

Chapter 5

**ARCHAEOZOOLOGICAL MATERIAL FROM THE
SETTLEMENT SITES AT LINNAALUSTE AND THE
HILL FORT AT KEAVA**

Liina Maldre

Abstract

The present paper discusses the results of archaeozoological analyses of materials collected from the settlements of Linnaaluste and from the hill fort of Keava. Also the issues concerning the anatomical composition of bone material and the age of animals at slaughter are examined. The prevailing part of bone fragments belong to domesticated animals. The sheep/goats are dominating species in the materials of the Viking Age settlements (I and III). The percentage of sheep/goat is somewhat smaller and the percentage of pig is greater in the material of Final Iron Age hill fort. The relative importance of pig is even more prominent in the material of II settlement, which is mixed with bone fragments of later period. The percentage of cattle is approximately the same in all materials. The bones of game are few, the represented species are beaver, elk, fox, hare and bear. The comparative analyses of results are conducted; for comparison the archaeozoological data of other Estonian settlements and hill forts from Viking Age and Final Iron Age are used.¹

¹ This study was supported by the target financed research project No. SF0130012s08 and grants from Estonian Science Foundation (Nos 7880 and 8526).

Introduction

The analysis of animal bones recovered from excavations allows us to establish the proportions of hunting and cattle breeding in the procurement of animal raw material; the species composition of animal bones indicates the structure of livestock, and the slaughter age of animals may suggest the purpose of breeding certain species. Food provision for people was not the only aim of cattle breeding: cattle and horses were also used as draught animals, sheep and goats provided wool; hides of slaughtered animals were certainly used, various artefacts were made from animal bones. As for cattle, their role in manuring fields must certainly be mentioned.

Of bone finds from the Estonian Viking Age settlement sites, only those from the Pada settlement have been thoroughly discussed (Maldre 2007), while the analyses of bones from the Late Iron Age hill forts have been limited to the establishment of the ratio of different species (Paaver 1965b).

The aim of this chapter is to give a survey of cattle breeding in the Linnaaluste settlements and the hill fort of Keava. The settlement sites of Linnaaluste I and III were dated to the Pre-Viking and Viking Ages, whereas the hill fort belongs to the Final Iron Age and settlement II to the Final Iron Age and the Middle Ages (chapters 1 and 3). Hence it is also to some extent possible to observe the development of cattle breeding in this region in a long-time perspective.

Material and methods

The osteological material of the Linnaaluste settlement sites is poorly preserved and mostly consists of small fragments. A total of 2800 bones and bone fragments were recovered (including bone fragments with working traces that were discovered among animal bones). 567 bone finds (20%) of them could be determined. The ratio of determined bone fragments varied between 13.4 and 25.6% in different excavations. Bone material collected during the monitoring (surface survey) of settlement site II was considerably better preserved, the ratio of determined bones being about 40% (Fig. 5.1). The species and anatomical composition of bone material from settlement sites I and III are presented in Table 5.1, and from settlement site II in Table 5.2.

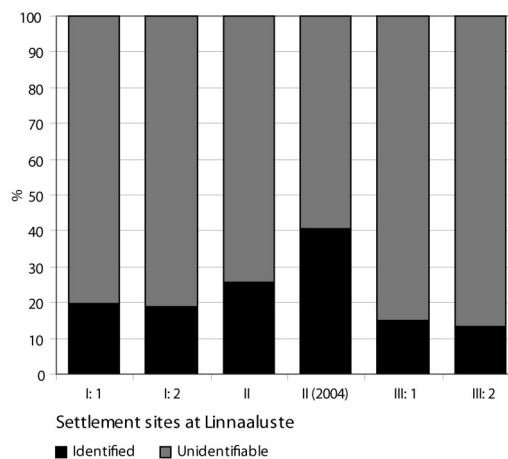


Fig. 5.1. Ratio of determined bones in the settlement sites at Linnaaluste.

Table 5.1. Species and anatomical composition of bones from settlement sites I and III at Linnaaluste

	<i>Cornus/Proc. corn.</i>	<i>Cranium</i>	<i>Mandibula</i>	<i>Dentes</i>	<i>Vertebrae</i>	<i>Costae</i>	<i>Scapula</i>	<i>Humerus</i>	<i>Radius et ulna</i>	<i>Ossa carpalia</i>	<i>Os metacarpale</i>	<i>Pelvis</i>	<i>Femur</i>	<i>Tibia et fibula</i>	<i>Ossa tarsalia</i>	<i>Os metatarsale</i>	<i>Os metapodiale</i>	<i>Ossa sesamoidea</i>	<i>Phalanges</i>	Total	%
Linnaaluste I: 1																					
<i>Bos taurus</i>				8	1													1	10	23.8	
<i>Ovis/Capra</i>				13		1			1			1	1							17	40.5
<i>Sus scrofa dom.</i>				9																9	21.4
<i>Equus caballus</i>				1																1	2.4
<i>Rodentia</i>				1				1					2							4	9.5
<i>Homo sapiens</i>				1																1	2.4
Total				33	1	1		1	1			1	3					1	42	100	
%				78.6	2.4	2.4		2.4	2.4			2.4	7.1					2.4	100		
Linnaaluste I: 2																					
<i>Bos taurus</i>		6	5	14	2	3	2	3		3	3	1	1	3	2	6		1	5	60	31.7
<i>Ovis aries</i>																1				1	0.5
<i>Ovis/Capra</i>		3	2	21		1	1	2	12	2	2	2	2	4	1	7			4	66	34.9
<i>Sus scrofa dom.</i>		1	2	8				2					2	1					1	17	9.0
<i>Equus caballus</i>				6					1						2				2	11	5.8
<i>Canis fam.</i>													1							1	0.5
<i>Alces alces</i>	2																3		2	7	3.7
<i>Ursus arctos</i>																			1	1	0.5
<i>Castor fiber</i>		8	1	7					3			1								20	10.6
<i>Rodentia</i>				1										1						2	1.1
<i>Anura</i>									1											1	0.5
<i>Homo sapiens</i>					2															2	1.1
Total	2	18	11	58	2	4	3	7	17	5	5	4	7	8	5	14	3	1	15	189	100
%	1.1	9.5	5.8	30.7	1.1	2.1	1.6	3.7	9.0	2.6	2.6	2.1	3.7	4.2	2.6	7.4	1.6	0.5	7.9	100	
Linnaaluste III: 1																					
<i>Bos taurus</i>		1		2	1															5	11.9
<i>Ovis aries</i>																				1	2.4
<i>Ovis/Capra</i>		1	3	10		1		1	4		1		1		1				1	24	57.1
<i>Sus scrofa dom.</i>		1		3					1	1				1						1	8
<i>Equus caballus</i>				1																1	2
<i>Rodentia</i>				1										1						2	4.8
Total		3	4	16	1	1		1	5	1	1		2	1	2				4	42	100
%		7.1	9.5	38.1	2.4	2.4		2.4	11.9	2.4	2.4		4.8	2.4	4.8				9.5	100	
Linnaaluste III: 2																					
<i>Bos taurus</i>		1	1	9		3	1	1	3			1						1		21	25.3
<i>Ovis aries</i>																			1	1	2
<i>Ovis/Capra</i>		2	4	28				1			3	2	2	1		1	4		1	49	59.0
<i>Sus scrofa dom.</i>		1		2	1		1									1			2	8	9.6
<i>Alces alces</i>	3																			3	3.6
Total	3	4	5	39	1	3	3	1	3		3	3	2	1		2	6		4	83	100
%	3.6	4.8	6.0	47.0	1.2	3.6	3.6	1.2	3.6		3.6	3.6	2.4	1.2		2.4	7.2		4.8	100	

Table 5.2. Species and anatomical composition of bones in settlement site II at Linnaaluste

