Valdis Bērziņš

SĀRNATE: LIVING BY A COASTAL LAKE DURING THE EAST BALTIC NEOLITHIC
Academic dissertation to be presented, with the assent of the Faculty of Humanities of the University of Oulu, for public defence in Keckmaninsali (Auditorium HU106), Linnanmaa, on November 28th, 2008, at 12 noon
Abstract

This study is a re-analysis of the material from the wetland settlement of Sārnate, excavated between 1938 and 1959 by Eduards Šturms and Lūcija Vankina. The site, dated to the Neolithic of the East Baltic, is located on a former lakeshore in the littoral belt of the Kurzeme Peninsula, western Latvia.

First, the many separate dwelling assemblages of material were arranged into three major groups on the basis of their pottery: dwellings with Comb Ware (undated), dwellings with Early Sārnate Ware (c. 4365–3780 cal BC) and dwellings with Late Sārnate Ware (c. 3630–2850 cal BC). The Comb Ware from Sārnate represents a heterogeneous and poorly-preserved corpus. Early and Late Sārnate Ware are seen as belonging to a tradition of shell-tempered, low-fired vessels that served mainly as cooking pots. Ceramic bowls, represented in Late Sārnate Ware, are interpreted as fat-burning lamps.

The dwellings with Early and Late Sārnate Ware have produced a range of net fishing gear, as well as components of eel clamps and fish-screens.

The houses of the Early and Late Sārnate Ware groups were quite substantial post-built structures, but not true pile dwellings. The hearths consisted of a bed of sand, with a substructure of timber and bark. Experimental work suggests that food was cooked by standing the pointed base of the pot in the sand of the hearth and building up the fire around it. Spatial analysis of the structural remains and artefact distributions in the best-preserved dwellings with Late Sārnate Ware, aligned with their long axes perpendicular to the former shoreline, revealed the concentration at one end of the hearth of tools and refuse connected with activities relating mainly to food processing, i.e. a ‘kitchen area’.

For the Early and Late Sārnate phases, we can reconstruct the basic settlement-subsistence pattern, characterised by utilisation of a diverse range of subsistence resources, mainly those of the eutrophic lagoonal lakes, and a semi-sedentary or sedentary pattern of life, with a permanent occupation at Sārnate. A similar mode of subsistence and settlement was probably practiced at other lagoonal lakes along the East Baltic coast.

Keywords: archaeology, economic prehistory, fishing, Latvia, Neolithic, pottery, spatial analysis
Bērziņš, Valdis, Sarnate: elämää rannikolla sijaitsevan järven rannalla Itä-Baltian neoliittisella kaudella
Humanistinen tiedekunta, Yleinen arkeologia, Oulun yliopisto, PL 1000, 90014 Oulun yliopisto
Oulu

Tiivistelmä


Varhaisen ja myöhäisen Sarnate-keramiikan asuinpaikoilta on löydetty kalastusverkkoja sekä ankeriaankalastusvälineen ja liistekatiskan osia.

Varhaisen ja myöhäisen Sarnate-keramiikan piiriin kuuluvat talot olivat melko kookkaita paaluille pystytettyjä rakennelmiä, mutta eivät varsinaisia paaluasumuksia. Liedet muodostivat hiekkakerroksesta, jossa oli puusta ja kaarnasta tehty rakennelma. Kokeiden perusteella arvelaan, että ruoka valmistettiin asetamalla astian terävä pohja lieden hiekka-alustalle ja polttamalla tulta astian ympärillä. Parhaiten säilyneiden myöhäistä Sarnate-keramiikkaa edustavien, pitkäakseli kohtisuorassa muinaiseen rantaviivaan nähden olevien asumusten rakenteiden ja esineiden spatiaalinen analyysi paljastaa etupäässä ruuan valmistamiseen liittyviä toimintoihin yhdistettävien työkalujen ja jätteiden keskittyvän lieden toiseen päähän, toisinaan sanoen "keittiöön".

Varhaiselle ja myöhäiselle Sarnate- vaiheelle voidaan rekonstruoida asutus- ja elinkeinomalli, jolle on ominaista erilaista, pääasiassa eurofistien laguunien, toimeentulosressurssien hyväksikäyttö sekä puolipysyvä tai pyysyvä elintapa Sarnaten ollessa jatkuvasti asutettu. Samankaltaisia elinkeinoja ja asutusta harjoitettiin todennäköisesti muillakin laguuninäissä Itä-Baltian rannikolla.

Asiasanat: arkeologia, esihistoriallinen ekonomia, kalastus, keramiikka, Latvia, neolitikum, spatiaalinen analyysi
Bērziņš, Valdis, Sārnate: dzīve piejūras ezerā krastā Austrumbaltijas neolīta laikā
Humanitāro zinātnu fakultāte, vispārējā arheologija, Oulu universitāte, PL 1000, FI-90014 Oulu universitāte, Somijā
Oulu

Kopsavilkums

Kollekcijas veidoji materiāls no daudzām atsevišķām mītnēm, kuras vispirmas avienotas trīs galvenajās grupās, vadoties pēc keramikas rakstura: mītnes ar ūdens un bedrīšu keramiku (nav datētas), mītnes ar agro Sārnates tipa keramiku (ap 3465–3780 kal. g. pr. Kr.) un mītnes ar vēlo Sārnates tipa keramiku (ap 3630–2850 kal. g. pr. Kr.). Sārnates apmetnē iegūtās ķemmes un bedrīšu keramika ir neviendabīga, turklāt slikti saglabājusies. Savukārt agrā un vēlā Sārnates tipa keramika pēc ķemmes un bedrīšu keramikas tradīcijai, kuras raksturīgās izēmēs ir mēla masas liešanās ar griešanu un apsedzināšana zemā temperatūrā. Mēlē trauki izmantoti galvenokārt vārīšanai. Mēla blodīgas, kas pārstāvētas vēlajā Sārnates tipa keramikā, uzskatāmas par tauku lampījām.

Mītnēs ar agro un vēlo Sārnates tipa keramiku iegūti dažāda veida zvejas tīklu piederumi, kā arī Zemgales un sveces aizpaužu laikā laikā gāja arī ķemmes un bedrīšu keramiku.

