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SEALING AND ANIMAL HUSBANDRY IN THE ÅLANDIC MIDDLE AND LATE NEOLITHIC

Abstract

Osteological analyses of faunal assemblages from Pitted Ware sites on the Åland Islands are presented. All assemblages are dominated by seals. Especially the utilization of the harp seal formed an important part of the subsistence economy in the archipelago. The exploitation of the harp seal was extensive on the older Pitted Ware sites (Jettböle 1) and probably of great importance also on the younger sites. There are, however, some differences in the exploitation patterns of the harp seal and possibly also of the ringed seal between Jettböle I and the younger Pitted Ware sites.

On some of the sites a small number of bones of elk, red deer, cattle, sheep, pig and beaver was also identified. The dietary importance of elk and red deer has probably been very limited. Instead the bones and antler of these animals were utilized as raw material for bone tool manufacture. Radiocarbon dates indicate that cattle, sheep and possibly pig were introduced in the islands in the early Late Neolithic period. The introduction seems contextually to take place on the younger Pitted Ware sites but the chronological resolution is coarse. The pottery of these sites shows influences mainly from Corded Ware but Late Neolithic Kiukais pottery has also been discovered on some of the sites. Although the exploitation of seals apparently is less extensive on the younger Pitted Ware sites it is improbable that the appearance of the domesticated animals is only related to an economic sphere. The archaeological find material indicates that a larger set of new elements is introduced at the same time and the domesticated animals are probably only one part of this complex.

Keywords: Åland Islands, Middle Neolithic, Neolithisation, Late Neolithic, Pitted Ware Culture.

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INTRODUCTION

The Åland Islands are one of the few areas in Finland where organic material has been preserved on Stone Age sites. This is mainly due to the lime rich soil of the islands which has favoured the preservation of unburned bone on a number of sites - perhaps the best known is the site of Jettböle in the parish of Jomala. Unburned bones have not been preserved on all Ålandic Stone Age sites. The oldest sites in the archipelago which belong to the Comb Ceramic Culture, dated to approximately 5100-3600 cal BC, contain only burned fragments of bones. This is also the case on many of the Pitted Ware Culture sites which

on Åland are dated to approximately 3300- 2000/1800 BC cal, i.e. the Middle and Late Neolithic periods (Carpelan 1999:266; Olsson 1996; Olsson and Holm 1997:218)

At present, approximately 30 sites which belong to the Pitted Ware Culture have been discovered in the Åland Islands. The sites are often very rich in finds of Pitted Ware pottery and stone artefacts. On a number of sites unburned bones have been preserved. Most of the sites have been partly excavated but there are also several find locations which have been classified as Pitted Ware sites only by examination of stray finds and the altitude above the present sea level. The geographical distribution shows that at the time of

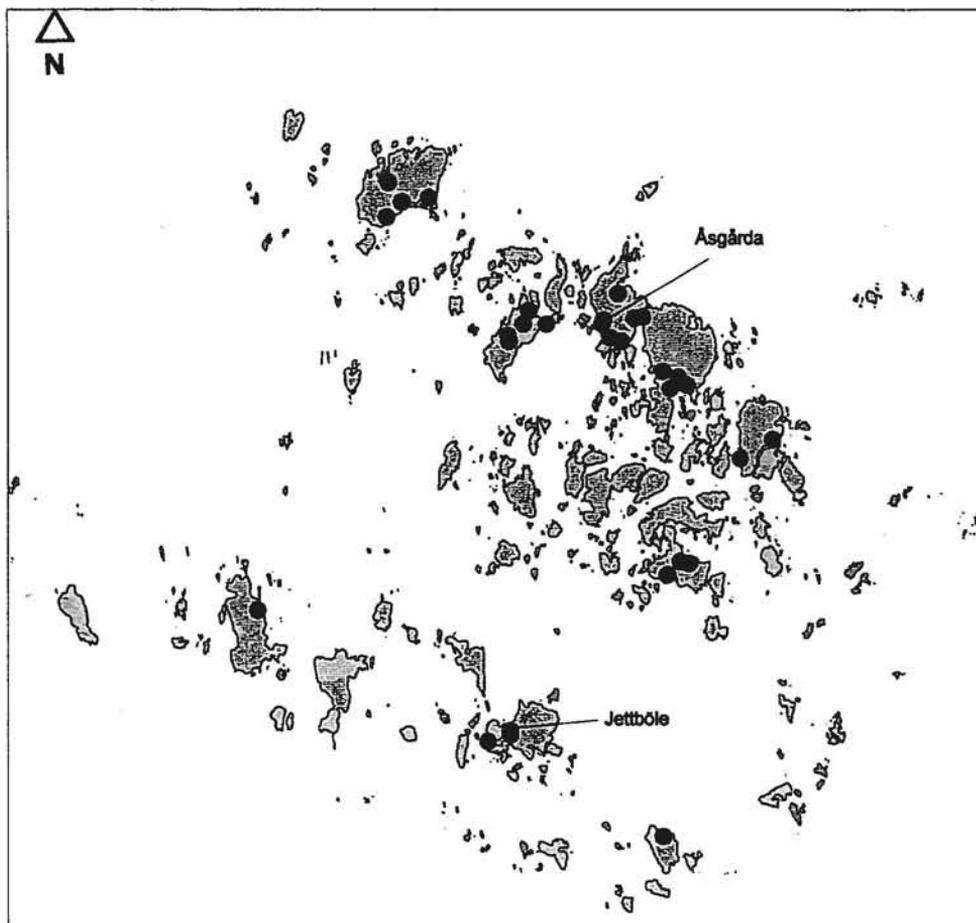


Fig. 1. Distribution of the Pitted Ware sites on Åland. The shoreline follows 30 m.a.s.l. roughly dated to the younger phase of the Pitted Ware Culture on Åland. Scale 1:400 000. Map made by Jan-Erik Tomtlund.

occupation the sites were concentrated to the larger islands of the archipelago (Fig. 1). Since detailed field surveys have been performed only in the northern areas of Åland the number of sites will probably increase as ongoing surveys are completed.

On the basis of ornamentation and morphology of the pottery as well as the altitude above the present sea level the sites can be divided into two chronological groups. The division is mainly based on pottery studies by Meinander (1957; 1962; 1984) but also by Cederhvarf (1912), the excavator of the Jettböle site. The sites with the older Jettböle I type of pottery are roughly dated to the early Middle Neolithic period (MNA) while sites with the younger Jettböle II type of

pottery can be dated to the late Middle Neolithic period (MNB) and the Late Neolithic period (Stenbäck 1998).

The importance of the marine resources and especially seal hunting has often been stressed when discussing the subsistence economy of the Ålandic Pitted Ware sites (Dreijer 1983:40ff; Edgren 1992:101; Lidén *et al.* 1995; Lindqvist 1988; Núñez 1986a; Núñez and Storå 1997; Welinder 1976). There is no reason to doubt these interpretations but it is noteworthy that osteological analyses have been available from three sites only, Jettböle I (Winge 1914), Alkär (Welinder 1976) and Kolsvidja I (Lindqvist 1988). All these sites belong to the older group of Pitted Ware sites. A slightly different subsistence economy on

Site	Pottery style	Altitude	Human r.	Domest.	Clayidols
Kolsvidja I	Fagervik II-III, Sipilänhaka Comb Ceramic (III:2)	37	*		
Jettböle I	Fagervik III, (Corded Ware - 1 sherd)	c.35	*	?	
Smikärr	Fagervik III (Säter III)	37	*		
Härdalen	Fagervik III	c.35	*		
Alkärr	Fagervik III (Säter III),	30		?	
Glamilders	Fagervik IV?, Pyheensilta	c.35	*	*	
Källsveden	Fagervik IV,	c.30	*	*	*
Svinvallen	Fagervik IV, Kiukais, (Corded Ware)	28	*	*	*
Jettböle II	Fagervik IV, Corded Ware,	c.30	*	*	*
Åsgårda 34.20	Fagervik IV, Pyheensilta?, Corded Ware ?, Kiukais ?	c.30	*	*	0

Table 1. The pottery classification and some descriptive data of the studied sites.

the younger Pitted Ware sites has been suggested by Meinander (1957) but osteological analyses have not been available. In the present study osteological analyses from ten sites, including five Ålandic younger Pitted Ware sites, have been performed.

Initially the purpose of the osteological analyses presented here was to study the exploitation of seals. However, as the analyses progressed, small numbers of bones of terrestrial mammals were also identified in several of the assemblages. At first, these bones - especially those of domesticated animals - were considered recent intrusions in the assemblages but as the contextual circumstances were examined more thoroughly a Stone Age origin of the bones could not be ruled out. The presence of these bones indicated that in terms of mammal utilization the subsistence economy was not solely based on seals. In this paper I intend to investigate the find contexts of the bones of terrestrial mammals and date the introduction of domesticated animals in the Åland Islands. The subsistence economy regarding the mammal utilization is discussed while the importance of fish and birds is not evaluated.

MATERIAL AND METHODS

The faunal assemblages from ten Pitted Ware sites were studied in detail. Quantitatively the assemblages are the largest from the Pitted Ware sites (Table 1) and they have been recovered in connection with archaeological excavations between 1905 and 1994. In general the bones, at

least in the larger assemblages, are well preserved but there are differences in recovery technique and local preservation conditions which complicate direct comparisons of the assemblages. Unfortunately, post excavation damage is common especially in the assemblages which were excavated at the beginning of the 20th century.

