	*11,1*	*37,8*	*66,9*	*7,5*	*25,6*	*58,4*	*41,6*
Phase 2	M 503 E	262	226	149	61	1	62	119	49,0	11,6	39,4	64,1	8,1	27,7	55,5	44,5
	M 503 F	108	106	80	26	3	21	74	45,4	8,8	45,8	62,2	6,1	31,7	51,2	48,8
	M 503 E+F	49	31	9	11	2	3	11	66,2	4,1	29,7	76,2	2,9	21,0	69,0	31,0
	M 503 G	772	534	286	153	10	159	201	55,9	11,5	32,5	68,2	8,3	23,5	61,7	38,3
	M 159	1732	1750	1053	533	58	301	928	47,1	8,2	44,7	64,2	5,5	30,3	54,8	45,2
	M 147	808	745	395	163	14	209	292	50,8	13,2	36,0	66,5	9,0	24,5	59,1	40,9
	M 90 E	125	119	49	24	2	22	40	56,3	9,9	33,8	71,6	6,5	22,0	64,0	36,0
	M 114 D	120	146	28	29	5	19	54	59,7	9,5	30,8	76,7	5,5	17,9	66,3	33,7
	M 139 D	508	540	203	123	14	99	205	53,6	10,5	35,9	70,5	6,7	22,9	61,9	38,1
	M 163	87	73	60	18	2	19	35	46,8	10,2	43,0	61,8	7,3	30,9	54,4	45,6
	M 65 D	375	329	187	82	5	67	123	52,4	9,4	38,3	67,4	6,4	26,2	60,3	39,7
	M 87 C+D	193	188	92	23	2	44	57	54,5	12,4	33,1	70,3	8,1	21,6	63,6	36,4
	M 104	940	934	323	171	15	161	285	58,4	10,0	31,6	73,7	6,3	20,0	66,2	33,8
	M 89J+K	91	82	30	18	3	14	33	58,3	9,0	32,7	72,7	5,9	21,4	63,8	36,2
	M 118B+C	56	51	22	7	2	6	21	60,2	6,5	33,3	74,3	4,2	21,5	64,8	35,2
	M 75	26	23	13	6	0	2	21	55,3	4,3	40,4	70,0	2,9	27,1	53,8	46,2
	M 78 B	541	274	132	58	3	69	140	67,4	8,6	24,0	75,7	6,4	17,9	67,0	33,0
	M 78 C	861	804	329	180	16	108	297	57,6	7,2	35,1	72,5	4,7	22,8	64,2	35,8
	M 66	129	90	69	36	7	20	43	49,4	7,7	42,9	62,4	5,7	31,9	55,6	44,4
	M 56 C-M	168	152	70	21	1	95	72	47,3	26,8	25,9	63,1	18,7	18,1	55,3	44,7
	Total /average	*7951*	*7197*	*3579*	*1743*	*165*	*1500*	*3051*	*53,2*	*10,0*	*36,7*	*68,4*	*6,8*	*24,8*	*60,1*	*39,9*
Phase 3	M 73	301	304	167	52	25	77	119	48,4	12,4	39,2	65,3	8,3	26,3	57,9	42,1
	M 14	876	735	345	123	18	135	362	58,5	9,0	32,5	72,2	6,0	21,8	62,1	37,9
	M 60	514	656	331	45	20	105	528	50,6	10,3	39,0	70,0	6,3	23,7	53,2	46,8
	M 60 C	421	672	271	54	25	77	350	49,6	9,1	41,3	71,9	5,1	23,0	58,4	41,6
	M 36	138	138	95	24	1	33	99	47,4	11,3	41,2	64,3	7,7	28,0	52,3	47,7
	Total /average	*2250*	*2505*	*1209*	*298*	*89*	*427*	*1458*	*52,7*	*10,0*	*37,4*	*70,2*	*6,3*	*23,5*	*57,7*	*42,3*
Others	M 113A-F	184	117	38	21	1	40	36	64,8	14,1	21,1	75,1	10,0	15,0	68,9	31,1
	M 68 B	6	3	2	3	0	0	1	54,5	0,0	45,5	64,3	0,0	35,7	60,0	40,0
	M 128F	55	43	21	16	1	14	13	51,4	13,1	35,5	65,3	9,3	25,3	60,1	39,9
	M 146A-B	33	40	18	5	1	23	7	41,3	28,8	30,0	60,8	19,2	20,0	57,5	42,5
	M 164B	44	49	27	5	1	49	24	34,9	38,9	26,2	53,1	28,0	18,9	46,7	53,3
	M 66 B	304	255	148	87	10	31	182	52,5	5,2	42,3	67,0	3,6	29,4	55,0	45,0
	M 96	102	87	50	14	0	18	43	55,4	9,8	34,8	69,7	6,6	23,6	60,2	39,8

Appendix 13. Number of all identified specimens of major domestic animals and their proportion at Aboa Vetus contexts. LU= large ungulate, SU=small ungulate. For closer description see text.