Agrā un vēlā Sārnates tipa keramikas darinātāji ļoti īpaši samērā fundamentālas konstrukcijas stabu celtnei. Nav pamata tās uzskatīti par pāju būvēm. Mītnēm raksturīgi smilšu pavardi, kurus pamatā ir kokus un mizu konstrukcija. Pēc arheologisko eksperimentu rezultātiem secināts, ka vārāmē trauku nedaudz iedziļināja pavarda smiltis un uguni kūra to. Pievērsot uzmanību mītnēm ar vislabāk saglabājusos materiālu, kas orientētas ar garenasi perpendikulāri senajai krasta līnijai, analizēta konstruktīvo paliekumu un senletu planigrāfiju. Šīm mītnēm vienā pavarda galā konstatēta galvenokārt ar pārtikas gatavošanu saistītu rīku un atkritumu koncentrāciju (t.s. virtuvēs zona).

No mītnēm ar agro un vēlo Sārnates keramiku iegūtās materiāls lauj pamatvilcienos rekonstruēt iedziļotāju saimniecību. Izmantota daudzveidīga pārtikas resursu bāze, bet īpatī ko nozīmīgi bijuši resursi, kas iegūstami no eirofājiem lagūnu ezeriem. Sārnates apmetnē bijusi apdzīvota cauru gadu, tās iedziļotāji piekopošu daļēju vai pilnīgu vietiem. Līdzīgs dzīvesveids, domājams, bijis lagūnu ezeru kustīgo mīosošā kopienā arī citviet Austrumbaltijas piekrastes joslā.

Atsākumus vārdi: arheologija, keramika, Latvija, neolīts, saimnieciskā aizvēsture, telpas analizē, zveja
Preface

There seems to be something uniquely exciting, something immensely satisfying, about a major ethnographic study of one particular community – the kind of holistic study that presents a comprehensive portrait of a human group. Take Frederica de Laguna’s monumental work ‘Under Mount St Elias. The History and Culture of the Yakutat Tlingit’ (De Laguna 1972). She examines this particular native Alaskan village community from a multitude of viewpoints, describing local geography, subsistence activities, domestic life, the various tools and utensils; social structure, travel, trade and warfare; feasting, recreation and art; cosmology, beliefs about the individual and the body, myths and tales; shamanism and magic… All very detailed, all very specific. But at some point, the pieces begin to fit together. We begin to understand, to build up an overall picture in our minds: at some point, the whole has become greater than the sum of the parts. We have started to develop an insight into that community, in a way akin to that in which we already have already developed an insight into our own society.

Because of the fragmented nature of the archaeological record, obtaining the same kind of insight into the life of a prehistoric human group is much more difficult. Certainly, if we cherish any hope of such a result, we must turn to the best-preserved archaeological remains: those that offer the greatest range of different lines of evidence, the greatest number of pieces from the puzzle, which we may scrutinise in the anticipation that they must eventually fit together so as to give an intelligible picture of the whole. In our temperate region, this means selecting as the focus of study a superbly preserved wetland site: a site of the kind that have occasionally been preserved owing to very favourable natural conditions, discovered as an extraordinary piece of archaeological good fortune and excavated with great energy and perseverance over many years. Sārnate is just such a site – and the collection of material excavated from this site is a true goldmine of archaeological evidence.

Continuing the pioneering work of Eduards Šturms and the comprehensive study undertaken by Lūcija Vankina, I have been exploring this collection, extracting new evidence and attempting to fit the various elements together. Although the source is by no means exhausted yet, it is time for me to take stock of what has been obtained and apply it in order to paint as clear a picture as I can.

My work on Sārnate began in 1993, when Jānis Ciglis, of the Archaeology Department at the National History Museum of Latvia, gave me a copy of Lūcija Vankina’s monograph ‘The Bog Settlement of Sārnate’. His intention was to spur
my interest in the Sārnate collection, one of the museum’s treasures, and in this he has more than succeeded. Since that time, the museum staff have become habituated to my never-ending visits for the purpose of scrutinising the artefacts and the excavation reports. During these years, my friends and colleagues at the museum have been most helpful and supportive in every way, as I gradually came to grips with this material.

In 1998, I completed my master’s paper at the University of Latvia on the subject of ‘Pottery production and use at Sārnate Neolithic settlement’. That my studies on Sārnate subsequently took on the shape of a doctoral thesis at Oulu University was the result of a meeting in Riga between two people renowned for their enthusiasm about international research cooperation, namely Ilga Zagorska, Ph.D., Researcher at the Institute of Latvian History, and Professor Milton Núñez of Oulu University. I am very grateful to them both: to Milton, who agreed to supervise my work, and to Ilga, who eventually had the task of scrutinising the manuscript as one of the two official reviewers. My thanks also to Professor Kjel Knutsson of Uppsala University for his review.

My research at the Institute of Latvian History has for many years been conducted in the frame of projects led by Professor Andrejs Vasks, who supervised my master’s paper and shared his experience in pottery analysis. In my pottery studies, I have also benefited immensely from collaboration and exchange of ideas with pottery specialist and experimental archaeologist Baiba Dumpe from the National History Museum of Latvia. Another pottery zealot, Ole Stilborg, Ph.D, from the Department of Geology, Lund University, has applied his analytical skills to Latvian Neolithic pottery, and has joined us in a fruitful discussion on early ceramics. Throughout these years, my colleague Ilze Loze, Dr habil., at the Institute of Latvian History has encouraged and advised me in the field of Neolithic studies.

Several people have helped me gain an understanding of fish and fishing. I would like to thank Andris Celmiņš, MA (Museum of the History of Riga and Navigation), and Modris Šķīņķis, who read and commented on my initial study of net fishing, applying their practical experience, as well as Ritma Gaumiga of the Latvian Fish Resources Agency, who patiently analysed my writing on fishing seasonality from biologist’s perspective and helped me immensely with literature. I was kindly permitted to view comparative material in the ethnographic collections of the National History Museum, the Open-Air Museum of Latvia and the Daugava Museum. Thanks to Baiba Korše’s enthusiastic response, my studies at the Ventspils Seaside Open-Air Museum were particularly fruitful. Satu
Koivisto, MA, of the National Board of Antiquities, Helsinki, kindly acquainted me with the main characteristics of the prehistoric fishing gear from Purkajansuo, making possible a comparison with this outstanding material. As the opponent at the doctorand seminar, she examined the whole thesis most thoroughly.