Special focus is given to faunal remains which have been discovered from "larger" excavation units. The aim was to relate as far as possible the faunal assemblages to the overall archaeological contextual circumstances. On many of the sites test excavations have been carried out and small amounts of bones have been recovered in small testpits from different parts of the sites. Since the contextual circumstances of these finds are difficult to interpret the faunal remains of these excavations are only briefly commented upon. Although not quantified in detail, all existing assemblages from Pitted Ware and also from Kiukais sites have been examined in order to identify bones of terrestrial mammals. Unfortunately, the faunal remains of the Late Neolithic Kiukais sites are very small and uninformative regarding the subsistence economy.

Quantification was performed according to the number of identified specimens, NISP (Lyman 1994). Considering probable inequalities in recovery technique, differential preservation conditions and the possibilities for osteological identification, only specimens of the following selected skeletal elements of seals were quantified: the temporal bone of the skull (*os temporale*), the lower jaw (*mandibula*), the shoulder blade (*scap-*

Seals	Harp seal	Ringed seal	Grey seal	Seal sp.	Porpoise	Total
Kolsvidja I, 1981	8	12		21		41
Jettböle I, 1905-11	1 217	334	1	889	+	2441
Jettböle I, 1999	166	63		118	+	347
Smikärr, 1955	15	29		26		70
Härdalen, 1990-91	19	6		11	+	36
Alkärr, 1934	10	21		18		49
Glamilders, 1906,	46	22	2	34	+	104
Källsveden, 1906	197	95	6	253	+	551
Jettböle II, 1905-11	220	143	1	327	+	691
Svinvallen 1957	1	9		17		27
Åsgårda 34.20	441	193	11	528	+	1173
Total	2 340	927	21	2 242		5530

Table 2. Identified specimens of seals and porpoise on Ålandic Pitted Ware sites. Quantification according to NISP. For porpoise only presence (+) or absence was registered.

ula), the upper arm (*humerus*), the radius and ulna of the lower arm (*radius/ulna*), the metacarpal I of the hand (*metacarpale I*), the pelvic bone (*os coxae*), the thigh bone (*femur*), the tibia and fibula of the lower leg (*tibia/fibula = os cruris*), and the metatarsal I (*metatarsale I*) and astragalus (*astragalus/talus*) of the foot. However, all the bones of terrestrial mammals which were identified are reported here. In the text the terms "bone" and "specimen" are used as synonyms to denote "a bone or tooth, or fragment thereof". A single complete bone is termed "element" as defined by Grayson (1984:16).

The following species are mentioned in the text: harp seal (*Phoca groenlandica*), ringed seal (*Phoca hispida*), grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina*), cattle (*Bos primigenius f. taurus*), sheep (*Ovis aries*), goat (*Capra hircus*), pig (*Sus scrofa f. domesticus*), red deer (*Cervus elaphus*), elk (*Alces alces*), hare (*Lepus timidus*), dog (*Canis lupus f. familiaris*), horse (*Equus caballus*), beaver (*Castor fiber*), porpoise (*Phocaena phocaena*), cod (*Gadus morhua*) and herring (*Clupea harengus*). A rather large part of the specimens could not be identified as to species. In this case the specimens identified as large ruminant most probably belong to elk or cattle and specimens identified as small ruminant most probably originate from sheep or goat. Specimens of seals which could not be determined to species were identified as "seal sp".

Twelve bones were submitted for AMS dating at the Ångström Laboratory, Div. of Ion Physics, ¹⁴C-lab, Uppsala. Calibrated ages will be used in the text referred to as dates BC and calibration of

radiocarbon dates has been done using the OxCal v.3.4 software (Bronk Ramsey 2000). The datings have been financed by the Section for Archaeology of the Bureau of Antiquities at the Government of Åland.

CONTEXTUAL CIRCUMSTANCES OF THE FAUNAL REMAINS

A total of 186 specimens of terrestrial mammals was identified in the assemblages. Tables 2 and 3 present the species composition from the sites. The anatomical representation is presented in Appendix 1 and the results of the radiocarbon datings are presented in Table 4. The contextual circumstances of the assemblages are described below. The sites are presented in rough chronological order. The original documentation and excavation reports are found in the archives of Ålands Museum in Mariehamn and the National Board of Antiquities in Helsinki.

Kolsvidja I, Smedsböle, Sund. The site has been excavated in 1952, 1981 and 1982 (Lindqvist 1988; Meinander 1957; Vikkula 1981). In this context perhaps the most interesting find from the site is a carbonized grain of barley (*Hordeum sp*) which was discovered in connection with the fine mesh sieving of soil samples of the cultural layer (Lindqvist 1988). However, the contextual circumstances of the grain have been questioned (Núñez 1989) and there is some doubt whether the grain is associated with the Stone Age finds. In an analysis of faunal remains from the soil samples collected by Lindqvist (1988), Ericson (1988) identified

Mammals	Jettböle I	Glamilders	Källsveden	Svinvallen	Jettböle II	Åsgårda	Alkärr	Total
Cattle	4	3	6	2	16	31		62
Elk	12+1	3			2	2		20
Red deer			1		7			8
Large ruminant	8	4	13		16	24	4	69
Sheep		1				3		4
Small ruminant		1			4	2		7
Pig	1		3	2	5	2+1?		14
Beaver						2		2
Hare	+		+			+		
Dog	+		+			+		
Total:	26	12	23	4	50	67	4	186

Table 3. Identified specimens of terrestrial mammals on Pitted Ware sites on the Åland islands. Quantification according to NISP. For hare and dog only presence (+) or absence was registered.

Site	Find ID	Lab ID	¹⁴ C age BP	δ ¹³ C ‰ PDB	Species, element
Jettböle I	NM5180:707	Ua-10687	4275±65	-22.82	Elk, McIII-IV
	NM4781:342	Ua-10688	3825±70	-23.93	Elk, MtIII-IV
	NM5907:946	Ua-11465	4375±70	-22.14	Elk, Radius
Jettböle II	NM 5180:85	Ua-10686	3400±60	-23.49	Cattle, Tooth, Molar 1 or 2 maxilla
Källsveden	NM4782:690	Ua-11461	925±80	-26.04	Pig, toothfragment, Molar
	NM4789:33	Ua-10690	2820±70	-23.34	Cattle, Femur
	NM4789:61	Ua-11464	3370±70	-24.14	Pig, Patella
Glamilders	NM4784:524	Ua-11462	3580±60	-22.47	Elk, MtIII-IV
	NM4784:687	Ua-11463	270±60	-20.93	Cattle, tooth, Pd4.
Åsgårda 34.20	ÅM662:1937	Ua-10689	3725±65	-22.55	Cattle, Humerus
	ÅM662:2138	Ua-11460	3710±80	-20.79	Sheep, Ct
	ÅM662:3970	Ua-4929	2665±60	>-21 (estim.)	Cattle, tooth, Molar 3 maxilla

Table 4. AMS dates from Ålandic Pitted Ware sites.

the harp seal as well as a large number of fish bones of predominantly cod and herring. Lindqvist's study highlights the apparently large significance of fishing in the subsistence economy of the Ålandic Pitted Ware sites but at the same time also the problems involved in order to collect representative samples of fish bones. Apparently, some faunal remains were recovered in the 1952 excavations (Meinander 1957: Findtable) but later it has been impossible to locate these bones. No radiocarbon dates are available from Kolsvidja but the ornamentation of the pottery indicates that this must be one of the oldest Ålandic Pitted Ware sites in the islands (Meinander 1957).

In this study the bones from the 1981 excavation originating from a 28 m² large trench were

analysed. The trench is situated in the same area of the site as the finds published by Lindqvist (1988). The small size of the assemblage limits interpretations but bones of the ringed seal and the harp seal were identified. The absence of terrestrial mammals is noteworthy. A few specimens of human bones from the lower legs (ÅM 528:72-73) of one individual were also identified. Unfortunately, there are no finds of bone from the younger part of the site, Kolsvidja II, where the pottery has been classified as Jettböle II type (Meinander 1957).

Jettböle I, Jettböle, Jomala. The faunal remains originate from the excavations in 1905, 1906, 1908 and 1911 by Björn Cederhvarf (NM 4630, 4781, 5180, 5907). From Jettböle I the faunal remains come from one of the main

Site	Find ID	Lab ID	¹⁴ C age BP	d ¹³ C ‰ PDB	Species, element
Jettböle I*	?	CAMS 6262	4430±60	-15.9	Human skullbone
	NM 5907:946	CAMS 6263	4320±60	-14.8	Human skullbone
	NM 5907:719	CAMS 6264	4520±60	-15.3	Human skullbone
Jettböle II	NM 5180:66	Ua-15882	4125±80	-25.9	Crust on pottery
Åsgårda 34.20	ÅM 662:4905	Ua-4928	4190±60	-26.55	Crust on pottery
	ÅM 662:4651	Ua-4927	4120±60	-27.04	Charred hazel-nut

Table 5. AMS datings from the sites Jettböle I and Åsgårda. * Jettböle I datings from Lidén *et al.* 1995

Jettböle I	Upper layer	Lower layer	?	Total
Harp seal	250	800	167	1217
Ringed seal	101	193	40	334
Grey seal	1			1
Seal sp.	196	578	115	889
Cattle	1	1	2	4
Elk	5+1	5	2	13
Large ruminant		6	2	8
Pig			1	1
Dog	+	+		

Table 6. Stratigraphical distribution of the faunal remains in the upper and lower part of the cultural layer of the main trench of Jettböle I.