		NISP							%							
	Context	Cattle	LU	Sheep/goat	Sheep	Goat	Pig	SU	Cattle	Pig	Sheep/goat	Cattle+LU	Pig	Sheep/goat	Cattle+LU	Sheep/goat, pig, SU
Phase 1	R 1b6375	196	310	186	28	8	35	196	43,3	7,7	49,0	66,3	4,6	29,1	52,8	47,2
	R 25	551	659	544	156	40	187	455	37,3	12,7	50,1	56,6	8,8	34,6	46,7	53,3
	R 19 U	888	986	612	181	38	200	660	46,3	10,4	43,3	64,5	6,9	28,6	52,6	47,4
	Total /average	*1635*	*1955*	*1342*	*365*	*86*	*422*	*1311*	*42,3*	*10,3*	*47,5*	*62,5*	*6,7*	*30,8*	*50,7*	*49,3*
Phase 2	K 94:8	136	88	55	24	4	64	16	48,1	22,6	29,3	60,4	17,3	22,4	57,9	42,1
	K 94:9	84	62	55	15	2	26	49	46,2	14,3	39,6	59,8	10,7	29,5	49,8	50,2
	K 94:10	422	419	268	118	20	349	260	35,9	29,7	34,5	52,7	21,9	25,4	45,3	54,7
	K 94:11	288	227	292	93	21	108	271	35,9	13,5	50,6	50,0	10,5	39,5	39,6	60,4
	K 94:12	632	484	655	166	47	677	625	29,0	31,1	39,9	41,9	25,4	32,6	34,0	66,0
	Total /average	*1562*	*1280*	*1325*	*416*	*94*	*1224*	*1221*	*39,0*	*22,2*	*38,8*	*53,0*	*17,1*	*29,9*	*45,3*	*54,7*
Phase 3	K 94:13	57	47	17	9	0	14	38	42,2	10,4	29,6	57,1	7,7	22,0	57,1	42,9
	R 9	19	18	4	4	1	6	16	55,9	17,6	26,5	71,2	11,5	17,3	54,4	45,6
	R 12	16	10	14	6	0	4	11	40,0	10,0	50,0	52,0	8,0	40,0	42,6	57,4
	R 13	131	128	88	30	4	25	85	47,1	9,0	43,9	63,8	6,2	30,0	52,7	47,3
	Total /average	*223*	*203*	*123*	*49*	*5*	*49*	*150*	*46,3*	*11,8*	*37,5*	*61,0*	*8,3*	*27,3*	*51,7*	*48,3*
Others	R 19 A	141	108	70	18	3	24	50	55,1	9,4	35,5	68,4	6,6	25,0	60,1	39,9
	Ku 12 and extension	193	175	93	35	5	38	85	53,0	10,4	36,5	68,3	7,1	24,7	59,0	41,0

Appendix 14. Number of identified specimens of major domestic animals excluding the infant bones and whole skeletons and their proportion at Aboa Vetus contexts. LU= large ungulate, SU=small ungulate. For closer description see text.

		NISP							%							
	Context	Cattle	LU	Sheep/goat	Sheep	Goat	Pig	SU	Cattle	Pig	Sheep/goat	Cattle+LU	Pig	Sheep/goat	Cattle+LU	Sheep/goat, pig, SU
Phase 1	R 1b6375	196	310	186	28	8	34	196	43,4	7,5	49,1	66,4	4,5	29,1	52,8	47,2
	R 25	545	659	544	156	40	182	455	37,2	12,4	50,4	56,6	8,6	34,8	46,6	53,4
	R 19 U	882	986	611	181	38	196	660	46,2	10,3	43,5	64,5	6,8	28,7	52,6	47,4
	Total /average	*1623*	*1955*	*1341*	*365*	*86*	*412*	*1311*	*42,4*	*10,8*	*46,8*	*61,9*	*7,1*	*31,0*	*50,4*	*49,6*
Phase 2	K 94:8	133	88	55	24	4	26	16	55,0	10,7	34,3	67,0	7,9	25,2	63,9	36,1
	K 94:9	84	62	53	15	2	23	48	47,5	13,0	39,5	61,1	9,6	29,3	50,9	49,1
	K 94:10	414	419	259	118	20	157	260	42,8	16,2	41,0	60,1	11,3	28,6	50,6	49,4
	K 94:11	278	227	228	93	21	102	202	38,5	14,1	47,4	53,2	10,7	36,0	43,9	56,1
	K 94:12	631	484	653	166	47	215	624	36,9	12,6	50,6	50,8	9,8	39,4	39,5	60,5
	Total /average	*1540*	*1280*	*1248*	*416*	*94*	*523*	*1150*	*40,3*	*13,7*	*46,0*	*55,3*	*10,3*	*34,5*	*45,1*	*54,9*
Phase 3	K 94:13	57	47	17	9	0	14	38	58,8	14,4	26,8	72,2	9,7	18,1	57,1	42,9
	R 12	15	10	14	6	0	4	11	38,5	10,3	51,3	51,0	8,2	40,8	41,7	58,3
	R 13	126	128	88	30	4	24	85	46,3	8,8	44,9	63,5	6,0	30,5	52,4	47,6
	R 9	18	18	4	4	1	6	16	54,5	18,2	27,3	70,6	11,8	17,6	53,7	46,3
	Total /average	*216*	*203*	*123*	*49*	*5*	*48*	*150*	*49,0*	*10,9*	*40,1*	*65,1*	*7,5*	*27,5*	*52,8*	*47,2*
Others	R 19 A	140	108	70	18	3	22	50	55,3	8,7	36,0	68,7	6,1	25,2	60,3	39,7
	Ku 12 and extension	188	175	93	35	5	36	85	52,7	10,1	37,3	68,2	6,8	25,0	58,8	41,2

Appendix 15. Number of identified specimens of major domestic animals excluding the infant bones and whole skeletons and their proportion at Åbo Akademi contexts. LU= large ungulate, SU=small ungulate. For closer description see text.