	<i>Cornus/Proc. corn.</i>	<i>Cranium</i>	<i>Mandibula</i>	<i>Dentes</i>	<i>Vertebrae</i>	<i>Scapula</i>	<i>Humerus</i>	<i>Radius et ulna</i>	<i>Ossa carpalia</i>	<i>Os metacarpale</i>	<i>Pelvis</i>	<i>Femur</i>	<i>Tibia et fibula</i>	<i>Ossa tarsalia</i>	<i>Os metatarsale</i>	<i>Os metapodiale</i>	<i>Phalanges</i>	Total	%
Linnaaluste II																			
<i>Bos taurus</i>	1	3	1	19	2		1		1			1			1	3	33	25.6	
<i>Ovis/Capra</i>		1	3	30			2	3		1	1		2	1	1	1	1	47	36.4
<i>Sus scrofa dom.</i>		4	2	24		1	3	3			1		3	2			3	46	35.7
<i>Equus caballus</i>									1					1	1		3	2.3	
Total	1	8	6	73	2	1	6	6	2	1	2	1	5	4	3	4	4	129	100
%	0.8	6.2	4.7	56.6	1.6	0.8	4.7	4.7	1.6	0.8	1.6	0.8	3.9	3.1	2.3	3.1	3.1	100	
Linnaaluste II (bones gathered during monitoring in 2004)																			
<i>Bos taurus</i>		1	2	25	1	2		3	1	2		1		1				39	47.6
<i>Ovis/Capra</i>				12			1	1					6					20	24.4
<i>Sus scrofa dom.</i>		1		14	2						1		1		1			20	24.4
<i>Equus caballus</i>				2					1									3	3.7
Total		2	2	53	3	2	1	4	1	3	1	1	6	2	1			82	100
%		2.4	2.4	64.6	3.7	2.4	1.2	4.9	1.2	3.7	1.2	1.2	7.3	2.4	1.2			100	

Bone material collected from settlement site II during the monitoring in 2004 consists of animal bones belonging to different periods, some of which were quite recent or even contemporary. Since it is not possible to date bones by sight, the entire material has been discussed together.

Besides the bones mentioned in Table 5.2, hen bones were recovered from trench 1 of settlement site I, one bird bone from the excavation area and two hen bones from the monitoring of settlement site II, one fish bone from trench 1, and two bird bones (one of them belonging to a hen) and 12 fish bones from trench 2 of settlement site III. Osteological material from the settlement sites also include burnt bone fragments; they were most numerous in trench 2 of settlement site I and least in settlement site II (Fig. 5.2). Burnt animal bones in the cultural layer

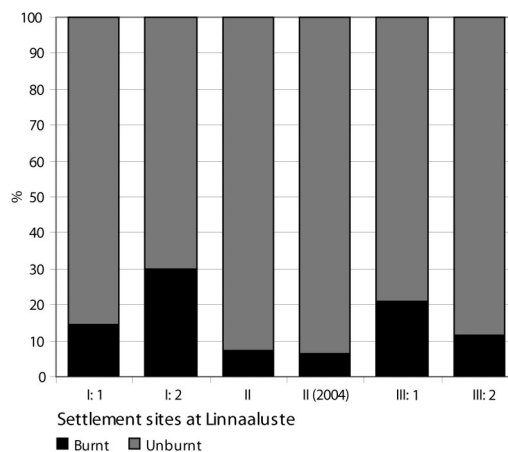


Fig. 5.2. Ratio of burnt bones in the settlement sites at Linnaaluste.

are quite customary, and most likely some of the bones left over at meals were simply tossed into the fireplace.

The osteological material from the excavations of the settlement site I is provisionally discussed separately because it is of a different nature and probably also of different origin. Bones from excavations of settlement site III are discussed together, since the excavations were located quite close to each other and were not naturally separated. The minimum number of individuals was established by layers. The minimum number of individuals was established for the whole material in excavation I: 2 and on the basis of the monitoring.

The osteological material collected from the hill fort of Keava consisted of nearly 10,700 bone fragments, 2533 of which could be determined. In addition to these, 50 bird bones (at least 16 of them belonging to hens) and 12 fish bones were recovered. The ratio of determined and undeterminable, as well as burnt and unburnt bones, are presented in Figures 5.3 and 5.4. The anatomical and species structure of bones collected from the rampart and compound (area I) of the hill fort is presented in Table 5.3, and the material from the gateway (area II) in Table 5.4.

structure of bones collected from the rampart and compound (area I) of the hill fort is presented in Table 5.3, and the material from the gateway (area II) in Table 5.4.

Bone material recovered from the gateway (area II) does not differ considerably from the rest of the bones. In the tables we can observe that the main difference lies in the number of bones of rodents – in the gateway they constituted a considerable proportion of the determined bones. As for the bones of domestic animals, there are fewer cattle bones, and pig bones are more numerous; the ratio of sheep/goat bones is the same. The anatomical composition of bones from different plots is almost identical too, the only difference being the relatively large number of pig vertebrae in the gateway. In excavation area I of Keava hill fort, the minimum number of individuals was established for the whole material, and in area II it was established by layers and find spots. In order to determine the age of animals at slaughter, the ages of the ossification of epiphyses, the replacement of milk teeth and the eruption of permanent teeth presented by I. A. Silver

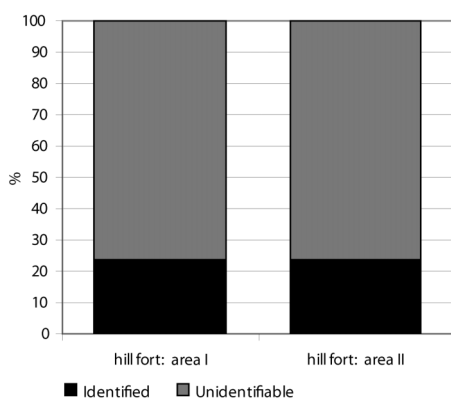


Fig. 5.3. Ratio of determined bones from the hill fort at Keava.

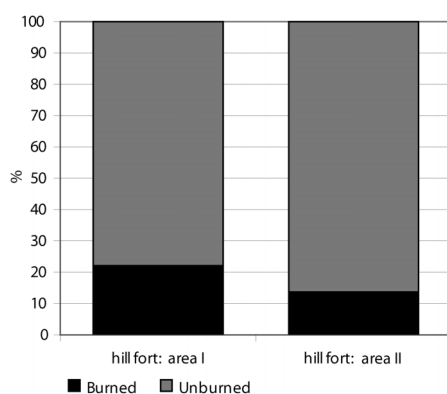


Fig. 5.4. Ratio of burnt bones from the hill fort at Keava.

Table 5.3. Species and anatomical composition of the osteological material recovered from Keava hill fort (area I)

Species	Cranium	Mandibula	Dentes	Vertebrae	Costae	Scapula	Humerus	Radius et ulna	Ossa carpalia	Os metacarpale	Pelvis	Femur	Patella	Tibia et fibula	Ossa tarsalia	Os metatarsale	Os metapodiale	Ossa sesamoidea	Phalanges	Total	%
<i>Bos taurus</i>	108	67	160	62	34	13	17	26	14	29	14	18	1	12	21	36	4	13	47	696	30.1
<i>Ovis/Capra</i>	85	58	178	98	38	24	32	65	2	21	26	25	2	41	15	35	13	1	24	783	33.9
<i>Capra hircus</i>	8			1		1	3	4	1	1				1			1		17	38	1.6
<i>Ovis aries</i>	11			2		2	12	14	4	7	2			3	14	9			42	122	5.3
<i>Sus scrofa dom.</i>	54	31	96	42	39	17	13	40	9	20	14	16	2	38	16	13	27		63	550	23.8
<i>Equus caballus</i>	4	1	12	2	1		1	2	1	1	1	2		2	2	1			1	34	1.5
<i>Canis fam.</i>											1			1	2				1	5	0.2
<i>Bos? Alces alces?</i>															1					1	0.0
<i>Ovis/Capra?</i>															1					1	0.0
<i>Capreolus?</i>																					
<i>Sus ferus?</i>		1	1																	2	0.1
<i>Vulpes vulpes</i>	1			1			2	2												6	0.3
<i>Lepus sp.</i>	1				1	1										2				5	0.2
<i>Castor fiber</i>			1																	1	0.0
Rodentia	8	18	6			1	2	1			10	5		6						57	2.5
<i>Talpa europaea</i>						1	1													2	0.1
<i>Bufo bufo</i>											1			1						2	0.1
Anura							2							3						5	0.2
<i>Homo sapiens</i>							2													2	0.1
Total	280	176	454	208	113	60	87	154	31	79	67	68	5	108	72	96	45	14	195	2312	100
%	12.1	7.6	19.6	9.0	4.9	2.6	3.8	6.7	1.3	3.4	2.9	2.9	0.2	4.7	3.1	4.2	1.9	0.6	8.4	100	