Jettböle I, 1999	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	Total
Harp seal		1	3	3	8	15	21	27	28	21	17	16	6	166
Ringed seal	2	2	1	5	2	5	6	14	9	7	4	4	2	63
Seal sp.	3	3	5	9	6	11	15	13	17	14	6	9	7	118
Elk								1	1					2
Dog								1	1	2				4
Human			1											1
Porpoise	1		1	1		3	9	11	4	3	3	1		37
Total	6	6	11	18	16	34	51	67	60	47	30	30	15	391

Table 7. Stratigraphical distribution of faunal remains in different layers of the test trench excavated in 1999 from Jettböle I. The cultural layer was excavated in 5 cm technical layers. As a comparison the distribution of porpoise is also included. Layers 1 to 6 roughly corresponds to the upper part and layers 7-13 to the lower part of the cultural layer as in table 6.

trenches (trench A-180 m²) where the cultural layer contained large amounts of unburned bones. The sample comprises most of the bones from this site. Only small amounts of unburned bones have been discovered in the other excavation units. In a small sample of the faunal material Herluf Winge (1914) identified bones of harp seal and ringed seal together with dog, porpoise and several species of fish and birds. This sample has been reanalysed and is included in this study. Before the excavations the upper part of the stratigraphy of the site

had been partly damaged by a gravel-pit.

In this area of the site the depositional processes are startling. Complex mortuary practices (Götherström *et al.* in press) and possibly cannibalistic activities seem to have taken place (Cederhvarf 1912; Grönroos 1913; Núñez 1995). The well-known burial and most of the human remains from Jettböle I were also discovered in this trench (Ailio 1909; Grönroos 1913; Götherström *et al.* in press; Núñez 1995). The distribution of finds indicates the presence of three different areas

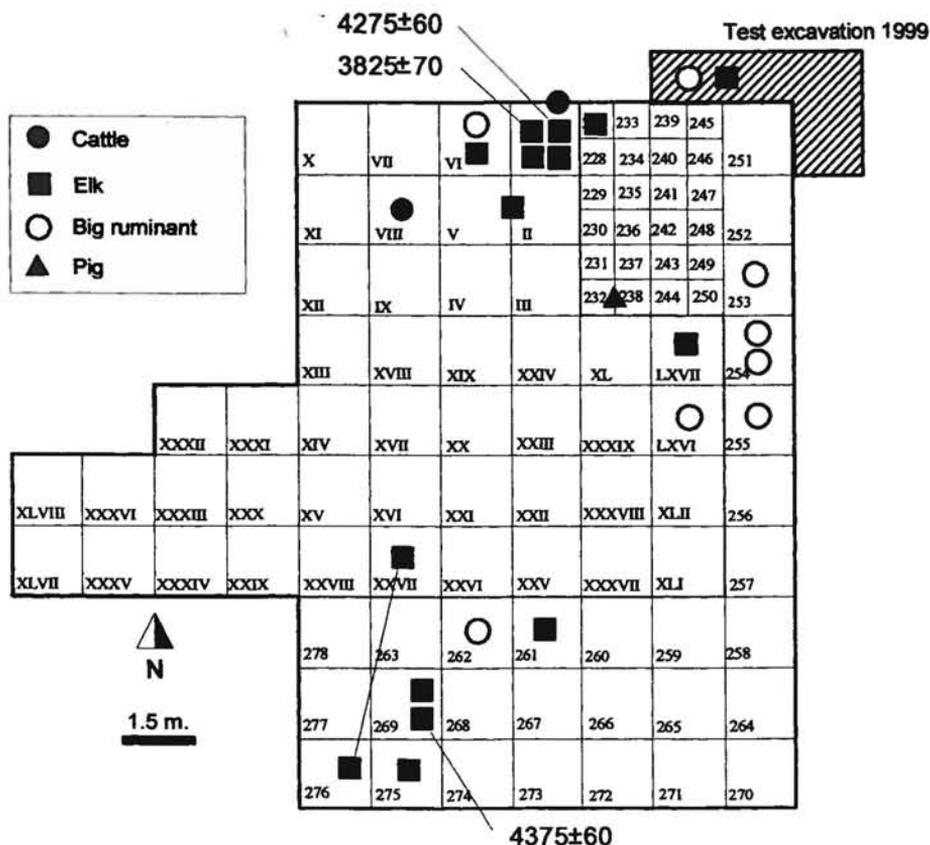


Fig. 2. Spatial distribution of the terrestrial mammal bones in the main trench of Jettböle I. The bones were recovered in three concentrations.

within the trench were the depositional processes seem to be somewhat different. The anatomical representation of the seals indicates a different handling of body parts in the three areas (Götherström *et al.* in press).

Three radiocarbon datings of human remains have resulted in Middle Neolithic dates around 3370-2840 cal BC, Table 5 (Lidén *et al.* 1995). Radiocarbon dates of elk performed for this study are in good agreement with the previous datings and also with the indication of the archaeological finds. However, one dating from the upper part of the cultural layer seems to be slightly younger. Instead the date is in rather good agreement with the expected age of the younger settlement phase of the site, Jettböle II, see below. Therefore, some intrusions of finds from the younger settlement phase in the upper part of the stratigraphy of Jettböle I have to be considered likely

(Götherström *et al.* in press). It can be noted that the only potsherd of Corded Ware from Jettböle I was discovered in the upper part of the stratigraphy (4781:454 in layer 3 in square VI, see Meinander 1957: Figure 14).

The faunal assemblage is clearly dominated by the harp seal and the ringed seal but a small number of bones of the grey seal, elk, cattle, pig, dog and hare was also identified. Figure 2 presents the spatial distribution of these mammals. Spatially the distribution is similar with that of the other find categories (Götherström *et al.* in press). The southern and eastern concentrations of bones are associated with hearths and Cederhvarf (1912) apparently interpreted these two areas as some kind of pit-houses (Sw. *bostadsgrop*). The northern concentration where no features were found was interpreted as a refuse layer. The cultural layer in this part of the excava-

Källsveden (182)	L 1	L 2	L 3	L 4	Total
Harp seal	12	46	60	17	135
Ringed seal	4	14	31	9	58
Grey seal			1+2?		3
Seal sp.	32	49	53	17	151
Cattle	2				2
Red deer		1			1
Large ruminant	4	3	2		9
Pig			2	1	3
Human		1		1	2
Clay idol*	1				1

Table 8. Stratigraphical distribution of the faunal remains in different layers of the richest test pit, number 182, from Källsveden. *The clay idol was discovered in the nearby test-pit 181.

tion trench contained large amounts of bones and in the find catalogue this layer is termed "bone-layer". Most of the bone artefacts were discovered in the northern part of the trench.

The distribution of the bones in the different layers is presented in Table 6. The cultural layer has only tentatively been divided into an upper and a lower part without clear-cut boundaries. Thus, it is apparent that the majority of the bones was discovered in the lower part of the stratigraphy. For a comparison the stratigraphical distribution of faunal remains from a trial excavation in 1999 is presented in Table 7. The latter distribution shows that bones became more numerous in layers 5 to 6 and downwards, which is approximately 25-30 cm:s below the bottom of the top soil. Stratigraphically cattle, elk and dog are present in both the upper and lower part of the stratigraphy. The exact find context of the only pig bone cannot be established. Although one of the cattle bones (a knee-cap - NM 5180:692) was discovered fairly deep in the cultural layer it was discovered adjacent to the gravel-pit which may have disturbed the upper part of the stratigraphy. Whether the cattle and pig bones originate from the Jettböle I phase is therefore unfortunately unknown.

Smikärr, Östergeta, Geta. The faunal remains (NM 14103) originate from the excavations of the younger part of the site in 1955 by C. F. Meinander (1964). The pottery of the site has been classified as Jettböle I type. Although the main trench was rather large (60 m²) and contained numerous finds of pottery and lithics only small amounts of bone were discovered. 70 fragments were identified and somewhat surprisingly the ringed seal

seems to dominate over the harp seal. The assemblage is, however, too small to draw any further conclusions regarding this fact, see below. Except for a few fragments of a human thigh-bone (NM 14103:491) no other mammals were identified in the assemblage. Neither were any bones of terrestrial mammals identified among the finds of the 1983 test excavation of the site (ÅM 543).

Härdalen, Näs, Saltvik. The faunal remains were discovered in archaeological excavations in 1990 and 1991 (ÅM 642 and ÅM 649). In connection with the excavation of a cairn or heap of fire-cracked stones, probably from the Bronze Age, an underlying cultural layer was discovered which contained large amounts of lithics, some unburned bones and Pitted Ware pottery of Jettböle I type but also a few potsherds of Comb Ceramic type. The excavated area was approximately 30 m². The bones in the Pitted Ware cultural layer were not very numerous but rather well preserved. Bones of the harp seal and the ringed seal were identified and also one human tooth (ÅM 642:22) which was discovered fairly deep in the cultural layer. The tooth probably originates from the Stone Age settlement phase. The soil in the Bronze Age construction contained four fragments of teeth of cattle, one tooth of sheep or goat and also one tooth of horse which may be the oldest appearance of this animal in the islands. However, the horse tooth was discovered in the uppermost layer of the stratigraphy and a later intrusion cannot be excluded. No bones of terrestrial mammals were identified in the Pitted Ware layers but in the bottom of the cultural layer was found an awl-like artefact (ÅM 649:158) of a long bone fragment which probably