		NISP							%							
	Context	Cattle	LU	Sheep/goat	Sheep	Goat	Pig	SU	Cattle	Pig	Sheep/goat	Cattle+LU	Pig	Sheep/goat	Cattle+LU	Sheep/goat, pig, SU
Phase 1	M 512	371	371	182	72	11	129	122	48,5	16,9	34,6	65,3	11,4	23,3	59,0	41,0
	M 513	389	306	221	112	8	85	114	47,7	10,4	41,8	62,0	7,6	30,4	56,3	43,7
	M 513 B	256	201	167	73	7	70	136	44,7	12,2	43,1	59,0	9,0	31,9	50,2	49,8
	M 503 M	139	112	70	23	3	41	56	50,4	14,9	34,8	64,7	10,6	24,7	56,5	43,5
	M 511 B	142	125	107	39	5	33	137	43,6	10,1	46,3	59,2	7,3	33,5	45,4	54,6
	M 173	1267	1275	555	203	33	208	529	55,9	9,2	34,9	71,8	5,9	22,3	62,5	37,5
	M 118	786	725	329	214	11	128	213	53,5	8,7	37,7	68,9	5,8	25,3	62,8	37,2
	M 130 E	384	379	219	95	19	95	265	47,3	11,7	41,0	64,1	8,0	28,0	52,4	47,6
	Total /average	*3734*	*3494*	*1850*	*831*	*97*	*789*	*1572*	*51,1*	*10,8*	*38,0*	*67,0*	*7,3*	*25,7*	*58,4*	*41,6*
Phase 2	M 503 E	262	226	149	61	1	59	118	49,2	11,1	39,7	64,4	7,8	27,8	55,7	44,3
	M 503 F	108	106	79	26	3	21	74	45,6	8,9	45,6	62,4	6,1	31,5	51,3	48,7
	M 503 E+F	49	31	9	11	2	3	11	66,2	4,1	29,7	76,2	2,9	21,0	69,0	31,0
	M 503 G	768	534	284	152	10	156	201	56,1	11,4	32,6	68,4	8,2	23,4	61,9	38,1
	M 159	1727	1750	1046	530	54	281	928	47,5	7,7	44,8	64,5	5,2	30,3	55,1	44,9
	M 147	804	745	391	163	14	149	292	52,9	9,8	37,3	68,4	6,6	25,1	60,6	39,4
	M 90 E	125	119	49	24	2	22	40	56,3	9,9	33,8	71,6	6,5	22,0	64,0	36,0
	M 114 D	120	146	28	29	5	14	54	61,2	7,1	31,6	77,8	4,1	18,1	67,2	32,8
	M 139 D	505	540	203	123	14	97	205	53,6	10,3	36,1	70,5	6,5	22,9	61,9	38,1
	M 163	87	73	48	17	2	19	35	50,3	11,0	38,7	65,0	7,7	27,2	56,9	43,1
	M 65 D	374	329	187	82	5	67	123	52,3	9,4	38,3	67,3	6,4	26,2	60,2	39,8
	M 87 C+D	192	187	92	23	2	43	57	54,5	12,2	33,2	70,3	8,0	21,7	63,6	36,4
	M 104	928	934	321	171	15	159	284	58,2	10,0	31,8	73,7	6,3	20,1	66,2	33,8
	M 75	26	23	13	6	0	2	21	55,3	4,3	40,4	70,0	2,9	27,1	53,8	46,2
	M 89J+K	88	82	30	18	3	14	33	57,5	9,2	33,3	72,3	6,0	21,7	63,4	36,6
	M 118B+C	56	51	22	7	2	6	21	60,2	6,5	33,3	74,3	4,2	21,5	64,8	35,2
	M 78 B	540	274	132	57	3	67	140	67,6	8,4	24,0	75,9	6,2	17,9	67,1	32,9
	M 78 C	860	804	328	180	16	107	297	57,7	7,2	35,1	72,5	4,7	22,8	64,2	35,8
	M 66	129	90	69	36	7	20	43	49,4	7,7	42,9	62,4	5,7	31,9	55,6	44,4
	M 56 C-M	162	152	70	21	1	36	72	55,9	12,4	31,7	71,0	8,1	20,8	61,1	38,9
	Total /average	*7910*	*7196*	*3550*	*1737*	*161*	*1342*	*3049*	*53,8*	*9,1*	*37,1*	*69,0*	*6,1*	*24,9*	*60,6*	*39,4*
Phase 3	M 73	299	304	166	52	25	75	118	48,5	12,2	39,4	65,5	8,1	26,4	58,0	42,0
	M 14	872	735	345	123	18	132	362	58,5	8,9	32,6	72,2	5,9	21,8	62,1	37,9
	M 60	503	655	330	45	20	100	528	50,4	10,0	39,6	70,1	6,0	23,9	53,1	46,9
	M 60 C	416	672	271	54	25	76	350	49,4	9,0	41,6	71,9	5,0	23,1	58,4	41,6
	M 36	137	138	93	24	1	27	98	48,6	9,6	41,8	65,5	6,4	28,1	53,1	46,9
	Total /average	*2227*	*2504*	*1205*	*298*	*89*	*410*	*1456*	*52,7*	*9,7*	*37,6*	*70,3*	*6,1*	*23,6*	*57,8*	*42,2*
Others	M 113A-F	184	117	38	21	1	24	36	68,7	9,0	22,4	78,2	6,2	15,6	71,5	28,5
	M 68 B	6	3	2	3	0	0	1	54,5	0,0	45,5	64,3	0,0	35,7	60,0	40,0
	M 128F	55	43	21	16	1	14	13	51,4	13,1	35,5	65,3	9,3	25,3	60,1	39,9
	M 146A-B	33	40	18	5	1	9	7	50,0	13,6	36,4	68,9	8,5	22,6	64,6	35,4
	M 164B	44	49	27	5	1	17	24	46,8	18,1	35,1	65,0	11,9	23,1	55,7	44,3
	M 66 B	304	255	148	86	10	30	182	52,6	5,2	42,2	67,1	3,6	29,3	55,1	44,9
	M 96	102	87	50	14	0	18	43	55,4	9,8	34,8	69,7	6,6	23,6	60,2	39,8

Appendix 16. The number and relative proportions of sheep and goat specimens.

ÅA	Context	NISP Sheep & goat	% Sheep	% Goat
Phase 1	M 512	83	86,7	13,3
	M 513	120	93,3	6,7
	M 513 B	80	91,3	8,8
	M 503 M	26	88,5	11,5
	M 511 B	44	88,6	11,4
	M 173	237	85,7	14,3
	M 118	225	95,1	4,9
	M 130 E	114	83,3	16,7
	Total /average	929	*89,5*	*10,5*
Phase 2	M 503 E	62	98,4	1,6
	M 503 F	29	89,7	10,3
	M 503 E+F	13	84,6	15,4
	M 503 G	163	93,9	6,1
	M 159	591	90,2	9,8
	M 147	177	92,1	7,9
	M 90 E	26	92,3	7,7
	M 114 D	34	85,3	14,7
	M 139 D	137	89,8	10,2
	M 163	20	90,0	10,0
	M 65 D	87	94,3	5,7
	M 87 C+D	25	92,0	8,0
	M 104	186	91,9	8,1
	M 75	6	100,0	0,0
	M 89J+K	21	85,7	14,3
	M 118B+C	9	77,8	22,2
	M 78 B	61	95,1	4,9
	M 78 C	196	91,8	8,2
	M 66	43	83,7	16,3
	M 56 C-N	22	95,5	4,5
	Total /average	1908	*91,4*	*8,6*
Phase 3	M 73	77	67,5	32,5
	M 14	141	87,2	12,8
	M 60	65	69,2	30,8
	M 60 C	79	68,4	31,6
	M 36	25	96,0	4,0
	Total /average	387	*77,0*	*23,0*
AV				
Phase 1	R 1b6375	36	77,8	22,2
	R 25	196	79,6	20,4
	R 19 U	219	82,6	17,4
	Total /average	451	*80,9*	*19,1*
Phase 2	K 94:8	28	85,7	14,3
	K 94:9	17	88,2	11,8
	K 94:10	138	85,5	14,5
	K 94:11	114	81,6	18,4
	K 94:12	213	77,9	22,1
	Total /average	510	*81,6*	*18,4*
Phase 3	K 94:13	9	100,0	0,0
	R 12	6	100,0	0,0
	R 13	34	88,2	11,8
	R 9	5	80,0	20,0
	Total /average	54	*90,7*	*9,3*

Appendix 17. The number and proportion of hare specimens counted from all specimens in context.