For a long time now, I have had the benefit of close collaboration with the natural science community. Many years ago, the late Silvija Mūrniece outlined the palaeogeography of the Sārnate area. Professor Laimdota Kalniņa (Faculty of Geology and Earth Sciences, University of Latvia) has shared with me the results of continued geological and pollen studies in the area. Her colleague Jānis Lapinsksis, Ph.D., advised me on specific questions of coastal geology. Lembi Lāugas, Ph.D. (Institute of History, Tallinn University), kindly re-examined the faunal collection, and Birgitta Johansson, Ph.D., shared her mollusc knowledge.

During my stays in Oulu, I enjoyed the hospitality of that hive of activity, the Archaeological Laboratory, which, moreover, turned out to have a microscope excellently suited for my charcoal studies. Many thanks for all the help.

Back here in Riga, I have gained a great deal from working and talking with many fellow researchers, in particular my ‘Stone Age colleagues’ Normunds Grasis and Egita Ziediņa, MA, anthropologist Guntis Gerhards, Ph.D, and dendrochronologist Māris Zunde, Ph.D.

Research for this thesis was undertaken in the frame of several successive Latvian Council of Science research projects under the leadership of Professor Andrejs Vasks, and projects led by Andrejs Vasks and Ieva Ose, Ph.D, within the state-funded _Letonica_ programme. Radiocarbon dating and wood charcoal identification have been supported by the Culture Capital Foundation of Latvia, while the expenses of several visits to Oulu have been covered by the Finnish organisation CIMO.

My wife Anda has patiently drawn a large number of the artefact illustrations that appear in this work (all drawn from the original objects). I am also grateful to the publishers _Zinātne_ for permission to reprint several illustrations from Vankina’s monograph, to Rimutė Rimantienė for allowing me to include a drawing from a published paper of hers, and to the late Aina Alksne-Alksnīte, who permitted me to use her portraits of Šturms and Vankina. (The unattributed illustrations are my own.)

During these years, by their help and support in all kinds of ways, my family has created the conditions in which I could pursue my research. To Anda I am most grateful for the shared experience of these past days and years…
This work is dedicated to the memory of Lūcija Vankina, who spent a great part of her life piecing together the puzzle that we continue to piece together at the present day.

Riga, 3 October 2008

Valdis Bērziņš
Abbreviations

A  Collections of the Archaeology Department, National History Museum of Latvia
AA Archive of the Archaeology Department, National History Museum of Latvia
VI Former collections of the Institute of Latvian History at the University of Latvia, now kept at the Archaeology Department, National History Museum of Latvia
List of tables

Table 1. Revised division of dwellings and separate excavation areas at Särnate ................................................................. 57
Table 2. Radiocarbon dates from Särnate settlement ....................................................... 105
Table 3. Oval bowls from the dwellings with Late Särnate Ware. ................................. 159
Table 4. Summary table of characteristics of the round pots of the three pottery wares. .................................................................................................................. 170
Table 5. Size estimates of round pots, and volume estimates based on the summed cylinders method .......................................................................................... 185
Table 6. Alignment of hearths of the dwellings included in the spatial analysis ................................................................................................................................. 309
Table 7. Evidence of the use of different resource groups from dwellings with good organic preservation ........................................................... 389
Table 8. Summarised data on the round pots (based on rim sherds): fabric, surface finish and rim form ................................................................. 442
Table 9. Summarised data on the round pots (based on rim sherds): decoration, use alteration and repair features .................................... 445
Table 10. Summarised data on potsherds from Dwellings 1–15DR ................................. 448
Table 11. Correspondence analysis of pottery rim subtypes. Eigenvalues and corresponding inertia ........................................................................ 451
Table 12. Correspondence analysis of pottery rim subtypes. Column and row contributions to inertia (%), for the first four axes................................. 451
Table 13. Correspondence analysis of pottery rim decoration elements. Eigenvalues and corresponding inertia ................................................................. 452
Table 14. Correspondence analysis of pottery rim decoration elements. Column and row contributions to inertia (%) ................................................. 452
Table 15. Data on amber ornaments ................................................................................. 453
Table 16. Correspondence analysis of amber ornament sub-types. Eigenvalues and corresponding inertia ................................................................. 455
Table 17. Correspondence analysis of amber ornament sub-types. Column and row contributions to inertia (%) for the first four axes ................. 455
Table 18. Summarised data on the fishing gear ............................................................... 457
Table 19. Unperforated floats: shape in plan view .......................................................... 460
Table 20. Data on the Särnate hearths ............................................................................. 462
Table 21. Taxonomic determination of wood used for artefacts .................................... 464
Table 22. Results of wood charcoal analysis ................................................................... 468
Table 23. List of mammal remains ................................................................. 470
Table 24. List of fish bones ........................................................................ 471
Table 25. Summary table of mammal and fish remains from Särnate. ........ 472
List of figures

Fig. 1.  Map of the East Baltic region, showing the location of Sārnate and the other sites mentioned in the text. ......................................................... 39

Fig. 2.  General present-day map showing the location of the Sārnate site in the north-western part of the Kurzeme Peninsula. The shaded area indicates land above 50 m a.s.l. The square marks the area shown in Fig. 3. The star marks the position of the Sārnate site. ........................................................................................................... 45

Fig. 3.  Present-day location map, showing Sārnate Bog, the adjacent part of the Užava Valley and the Baltic Sea coast. The square marks the area shown in Fig. 4; the star marks the position of the Sārnate site. ........................................................................................................... 46

Fig. 4.  Present-day topographic map of the immediate environs of the Sārnate site. ........................................................................................................... 47

Fig. 5.  Eduards Šturms (1895–1959) and Lūcija Vankina (1908–1989) Drawings: A.Alksne-Alksnīte. .............................................................. 48

Fig. 6.  Eduards Šturms (at centre in the white cap) excavating Dwelling F at Sārnate in 1939 (Šturms 1938–1940). ............................ 52

Fig. 7.  Plan of Dwelling N (Vankina 1970, Fig. 67). ........................................ 54

Fig. 8.  Lūcija Vankina with the local people who worked on the excavation in 1956 (Vankina 1969, Fig. 32) .......................................... 57

Fig. 9.  General site plan: dwellings with and without preserved organic remains. ..................................................................................... 61

Fig. 10.  Pottery attributes and measurements. A – orientation of the everted rim, as viewed in profile, in relation to the inner surface of the vessel body: 1 – steeply-sloping; 2 – sloping at 45°; 3 – gently sloping; 4 – perpendicular. B – orientation of the flat lip in relation to the inner surface of the vessel body or everted rim: 1 – steeply-sloping; 2 – sloping at 45°; 3 – gently-sloping; 4 – perpendicular; C – measurements on rim impressions: a – length of impressions; b – width of impressions; c – angle of the long axis of the impressions in relation to the line of the vessel rim. ........................................................................................................... 87

Fig. 11.  Typology of rim forms. ........................................................................ 89
Fig. 12. Striated rim sherd decorated with tooth impressions and pits, and with a drilled hole. Dwelling N. A 11419: 82. Image: N.Grasis.  