Table 5.4. Species and anatomical composition of the bones recovered from area II of Keava hill fort

Species	Cranium	Mandibula	Dentes	Vertebrae	Costae	Scapula	Humerus	Radius et ulna	Ossa carpalia	Os metacarpale	Pelvis	Femur	Patella	Tibia et fibula	Ossa tarsalia	Os metatarsale	Os metapodiale	Ossa sesamoidea	Phalanges	Total	%
<i>Bos taurus</i>	8	6	6	6	1	1	2	2	1		1			5	1	1		1	3	45	20.4
<i>Ovis/Capra</i>	7	3	17	10	2	4	1	4	1	1	5	2	1	4	1	3			3	69	31.2
<i>Capra hircus</i>												1			2	2				5	2.3
<i>Ovis aries</i>																1			6	7	3.2
<i>Sus scrofa dom.</i>	5	4	8	18	6	2	2	3	1	1	1			2	2	2	1		7	65	29.4
<i>Equus caballus</i>	1	2																		3	1.4
<i>Canis familiaris</i>																2				2	0.9
<i>Lepus sp.</i>														1						1	0.5
Rodentia	7	7	1	2			1	1			1	2		1						23	10.4
Anura											1									1	0.5
Total	28	22	32	36	9	7	6	10	3	2	9	5	1	12	7	11	1	1	19	221	100
%	12.7	10.0	14.5	16.3	4.1	3.2	2.7	4.5	1.4	0.9	4.1	2.3	0.5	5.4	3.2	5.0	0.5	0.5	8.6	100	

(1969) were used. Bones of sheep and goats were identified on the basis of distinctive marks presented by J. Boessneck, H. H. Müller and M. Teichert (1964).

Stock breeding

Settlement sites

The species composition of the bones of domestic animals varies greatly at the settlement sites of Linnaaluste, in terms of both the number of bone fragments (Fig. 5.5) and the minimum number of individuals (Fig. 5.6). Sheep and goat rearing was quite important in this region in the Viking Age. Although no goat bones were identified, this does not mean that goats were not reared at all. Bones of these species were particularly numerous in settlement III. Their number was somewhat smaller in the excavation of settlement site II at Linnaaluste, and smaller still among the bones recovered during the monitoring in 2004.

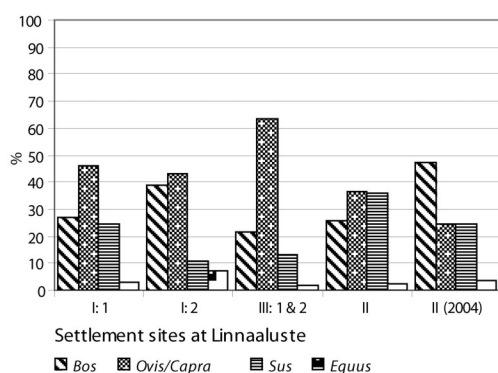


Fig. 5.5. Ratio of species on the basis of the number of bone fragments.

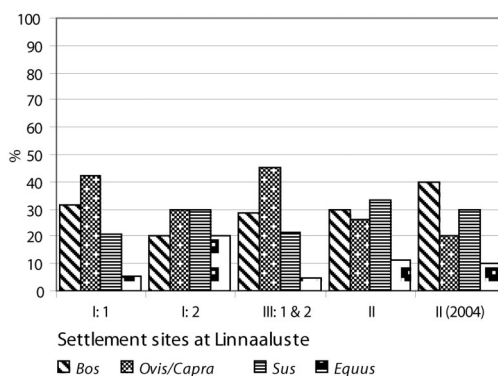


Fig. 5.6. Minimum number of specimens.

The anatomical structure of bones is quite similar in the Viking Age and in later material (bones from the excavation and monitoring of settlement site II were analysed together) (Figs 5.7 and 5.8) and typical of heavily fragmented material.

Since the material is very fragmentary and tooth fragments constitute a considerable part of determinable bones, the establishing of minimum number of individuals and slaughter age was complicated. The sheep/goat bones recovered from the Linnaaluste III settlement site belonged to at least 19 specimens; on 18 of them an approximate slaughter age could be determined: one animal (5.6%) was slaughtered at an age below 6 months, one was slaughtered at about 1 year, five individuals (27.8%) were slaughtered at an age below 2 years and the remaining 11 animals (61.1%) had been more than 2 years old (1 of these definitely over 3 years). In other excavations fewer individuals could be determined and thus the results may be quite random. In excavation I: 1 at Linnaaluste,

bones of at least eight sheep or goats were recovered; one of these had been slaughtered as a lamb/kid, one during the first year, two at an age under 2 years and only one was definitely older than 2 years (the age of two individuals could not be determined). Hence, we mostly have the remains of young animals here. From the second excavation trench of settlement site I, bones of at least three specimens were recovered, one of them younger than 2 years, one about two years of age and one older. Among the bone material of the Linnaaluste II settlement site, however, mainly adult individuals are represented – one young animal, one over 21 months of age and five over 2 years. The bones collected during the monitoring of the same settlement included the remains of at least two animals, one of them slaughtered at an age under 18 months and the other older than 2 years.

Cattle were raised in somewhat smaller numbers, and the number of bone fragments of cattle is everywhere smaller than that of sheep/goats, except among the bones collected during the monitoring of settlement site II. On the basis of the minimum number of individuals, the ratio of cattle is higher than that of sheep/goats in both excavation trenches of settlement site II. The slaughtering age of cattle could not be accurately determined because bones that would have made that possible were very few. Among the Viking Age bone material, at least 20 individuals were represented; at least two of them were slaughtered before 2 years of age, two before 3 years of age, one was older than 2.5 years, five were adult animals, and for 10 individuals it was impossible to determine their age, but apparently it was more than 2 years. Cattle bones recovered from settlement site II belonged to at least nine individuals, one of them a calf aged 6–12 months, one less than 33 months, one more than 27 months old, two more than 33 months and three specimens whose age could not be determined, but who were apparently also adult animals. The material collected

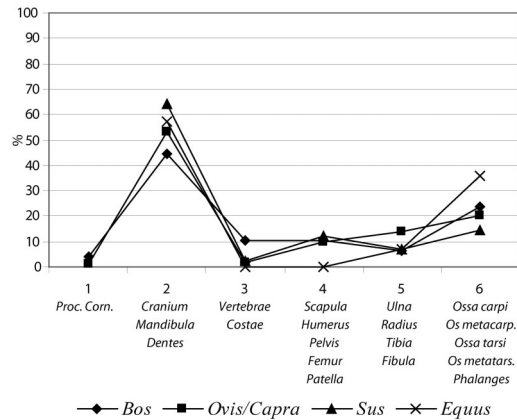


Fig. 5.7. Anatomical composition of the Viking Age bone material.