ÅA	Context	NISP hare	%
Phase 1	M 512	8	0,5
	M 513	6	0,4
	M 513 B	9	0,8
	M 503 M	3	0,5
	M 511 B	3	0,3
	M 173	33	0,6
	M 118	9	0,4
	M 130 E	15	0,8
	Total /average	*86*	*0,5*
Phase 2	M 503 E	2	0,2
	M 503 F	2	0,4
	M 503 E+F	1	0,7
	M 503 G	8	0,3
	M 159	123	1,3
	M 147	25	0,7
	M 90 E	11	2,2
	M 114 D	5	0,9
	M 139 D	18	0,9
	M 163	2	0,6
	M 65 D	7	0,4
	M 87 C+D	4	0,4
	M 104	25	0,7
	M 75	0	0,0
	M 89J+K	1	0,3
	M 118B+C	4	1,6
	M 78 B	7	0,3
	M 78 C	16	0,5
	M 66	18	3,1
	56 C-N	52	5,7
	Total /average	*331*	*0,9*
Phase 3	M 73	8	0,5
	M 14	70	1,9
	M 60	24	0,7
	M 60 C	8	0,3
	M 36	11	1,0
	Total /average	*121*	*1,0*
Others	M 113A-F	9	1,4
	M 68 B	0	0,0
	M 128F	1	0,5
	M 146A-B	0	0,0
	M 164B	2	0,8
	M 66 B	16	1,0
	M 96	26	4,3
AV			
Phase 1	R 1b6375	4	0,3
	R 25	18	0,5
	R 19 alta	30	0,6
	Total /average	*52*	*0,5*
Phase 2	K 94:8	11	2,1
	K 94:9	8	1,3
	K 94:10	24	1,0
	K 94:11	40	1,3
	K 94:12	57	0,8
	Total /average	*140*	*1,0*
Phase 3	K 94:13	4	1,3
	R91213	6	0,8
	Total /average	*10*	*0,9*
Others	Ku 12 and extension	3	0,3
	R 19 päältä	1	0,2

Appendix 18. Minimum number of elements (MNE) and number of identified specimens (NISP) of cattle (including large ungulates) at Åbo Akademi and Aboa Vetus.

	ÅA phase 1 MNE	ÅA phase 1 NISP	ÅA phase 2 MNE	ÅA phase 2 NISP	ÅA phase 3 MNE	ÅA phase 3 NISP	AV phase 1 MNE	AV phase 1 NISP	AV phase 2 MNE	AV phase 2 NISP	AV phase 3 MNE	AV phase 3 NISP
Cranium	41	962	92	1976	17	284	23	199	30	294	2	16
Mandibula	76	415	196	818	29	167	35	120	28	99	4	13
Atlas	33	63	58	132	18	44	11	25	14	26	2	3
Axis	30	53	47	112	9	21	12	19	6	8	2	3
Vert cerv	82	222	140	448	55	158	39	141	35	86	7	15
Vert thor	125	380	210	803	83	252	68	248	83	186	11	30
Vert lumb	92	337	160	630	54	237	52	192	53	151	4	16
Vert sacr	6	60	14	128	6	49	13	35	6	36	1	1
Costa	236	1359	603	2910	193	1009	157	807	99	443	25	82
Sternum	4	10	24	62	5	10	2	4	3	7	0	
Scapula	47	300	87	589	26	150	32	135	25	89	4	13
Humerus	43	177	95	338	28	114	25	78	24	108	5	10
Radius	47	160	115	198	36	161	35	157	34	83	6	11
Ulna	43	94	94	204	28	66	40	64	24	41	7	7
Carpi	109	109	251	251	55	77	56	56	41	42	6	6
Mc	68	87	175	217	43	56	25	29	40	52	4	4
Os coxae	51	243	124	492	30	135	28	116	33	92	4	15
Femur	39	202	71	408	31	135	26	132	29	115	3	9
Patella	14	15	28	28	11	12	9	9	11	11	1	1
Tibia	65	193	133	398	30	125	39	108	29	86	5	20
Malleolare	13	14	10	10	3	3	4	4	4	4	0	
Calcaneus	82	87	143	159	43	48	49	60	36	40	6	6
Talus	61	67	141	147	46	54	31	32	26	29	10	10
Tarsi	73	68	147	139	31	31	47	36	30	29	1	1
Mt	69	108	187	253	52	99	28	39	34	49	11	15
Ph 1	169	175	404	416	132	138	108	118	79	90	9	9
Ph 2	107	140	269	269	86	90	92	93	50	50	6	6
Ph 3	81	81	185	186	91	91	48	53	36	37	11	11

Appendix 19. Minimum number of elements (MNE) and number of identified specimens (NISP) of small bovids at Åbo Akademi and Aboa Vetus.