Fig. 13. Ternary diagram of the composition of the dwelling pottery assemblages in terms of the percentages of vessels with porous fabric, mineral-tempered fabric and a combination of pores and mineral temper (including only those dwellings that have at least five vessels whose fabric class can be determined).  

Fig. 14. Ternary diagram of the composition of the dwelling pottery assemblages in terms of the percentages of vessels with smooth, undulating and striated exterior finish (including only those dwellings that have at least five vessels with determinable surface finish).  

Fig. 15. Correspondence analysis of dwelling pottery assemblages according to rim form sub-types, first two factorial axes.  

Fig. 16. Correspondence analysis of dwelling pottery assemblages according to stamp forms used for rim decoration, first two factorial axes.  

Fig. 17. Diagram showing the overall grouping of dwelling pottery assemblages according to exterior finish, rim form and rim decoration stamp.  

Fig. 18. Plot of calibrated radiocarbon dates from Särnate.  

Fig. 19. Site plan with dwellings grouped according to pottery wares.  

Fig. 20. Ternary diagram of the composition of pottery assemblages in the dwellings with Comb Ware in terms of the percentages of sherds with porous fabric, mineral-tempered fabric and a combination of pores and mineral temper.  

Fig. 21. Ternary diagram of the composition of the pottery assemblages in the dwellings with Comb Ware in terms of the percentages of sherds decorated with elongated stamps, with short stamps and with a combination of elongated and short stamps.  

Fig. 22. Common amber ornament forms at Sārnate. 1 – droplet-shaped pendant; 2 – discoidal bead; 3 – cylindrical bead; 4 – barrel-shaped bead; 5 – biconvex button-shaped bead; 6 – flat-convex button-shaped bead; 7 – trapezoidal pendant with straight base; 8 – trapezoidal pendant with concave base; 9 – rounded pendant; 10 – irregular pendant; 11 – ring (Vankina 1970, Figs. LI: 5; LI: 19; LII: 1; XLIX: 23; LI: 12; XLVIII: 16; XLIX: 3; LII: 11; XLIII: 9; XLVI: 5; LI: 9). ........................................................ 120

Fig. 23. Typological scheme of amber ornaments. ........................................... 121

Fig. 24. Correspondence analysis of dwelling amber assemblages, first two axes. .................................................................................................................. 122

Fig. 25. Early Sārnate Ware. 1 – vessel base, Dwelling MZA/MZR/MD (A 11417: 313); 2–4 – vessel rims, showing the orientation of platy pores and coil junctions. Drawing: A.Bērziņa. ............................................. 138

Fig. 26. Vessel rim diameters: Early Sārnate Ware, all Dwellings. Black – everted rims; grey – direct rims. The length of the bar represents the error interval in calculating the rim diameter. .................. 139

Fig. 27. Vessel rim diameters: Dwelling MZA/MZR/MD. ............................................ 139

Fig. 28. Plot of rim diameter against wall thickness for Early Sārnate Ware vessels. .................................................................................................................... 140

Fig. 29. Early Sārnate Ware vessels, Dwelling MIB, A 11417: 315; A 11417: 314. Shading: a – organic residue/soot not forming a separate layer; b – organic residue/soot forming a separate layer. Drawing: A.Bērziņa. .............................................................. 144

Fig. 30. Late Sārnate Ware. 1 – knot and plait impressions; 2, 3 – vessel rims, showing coil junctions indicative of N-technique; 4–8 – vessel bases (Dwelling ADA, A 11415: 73; Dwelling G, A 11415: 362; Dwelling G, A 11421: 42; Dwelling G, A 11415: 459; Dwelling G, A 11415: 357). Drawing: A.Bērziņa. ......................................................... 149

Fig. 31. Rim diameters of pots: Late Sārnate Ware, all dwellings. Black – everted rims; grey – direct rims. ................................................................. 150

Fig. 32. Rim diameters of pots, Dwelling ADA. ............................................... 151

Fig. 33. Rim diameters of pots, Dwelling F. ....................................................... 151

Fig. 34. Rim diameters of pots, Dwelling G. ....................................................... 151

Fig. 35. Rim diameters of pots, Dwelling K. ....................................................... 151

Fig. 36. Rim diameters of pots, Dwelling Y. ....................................................... 152
Fig. 37. Late Särnate Ware, profiles of pots. 1–5, 8, 9 – Dwelling F; 6, 7, 10–12 – Dwelling K. A 11415: 257, 323, 254, 253, 255; A 11418: 81/82; A 11416: 112; A 11415: 252, 258; A 11416: 91, 86/131, 110.............................................................. 153

Fig. 38. Late Särnate Ware, round pots. 1 – Dwelling ADA; 2 – Dwelling G; 3 – Dwelling K. A 11415: 9, 459; A 11416: 112. Shading: a – organic residue/soot not forming a separate layer; b – organic residue/soot forming a separate layer. Drawing: A.Bērziņa. ............... 157

Fig. 39. Oval bowls. 1 – Dwelling N; 2 – Dwelling T; 3 – Dwelling ADR; 4 – Dwelling Ze; 5 – Dwelling K. A 11420: 34; A 11419: 257; A 11418: 124; A 11580: 99; A 11416: 87. Shading: see Fig. 38. ............... 160

Fig. 40. Plot of length against width of Late Särnate Ware oval bowls. .......... 162

Fig. 41. Profiles of pots, Dwelling L. A 11417: 172, 188, 188, 194. ............... 173