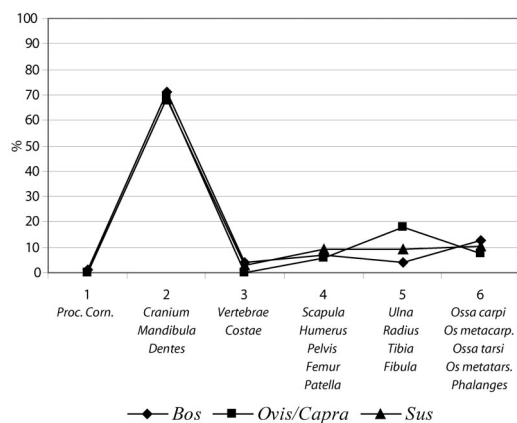


Fig. 5.8. Anatomical composition of the bone material from settlement site II at Linnaaluste.

in 2004 contained bones of at least four individuals, one of them a calf under 6 months, one aged approximately 27 months, one older than 27 months and one older than 30 months.

The ratio of pig bones varies in different excavations. Among the Viking Age bone material of settlement sites I and III they constitute 13.5% of all bones of domestic animals, but on the basis of the minimum number of individuals their ratio is somewhat higher. In the excavation of settlement site II, the number of pig bones was considerably larger. It is impossible to say whether this is due to the mixed later material or some other reason. At any rate, in bone finds collected during the monitoring, the ratio of pig bones is considerably smaller, and among the bone finds from the Keava hill fort the percentage of pig bones was also lower. Among the Viking Age bones, the remains of at least 16 individuals could be determined. Remains of piglets were absent, but at least one animal had been slaughtered before the age of 1 year, and two before the age of 2 years. Two specimens were definitely older than 18 months, although the age of the remaining animals could not be established. In the excavation of settlement site II at Linnaaluste, remains of at least nine pigs were determined, 2 of them slaughtered before the age of 6 months, five before the age of 15 months, one animal was more than two years old, and one was slaughtered before the age of 3.5 years. Among the bones collected in 2004, at least three individuals are represented – one younger than 6 months, one younger than 15 months and one older than 18 months.

The number of horse bones was largest in the second excavation trench of settlement site I (11 fragments, 7.1% of all bones of domestic animals), but they were completely absent in the second excavation trench of settlement site III. In the first trench of settlement I, one horse tooth (2.7%) and in the first trench of settlement III, two horse bones (5%) were recovered. In settlement II, horse bones made up 2.3% of all bones of domestic animals, and among the bone finds collected in 2004 the ratio of horse bones was 3.7%. Very little can be learned about the slaughter age of horses on the basis of the osteological material from Linnaaluste. In the first excavation trench of settlement I we recovered only one heavily worn milk tooth, which may have been lost in the course of replacement of teeth and need not belong to a slaughtered animal. In the second trench of settlement I at least two horses were represented, one of them a colt or young horse (with a slightly worn milk tooth (incisor) and a fragment of an unerupted permanent tooth), the other an adult, probably an elderly individual (tooth fragments and *ossa tarsi* with pathologies). Horse bones from settlement III belong to two evidently adult specimens. Bones of at least three individuals were recovered from settlement II. Their age cannot be determined, but they were evidently adults. Horse bones collected during the monitoring of settlement site II belong to at least one animal, which was an adult but not very old.

Hill fort

Osteological material from the Keava hill fort also contains predominantly sheep/goat bones, based on both the number of identified bone specimens (NISP)

and by the minimum number of individuals (MNI). The amount of cattle and pig bones is somewhat smaller, and horses are modestly represented (Fig. 5.9).

The anatomical structure of bone material (Fig. 5.10) is quite typical. The very small ratio of horn cores of cattle and sheep/goat is generally typical of the bone material of pre-historic settlements, and evidently also of hill forts. The small number of vertebrals and ribs is due to the fragmentary nature of the material, which makes bones undeterminable.

Sheep/goat bones belong to at least 55 specimens; sheep is represented by at least 14 and goat by at least 10 individuals. Slaughter ages were determined on the basis of epiphyses of bones and the replacement of mandibular and maxillary teeth (Fig. 5.11). Although different bones yield quite different results, we may summarily assert that up to 10% of specimens were slaughtered before the age of 6 months, and another 10% during the next 6 months of age; by the age of 2 years, about half of the animals had been slaughtered. The distal epiphyses of metatarsal bones indicate that by the age of 28 months more than 60% of animals had been slaughtered, but the epiphyses of all other long bones, which ossify later, do not confirm this. Therefore it seems that most of the animals that were kept until the age of 2 years also lived longer than 3.5 years.

Cattle bones belong to at least 33 individuals, and they also contain only a relatively small quantity of fragments allowing the determina-

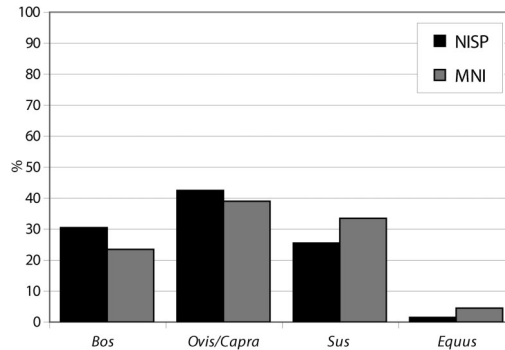


Fig. 5.9. Number of bone fragments and minimum number of individuals (%) from the hill fort at Keava.

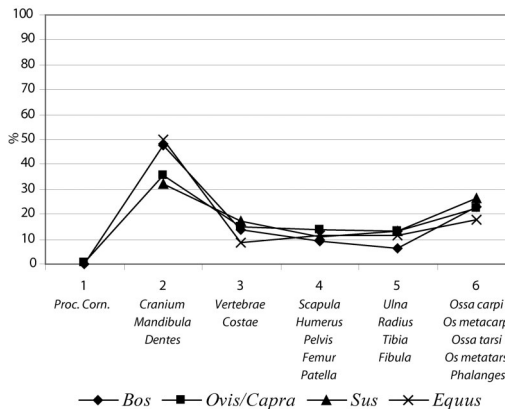


Fig. 5.10. Anatomical composition of bone material from the hill fort at Keava.

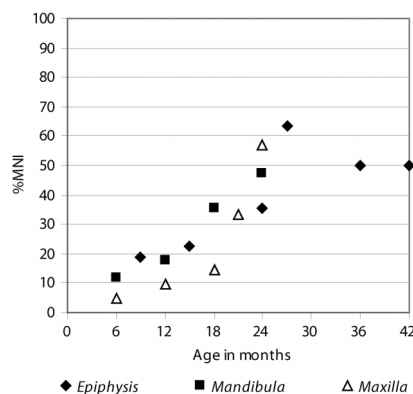


Fig. 5.11. Slaughter ages of sheep/goats, hill fort at Keava.

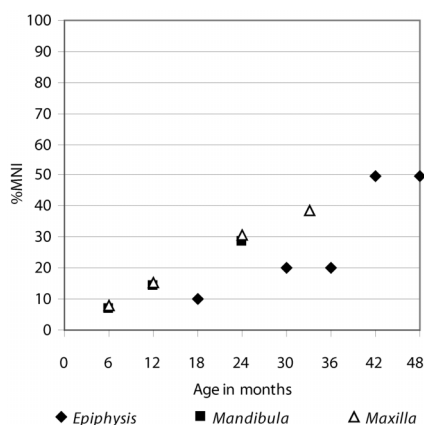


Fig. 5.12. Slaughter ages of cattle, hill fort at Keava.