	ÅA phase 1 MNE	ÅA phase 1 NISP	ÅA phase 2 MNE	ÅA phase 2 NISP	ÅA phase 3 MNE	ÅA phase 3 NISP	AV phase 1 MNE	AV phase 1 NISP	AV phase 2 MNE	AV phase 2 NISP	AV phase 3 MNE	AV phase 3 NISP
Cranium	53	523	92	991	192	21	20	223	34	260	2	12
Mandibula	178	283	305	490	129	47	102	157	75	134	8	13
Atlas	27	37	45	64	22	12	9	12	22	40	5	5
Axis	23	35	54	72	22	10	17	20	14	20	2	2
Vert cerv	80	95	143	204	68	42	29	48	45	80	4	5
Vert thor	37	43	139	170	37	29	27	29	71	77	6	6
Vert lumb	37	45	107	144	61	47	29	33	45	59	4	4
Vert sacr	3	5	18	34	8	4	4	7	7	11	1	3
Costa	49	49	130	130	28	27	19	19	53	53	7	7
Sternum	1	1	1	2	1	1	0	0	3	4	1	1
Scapula	56	160	95	268	85	31	28	81	31	63	8	11
Humerus	70	138	149	227	86	51	63	116	48	92	8	9
Radius	105	167	130	296	153	54	62	141	46	77	4	9
Ulna	44	41	70	98	42	34	28	38	20	30	7	8
Carpi	10	10	21	21	0	0	2	2	18	18	0	0
Mc	114	138	266	316	73	52	64	90	46	57	0	0
Os coxae	74	131	155	256	134	67	52	98	44	83	12	16
Femur	29	96	51	154	61	24	16	54	28	64	7	9
Patella	5	5	3	3	0	0	1	1	2	2	1	1
Tibia	89	215	84	376	102	33	66	154	37	103	6	12
Calcaneus	39	40	67	67	14	14	23	23	29	33	5	6
Talus	44	44	75	75	13	13	23	25	25	26	3	3
Tarsi	12	12	32	32	0	0	8	8	11	11	0	0
Mt	104	139	218	329	74	47	61	94	47	60	4	6
Ph 1	52	54	143	144	30	30	36	36	61	73	5	5
Ph 2	11	11	27	27	3	3	6	6	20	20	0	0
Ph 3	2	2	32	32	1	1	2	2	15	15	0	0

Appendix 20. Minimum number of elements (MNE) and number of identified specimens (NISP) of pig at Åbo Akademi and Aboa Vetus.

	ÅA phase 1 MNE	ÅA phase 1 NISP	ÅA phase 2 MNE	ÅA phase 2 NISP	ÅA phase 3 MNE	ÅA phase 3 NISP	AV phase 1 MNE	AV phase 1 NISP	AV phase 2 MNE	AV phase 2 NISP	AV phase 3 MNE	AV phase 3 NISP
Cranium	14	118	29	266	7	68	9	62	10	94	2	8
Mandibula	50	83	57	110	9	17	17	37	27	44	3	3
Atlas	8	10	17	20	5	10	2	2	4	6	0	0
Axis	2	2	6	7	2	2	3	3	3	4	1	1
Vert cerv	6	6	10	19	7	7	7	8	18	18	0	0
Vert thor	15	17	24	33	8	8	8	8	8	15	3	3
Vert lumb	21	25	29	32	9	9	5	7	15	22	0	0
Vert sacr	3	4	2	4	1	1	2	5	1	4	0	0
Costa	29	29	38	38	17	17	11	11	19	19	1	1
Sternum	0	0	1	1	1	1	0	0	1	5	0	0
Scapula	17	40	19	47	7	13	7	22	10	18	0	0
Humerus	26	46	33	65	14	23	9	19	9	23	3	3
Radius	17	28	31	43	11	17	4	9	8	12	3	3
Ulna	29	34	38	49	17	21	13	13	9	14	3	4
Carpi	10	11	13	14	0	0	3	3	7	7	0	0
Mc	10	11	28	29	10	14	10	10	12	13	0	0
Os coxae	22	34	42	62	12	30	13	20	13	16	2	3
Femur	11	31	18	58	11	26	9	20	11	28	1	2
Patella	2	2	2	2	1	1	0	0	0	0	0	0
Tibia	23	46	28	75	9	27	17	29	7	13	2	2
Fibula	13	22	9	25	4	5	4	9	7	9	1	1
Calcaneus	13	13	28	29	15	16	12	12	11	11	0	0
Talus	17	17	21	21	5	5	9	9	7	7	0	0
Tarsi	3	3	10	10	0	0	0	0	4	4	0	0
Mt	18	19	38	41	7	8	14	14	7	8	4	4
Ph 1	12	12	37	39	10	11	9	10	13	13	0	0
Ph 2	10	10	14	14	5	5	5	5	4	4	0	0
Ph 3	3	3	7	7	3	3	5	5	8	8	0	0

Appendix 21. Cattle MAU and %MAU data.