Fig. 42. Vessels from Dwelling S. A 11580: 198, 200. Shading: a – organic residue/soot not forming a separate layer; b – organic residue/soot forming a separate layer. Drawing: A.Bērziņa. .......................... 174

Fig. 43. Graph of vessel rim diameter against estimated volume when filled to 90% of height (I – vessels with direct rims; S – vessels with everted rims). .............................................................. 185

Fig. 44. Experimentally tested cooking method, where the vessel is supported with its base in the sand of the hearth. a – sand; b – bark layer; c – poles. Drawing: A.Bērziņa. ........................................... 205

Fig. 45. Cooking experiment using a replica vessel supported with its base in the sand. .............................................................................................. 206

Fig. 46. Cooking in several replica vessels on the reconstructed hearth. Photo: B.Dumpe. ................................................................. 207

Fig. 47. Replica vessel used in cooking experiments. a – after firing, unused; b – after one cooking episode (boiling meat); c – after six cooking episodes (the last of which was boiling meat); d – after seven cooking episodes (in the last of which, wheat groats porridge was cooked, burned because the fire was too hot). Photos: B.Dumpe, V.Bērziņš. ................................................................. 208

Fig. 48. Replica vessel after cooking experiment, showing a band of sooting along a crack, where the surface had been kept cool during cooking by seepage of liquid. ................................................................. 209

Fig. 49. Classification of bark float shapes in plan and in longitudinal/cross-section............................................................................... 223
Fig. 50. Pine bark floats perforated at one end. 1, 3, 4 – Dwelling A ZA; 2 – Dwelling K; 5 – Finds Unit K/MD. A 11580: 159, 158, 157; A 11416: 61; A 11421: 60. Drawing: A.Bērziņa. .............................................. 226

Fig. 51. Pine-bark floats with a central perforation. 1, 2, 11, 12 – Dwelling T; 3, 4, 9 – Dwelling N; 5 – Dwelling L; 6, 10 – Dwelling K; 7, 8 – Dwelling A DA. A 11419: 86; A 11418: 104, 90; A 11417: 234; A 11419: 39, 38, 16; A 11417: 187; A 11416: 95, 57; A 11415: 115, 116. Drawing: A.Bērziņa. ........................................ 230

Fig. 52. Alternative modes of attachment of end-notched stone sinkers. Examples from Estonian and Finnish ethnographic material. a – Manninen 1931, Fig. 193a; b – Sirelius 1906, Fig. 234. ................................. 235

Fig. 53. Side-notched and unworked large stone sinkers with preserved binding. 1 – Dwelling I D; 2 – Dwelling T; 3, 4 – Dwelling A DA. A 11416: 43; A 11418: 97; A 11415: 67, 69. Drawing: A.Bērziņa. ................................................................. 236

Fig. 54. 1 - a set net, as used along the East Baltic coast in recent times (Heinemann 1905, Fig. 1); a seine net with a bag (Seligo 1926, Fig. 69); 1, 2 - end-sticks for nets, Dwelling K. A 11416: 72, A 11418: 66 (Vankina 1970a, Fig. XXI: 8, 9). .................................................. 238

Fig. 55. Remains of a lath screen (?) in situ in the north-western part of Dwelling K (Vankina 1950, Fig. 41). ................................................................. 242

Fig. 56. Remains of a lath screen (?) in situ in the southern part of Dwelling K (Vankina 1970e, Fig. IVa). ................................................................. 243

Fig. 57. Remains of a lath screen found between Dwellings K and MD, in situ (Vankina 1970e, Fig. 35). ................................................................. 244

Fig. 58. Part of the lath screen found between Dwellings K and MD, showing bast binding (Vankina 1970c, Fig. 37). .............................................. 245

Fig. 59. Preserved remains of the lath screen found between Dwellings K and MD. ................................................................. 245

Fig. 60. Left: making a lath screen for a katīca at Kalnciems on the River Lielupe (Ligers 1942, Fig. 17). Right: A katīca as used in Lake Babīte (Tročīgs 1940, Fig. on p. 120). .............................................. 247

Fig. 61. Rolled-up katīca screens being transported to the fishing location (Ligers 1942, Fig. 23). ........................................................................ 248
Fig. 62. Wooden lateral arms of eel clamps from Sārnate. 1 – Dwelling N; 2 – Dwelling K; 3 – Dwelling G; 4 – Dwelling ADR. A 11419: 58; A 11418: 59; A 11415: 384; A 11418: 147 (Vankina 1970a, Fig. II: 3–6). ................................................................. 251
Fig. 63. Head of an eel clamp from Šventoji 4 (Rimantienė 1995, Fig. 2). .............................................................................................................. 252
Fig. 64. Pine bark floats from Dwelling M\textsubscript{2N}/M\textsubscript{2R}/M\textsubscript{D}. A 11415: 508, 507; A 11417: 289; A 11415: 577. Drawing: A.Bērziņa. ......................... 255
Fig. 65. Length and width of unperforated pine-bark floats from dwellings with Early Sārnate Ware. ................................................................. 255
Fig. 66. Histogram of weights of small, unworked pebble sinkers from dwellings with Early Sārnate Ware. ......................................................... 256
Fig. 67. Length and width of unperforated pine bark floats from dwellings with Late Sārnate Ware. ................................................................. 259
Fig. 68. Histogram of weights of small, unworked pebble sinkers from dwellings with Late Sārnate Ware. ................................................................. 260
Fig. 69. Histogram of weights of end-notched pebble sinkers from dwellings with Late Sārnate Ware. ........................................................................ 262
Fig. 70. Histogram of weights of side-notched pebble sinkers from the dwellings with Late Sārnate Ware. ................................................................. 263
Fig. 71. Set of pine-bark floats and pebble sinkers from the net find in Dwelling A\textsubscript{DR}. 1–11 – floats; 12–17 – sinkers. A 11418: 120k, i, c, l, g, h, f, n, n, e, d, a, b, r, o, s, p. Drawing: A.Bērziņa............... 264
Fig. 72. Floats and sinkers from Dwelling L. 1–3 – pine bark floats; 4–6 – stone sinkers. A 11417: 184, 181, 182, 176, 174, 306. Drawing: A.Bērziņa................. 269
Fig. 73. Length and width of unperforated pine-bark floats from the ungrouped dwellings. ................................................................................. 270
Fig. 74. Schematic plans of Dwellings 3 and 5, showing the extent of the dwelling sand layer and the spread of charcoal and ash at its centre. .................................................................................................. 277
Fig. 75. Plans of the hearth of Dwelling E, showing the topmost bark layer (left) and the overlying sand layer delimited by poles (right) (Vankina 1970a, Fig. 23). ................................................................. 279
Fig. 76. Spread of laths in the hearth of Dwelling M\textsubscript{0} (Vankina 1970b, Fig. 17). ............................................................................................................. 281
Fig. 77. The raft of longitudinal logs at the base of the main hearth of Dwelling F (F1). In the foreground is a spread of short transverse timbers underlying the logs, perhaps serving to provide additional support on one side (Šturms 1938–40, Fig. 28). ................................................................. 282