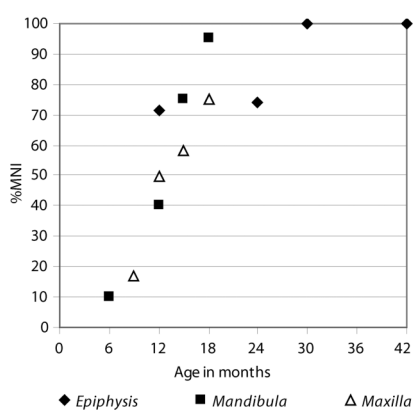


Fig. 5.13. Slaughter ages of pigs, hill fort at Keava.

tion of age. Less than 10% of cattle were slaughtered at an age of less than 6 months, but nearly 30% before two years of age. About one half of the animals lived beyond the age of 4 years (Fig. 5.12).

On the basis of MNI, pig bones belong to at least 47 animals. Pigs were slaughtered young: 40% or more during their first year, and bones of pigs over 2.5 years of age were completely absent (Fig. 5.13).

Horse bones belonged to at least seven individuals: one colt below 6 months of age, two young animals (younger than 3 years old) and four adults (one over 3.5 years old, one about 6 years old and two adults whose age could not be determined more accurately).

Hunting

Hunting and fishing did not play an important role in the settlement sites of Linnaaluste in the Viking Age. The number of game bones was greatest in the second excavation trench of site I, where they constituted nearly 15% of all determinable bones. Most of the game bones (20 fragments) belong to beaver, seven to elk and one to bear. Beaver bones were found in at least two specimens. The majority of beaver bones consist of skull fragments and teeth, apparently belonging to the same animal;

some other bones may also belong to the same specimen. Nevertheless, considering the state of preservation and the colour of the bones, one cannot rule out the possibility that they belong to some later period. Bear was represented by one (first) phalanx. Two small antler fragments, three rudimentary metacarpal bones and two phalanges belong to elk, and these come from at least two specimens. Antler chips and one of the rudimentary metacarpals bear working traces. Three antler fragments with cutting traces were also found in the second excavation trench of settlement site III; special mention should also be made of a pendant made from an eagle's talon found from the same excavation (Konsa et al. 2003, 54; chapter 4). No game bones were found from settlement site II at Linnaaluste.

Among the bone material from the Keava hill fort, game bones occupy an insignificant proportion, only 0.7% of all bones (bones of rodents, moles and

frogs have not been taken into consideration). Hare and fox are each represented by 6 bones, and one tooth belongs to a beaver. Hare bones belong to at least three specimens, fox bones evidently come from one animal. The astragalus of hare, found from area II, has been made into a pendant. One fox humerus bears small cutting traces, which may indicate flaying. While the Viking Age settlement sites also contained fragments of elk bones and antlers, nothing of the kind came to light from the hill fort (except one fragment of a centroquartale bone, which may belong to either elk or cattle).

Bird bones were few in the settlement sites and the hill fort, and thus we may assume that bird hunting was of no importance in this district in the later Iron Age. Fish bones are also few in number. These have not all been determined, but it is certain that they include bones of *Cypriniformes*.

Discussion and conclusions

Species composition of bones of domestic animals

Compared with the osteological material from other Estonian Viking Age settlements and hill forts (Fig. 5.14), the ratio of different domestic animals in Linnaaluste seems to resemble most closely the osteological material from the Tornimäe settlement on the Island of Saaremaa (Mägi 2005; Maldre 2006). These two are the only Viking Age settlement sites where sheep/goat bones constitute nearly half of all bones of domestic animals, and the ratio of horse bones is very small there. From central Estonia, only bone material from the Saadjärve settlement (Lõugas 1997, 75; Lavi 2002, 242) can be compared with Linnaaluste. There, bones of sheep and goats constitute the majority of bones, but their ratio is considerably lower than at Linnaaluste; there is no great difference in the occurrence of cattle and pig bones, but horse bones occur in considerably larger numbers. Since the amount of determined bones is small at Saadjärve, the results may be somewhat incidental. At the Pada settlement site in north-eastern Estonia, the

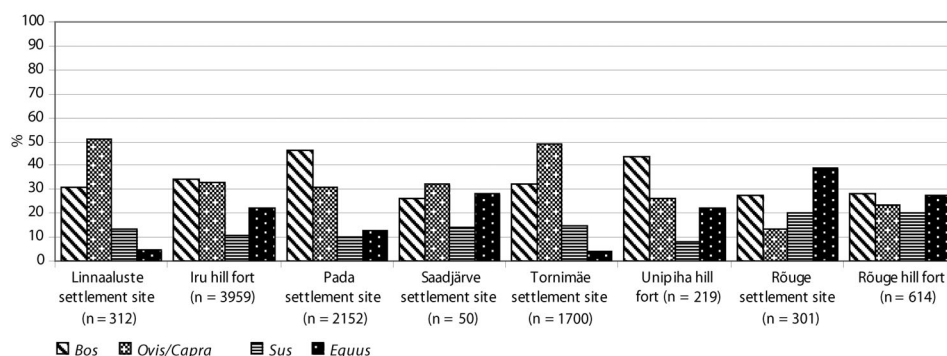


Fig. 5.14. Ratio of domestic animal species on the basis of the number of bone fragments in Viking Age sites.

percentage of cattle bones is much higher than in other Viking Age sites of northern Estonia. In terms of the ratio of horse bones, the osteological materials of Iru hill fort and the settlement of Saadjärve more closely resemble the materials from southern Estonia. In northern Estonia and Saaremaa the ratio of pig bones in the Viking Age remains between 10–15%, but the data about southern Estonia are contradictory – in Rõuge settlement and hill fort the percentage of pig bones is about 20%, while in the hill fort of Unipiha it is below 10% (Paaver 1965b, appendix II; 1970). The occurrence of cattle bones is relatively constant in the Viking Age, in most of the sites their percentage is about 30% and it only exceeds 40% in Pada settlement and Unipiha hill fort.

In the material from the Keava hill fort, bones of sheep/goats still predominate, but compared with the Viking Age material of the Linnaaluste settlement the ratio of these species has decreased by nearly 10%. The percentage of pig bones increased considerably, and the relative amount of cattle bones remained at the same level. In Fig. 5.15 I have presented for comparison the species composition of bone material from some other Final Iron Age strongholds in Estonia. In the bone material from Varbola Jaanilinn, a hill fort located close to Keava, the ratio of cattle bones is higher, and the ratio of sheep/goat bones somewhat lower. The bone material from the Saadjärve hill fort (Maldre 1997) differs from them considerably, particularly in terms of its very low ratio of cattle bones and its high ratio of horse bones. Since Viking Age finds have also been recovered from the Saadjärve hill fort (Lavi 2002, 238 ff.), it is quite possible that the high ratio of horse bones is partly due to the earlier mixed material. Compared with the settlement site of Pada, the ratio of cattle bones has slightly decreased and the percentage of sheep/goat bones has increased in the osteological material from the Pada hill fort, but considering the very small amount of bones from the fort,

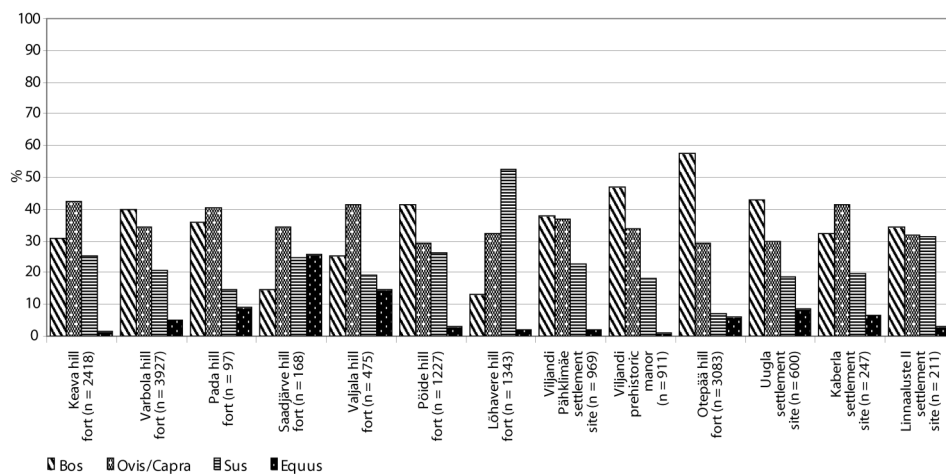


Fig. 5.15. Ratio of domestic animal species on the basis of the number of bone fragments in Late Iron Age and Medieval sites.