	ÅA 1		ÅA2		ÅA 3		AV 1		AV 2		AV 3	
	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU
Cranium	41,0	100,0	92,0	93,9	17,0	65,4	23,0	93,9	30,0	100,0	2,0	36,4
Mandibula	38,0	92,7	98,0	100,0	14,5	55,8	17,5	71,4	15,0	50,0	2,0	36,4
Atlas	33,0	80,5	58,0	59,2	18,0	69,2	11,0	44,9	14,0	46,7	2,0	36,4
Axis	30,0	73,2	47,0	48,0	9,0	34,6	12,0	49,0	6,0	20,0	2,0	36,4
Vert cerv	16,4	40,0	28,0	28,6	11,0	42,3	7,8	31,8	7,0	23,3	1,4	25,5
Vert thor	9,6	23,5	16,2	16,5	6,4	24,6	5,2	21,4	6,4	21,3	0,8	15,4
Vert lumb	15,3	37,4	26,7	27,2	9,0	34,6	8,7	35,4	8,8	29,4	0,7	12,1
Vert sacr	6,0	14,6	14,0	14,3	6,0	23,1	13,0	53,1	6,0	20,0	1,0	18,2
Costa	9,1	22,1	23,2	23,7	7,4	28,6	6,0	24,6	3,8	12,7	1,0	17,5
Sternum	0,7	1,6	4,0	4,1	0,8	3,2	0,3	1,4	0,5	1,7	0,0	0,0
Scapula	23,5	57,3	43,5	44,4	13,0	50,0	16,0	65,3	12,5	41,7	2,0	36,4
Humerus	21,5	52,4	47,5	48,5	14,0	53,8	12,5	51,0	12,0	40,0	2,5	45,5
Radius	23,5	57,3	57,5	58,7	18,0	69,2	17,5	71,4	17,0	56,7	3,0	54,5
Ulna	21,5	52,4	47,0	48,0	14,0	53,8	20,0	81,6	12,0	40,0	3,5	63,6
Carpi	9,1	22,2	20,9	21,3	4,6	17,6	4,7	19,0	3,4	11,4	0,5	9,1
Mc	34,0	82,9	87,5	89,3	21,5	82,7	12,5	51,0	20,0	66,7	2,0	36,4
Os coxae	25,5	62,2	62,0	63,3	15,0	57,7	14,0	57,1	16,5	55,0	2,0	36,4
Femur	19,5	47,6	35,5	36,2	15,5	59,6	13,0	53,1	14,5	48,3	1,5	27,3
Patella	7,0	17,1	14,0	14,3	5,5	21,2	4,5	18,4	5,5	18,3	0,5	9,1
Tibia	32,5	79,3	66,5	67,9	15,0	57,7	19,5	79,6	14,5	48,3	2,5	45,5
Malleolare	6,5	15,9	5,0	5,1	1,5	5,8	2,0	8,2	2,0	6,7	0,0	0,0
Calcaneus	41,0	100,0	71,5	73,0	21,5	82,7	24,5	100,0	18,0	60,0	3,0	54,5
Talus	30,5	74,4	70,5	71,9	23,0	88,5	15,5	63,3	13,0	43,3	5,0	90,9
Tarsi	12,2	29,7	24,5	25,0	5,2	19,9	7,8	32,0	5,0	16,7	0,2	3,0
Mt	34,5	84,1	92,5	94,4	26,0	100,0	14,0	57,1	17,0	56,7	5,5	100,0
Ph 1	21,1	51,5	50,5	51,5	16,5	63,5	13,5	55,1	9,9	32,9	1,1	20,5
Ph 2	13,4	32,6	33,6	34,3	10,8	41,3	11,5	46,9	6,3	20,8	0,8	13,6
Ph 3	10,1	24,7	23,4	23,9	11,4	43,8	6,0	24,5	4,5	15,0	1,4	25,0

Appendix 22. Number of cattle mandibles in each age category. Categories according to O'Connor (2003: 160).

	ÅA 1	ÅA 2	ÅA 3	AV 1	AV 2	AV 3
N		1			1	
J	3	3		1		
I	3		1		1	
SA1	8	14		1	2	
SA2	8	26	1	3	1	2
A1	8	15	1	4	1	
A2	2	12	1	1		
A3	15	58	10	8	11	2
E	4	16	4	5	11	
n	51	145	18	23	28	4

Appendix 23. Number and percentages of open, closing and fused epiphyses of cattle. For list of epiphyses included in each group see table 7.

ÅA 1	O	C	F	AV 1	O	C	F
Early	3	0	128	Early	1	0	69
Intermediate	74	4	118	Intermediate	30	2	46
Late	124	6	96	Late	74	3	63
Early	2,3	0,0	97,7	Early	1,4	0,0	98,6
Intermediate	37,8	2,0	60,2	Intermediate	38,5	2,6	59,0
Late	54,9	2,7	42,5	Late	52,9	2,1	45,0
ÅA 2	O	C	F	AV 2	O	C	F
Early	0	1	250	Early	2	0	69
Intermediate	183	12	256	Intermediate	23	1	65
Late	222	24	168	Late	79	10	85
Early	0,0	0,4	99,6	Early	2,8	0,0	97,2
Intermediate	40,6	2,7	56,8	Intermediate	25,8	1,1	73,0
Late	53,6	5,8	40,6	Late	45,4	5,7	48,9
ÅA 3	O	C	F	AV 3	O	C	F
Early	1	0	83	Early	0	0	13
Intermediate	22	0	64	Intermediate	9	0	9
Late	72	6	70	Late	11	1	7
Early	1,2	0,0	98,8	Early	0,0	0,0	100,0
Intermediate	25,6	0,0	74,4	Intermediate	50,0	0,0	50,0
Late	48,6	4,1	47,3	Late	57,9	5,3	36,8

Appendix 24. Lipping and exostosis in cattle phalanxes, number of observations. Stages according to Bartosiewicz et al. (1997).

	ph 1		ph 2		ph 3	
	prox	dist	prox	dist	prox	dist
lipping 2	48		32	1	7	
lipping 3	10	1	9		1	
lipping 4	6		2			
exostosis 2	2	9	6			
exostosis 3	2	2				
exostosis 4						

Appendix 25. Pathologies in cattle metapodials, number of observations. Stages according to Bartosiewicz et al. (1997).

	mc		mt	
	prox	dist	prox	dist
lipping 2	1		10	1
lipping 3	1		2	
lipping 4				
exostosis 2	2	1	1	
exostosis 3	1		3	
exostosis 4				
broadning 2	1	5		4
broadning 3		2		1
broadning 4		2		
palmar dep 2		3		
palmar dep 3		2		
palmar dep 4				
dist eburnation		1		
prox eburnation			1	

Appendix 26. Small bovid MAU and %MAU data.