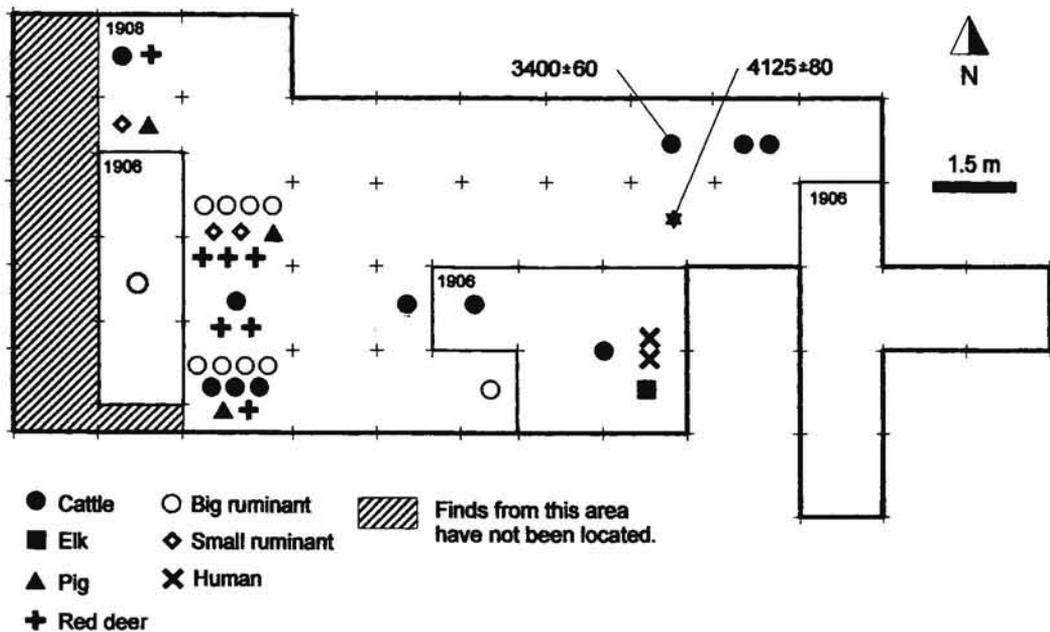


Fig. 3. Spatial distribution of the terrestrial mammal bones in the main trench of Jettböle II. Most bones were recovered in the western part of the trench. The finds from some of the squares in the western part of the trench have not been located. The drawing is not in exact scale.

comes from a large mammal.

Alkärr, Långbergsöda, Saltvik. Excavations have been conducted in 1934 and 1939 by Matts Dreijer (ÅM 23). The bone assemblage contains highly fragmented burned and unburned fragments of bone. According to an anonymous osteological report (in the archives of Ålands Museum, see Welinder 1976) the only identified species was the harbour seal and three long-bone fragments of a large mammal. However, in the re-examination of the assemblage no bones of the harbour seal were identified. Instead, bones identified to species belonged to the ringed seal and the harp seal. One fragment of burned antler and four fragments of long bone shafts originate from a large mammal, probably ruminant. Among the faunal remains from the 1979 excavations no specimens of terrestrial mammals were identified (ÅM 476).

Glamilders, Långbergsöda, Saltvik. The faunal remains originate from the 1906 excavations by Björn Cederhvarf (NM 4784 and NM 4785) and one specimen from the 1926 excavations by Alfred Hackman (NM 8679). Although the excavated area in 1906 was large (c. 185 m²) most of the

seal bones were discovered within a 6 m² large area, fairly deep in the cultural layer approximately 40-60 cm below the surface. This is the area where Cederhvarf discovered two find complexes with three rectangular hearths which have been interpreted as the remains of house structures (Ailio 1909; Meinander 1964). One radiocarbon dating of a bone of elk from layer 3-4 resulted in a Late Neolithic date which seems to be slightly younger than expected but it is in good agreement with the settlement phases of the nearby Svinvallen and Myrsbacka I. The pottery ornamentation would indicate a slightly higher age of Glamilders (Meinander 1957) than the latter two. The finds from the 1975 test excavations contained no bones of terrestrial species (ÅM 475).

The faunal assemblage is dominated by the harp seal and the ringed seal. Two bones of the grey seal were also identified. To this can be added one burned fragment of antler from elk which was discovered in the finds from the 1926 excavations (NM 8679:117) and most probably originate from the Stone Age. In the analysis three human specimens were also identified; one tooth (NM4789:319), one metacarpal bone (NM4784:524)

Jettböle II	L 1	L 2	L 3	L 4	L 5	?	Total
Harp seal	12	44	32	25	8	28	149
Ringed seal	15	37	25	5	1	21	104
Grey seal				1			1
Seal sp.	17	58	50	31	6	63	225
Cattle	3	2		3		3	11
Elk			1				1
Red deer		1	2	2	1	2	8
Large ruminant		2	3	5		1	11
Small ruminant	1		1	1		1	4
Pig	1					2	3
Clay idols	16	28	15		1	23	83

Table 9. Stratigraphical distribution of the faunal remains in different layers of the main trench of Jettböle II. Most of the clay idols were discovered in this trench.

and a burned skull fragment (4784:686), all from the find rich area.

The contextual circumstances for most of the bones of cattle and sheep from Glamilders have to be considered with caution. One bone of cattle (4784:613) and three of a large ruminant were recovered together with most of the seal bones in layer 3 and 4. These bones probably originate from the Stone Age. The other bones of cattle and sheep were recovered in the upper part of the stratigraphy in other parts of the excavation area. As the only find of cattle submitted for AMS dating (NM 4784:687) resulted in a recent dating it has to be questioned whether these dispersed specimens are in fact associated with the Stone Age finds. The dated tooth of cattle was discovered outside the find rich area in layer 2 of the cultural layer. There is also a small number of bones of both cattle and sheep among the finds from the excavations in 1926 and 1928 (NM 8679 and NM 8941) but on basis of the general structure and appearance of these bones they have been regarded as recent intrusions. The upper part of the stratigraphy has apparently been disturbed in later times.

Källsveden, Långbergsöda, Saltvik. Excavations have been carried out in 1906, 1957 and 1975. The faunal remains originate from the excavations in 1906 by Björn Cederhvarf (NM 4789) who excavated several test-pits within the site. Apparently, the character of the cultural layer and the find density varied greatly. Most of the faunal remains were discovered in two test pits, nr 181 and 182 which were excavated only a few meters apart. The cultural layer in test-pits 182 was 44 cm:s thick and contained large amounts of finds.

The pottery is of Jettböle II type and in layer 1 of pit 181, which comprised the topmost 15 cm:s of the cultural layer, one fragment of a clay idol was discovered (Cederhvarf 1912). According to the find catalogue a few fragments of idols were also discovered in the excavations in 1957 (ÅM 321). Only a few fragments of burned seal bones were discovered in 1957 and the 1975 test excavations (ÅM 479).

The faunal assemblage analysed is dominated by the harp seal and the ringed seal, followed by small numbers of specimens of the grey seal, cattle, red deer and pig. Three charred fragments of human skull bones were also identified (4789:33, 54 and 77). Table 8 presents the distribution of the finds in the different layers of test-pit 182. Bones of cattle and red deer are present in the upper part of the stratigraphy while pig seems to be present only in the lower part. The stratigraphy is difficult to interpret. Radiocarbon dates indicate that at least the upper layers contain finds of different age. One bone of cattle in layer 2 was dated to the late Bronze Age and a pigbone in layer 3 was dated to the latest part of the Late Neolithic or early Bronze Age. However, both dates are slightly younger than expected.

Jettböle II, Jettböle, Jomala. From Jettböle II all faunal remains were analysed and the main part of the bones come from the largest trench where the well-known clay idols were discovered (Cederhvarf 1912). This trench of approximately 90 m² (Cederhvarf 1912) was excavated in 1906 and 1908 (NM 4782 and NM 5180). The cultural layer was approximately 40-60 cm:s thick except in certain areas where the thickness was up

to 90 cm. Cederhvarf interpreted these pit-like features as refuse pits. The majority of the finds was discovered in the western part while the clay idols were more evenly distributed over the trench.

The faunal assemblage is dominated by the harp seal and the ringed seal followed by the grey seal, cattle, elk, sheep/goat, pig and red deer. A few fragments of human bones were also identified (4782:445 - skull fragments, 4782:446 - fragments of a thigh bone). Most of the identified bones of terrestrial mammals were concentrated to three squares in the western part of the trench (Fig 3). The cultural layer was exceptionally thick in this area and most of the finds were discovered in two refuse pits. The stratigraphical distribution of the bones within the trench is presented in Table 9. The bones of cattle, red deer and large and small ruminant occur both in the upper and lower part of the stratigraphy. It has to be noted, however, that layers 4 and 5 are associated with the pit-like features and are not present in all areas of the trench.

One pig bone was discovered in layer 1 but pig is present also in the lower layers since one of the two other finds was discovered in layer 2 or 3. All three pig bones and also those of red deer are burned or charred by fire. These bones probably originate from the Stone Age. Interestingly the clay idols are concentrated to layers 1 to 3.

One radiocarbon dating of a cattle tooth resulted in a Late Neolithic / early Bronze Age date. Considering the contextual circumstances the age is somewhat later than expected. A dating of organic crust on pottery has given a late Middle Neolithic date. However, the tooth was discovered in layer 1 which indicates that there may be later intrusions in the upper part of the stratigraphy of the site. This is further supported by the dating of one pig bone which resulted in an Iron Age date. This bone was however not recovered within the main trench. One of the datings from Jettböle I which falls in the early Late Neolithic can probably be associated with the settlement of Jettböle II. Unfortunately due to poor preservation, radiocarbon dates could not be obtained for the specimens of cattle from layer 4.