the results are not very reliable. On the basis of currently available information, it seems that the importance of sheep/goat rearing probably decreased slightly in northern Estonia and Saaremaa in the Final Iron Age – while in the Viking Age the highest ratio of these species among all bones of domestic animals was about 50%, the respective number in the Final Iron Age was only slightly over 40%. The lowest is the ratio of sheep/goat bones in Põide (Lõugas 1997, 74), where they constitute 29% of all bones of domestic animals, and the highest is in Valjala (Paaver 1965a) and Keava. In southern Estonia the importance of sheep and goat breeding evidently increased in the Final Iron Age, and the ratio of bones of these species is 30–37% (Paaver 1965b; Saks & Valk 2002; Valk 2003; Haak 2007). The percentage of cattle bones varies greatly in different complexes: in the strongholds of central and north-east Estonia, the ratio of cattle bones in the Final Iron Age remains between 30–40% of all bones of domestic animals, with the only exception being the Saadjärve hill fort, where the ratio of cattle bones was only 15%; the data concerning cattle bones in Saaremaa and south Estonia are inconsistent. Comparing the diagrams of the Viking Age and the Final Iron Age, a noticeable increase in the ratio of pig bones and a decrease of the ratio of horse bones in the Final Iron Age can be observed. Unfortunately no material for comparison belonging to the Final Iron Age is available from south-eastern Estonia. Since the Final Iron Age material mostly originates from hill forts, the question arises whether the differences in the species composition of bones of domestic animals are caused by certain changes in the principal directions of animal husbandry, or perhaps cattle breeding in hill forts was of a different nature than in settlements. Differences in the species composition of hill fort and settlement materials can be observed in the sites of both periods. In Rõuge hill fort, for instance, the ratio of sheep and goat bones is considerably higher, and the ratio of horse bones considerably lower than in the settlement; the ratios of pig and cattle bones are approximately the same. The species composition in the hill fort and settlement of Ķenteskalns, Latvia, dated to the Middle Iron Age, is also somewhat different: there the osteological material from the hill fort contains considerably more bones of sheep/goats and pigs, slightly more cattle bones and considerably fewer horse bones. In the osteological material of the Final Iron Age hill fort and settlement of Tērvete, Latvia, we can observe a much higher percentage of cattle bones, a slightly higher percentage of pig bones and considerably fewer horse bones in the hill fort; the ratio of sheep/goat bones is almost equal (Paaver 1965b, appendix II). The Final Iron Age bone material of the Linnaaluste II settlement site, both from the excavation and the monitoring, is heavily mixed with medieval and post-medieval material (Lang et al. 2005), and therefore they are presented together in Fig. 5.15. Compared with the Viking Age settlement site of Linnaaluste and the Keava hill fort, the percentage of cattle bones in the osteological material from the Linnaaluste II settlement site is slightly higher and the ratio of sheep/goat bones has decreased, but pig bones are represented in large numbers. In northern Estonia the settlement site of Kaberla can be chosen for comparison: there the continuity of settlement can be observed from the Viking Age to the present day

(Vedru 2003), and in western Estonia the settlement of Uugla, which has been dated to the 11th–14th centuries (Mandel 2006; 2007), is suitable for that purpose. Compared with Kaberla (Maldre 2003), the Linnaaluste II settlement contains fewer sheep and horse bones, and pig bones are more numerous, the ratio of cattle bones is about the same. The osteological material of Uugla (Maldre 2005) differs by a remarkably higher ratio of cattle bones, and the ratio of sheep/goat bones is about the same as in Linnaaluste II settlement, pig bones are modestly represented, but horse bones are quite numerous. The species composition of bones of domestic animals (414 bones) from the medieval settlement of Keldrimäe, which is a few kilometres from the stronghold of Varbola, can also be used for comparative purposes: cattle bones 33.6%, sheep/goat bones 35.0%, pig bones 22.7% and horse bones 8.7%. In both Linnaaluste II and Keldrimäe, the ratio of cattle and sheep/goat bones remains between 30–35%, in Linnaaluste II pig bones are much more numerous, and in Keldrimäe the percentage of horse bones is higher. On the basis of the currently available information it seems, however, that the importance of pig breeding truly increased in the Final Iron Age, which is also confirmed by finds of this period from the Linnaaluste II, Kaberla and Uugla settlements; it also appears that the ratio of horse bones in settlements is somewhat higher than in hill forts.

Slaughter age of animals

On the basis of osteological materials from the settlement sites I and III at Linnaaluste, it appears that nearly 13% of sheep/goats were slaughtered during the first year, and nearly 50% of specimens were slaughtered before 2 years of age; no bones of animals more than 3.5 years old could be determined. The results of analysis of sheep/goat bones from the Pada settlement were quite similar: 20–50% of animals (depending on bones used for age determination) were slaughtered before the age of 2, and about 10% of specimens lived over 3.5 years (Maldre 2007, 68). In the osteological material from Swedish Viking Age settlements (Pollista and Ängdala), the ratio of young animals is considerably higher. More than 30% of sheep mandibulae belong to specimens slaughtered before 9 months of age; the interval from 3/4–2 years is relatively poorly represented there. About 20% of animals have been kept over 4 years. Since sheep aged 3/4–2 years are obviously over-represented in towns of that region, it seems plausible that animals of this age were sold for meat in towns (Wigh 2001, 107). In the material from the Keava hill fort it can be observed that approximately half of sheep/goats were slaughtered before the age of two, but compared with the Viking Age material, the ratio of adult individuals is considerably higher, and the ratio of animals older than 3.5 years may amount to 50%. Sheep/goat bones from the Varbola hill fort produce quite a similar diagram of slaughter ages: here as much as 60% of specimens lived over 3.5 years. In the osteological material from Pähklimägi in Viljandi, which has been dated to the Viking Age and the Final Iron Age, bones of young sheep and goats, including lambs and kids, prevail

(Saks & Valk 2002). At Linnaaluste II settlement site, mainly specimens older than two years are represented. Consequently it seems that in the Final Iron Age, the breeding of sheep for wool and goats for milk became more important.

Compared with the settlement of Pada, the ratio of calf bones seems lower in the osteological material from Linnaaluste – in Pada 10% of individuals were slaughtered before 6 months of age (Maldre 2007, 65), while no calf bones could be determined among the material from the settlements of Linnaaluste I and III. In other respects differences do not seem to be worth mentioning – although age could not be properly determined on cattle bones from Linnaaluste, it nevertheless seems that most of them belong to adult animals. The result of research carried out in Sweden show that in the Viking Age settlements 50% or even more cattle were slaughtered before the age of four (Wigh 2001, 106). A similar age structure can also be observed in cattle bones from Keava: half of the specimens lived over 4 years. Among cattle bones from Linnaaluste II settlement, bones of adult animals prevail, but calves and young specimens are also represented. In the osteological material from Varbola, the ratio of young cattle is somewhat higher: the percentage of specimens slaughtered during the first 6 months is the same as in Keava; nearly 20% of animals were slaughtered by the end of the second year, but only 30% of animals were kept over 4 years. According to Paul Saks, cattle bones from Pähklimägi in Viljandi mainly belong to subadult animals, and calf bones are missing there (Saks & Valk 2002). Thus it seems, at least on the basis of the currently available material, that no fundamental changes in the slaughter ages of cattle took place in the Final Iron Age; apparently such an age structure of cattle was most economically feasible and met the needs of the population.