	ÅA 1		ÅA 2		ÅA 3		AV 1		AV 2		AV 3	
	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU	MAU	%MAU
Cranium	53,0	59,6	92,0	60,3	21,0	62,7	20,0	39,2	34,0	90,7	2,0	33,3
Mandibula	89,0	100,0	152,5	100,0	23,5	70,1	51,0	100,0	37,5	100,0	4,0	66,7
Atlas	27,0	30,3	45,0	29,5	12,0	35,8	9,0	17,6	22,0	58,7	5,0	83,3
Axis	23,0	25,8	54,0	35,4	10,0	29,9	17,0	33,3	14,0	37,3	2,0	33,3
Vert cerv	16,0	18,0	28,6	18,8	8,4	25,1	5,8	11,4	9,0	24,0	0,8	13,3
Vert thor	2,8	3,2	10,7	7,0	2,2	6,7	2,1	4,1	5,5	14,6	0,5	7,7
Vert lumb	6,2	6,9	17,8	11,7	7,8	23,4	4,8	9,5	7,5	20,0	0,7	11,1
Vert sacr	3,0	3,4	18,0	11,8	4,0	11,9	4,0	7,8	7,0	18,7	1,0	16,7
Costa	1,9	2,1	5,0	3,3	1,0	3,1	0,7	1,4	2,0	5,4	0,3	4,5
Sternum	0,2	0,2	0,2	0,1	0,2	0,5	0,0	0,0	0,5	1,3	0,2	2,8
Scapula	28,0	31,5	47,5	31,1	15,5	46,3	14,0	27,5	15,5	41,3	4,0	66,7
Humerus	35,0	39,3	74,5	48,9	25,5	76,1	31,5	61,8	24,0	64,0	4,0	66,7
Radius	52,5	59,0	65,0	42,6	27,0	80,6	31,0	60,8	23,0	61,3	2,0	33,3
Ulna	22,0	24,7	35,0	23,0	17,0	50,7	14,0	27,5	10,0	26,7	3,5	58,3
Carpi	0,8	0,9	1,8	1,1	0,0	0,0	0,2	0,3	1,5	4,0	0,0	0,0
Mc	57,0	64,0	133,0	87,2	26,0	77,6	32,0	62,7	23,0	61,3	0,0	0,0
Os coxae	37,0	41,6	77,5	50,8	33,5	100,0	26,0	51,0	22,0	58,7	6,0	100,0
Femur	14,5	16,3	25,5	16,7	12,0	35,8	8,0	15,7	14,0	37,3	3,5	58,3
Patella	2,5	2,8	1,5	1,0	0,0	0,0	0,5	1,0	1,0	2,7	0,5	8,3
Tibia	44,5	50,0	42,0	27,5	16,5	49,3	33,0	64,7	18,5	49,3	3,0	50,0
Malleolare	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Calcaneus	19,5	21,9	33,5	22,0	7,0	20,9	11,5	22,5	14,5	38,7	2,5	41,7
Talus	22,0	24,7	37,5	24,6	6,5	19,4	11,5	22,5	12,5	33,3	1,5	25,0
Tarsi	2,0	2,2	5,3	3,5	0,0	0,0	1,3	2,6	1,8	4,9	0,0	0,0
Mt	52,0	58,4	109,0	71,5	23,5	70,1	30,5	59,8	23,5	62,7	2,0	33,3
Ph 1	6,5	7,3	17,9	11,7	3,8	11,2	4,5	8,8	7,6	20,3	0,6	10,4
Ph 2	1,4	1,5	3,4	2,2	0,4	1,1	0,8	1,5	2,5	6,7	0,0	0,0
Ph 3	0,3	0,3	4,0	2,6	0,1	0,4	0,3	0,5	1,9	5,0	0,0	0,0

Appendix 27. Number of small bovid mandibles in each age category. Categories according to O'Connor (2003: 160).

	ÅA 1	ÅA 2	ÅA 3	AV 1	AV 2	AV 3
N						
J	2	6			1	
I	12	21	4	3	8	1
SA1	43	77	7	20	15	1
SA2	3	14	4	2	3	1
A1	15	30	2	6	6	
A2	14	32	3	10	4	1
A3	41	78	8	23	10	
E		2				
n	130	260	28	64	47	4

Appendix 28. Number and percentages of open, closing and fused epiphyses of small bovids. For list of epiphyses included in each group see table 7.

ÅA 1	O	C	F	AV 1	O	C	F
Early	0	0	190	Early	1	0	100
Intermediate	44	2	147	Intermediate	27	2	90
Late	77	2	95	Late	42	1	50
Early	0,0	0,0	100,0	Early	1,0	0,0	99,0
Intermediate	22,8	1,0	76,2	Intermediate	22,7	1,7	75,6
Late	44,3	1,1	54,6	Late	45,2	1,1	53,8
ÅA 2	O	C	F	AV 2	O	C	F
Early	2	0	319	Early	1	2	102
Intermediate	156	11	320	Intermediate	50	1	52
Late	132	5	170	Late	69	5	57
Early	0,6	0,0	99,4	Early	1,0	1,9	97,1
Intermediate	32,0	2,3	65,7	Intermediate	48,5	1,0	50,5
Late	43,0	1,6	55,4	Late	52,7	3,8	43,5
ÅA 3	O	C	F	AV 3	O	C	F
Early	1	0	119	Early	1	0	18
Intermediate	34	0	49	Intermediate	1	0	5
Late	72	0	33	Late	10	1	6
Early	0,8	0,0	99,2	Early	5,3	0,0	94,7
Intermediate	41,0	0,0	59,0	Intermediate	16,7	0,0	83,3
Late	68,6	0,0	31,4	Late	58,8	5,9	35,3

Appendix 29. Pig MAU and %MAU data.