Svinvallen, Tengsöda, Saltvik. The faunal remains originate from the excavations in 1957 by C. F. Meinander (NM 16431) when approximately 47 m² was excavated. Among other finds were a few fragments of clay-idols and pottery of Jettböle II type together with Kiukais pottery and one

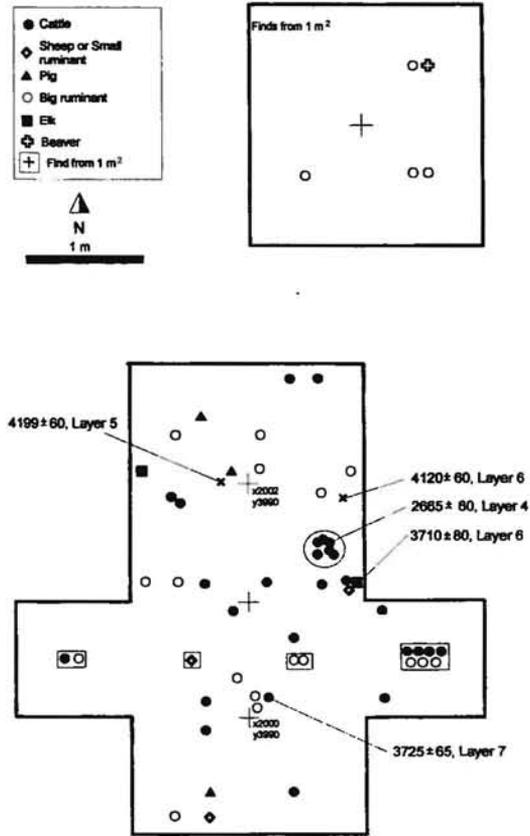


Fig. 4. Spatial distribution of the terrestrial mammal bones in the two main trenches of Åsgårda. Some of the finds have only been recovered from the whole 1 m². The bones were recovered scattered in the cultural layer except for a concentration of teeth of cattle which apparently originate from the same skull. One of these teeth was dated to the Bronze Age.

sherd of Corded Ware type (Dreijer 1940). The bones are highly fragmented and mostly burned. They were recovered fairly scattered in different parts of the excavation trenches. The assemblage is dominated by the ringed seal and only one fragment of the harp seal was identified. Apart from this, two bones from pig and one from cattle were identified - all burned or charred by fire. Most probably they are from the Stone Age context. One tooth of cattle was identified in the finds from the 1934 excavations by Dreijer (ÅM 22:8) but in the finds from the excavations in 1975 (ÅM 473) no bones of terrestrial mammals could be identified.

Åsgårda	L 0	L 1	L 2	L 3	L 4	L 5	L 6	L 7	L 8	Total
Harp seal			4	24	58	107	73	28	1	295
Ringed seal	1	2	7	16	31	46	30	10	1	144
Grey seal	1			1?	2	3	2			9
Seal sp.	4	9	21	53	81	123	60	20	3	374
Cattle		1	1	9	7	6	3			27
Elk						2				2
Large ruminant				3	1	9	1	2		16
Sheep							1			1
Small ruminant				1						1
Pig					1	1?	1			3
Human				1	1					2
Clay idols	1?	2	1	2	3+1?	16+1?	1	1+1?	2	28+4?

Table 10. Distribution of the faunal remains and clay idols in different layers of the main excavation trench from Åsgårda 34.20. The site was excavated in 5 cm thick technical layers.

Åsgårda 34.20, site II, Åsgårda, Saltvik. The site complex comprises two Pitted Ware sites; an older site where the pottery can be classified as Jettböle I type and a younger site where the pottery is of Jettböle II type mainly. The faunal remains of the younger site have been analyzed in this study. The bones originate from two trenches, excavated in 1991 and 1992, which comprised an area of 21 m² (Fig. 4) (ÅM 651 and ÅM 662). In the finds from a test excavation in 1994 one longbone fragment of a large ruminant (ÅM672:276) and one tooth from cattle (ÅM 672:405) were identified.

Unfortunately, the upper part of the cultural layer had been disturbed by plowing which complicates the interpretations of the stratigraphy of the site. The cultural layer contained very large amounts of lithics, pottery, burned and unburned bones. Among the most interesting finds were 32 fragments of clay idols of the same type as from the Jettböle II site. Equally, most of the pottery can be classified as Pitted Ware of Jettböle II type. There is a small number of potsherds resembling Pyheensilta, Corded Ware or Kiukais pottery together with a few sherds of epineolithic type and Bronze Age pottery of Otterböte type. However, the Kiukais, Corded Ware and Bronze Age sherds were discovered in the upper part of the stratigraphy in layers 1 to 4 of the bigger trench except for one of Corded Ware type which was discovered in layer 5. In the northwestern part of the smaller trench three Bronze Age sherds were discovered in layers 7, 8 and 10 but here a disturbance in the stratigraphy was clearly visible. In the bigger

trench one cattle tooth, which was discovered together with four other teeth in layer 4, was dated to the Bronze Age. The teeth originate from the same skull of an animal which was approximately 2,5-3 years of age at the time of death (P4 unerupted and M3 in primary wear). The skull can probably be associated with the potsherds of Bronze Age type.

Figure 4 presents the spatial distribution of the bones in the trenches and Table 10 presents the stratigraphical distribution in the bigger trench. The bones were recovered fairly scattered in the cultural layer except for the teeth from the above mentioned skull of cattle. In the large trench the layers 1 to 4 were apparently disturbed by plowing but in the lower layers the Pitted Ware cultural layer was probably undisturbed. During the excavation no disturbances of the lower layers could be distinguished and no later intrusions have been identified in the pottery. Two radiocarbon dates of organic crust on a potsherd and a charred hazel-nut from layer 5 and 6 resulted in rather consistent dates to the late Middle Neolithic period while two dates of bones of sheep and cattle from layer 6 and 7 seem to be slightly younger and fall in the early Late Neolithic, Tables 4 and 5. The sheepbone was discovered in the same square but approximately 10 cm:s below the cattle tooth which was dated to the Bronze Age.

The datings of cattle and sheep are the oldest from Åland. Stratigraphically they were recovered in those layers which were the richest in finds and

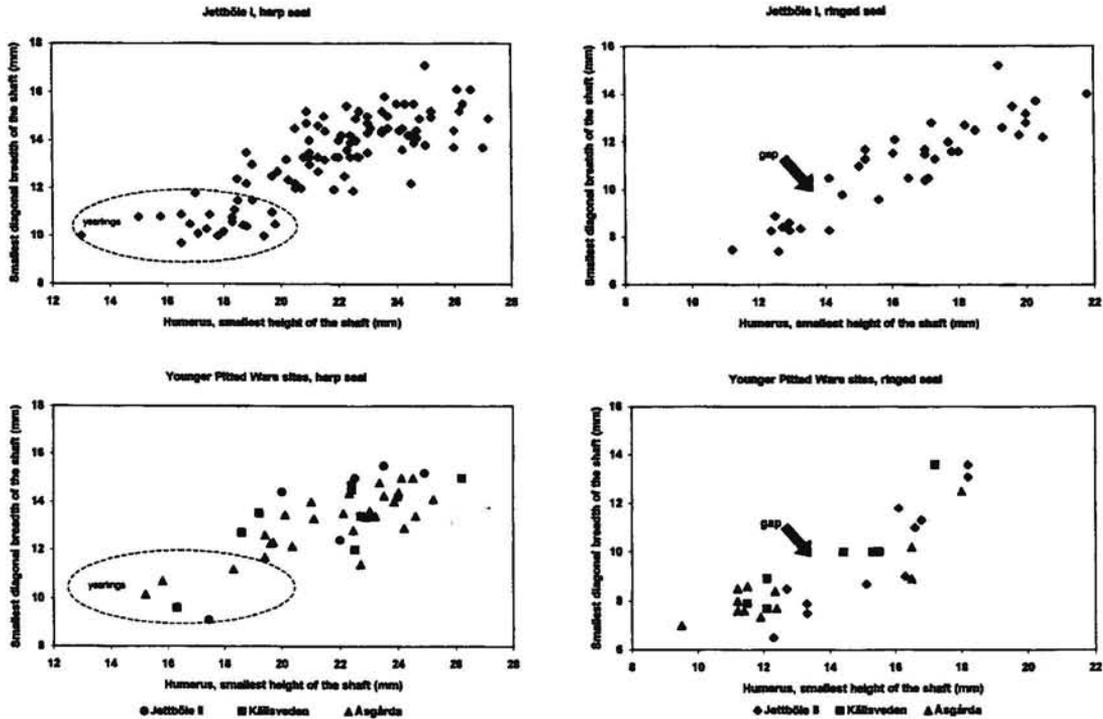


Fig. 5. The size distribution of the upper arm (humerus) of the harp seal and the ringed seal. Measurements according to Ericson and Storå 1999.

also contained most of the clay-idols. Since the datings from the lower layers indicate that the finds probably have accumulated over a relatively long time span the chronological resolution is rather coarse. The late Middle Neolithic and early Late Neolithic finds cannot be separated stratigraphically in the lower part of the cultural layer. However, it is noteworthy that Late Neolithic pottery of Kiukais type is not present in these lower layers.

The faunal remains are rather well preserved and the assemblage is dominated by the harp seal and the ringed seal. Small numbers of elk, beaver and the above mentioned cattle, sheep and pig, were also identified. Three human skull fragments were also found (ÅM 651:258, ÅM 662:2716 and ÅM 662:3556) all being charred by fire. Two teeth of beaver were discovered in layer 4 of the northern trench. They originate from the same animal.

RESULTS

The exploitation of seals

The faunal assemblages from all sites are dominated by seals. The harp seal seems to have been the most important species followed by the ringed seal. In some of the assemblages the ringed seal is the dominating species which indicates that there may be inter-site differences in the relative abundance of the seals. However, these differences need to be further studied before any conclusions can be drawn. Only 21 specimens of the grey seal have been identified from four sites, all from three of the younger sites except for one fragment from Jettböle I.