A somewhat surprising feature is the complete absence of piglet bones in the Viking Age material of Linnaaluste. This is probably partly due to the very poor state of preservation of the material. In the Pada settlement, for instance, 10–15% of individuals were slaughtered before the age of 6 months, at least 40% had been slaughtered before one year of age, and 20% more before the age of 1.5 years. The overwhelming majority of pigs in Pada settlement were slaughtered before the age of 2.5 years (Maldre 2007, 70). On the basis of pig bones from Linnaaluste settlements it is impossible to establish the precise structure of slaughter ages. It seems, however, that here, likewise in Pada, most of the pigs have been slaughtered before the age of 2.5 years (at least 50% of specimens before the age of 2). Slaughter ages of pigs of the Swedish Viking Age settlements suggest that quite a large number of pigs were slaughtered between the ages of 2 and 5 years, but the material also contains teeth of animals older than 5 years. In the osteological material from towns, bones of young pigs prevail. Bengt Wigh (2001, 106 f.) explains this with the fact that there was more woodland around settlements providing a feeding base for pigs, and therefore it was possible in the settlements to keep older pigs for a larger quantity of pork. The ratio of older pigs is also higher in more wooded surroundings in towns, e.g. in Sigtuna. In the hill fort of Keava the slaughter ages of pigs are quite similar to those in Pada, but the ratio of pigs

younger than 1.5 years is somewhat higher; as in Pada, no pig bones were discovered, proving the presence of animals older than 2.5 years. In the stronghold of Varbola nearly half of the pigs were slaughtered during their first year of life, a quarter was slaughtered during their second year, and 13% of specimens were kept over 3.5 years. At the settlement site of Linnaaluste II the ratio of piglets below 6 months of age is relatively high, and no bones of pigs older than 3.5 years were discovered here either. Thus in the Viking Age, as well as in the Final Iron Age, the overwhelming majority of pigs were slaughtered during their first two years of life. In regard of the fact that the importance of pig breeding increased considerably in the Final Iron Age, we can assume that changes also took place in slaughter age, which to some extent can be observed in the age structure of pig bones from Varbola. This hypothesis must be further verified on the basis of better preserved materials.

Data about the slaughter age of horses is scarce, and both young animals (including colts) and adult specimens are represented. Since there are few horse bones, we can presume that horse flesh as food did not occupy a position of importance. On the basis of the osteological material from Pähklimägi in Viljandi, Saks (Saks & Valk 2002) presents the very likely idea that horse flesh was fed to dogs and pigs.

Hunting

The low ratio of game bones is characteristic of the Viking Age material of northern Estonia (Fig. 5.16). In Linnaaluste and Pada settlements, Rõuge

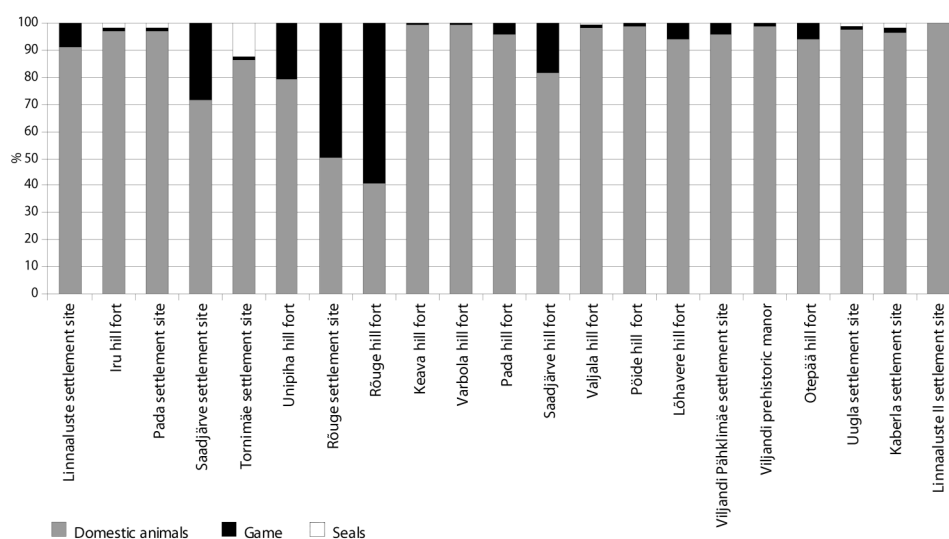


Fig. 5.16. Percentage of bones of domestic and wild animals and seals from different sites.

settlement and hill fort, Varbola, Lõhavere, Otepää and Valjala strongholds, artefacts made from game bones, and game bones with working traces have been included among the osteological material (Maldre 2001; Tamla & Maldre 2001; Luik & Maldre 2005a; 2005b). In the settlements of Linnaaluste, the percentage of game bones is relatively high due to the bones of wild animals found in one of the excavations, but this is most likely an anomaly caused by the small quantity of material. In Iru hill fort and Pada settlement the ratio of game bones (including seal) is about 3%. In the settlement of Tornimäe, located on the seashore, seal hunting has been considerably more extensive, but bones of other wild animals are poorly represented. In the settlement of Saadjärve, the importance of hunting seems to be considerably greater than in the sites of northern Estonia, and in this respect the osteological material from Saadjärve settlement is more similar to sites in south Estonia. Although only a small amount of animal bones were recovered from the settlement of Saadjärve we may assume, in view of the osteological material from Saadjärve hill fort, which contained a considerable amount of game bones, that the importance of hunting was indeed larger here than in the regions of northern Estonia. In the Final Iron Age, hunting also became economically insignificant in southern Estonia. The percentage of game bones is, however, a couple percent higher here than in northern Estonia and Saaremaa. It is still unclear why so many game bones were found in Saadjärve. This may be caused by mixing with earlier layers. Considering the fact that the osteological materials from Saadjärve and Rõuge are also quite similar in terms of the species composition of the bones of domestic animals, one cannot rule out the possibility that the importance of hunting remained larger in the Late Iron Age in the region of Saadjärve and very likely also in south-eastern Estonia. Unfortunately we do not possess any osteological material from south-eastern Estonia belonging to the Final Iron Age, so we cannot at the moment verify the hypothesis.

Since the amount of recovered game bones is very small in most sites, their distribution between different species may be quite incidental. In the Viking Age, it appears that beaver and elk were the main game animals (Fig. 5.17). The relatively high ratio of elk bones, at least in the settlements of Linnaaluste and Pada, is due to the quantity of antler artefacts and fragments with working traces (in Linnaaluste 5 of the 10 elk bones were antler fragments; in Pada 16 elk bones included 14 antler fragments), which are not necessarily evidence of hunting. Other skeletal elements are represented by single finds (mostly bones of distal parts of limbs), so we may assume that this was not just a case of found antlers being brought to the settlement. The elk bones recovered from the Rõuge settlement and hill fort display quite a different anatomical composition: osteological material did not contain any elk antlers (Paaver 1965b, 258 f., table 68), but they occur in large numbers among bone artefacts and bone working scrap: a total of 84 antler artefacts and fragments from the settlement and hill fort (Luik & Maldre 2005b), which constitutes 15.6% of all recovered elk bones. According to Kalju Paaver (1965b, 66 f.), the high percentage of beaver among game bones is characteristic