Fig. 78. The main hearth of Dwelling F (F1): the spread of transverse logs of the initial hearth sequence (Šturms 1938–40, Fig. 26). .......... 282

Fig. 79. Basal timbers and stakes of the hearth of Dwelling T (Vankina 1970a, Fig. 101). ................................................................. 283

Fig. 80. The main hearth of Dwelling F (F1): the bark layer of the initial hearth sequence, with logs delimiting the hearth (Šturms 1938–40, Fig. 24). ................................................................. 284

Fig. 81. Cross-sections of the hearths of Dwellings X, Y and K (Vankina 1970a, Figs. 107, 116, 48). ................................................................. 286

Fig. 82. Plan of the hearth of Dwelling ADR, showing several charcoal concentrations. (Vankina 1970a, Fig. 9)............................... 289

Fig. 83. The sand layer of Dwelling 6ZA, viewed from south-west (Vankina 1970e, Fig. 142). The pebbles forming a pile in the foreground are interpreted as net sinkers............................................... 295

Fig. 84. Plan of the site, showing the dwellings with Comb Ware and indicating the orientation of the long axes of the hearths......................... 296

Fig. 85. Schematic plan of Dwelling I1. For key to symbols, see Figs. 99–101, 103......................................................................... 300

Fig. 86. Dwelling Y in the course of excavation, view from the east (Vankina 1970f, Fig. 61). ................................................................. 302

Fig. 87. Schematic plans of Dwellings T and Y, showing the distribution of posts and stakes, the extent of the dwelling sand layer and the extent of the best-preserved bark layer (the hatching indicates the direction of the grain of the bark). Suggested lines of the walls are given: for Dwelling T, the reconstruction is after Vankina, while for Dwelling Y the reconstruction is the author’s own.................................................................................................................. 302

Fig. 88. Plan of the site, showing the dwellings with Late Sârnate Ware and indicating the orientation of the long axis of their hearths (compare with Fig. 84). ................................................................. 307

Fig. 89. Layout scheme for analysis of composite dwelling plans. .... 310
Fig. 90. Superimposed distributions of posts in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 314

Fig. 91. Superimposed distributions of groups of three or more posts separated by no more than 0.5 m in Dwellings A_D, F, G, N, T and Y, in relation to the centre and long axis of the hearth.
(There are no such groups in Dwelling X.) 315

Fig. 92. Superimposed distributions of sand layers in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 316

Fig. 93. Reconstructed general layout of Dwellings A_D, F, G, N, T, X and Y, with superimposed distributions of sand layers and groups of three or more posts, in relation to the centre and long axis of the hearth. 317

Fig. 94. Superimposed distributions of cooking utensils in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 318

Fig. 95. Superimposed distributions of nutshell layers and nut-cracking mallets in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 319

Fig. 96. Superimposed distributions of pottery bowls interpreted as lamps in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 320

Fig. 97. Superimposed distributions of finds connected with processing of materials in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 321

Fig. 98. Superimposed distributions of amber finds in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 322

Fig. 99. Superimposed distributions of various equipment used in outdoor activities in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 323

Fig. 100. Superimposed distributions of notched sinkers in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 324

Fig. 101. Superimposed distributions of wrapped pebble sinkers in Dwellings A_D, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth. 324
Fig. 102. Superimposed distributions of pine bark floats in Dwellings
\( A_{DA}, F, G, N, T, X \) and \( Y \), in relation to the centre and long axis
of the hearth................................................................. 325

Fig. 103. Geological map of Sārnate Bog and the surrounding area (based
on Murniece et al. 1999, Fig. 6). The square marks the area
shown in Fig. 4; the star marks the position of the Sārnate site. ....... 335

Fig. 104. Graph of faunal remains from dwellings with Late Sārnate
Ware: total number of fragments........................................... 473

Fig. 105. Graph of faunal remains from dwellings with Late Sārnate
Ware: number of dwellings with species present........................ 473
## Contents

Abstract

Tiivistelmä

Kopsavilkums

Preface

Abbreviations

List of tables

List of figures

Contents

1 Introduction 35

1.1 Scope and structure of the study ............................................................. 35

1.2 A brief history of research on the Neolithic of the East Baltic.............. 37

1.2.1 Cultures ........................................................................................ 38

1.2.2 An agreed periodisation scheme................................................... 41

1.2.3 Research focuses .......................................................................... 42

1.3 History of research on the Sārnate site.............................................. 43

1.3.1 Discovery and initial excavation .................................................. 43

1.3.2 Post-war excavation and interpretation ........................................ 44

1.3.3 The collection ............................................................................... 49

2 The approach to the study 51

2.1 Division into dwellings ........................................................................... 51

2.1.1 The initial concept ........................................................................ 51

2.1.2 Formalising the concept ............................................................... 52

2.1.3 Minor adjustments ........................................................................ 54

2.2 Analytical strategy: a theoretical approach ........................................... 62

2.2.1 ‘Cultural grouping’ and ‘cultural analysis’ ................................... 62

2.2.2 Patterning at different scales......................................................... 64

2.2.3 Spheres of culture......................................................................... 66

2.2.4 Kinds of attributes and types ........................................................ 69

2.3 Analytical strategy: application to the Sārnate material...................... 71

2.4 Statistical methods .................................................................................. 72

2.4.1 Univariate methods....................................................................... 74

2.4.2 Bivariate methods......................................................................... 74

2.4.3 Ternary diagrams......................................................................... 75

2.4.4 Correspondence analysis .............................................................. 76
3 Pottery: study methods and cultural grouping