	AV 1 MAU	%MAU	AV 2 MAU	%MAU	AV 3 MAU	%MAU	AV 1 MAU	%MAU	AV 2 MAU	%MAU	AV 3 MAU	%MAU
Cranium	14,0	56,0	29,0	100,0	7,0	82,4	9,0	100,0	10,0	74,1	2,0	100,0
Mandibula	25,0	100,0	28,5	98,3	4,5	52,9	8,5	94,4	13,5	100,0	1,5	75,0
Atlas	8,0	32,0	17,0	58,6	5,0	58,8	2,0	22,2	4,0	29,6	0,0	0,0
Axis	2,0	8,0	6,0	20,7	2,0	23,5	3,0	33,3	3,0	22,2	1,0	50,0
Vert cerv	1,2	4,8	2,0	6,9	1,4	16,5	1,4	15,6	3,6	26,7	0,0	0,0
Vert thor	1,1	4,3	1,7	5,9	0,6	6,7	0,6	6,3	0,6	4,2	0,2	10,7
Vert lumb	3,5	14,0	4,8	16,7	1,5	17,6	0,8	9,3	2,5	18,5	0,0	0,0
Vert sacr	3,0	12,0	2,0	6,9	1,0	11,8	2,0	22,2	1,0	7,4	0,0	0,0
Costa	1,0	4,1	1,4	4,7	0,6	7,1	0,4	4,4	0,7	5,0	0,0	1,8
Sternum	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	7,4	0,0	0,0
Scapula	8,5	34,0	9,5	32,8	3,5	41,2	3,5	38,9	5,0	37,0	0,0	0,0
Humerus	13,0	52,0	16,5	56,9	7,0	82,4	4,5	50,0	4,5	33,3	1,5	75,0
Radius	8,5	34,0	15,5	53,4	5,5	64,7	2,0	22,2	4,0	29,6	1,5	75,0
Ulna	14,5	58,0	19,0	65,5	8,5	100,0	6,5	72,2	4,5	33,3	1,5	75,0
Carpi	0,6	2,5	0,8	2,8	0,0	0,0	0,2	2,1	0,4	3,2	0,0	0,0
Mc	1,3	5,0	3,5	12,1	1,3	14,7	1,3	13,9	1,5	11,1	0,0	0,0
Os coxae	11,0	44,0	21,0	72,4	6,0	70,6	6,5	72,2	6,5	48,1	1,0	50,0
Femur	5,5	22,0	9,0	31,0	5,5	64,7	4,5	50,0	5,5	40,7	0,5	25,0
Patella	1,0	4,0	1,0	3,4	0,5	5,9	0,0	0,0	0,0	0,0	0,0	0,0
Tibia	11,5	46,0	14,0	48,3	4,5	52,9	8,5	94,4	3,5	25,9	1,0	50,0
Fibula	6,5	26,0	4,5	15,5	2,0	23,5	2,0	22,2	3,5	25,9	0,5	25,0
Calcaneus	6,5	26,0	14,0	48,3	7,5	88,2	6,0	66,7	5,5	40,7	0,0	0,0
Talus	8,5	34,0	10,5	36,2	2,5	29,4	4,5	50,0	3,5	25,9	0,0	0,0
Tarsi	0,3	1,2	1,0	3,4	0,0	0,0	0,0	0,0	0,4	3,0	0,0	0,0
Mt	2,3	9,0	4,8	16,4	0,9	10,3	1,8	19,4	0,9	6,5	0,5	25,0
Ph 1	0,8	3,0	2,3	8,0	0,6	7,4	0,6	6,3	0,8	6,0	0,0	0,0
Ph 2	0,6	2,5	0,9	3,0	0,3	3,7	0,3	3,5	0,3	1,9	0,0	0,0
Ph 3	0,2	0,8	0,4	1,5	0,2	2,2	0,3	3,5	0,5	3,7	0,0	0,0

Appendix 30. Number of pig mandibles in each age category. Categories according to O'Connor (2003: 160).

	ÅA 1	ÅA 2	ÅA 3	AV 1	AV 2	AV 3
N	3	2			5	
J	3	8	1	1	2	
I1	2	5	1	2	3	
I2	1	2		1	1	
SA1	7	15	1	1	12	1
SA2	4	5	1	2	4	2
A1	8	10	1	6	2	
A2	8	11		1		
A3						
E						
n	36	58	5	14	29	3

Appendix 31. Number and percentages of open, closing and fused epiphyses of pigs. For list of epiphyses included in each group see table 7. Phase 3 at Aboa Vetus is excluded due to small number of epiphyses.

ÅA 1	O	C	F	AV 1	O	C	F
Early	4	0	47	Early	3	0	12
Intermediate	35	2	11	Intermediate	24	1	13
Late	42	1	2	Late	18	0	1
Early	7,8	0,0	92,2	Early	20,0	0,0	80,0
Intermediate	72,9	4,2	22,9	Intermediate	63,2	2,6	34,2
Late	93,3	2,2	4,4	Late	94,7	0,0	5,3
ÅA 2	O	C	F	AV 2	O	C	F
Early	5,0	2,0	62,0	Early	2,0	0,0	19,0
Intermediate	62,0	5,0	26,0	Intermediate	26,0	1,0	2,0
Late	63,0	0,0	4,0	Late	3,0	0,0	0,0
Early	7,2	2,9	89,9	Early	9,5	0,0	90,5
Intermediate	66,7	5,4	28,0	Intermediate	89,7	3,4	6,9
Late	94,0	0,0	6,0	Late	31,0	0,0	0,0
ÅA 3	O	C	F				
Early	7,0	0,0	25,0				
Intermediate	24,0	0,0	4,0				
Late	36,0	0,0	2,0				
Early	21,9	0,0	78,1				
Intermediate	85,7	0,0	14,3				
Late	94,7	0,0	5,3				

Appendix 32. Abundance of major domesticates in different materials (NISP) (Helsinki: Tourunen 2002a tai b ;Pori: Tourunen 2002a tai b; Oulu Puputti 2005; Tornio Puputti 2006; Lund: Ekman 1973; Skara: Vretemark 1997; Birka: Wigh 2001; Pärnu: Maldre 1997 a tai b; Tartu: Maldre 1997 a tai b). Large ungulates are counted with cattle specimens. In Lund ribs and vertebrae are not identified. From Skara material dated to 1320-1360 AD is used.

	Turku	Helsinki	Pori	Oulu	Tornio	Lund	Skara	Birka	Pärnu	Tartu
Cattle	65	72	67	82	78	48	57	25	53	44
Sheep/goat	26	15	16	16	16	24	29	35	32	20
Pig	9	14	17	3	5	24	14	40	15	37
n	55275	2143	1055	220	2999	3681	2383	31270	1811	-

Appendix 33. Comparison of cattle age profiles based on mandibular teeth eruption and wear (Helsinki: Tourunen 2002 a tai b; Pori: Tourunen 2002 a tai b; Skara: Vretemark 1997; Birka: Wigh 2001). Birka percentages are based on estimation made from figure 15 (Wigh 2001: 62).

Years	Turku ÅA 1	Turku AV 2	Helsinki	Pori	Skara	Birka
over 4	37	79	38	70	67	70
2 ½ -4	20	4	19	20	12	11
1 ½ -2 ½	37	14	38	-	7	8
under 1 ½	6	4	5	10	14	11
n	51	28	21	10	86	33

Appendix 34. Comparison of small bovid age profiles based on mandibular teeth eruption and wear (Helsinki: Tourunen 2002 a tai b; Skara: Vretemark 1997; Birka: Wigh 2001).
Birka percentages are based on estimation made from figure 47 (Wigh 2001: 89).

Years	Turku ÅA 1	Turku AV 2	Helsinki	Skara	Birka
over 4	32	21	0	16	36
2-4	22	21	25	15	39
0,75-2	45	55	58	11	22
under 0,75	2	2	17	58	3
n	130	47	12	106	173