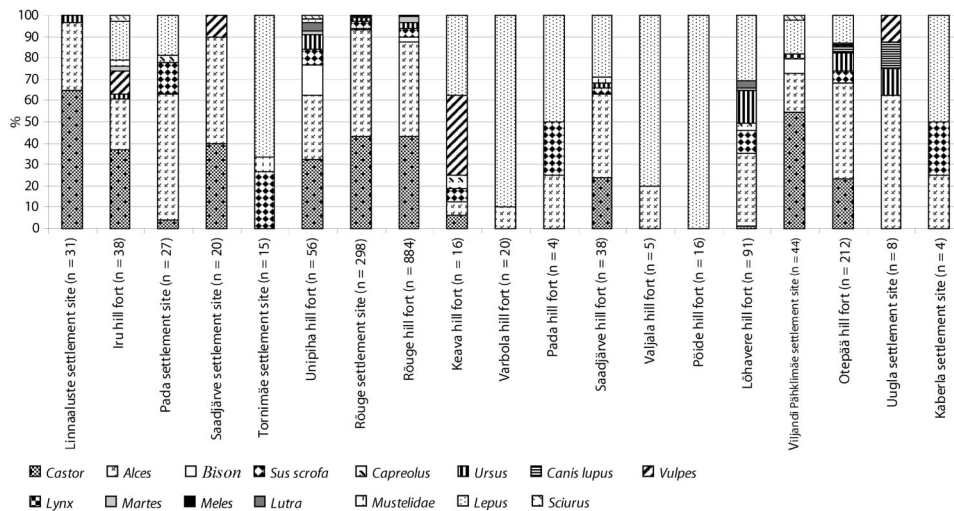


Fig. 5.17. Species composition of game bones from different sites.

of the sites of south Estonia and north-west Latvia. In northern Estonia, eastern Latvia and Lithuania, their percentage among game bones is considerably smaller. The ratio of beaver bones in the osteological material of Linnaaluste settlement is very high, but they seem to belong mainly to a single specimen. Nevertheless, the ratio of beaver bones is also quite high at Iru hill fort (Paaver 1966), and thus is comparable with sites in southern Estonia. In the Viking Age material, the settlement of Tornimäe stands out as an exception: no beaver or elk bones could be ascertained there. The occurrence of beaver in Saaremaa in the Late Iron Age is altogether questionable, since no beaver bones have been found at the sites of these periods. In the Bronze Age, at any rate, beavers lived in Saaremaa – osteological materials from Asva and Ridala contain a small amount of beaver bones (Paaver 1965b, 62, table 10; Maldre 2008, 264, table 1). Beaver bones from Asva, however, have not been accurately dated, and thus one cannot rule out the possibility that they may belong to the Iron Age. In the Final Iron Age the ratio of beaver bones seems to decrease, and in several settlements and hill forts of northern and western Estonia they are altogether absent. The occurrence of beaver bones evidently also depends on the existence or absence of living conditions suitable for beavers near settlements.

All hare bones that were found apparently belong to white hare (*Lepus timidus*), since *Lepus europaeus* was not yet widespread in Estonia at the times under discussion. Bones of white hare are particularly numerous on sites dated to the II millennium (Paaver 1965b, 55). Fig. 5.17 reveals that the ratio of hare bones in northern Estonia and Saaremaa is higher than in southern Estonia. Other species of wild animals are represented by single bone finds, and no conclusions can be drawn about them.

Summary

The osteological material of the Linnaaluste settlement sites is poorly preserved and mainly consists of small fragments. The ratio of determinable bone fragments varies in different excavations and ranges from 13.4 to 19.6 %. It was somewhat higher, 25.6%, in the excavation of the Linnaaluste II site, and the best preserved bone material was collected during the monitoring, where the ratio of determinable bones was 40%. The state of preservation of the osteological material from the Keava hill fort is slightly better than in the Viking Age settlements – 23.6% of recovered bones could be determined. Burnt bone fragments also occurred in all excavations.

The species composition of the osteological material of the Viking Age settlements of Linnaaluste I and III varies quite considerably in different excavations, but in all of these, bones of sheep/goats are most numerous. Summarily, sheep/goat bones make up a little more than half of the determined bones of domestic animals in the Viking Age bone material from Linnaaluste. Cattle bones constitute nearly 30%, pig bones 13% and horse bones 4% of the material. Of the bones from the Keava hill fort, bones of sheep/goats still prevail, but compared with the Viking Age material from Linnaaluste, the ratio of these species has decreased by nearly 10%, while the ratio of pig bones has increased considerably, and the relative number of cattle bones has remained constant. Compared with both the Viking Age settlement of Linnaaluste and the Keava hill fort, the ratio of cattle bones is a few percent higher, the importance of sheep/goat bones has decreased considerably, but pig bones occur in large numbers in the osteological material of the Linnaaluste II settlement site.

In the Viking Age settlements of Linnaaluste, nearly 13% of sheep/goats were slaughtered during their first year, and nearly half were slaughtered before two years of age; no bones belonging to animals more than 3.5 years of age could be determined. Cattle bones from the Linnaaluste settlements did not allow proper age determination, but it seems that most of the bones belong to adult animals, and calf bones were not found. Nor did the material contain piglet bones. It is quite possible that the absence of bones of juvenile specimens is caused by the poor state of preservation of the material. At least half of the pigs were slaughtered before two years of age, and an overwhelming majority before 2.5 years.

On the basis of the osteological material from the Keava hill fort, we may assert that here, too, about half of sheep/goats were slaughtered before two years of age, but compared with the Viking Age material, the ratio of adult specimens is considerably higher in the hill fort, where the ratio of animals older than 3.5 years may approach 50%. Hence the ratio of older animals was higher in the Final Iron Age, which might suggest the increased importance of wool production and probably also goat milk in that period. The analyses of cattle bones from the Keava hill fort indicate that half of the specimens lived over 4 years. Of the bones from the Linnaaluste II settlement site, bones of adult animals prevail, but calves and young specimens are also represented. Thus it seems that no substantial changes

in the age structure of cattle took place in the Final Iron Age. Pigs were slaughtered at a young age in the hill fort: 40% or even more during the first year of life, and bones of specimens more than 2.5 years old were completely absent. Hence in both the Viking Age and the Final Iron Age, the overwhelming majority of pigs were slaughtered during the two first years of age. In regard of the fact that the importance of pig breeding considerably increased in the Final Iron Age, we could presume that changes also took place in the slaughtering ages of pigs – the age structure of pig bones from Varbola, where 13% of specimens are more than 3.5 years old, seems to indicate this. This hypothesis must, however, be checked in the future on the basis of better preserved material.

The ratio of horse bones was highest in the second excavation of settlement I (11 bone fragments, 7.1% of all bones of domestic animals), while they were completely absent in the second excavation trench of settlement III. In the osteological material from the Keava hill fort, 37 horse bones could be determined, constituting only 1.5% of all determined bones of domestic animals. The decrease in the ratio of horse bones in the Final Iron Age can also be observed on other Estonian sites, and it seems that the Final Iron Age settlements contain slightly more horse bones than hill forts. The data about the slaughtering ages of horses are scanty. Most of the found bones evidently belong to adult animals, but young specimens are also represented.

Hunting and fishing did not play any important role in the Linnaaluste settlement in the Viking Age. The number of game bones was highest in the second excavation trench of settlement I, where they constituted nearly 15% of all determined bones. Most of the game bones (20 fragments) belonged to beaver; elk was represented by seven bones and bear by one bone. In the second excavation trench of the settlement III, three elk antler fragments with cutting traces were found; a pendant of eagle talon recovered from the same excavation, should be mentioned as particularly interesting finds. No game bones were found at the Linnaaluste II settlement. The ratio of game bones in the osteological material from Keava hill fort is insignificant, and they make up only 0.7% of all bones. Hare and fox are equally represented, each with 6 bone fragments; one tooth belongs to a beaver. Bird bones were few in the settlements and in the hill fort, and thus we may assume that bird hunting did not possess any importance in this region. Fish bones are also few in number. They have not all been determined, but they definitely include bones of *Cypriniformes*.