3.1 Introduction

3.2 Data collection

3.3 Grouping of dwelling pottery assemblages

3.4 Summary and conclusions

4 Amber ornaments and other classes of material: broader consideration of the groups of dwellings

4.1 Amber ornaments

4.2 Other classes of material

5 Pottery: cultural analysis and comparison

5.1 Comb Ware (Dwellings 1, 3, 4, 5, 6ZA, 7, 8, 10, 12ZA and 15DR)

5.2 Early Särnate Ware (Dwellings 2, D, E, IZ/Iz, MZA/MZB/MB, Para, RZ/RZ, and W)
5.7.6 Decoration ................................................................. 188
5.7.7 Firing .............................................................. 190
5.7.8 Knowledge and skills, time expenditure and seasonality of production ................................................................. 194
5.7.9 Pottery use .............................................................. 195
5.7.9.1 Introduction .............................................................. 195
5.7.9.2 Evidence from the Särnate pots ...................................... 196
5.7.9.3 The cooking experiments .............................................. 203
5.7.9.4 The question of permeability and sealants ...................... 212
5.7.9.5 The regional context of pottery use ................................ 213
5.7.10 Pottery repair and secondary use ................................................ 214
5.7.11 Discard patterns .............................................................. 216
5.8 Concluding remarks on the pottery .................................................. 218

6 Fishing gear ......................................................................... 221
6.1 Functional classification of the fishing gear .......................................... 222
6.1.1 Floats .............................................................................. 222
6.1.1.1 Unperforated pine bark floats ......................................... 223
6.1.1.2 Pine bark floats perforated at one end ............................ 225
6.1.1.3 Bark and wooden objects with an elongated central perforation .............................................................. 227
6.1.1.4 Small pine bark floats with a circular or square central perforation and notched ends ............................ 231
6.1.1.5 Birch bark rolls .............................................................. 231
6.1.2 Sinkers .............................................................................. 232
6.1.2.1 Unworked pebbles and pebbles wrapped in birch bark .............................................................................. 232
6.1.2.2 Unworked large stones tied with bast ...................................... 233
6.1.2.3 End-notched pebble sinkers ........................................... 234
6.1.2.4 Side-notched pebble sinkers .......................................... 235
6.1.3 End-sticks for nets ............................................................. 237
6.1.4 Netting and cordage ............................................................. 238
6.1.5 Screens for fishing structures ................................................. 241
6.1.6 Lateral arms of eel clamps ..................................................... 250
6.2 Fishing gear from the dwellings with Comb Ware (6ZA and 12DR) ...... 254
6.3 Fishing gear from the dwellings with Early Särnate Ware (2, D, E, I, I₁, M₂/₂, M₃/₃, Pᵥ, Rᵥ/Rᵥ and W)................................................................. 254
6.3.1 Floats .............................................................................. 254
6.3.2 Sinkers ........................................................................................ 256
6.3.3 Screens for fishing structures ..................................................... 257
6.3.4 Fishing methods ......................................................................... 257

6.4 Fishing gear from the dwellings with Late Särnate Ware
(Dwellings A_{DA}, A_{DR}, A_{ZA}, F, G, K, N, O, P_{o}, T, U, X, Y, Unit F/K and Hearth 3) ......................................................................................... 258
6.4.1 Floats .......................................................................................... 258
6.4.2 Sinkers ........................................................................................ 260
6.4.3 The net from Dwelling A_{DR} and finds of floats in association with sinkers .............................................................. 263
6.4.4 End-sticks for nets ..................................................................... 265
6.4.5 Screens for fishing structures ..................................................... 265
6.4.6 Lateral arms of eel clamps.......................................................... 265
6.4.7 Fishing methods ......................................................................... 265

6.5 Fishing gear from the ungrouped dwellings (Dwellings 6_{DR},
12_{DR}, B, C, H, J, L, S, Z_{a}, Unit K/M and Trench 1) .............................. 268
6.5.1 Floats .......................................................................................... 268
6.5.2 Sinkers ........................................................................................ 270
6.5.3 Screens for fishing structures ..................................................... 271
6.5.4 Fishing methods ......................................................................... 271

6.6 The development of fishing methods ................................................. 271

7 Hearths

7.1 The hearths of the dwellings with Comb Ware (3, 5, 6_{ZA}, 8 and
15_{DR}) .................................................................................................... 276

7.2 The hearths of the dwellings with Early Särnate Ware (D, E, I_{Z},
M_{D}, M_{ZA}, M_{ZR}, P_{a}, R_{Z}, R_{D1-3} and W) ............................................. 278

7.3 The hearths of the dwellings with Late Särnate Ware (A_{ZAD},
A_{ZA}, A_{DA}, A_{DR}, F_{1-3}, G, K, N, O_{1-3}, P_{o}, T, U, X, Y and Z_{a}) .............. 281

7.4 The hearths of the ungrouped dwellings (6_{DR}, 12_{DR}, 14, C, H, J,
L, P_{c}, S, V and Z_{a}) ............................................................................. 287

7.5 Comparison of the hearths of the different dwelling groups .......... 287
7.6 The hearths in use ........................................................................... 288
7.7 Parallels in the region ...................................................................... 290
7.8 Wood charcoal analysis .................................................................. 290
8 House remains and spatial structure

8.1 House remains and spatial structure in the dwellings with Comb Ware

8.1.1 House remains ................................................................. 293
8.1.2 Spatial structure at the site level ........................................ 295
8.1.3 Spatial structure at the dwelling level ................................. 297

8.2 House remains and spatial structure in the dwellings with Early Sārmate Ware .................................................................................................................................................................................. 297

8.2.1 House remains ................................................................. 297
8.2.2 Spatial structure at the site level ........................................ 299
8.2.3 Spatial structure at the dwelling level ................................. 299

8.3 House remains and spatial structure in the dwellings with Late Sārmate Ware .................................................................................................................................................................................. 300

8.3.1 House remains ................................................................. 300
8.3.2 Spatial structure at the site level ........................................ 304
8.3.3 Spatial structure at the dwelling level ................................. 308

8.3.3.1 Analytical methods ......................................................... 309
8.3.3.2 Results and interpretation ............................................... 313
8.3.3.3 Conclusions .................................................................... 320