In general the relative abundance of the harp seal compared to the ringed seal seems to be slightly lower on the younger sites than on Jettböle I

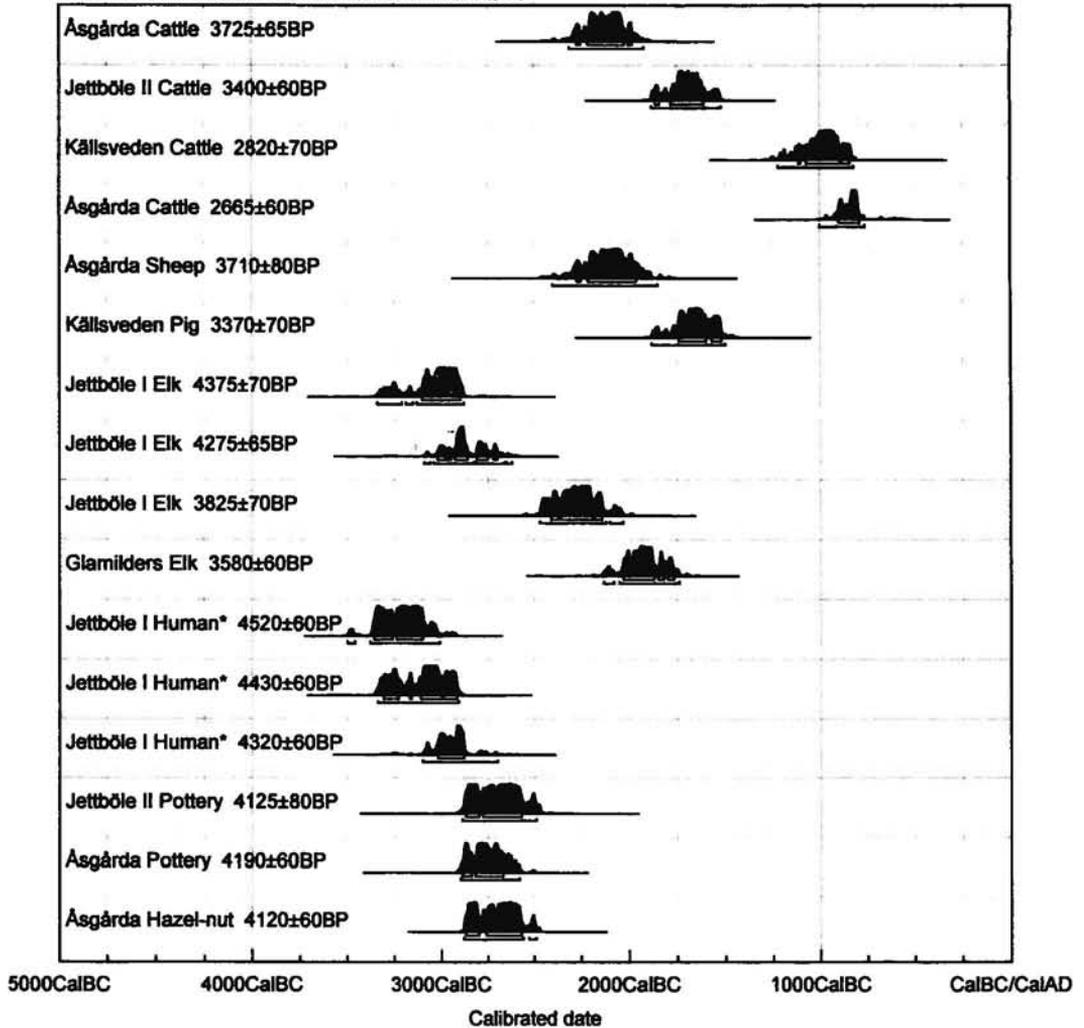


Fig. 6. Calibration of the radiocarbon datings (OxCal v3.4, Bronk Ramsey 2000). The time limits used here for the Middle Neolithic is 3300-2350 BC (Edenmo et al. 1997) and for the Late Neolithic 2350-1900/1700 (Carpelan 1999:266). * Jettböle I datings from Liden et al. 1995.

(Table 2). These differences in the relative abundance of the harp seal and the ringed seal indicate that the exploitation patterns may have changed over time. This is further supported by qualitative aspects of the seal bones. In fact, the age structure of the killed seals and the osteometric analyses indicate not only differences in the exploitation patterns between the harp seal and the ringed seal (Storå in press) but also differences between Jettböle I and the younger sites. However, since the exploitation of seals will be dealt with else-

where only some general observations will be presented here.

The size distribution (Fig. 5) of the upper arm (*humerus*) of the harp seal and the ringed seal can be used to examine the age structure of the killed seals. Of special interest is the size distribution of the yearlings i.e. seals less than one year of age, which highlights the hunting patterns in terms of seasonality. In the comparisons the bones from Jettböle I are compared with those from Åsgårda, Källsveden and Jettböle II. Unfortunately, there

are only a few measurable bones in the other assemblages.

For the ringed seal the limited size variation of the smallest bones indicates a restricted hunting period which seems to have been similar on all sites (Fig. 5). The sizes of the smallest individuals in the plots correspond to that of modern seals killed in the late winter and early spring. Therefore it seems probable that the prehistoric seals were killed at the same time of the year, namely on the ice in the breeding grounds (Storå in press). The gap in the size distributions indicates that there are fewer juvenile seals compared to adults and yearlings in the assemblages. This age structure is expected if the seals were mainly hunted in the breeding grounds. There are fewer "large" adult ringed seals in the younger assemblages than in the Jettböle I assemblage. However, it should be noted that the size distribution of the upper arm to some extent exaggerates this difference - the large individuals are not completely lacking (Storå in press).

For the harp seal the size distribution is more continuous and although the yearlings form a separate group the juvenile seals seem to be better represented than the ringed seal (Fig. 5). Bones of "small" yearlings are relatively few in all assemblages which seems to indicate that the main hunting season for the harp seal was later in the year than that for the ringed seal, probably in the later half of the year (Storå in press). The more dispersed size distribution of the yearlings on Jettböle I compared with that of the younger sites indicates a possible difference in the timing of the hunting season. Seals in the size interval between 16-18 mm (M7) are more common in the assemblage from Jettböle I than in those from the younger sites. It seems that the hunting season was longer on Jettböle I. Noteworthy is also the better representation of large individuals in the Jettböle I assemblage.

Domesticated animals

Bones of domesticated animals have been identified on six sites and radiocarbon datings are available from Åsgårda, Källsveden and Jettböle II. Although the contextual circumstances suggested that domesticated animals could have been introduced in the islands in the Middle Neolithic the radiocarbon dates were slightly

younger than expected. The oldest obtained dates fall in the early part of the Late Neolithic. Figure 6 presents the calibrated dates.

Cattle. Radiocarbon dates indicate that cattle were introduced in the islands in the beginning of the Late Neolithic (Åsgårda) (Fig. 6). Possibly somewhat older are the four bones of cattle at Jettböle I but the contextual circumstances of these finds are not satisfactory. A later intrusion cannot be excluded at this point. On the other sites the anatomical representation of cattle which includes fragments of many skeletal elements is an indication that these bones originate from complete animals and were not part of meat packages transported to the sites. The anatomical representation of specimens identified as coming from a large ruminant also gives some support to this interpretation (Appendix 1). On both Jettböle II and Åsgårda the specimens which morphologically show a closer resemblance with cattle bones than with elk come from several anatomical regions. This is also the case for the fragments of a large ruminant from Källsveden but here the stratigraphical circumstances of the bones are slightly more uncertain. Size comparisons of measurable skeletal elements (Appendix 2) indicate that the animals were of the same size as the somewhat older Alvastra cattle (During 1986).

Sheep. Sheep are present on Glamilders and Åsgårda and bones of a small ruminant are present also on Jettböle II. The radiocarbon date from Åsgårda indicates that sheep were introduced to the islands at the same time as cattle in the early part of the Late Neolithic. The stratigraphical circumstances of the bones from Glamilders are somewhat unclear and recent intrusions in the cultural layer cannot be excluded. From Jettböle II no radiocarbon dates are available but stratigraphically two of the bones of a small ruminant were discovered in the lower part of the stratigraphy. These finds seem to be associated with the Pitted Ware finds.

Pig. Bones of pig have been identified from Jettböle I and II, Källsveden, Svinvallen and Åsgårda. The oldest radiocarbon dating of pig to the very end of the Late Neolithic or beginning of the Bronze Age (Källsveden) is somewhat younger than those for cattle and sheep. The fact that several of the pig bones are affected by fire has restricted the possibilities of obtaining radiocarbon dates. However, the pig is present on all

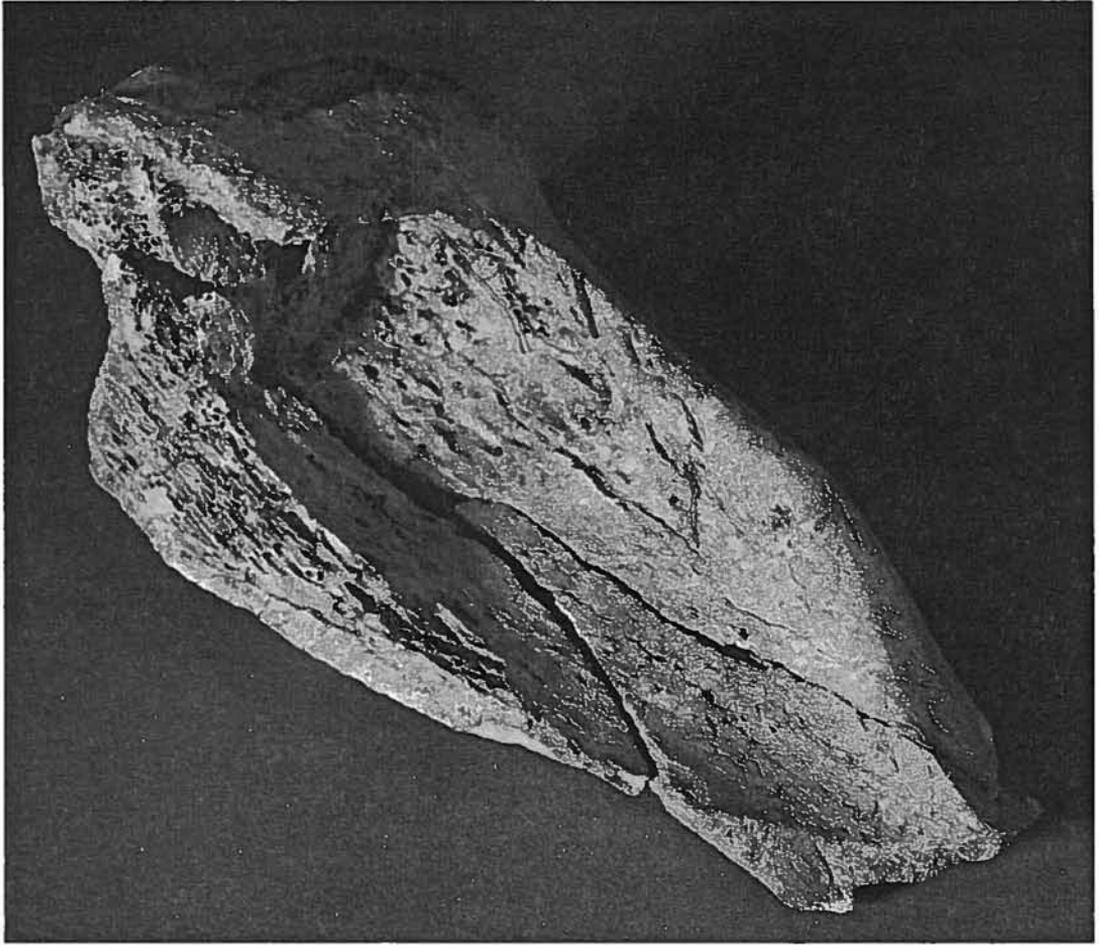


Fig. 7. A heavy pick-like tool of elk bone (radius) from Jettböle I (NM 4781:362). The length of the tool is approximately 100 mm. Photo Augusto Mendes.

younger Pitted Ware sites and one specimen was identified also in the Jettböle I assemblage. The find context indicates that in fact the pig could have been introduced earlier than the present dates show. On Åsgårda one bone of pig was discovered in the same layer as the cattle and sheep bones dated to the early Late Neolithic.

For pig the possibility that the identified specimens originate from wild boar has to be considered. However, due to the small size of the islands they could probably not have supported a permanent population of wild boar. The archaeological context indicates that these bones most probably originate from domesticated pigs which were kept in the islands.

Dog. No dog bones have been submitted for dating but there are several finds of dog in the assemblages from Jettböle I and the younger Pitted Ware sites. The special relationship between man and dog is highlighted on Jettböle I where the bones of two dogs were discovered in the same find concentration which also contained the remains of at least seven humans (Götherström *et al.* in press). Interestingly, some of these dog bones showed traces of cut-marks and apparently they have been deposited in connection with the complex activities which also involved the ritual treatment of human remains. The other bones of dog from Jettböle I and the other sites were recovered scattered in the cultural layer.

Wild mammals

Elk. Bones of elk have been identified from Jettböle I and II, Glamilders and Åsgårda. Radio-carbon datings have resulted in both Middle and Late Neolithic dates. It is, however, unlikely that the islands at this time would have supported a permanent population of elk. Occasional appearances of the species may have been possible. The elk was probably not important in the subsistence economy as a food resource. Instead, the anatomical representation and also some traces of modification on the bones indicate a specialized utilization of the bones themselves.

Most of the bones of elk were identified on Jettböle I in both the upper and the lower part of the cultural layer (Tables 6-7). On the other three sites smaller numbers of specimens were identified. The bones from all sites come from anatomically meat-poor areas of the body, antler and parts of the lower legs, and the anatomical representation can be taken as an indication that complete carcasses were not transported to the sites. Instead, it seems that selected skeletal elements suitable as raw material for bone tools were brought to the site. The identified longbones - radius, metapodials (MtIII-IV and McIII-IV) and tibia are all characterized by a long and rather straight shaft which would be suitable as raw material for the production of bone-tools - i.e. harpoons. On Jettböle I one axe or adze (NM 5907:16) and at least one harpoon (4781:634 - not included in the specimen count) are apparently made of antler from elk. One proximal end of radius has been modified into a rather heavy "pick-like" bone tool where the diaphysis end has been sharpened (Fig. 7). The edge morphology bears some resemblance to the famous ice-pick of Kirkkonummi (e.g. Edgren 1992:27-28). Also the smaller longbone fragments of elk and large ruminant bear some traces of modification. On Åsgårda the two metapodials of elk show no traces of modification but at least one of the longbone fragments of an unidentified large ruminant is probably a raw material for a bone tool. The "awl-like" tool from Härdalen shows that the general morphology of the bone tools was often left almost unmodified.

Red deer. This species has been identified on Jettböle II and Källsveden. It is unlikely that the red deer could have been hunted locally on the islands. Instead the burned fragments of red deer

antler from Jettböle II are associated with tool production in the same way as the bones and antler of elk from Jettböle I. Although discovered in different layers the pieces probably originate from the same antler. The metapodial from this site is also affected by fire but bears no traces of utilization. These specimens seem to be associated with the Stone Age finds. The red deer metapodial from Källsveden was discovered in the upper part of the stratigraphy which apparently also contains finds which are younger than the main Pitted Ware occupation. The limited representation of red deer most probably indicates that the bones and antler were transported to the islands.

Hare. A few specimens of hare are present in the assemblages from Jettböle I, Källsveden and Åsgårda. The islands were probably large enough to have a permanent population of hare at the end of the Stone Age. The identified bones of hare are vertebrae, longbones and metapodials. Thus, most anatomical parts are represented.

Beaver. From Åsgårda two teeth of this animal were identified. Since the islands hardly could have supported a population of beaver the teeth must have been transported to the islands, possibly as a tool. A parallel to this find may be found on some of the Gotlandic Pitted Ware sites where teeth of beaver have been recovered (Janzon 1974:78ff).

DISCUSSION

The composition of the faunal remains from the Pitted Ware sites indicates a heavy dependence on marine resources in the subsistence economy in both the Middle and Late Neolithic. Especially the exploitation of the harp seal seems to have been important but the relative abundance of the harp seal seems to decrease in the younger assemblages. This may reflect hunter preferences, but concerning the harp seal the availability of this prey species may also have been a factor. During the Subboreal Stone Age the harp seal is common in faunal assemblages from many coastal sites until the Late Neolithic period. After this the population seems to have decreased and the harp seal almost disappears from the assemblages (Ericson 1989). On Åland the faunal assemblage of the Bronze Age site of Otterböte (Forstén 1974; Gustavsson 1997:44-47) is dominated by the grey seal together with a few bones of the

ringed seal but the harp seal is absent. Apparently, at this time, the harp seal was uncommon in the waters around Åland. It is therefore interesting that the grey seal is more common in the assemblages of the younger Pitted Ware sites. This may indicate that the number of grey seals had increased in the areas around the islands already in the Late Neolithic. The number of harp seals had decreased at least to some extent. Although ecological factors have to be considered (Forstén and Alhonen 1975), the harp seals in the Baltic may also have suffered from the intense hunting pressure in the early Middle Neolithic (Storå in press). The differences observed between Jettböle I and the other younger sites in the exploitation patterns of the harp seal may therefore be explained not only in terms of preference of the hunters but also by a decreased availability.

The low frequency of wild terrestrial mammals in the Ålandic assemblages is probably a consequence of the long distance to the surrounding mainlands and the limited land surface available in the archipelago. Indigenous populations of larger terrestrial mammal species were probably absent but the hare could well have established a permanent population. The identified bones and antler fragments of elk and red deer probably originate from selected parts which have been transported to the sites as raw material for tool production. The only locally available bone were sealbones which are not very suitable as raw material. The often irregular morphology of seal bones limited the possibilities to produce larger bone implements. The restricted anatomical representation of elk can be taken as an indication that these bones do not originate from local kills. If the elk or the red deer were hunted on Åland a more complete anatomical representation would have been expected. An interesting parallel to these finds may be the finds of elk and red deer from Pitted Ware sites on Gotland (Ekman 1974) where a considerable number of antler points have been discovered (Janzon 1974:56ff). The raw material for these points probably have been transported to the Gotlandic sites.

Although the introduction of the domesticated animals on Åland appears to coincide with changes in the exploitation patterns of seals it seems improbable that the appearance is solely related to the economic sphere. The limited fre-

quency of the domesticated animals in the site refuse faunas indicates that, at least initially, they had a limited importance in the subsistence economy. Lepiksaar (1974; 1986) has suggested that the few specimens of cattle and sheep in Swedish Pitted Ware assemblages which otherwise are dominated by seals should not be taken as an indication of animal husbandry but represent transported pieces of meat. This has to be taken into consideration also for the Ålandic finds. However, the anatomical representation indicates that this is not the case. The identified specimens originate from both meat-rich and meat-poor anatomical parts and specimens from both juvenile and adult animals are present. Also, the archaeological find material indicates that many new cultural elements at the same time as the domesticated animals are introduced on the younger Pitted Ware sites. For example, the find material on the younger sites show several new features such as elements in the pottery ornamentation, the appearance of house structures, grinding stones and clay idols (Ailio 1909; Cederhvarf 1912; Äyräpää 1942; Meinander 1957; 1962; 1984; Núñez 1986b). The domesticated animals are probably only one, but an important, part of this larger complex of changes. Also, as has been pointed out earlier (Meinander 1957), the obtained radiocarbon dates indicate that the settlement is less bound to the shore line than in the previous periods.

The pottery at the younger Pitted Ware sites show clear influences from Corded Ware pottery (Meinander 1957; 1962; Nordman 1924) and it seems probable that the introduction of husbandry in some way is associated with these influences. It has to be noted, however, that the Corded Ware Culture is not well represented in the Islands (Edgren 1970; Nordman 1924) and this type of influence is not unique for the Ålandic material. The Corded Ware influences are common on Pitted Ware sites also in Eastern Middle Sweden (Olsson 1996; Olsson and Edenmo 1997).

The archaeological finds seem to indicate that the domesticated animals are introduced in a Pitted Ware context. However on the basis of the datings, the Kiukais material on some of the sites has to be considered. The potsherds of Kiukais type which were discovered in the upper part of the stratigraphy of Åsgårda are probably associated with the Late Neolithic finds. However, the

upper layers contained finds also of Pitted Ware and Bronze Age pottery which complicates the interpretations. The Kiukais sherds could be slightly younger than the dated bones of cattle and sheep, possibly even from the Bronze Age. Salo (1997:8-9) has dated the end of the Kiukais phase to approximately 1200 BC. Considering the small number of Kiukais sherds on Åsgårda it seems unlikely that all bones of the domesticated animals should be associated with this pottery. Instead, it appears that the bones of cattle, sheep, and possibly also pig are associated with Pitted Ware finds which are dated to the early part of the Late Neolithic. Also on Jettböle II the bones of domesticated animals are associated with Pitted Ware pottery and no Kiukais material has been reported from this site.

To some extent the presence of the Pitted Ware Culture in the Late Neolithic may explain the scarcity of finds of Kiukais and other Late Neolithic type in the Islands. Also in Eastern Sweden the Pitted Ware Culture is present in the Late Neolithic (Olsson 1996, see also Löfstrand 1974:130). The faunal remains from the Ålandic Late Neolithic Kiukais sites are inconclusive regarding the subsistence economy. On Krokars (NM 13268) only 9 burned fragments of bone have been discovered - 1 of the ringed seal, 3 of seal sp. and 5 unidentified. No faunal remains have been recovered from the Myrsbacka I site (ÅM 475 - and Meinander 1984). The site of Svinvallen has been classified as "mixed" with both Pitted Ware and Kiukais pottery but here the find context of the Kiukais pottery is not known at present (Meinander 1954; 1984). Unfortunately larger faunal assemblages from the succeeding time periods are lacking. At present this hinders interpretations regarding the subsequent incorporation of animal husbandry in the subsistence economy in the Åland Islands. However, the Bronze Age dates of cattle in the assemblages from Åsgårda and Källsveden can probably be associated with a more extensive husbandry. At this time the human impact on the vegetation is visible also in pollen data in a nearby mire (Andrén *et al.* 1996).

The obtained dates of domesticated animals are in rather good agreement with finds from Eastern Middle Sweden. Domesticated animals are present in this area from the Early Neolithic (Ahlfont *et al.* 1995; Ericson and Sten in press;

Kihlstedt *et al.* 1997; Segerberg 1999:177ff). Of particular interest here are the faunal assemblages from the Middle and Late Neolithic periods. Although most of the Pitted Ware assemblages are dominated by seals, domesticated animals have also been identified. The most common species, pig, is in some assemblages rather well represented while in general only small amounts of bones of cattle and sheep are present (Aaris-Sørensen 1978; Ahlfont *et al.* 1995; Hårding 1996; Kristensson *et al.* 1996; Lepiksaar 1974; Segerberg 1999:185ff; Welinder 1998:100-105). The importance of husbandry is difficult to interpret. It is not until the Late Neolithic that the relative abundance of domesticated animals increase in this area. In Finland the introduction of animal husbandry cannot be followed in detail due to the lack of preserved faunal remains. The possibly oldest bones of domesticated animals from Taipalsaari, Vaateranta (Räty 1995; Salo 1997:35 ff; Ukkonen 1996), Vantaa, Jokiniemi (as cited in Salo 1997:37 ff) and Kerava, Pisinmäki (as cited in Salo 1997:50ff) may be slightly older than their Ålandic counterparts. However, since these finds have been dated only on basis of their archaeological find contexts the chronological circumstances are difficult to interpret at present (Nunez 1999; Salo 1997; Taavitsainen pers. comm. 2000).

On Åland cultivation seems to have been introduced later than animal husbandry. Apart from a charred grain of barley from the site of Kolsvidja I (Lindqvist 1988) there is no direct evidence for cereals from the Pitted Ware sites. An indirect indication of the utilization of cereals is the grinding stones on the younger Pitted Ware sites but at present there are no indications of cultivation in pollen analyses before the beginning of the Iron Age or possibly the Late Bronze Age on Åland (Andrén *et al.* 1996; Fries 1961; 1963). Although the indications are sparse it seems that cultivation is present in Eastern Middle Sweden from the Early Neolithic and onwards (Ahlfont *et al.* 1995) and in Finland apparently from the Late Neolithic (Asplund *et al.* 1989; Salo 1997; Taavitsainen *et al.* 1998; Vuorela 1998; 1999; Vuorela and Hicks 1996).

On a general level the changes in the find material of the Ålandic younger Pitted Ware sites appear connected to a "process of neolithisation" in the Baltic area (e.g. Zvelebil 1998). Apparently

this process reaches the Åland Islands in the later part of the Middle Neolithic period when numerous new cultural elements are introduced on the sites. What we observe at the younger Pitted Ware sites on Åland is probably only the initial stages of a local adoption of animal husbandry which can be characterized as a "substitution phase" (Zvelebil and Rowley-Conwy 1984; Zvelebil 1998). The Late Neolithic seems to be a period when the established hunter-gatherer culture - on Åland to a high degree focusing on seal hunting - is transformed towards a more mixed subsistence economy in terms of mammal utilization. However, the marine resources were probably of great importance for a long time after the introduction of animal husbandry. It seems that this is also the case in both Eastern Middle Sweden and Finland at least in the coastal areas (Asplund *et al.* 1989; Edgren 1992:110ff; Kristensson *et al.* 1996; Núñez 1999).

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Appendix 1. Anatomical representation of the terrestrial mammals. Quantification according to NISP.

Jettböle I	Cattle	Elk	Pig	Large ruminant
Cornu		1+1(?)		
Dentes	3			
Vert. lumbalis				1
Radius		5		
Metacarpalia		3		
Os coxae			1	
Patella	1			
Tibia		2		
Metatarsalia		1		
Ossa longa				5
Metapodialia				2
Total	4	12+1	1	8

Glamilders	Cattle	Sheep	Elk	L. ruminant	S. ruminant
Cornu			1		
Maxilla				1	
Mandibula	1				
Dentes	1	1			1
Vertebrae				1	
Humerus	1				
Tarsalia			1		
Metatarsalia			1		
Ossa longa				2	
Metapodialia					
Total	3	1	3	4	1

Källsveden	Cattle	Pig	Red deer	L. ruminant
Dentes	2			1
Vertebrae				1
Vert. lumbalis				1
Atlas				1
Humerus	2			1
Radius				1
Os coxae	1			
Femur	1			2
Patella		1		
Metatarsalia			1	
Ph 3		1		
Ossa longa				3
Metapodialia		1		2
Total	6	3	1	13

Appendix I (continued)

	Alkärr		Svinvallen				
	L. ruminant		Cattle	Pig			
Cornu	1						
Dentes			1				
Ulna						1	
Patella						1	
Ph 2			1				
Ossa longa	3						
Total	4		2			2	

Jettböle II	Cattle	Pig	Elk	Red deer	L. ruminant	S. ruminant
Cornu				6		
Cranium	1					
Dentes	9	1				3
Vertebrae					1	
Vert. cervicalis	1					
Vert. thoracalis					1	1
Vert. lumbalis					1	
Costae					4	
Ulna	1					
Metacarpalia			2			
Os coxae	1					
Patella					1	
Tibia	1				1	
Metatarsalia	1	1				
Ph 2		1				
Sesamoidea	1					
Ossa longa					7	
Metapodialia		2		1		
Total	16	5	2	7	16	4

Åsgårda 34.20	Cattle	Sheep	Pig	Elk	Beaver	L. ruminant	S. ruminant
Cranium	3					1	
Mandibula	2					1?	
Dentes	12				1+1	1	1
Atlas	1					1	
Vert. cervicalis						2	
Vert. thoracalis						1	
Vert. lumbalis						1	
Costae						5	
Humerus	4						
Ulna	2						
Metacarpalia	2						
Tibia	2						
Tarsalia		1					
Metatarsalia	1						
Ph1	1						
Ph 2			2				
Ph 3		2					
Sesamoidea	1						
Ossa longa						11	
Metapodialia			1?	2			1
Total	31	4	2+1	2	1+1	24	2

Appendix 2. Measurements of cattle bones from Åsgårda 34.20 and Jettböle II. The bone from Källsveden has been dated to the Bronze Age. The Alvastra measurements from During 1986. Measurements according to Von den Driesch 1976.

Locality	Find nr.	Element	Measurement (mm)	Alvastra
Åsgårda	662:1937	Humerus	BT=78.45 Bd=89.38	66.5-78.5 84.5, 92.0
Åsgårda	662:1267	Humerus	BT=c.76	66.5-78.5
Åsgårda	662:3630	McIII-IV	Bp=60.7	
Åsgårda	662:1153	Ph1 anterior	Glpe ant=59.89	53.2-67.0
Åsgårda	651:1256	Maxilla M1-M3	M21=c.84	85.0, 85.1
Jettböle II	5180:21	Mandibula M3	L=39.53 B=13.92	35.5-42 14.0, 16.9
Jettböle II	4782:754	Tibia, distal epiphysis (unfused)	Bd=56.19	
Källsveden (Bronze Age)	4789:33	Femur	Bd=102.17	