8.4 House remains and spatial structure in the ungrouped dwellings ...... 325

8.4.1 House remains ................................................................. 325
8.4.2 Spatial analysis at the site level ......................................... 326

8.5 Comparison of house remains and spatial structure between groups ........................................................................................................................................................................... 326

8.6 Comparative material from the East Baltic region ...................... 328

9 Landscape and resources

9.1 Introduction ................................................................................ 331

9.2 Palaeogeography ....................................................................... 333

9.3 Landscape / resource areas ...................................................... 336

9.3.1 The house, the site and the immediate environs .................... 336

9.3.2 The local lake and river system .......................................... 337

9.3.2.1 Freshwater fish ............................................................. 338
9.3.2.2 Waterfowl ................................................................. 344
9.3.2.3 Beaver ........................................................................... 345
9.3.2.4 Water chestnut ........................................................... 346
9.3.2.5 Molluscs ...................................................................... 348
9.3.3 The River Užava ................................................................. 349
9.3.4 The beach and dunes .......................................................... 350
9.3.5 The sea ........................................................................... 352
  9.3.5.1 Conditions in the Baltic Sea ......................................... 352
  9.3.5.2 Sea travel ................................................................... 352
  9.3.5.3 Seals ......................................................................... 353
  9.3.5.4 Marine fish .................................................................. 358
9.3.6 Forest and meadowland ...................................................... 359
  9.3.6.1 Terrestrial mammals .................................................... 360
  9.3.6.2 Forest birds .................................................................. 366
  9.3.6.3 Plant foods ................................................................... 366
  9.3.6.4 Bee products ............................................................... 366
  9.3.6.5 Wood products ............................................................ 368
9.3.7 Cultivated land and pasture ............................................... 371
9.3.8 Distant resource areas and resources obtainable by exchange ................. 373
9.4 The annual resource cycle ..................................................... 374
  9.4.1 Introduction .................................................................. 374
  9.4.2 Spring ........................................................................... 375
  9.4.3 Summer ......................................................................... 375
  9.4.4 Autumn .......................................................................... 376
  9.4.5 Winter ........................................................................... 377
  9.4.6 Lacunae in the seasonality evidence ................................... 378
  9.4.7 Interannual variation and risk ............................................ 378
  9.4.8 Summary and comparison .............................................. 379
9.5 The pattern of resource use .................................................... 381
  9.5.1 Evidence for sedentism ..................................................... 381
  9.5.2 The context of sedentism .................................................. 383
  9.5.3 The question of resource specialisation .............................. 386
  9.5.4 Logistical forays .............................................................. 391
  9.5.5 Collective resource-use activities ...................................... 393
  9.5.6 Seasonal food shortages and storage ............................... 394
9.6 Social correlates of the resource-use pattern ............................ 396
9.7 Long-term trends ................................................................ 399
  9.7.1 Climatic change ............................................................... 399
  9.7.2 Sea- and lake-level change, eutrophication ....................... 400
  9.7.3 Human population size and pressure on resources .......... 401
9.7.4 Change in the pattern of resource procurement .................. 402
9.7.5 The adoption of food production .................................. 403
9.8 The essential characteristics of the resource-use pattern ............. 404

10 Summary and conclusions ................................................. 407
Bibliography ................................................................. 415
Appendices ................................................................. 439
1 Introduction

1.1 Scope and structure of the study

A wetland prehistoric site, such as Särmate, with superbly preserved organic objects and relatively undisturbed spatial structure, provides a great many lines of evidence about various aspects of their inhabitants’ lives. In this study, the focus is on artefact categories – pottery, fishing equipment, hearths, house structures – that all relate, in various ways, to the day-to-day activities that people conducted in order to satisfy their basic needs: food, warmth and shelter.

Hence, it can be expected that the study of these artefact categories will furnish information about the ways people went about satisfying these everyday, universal needs. Moreover, the results obtained from the study of particular categories of material might be interesting not only in their own right, but might also be usefully compared and combined, in order to build up a more general picture. And whatever view of human society we espouse, it seems evident that an understanding of those activities of the members of a past community that relate to the satisfaction of people’s everyday physiological needs can serve as a frame of reference for studying other aspects of the life of that community, namely those aspects connected more with inter-personal relationships. This is to say, using the accustomed terminology, that an understanding of subsistence and settlement patterns is distinctly advantageous – perhaps even prerequisite – for comprehending ideology, social structure and exchange. Accordingly, if we wish to extract more evidence from this outstanding site in order to improve our understanding of the particular region and period concerned, it seems that study of the former aspects should have priority.

The thesis is divided into ten chapters. Chapters 1 and 2 set out the background for the study. A brief history of research on the period and region concerned is followed by an account of previous research on the Särmate site and a basic description of the collection of finds. There follows a description of the theory and methods applied in the present study, focussing on particular concepts that are essential to the research framework. The statistical methods are described.

Chapters 3–8 are devoted to the study of specific classes of artefactual remains. First comes a detailed study of the pottery assemblage, which serves as the main basis for an overall ‘cultural grouping’ of the material (Chapter 3). There follows a brief chapter in which this pottery-based grouping of the material is
compared with the pattern obtained when grouping the amber ornaments, as a means of ascertaining whether the pottery-based grouping of the material can usefully serve as a frame for studying other artefact classes and other spheres of human activity (Chapter 4). Next comes an investigation of each particular pottery tradition, describing and seeking to understand the patterns of pottery production and use (Chapter 5). The extensive collection of fishing gear, which includes a large number of preserved organic artefacts, is analysed in Chapter 6. Considering the rarity of this kind of archaeological material and the importance of fishing as an economic activity in the region, the Sārnate fishing gear, interpreted in the light of evidence from ethnography and ichthyology, offers a rare and very valuable insight into the character of fishing activities. In Chapter 7, the unusual hearth structures at Sārnate are examined, following from which, in Chapter 8, an analysis is undertaken of house structures and the spatial distribution of artefacts.

In Chapter 9, the results and conclusions from the artefact studies are viewed in conjunction with palaeoeconomic and palaeoenvironmental data from the site and its environs, and in relation to comparative ethnographic data, attempting a spatial and temporal characterisation of the activities of the site inhabitants in relation to the landscape setting.

Chapter 10 presents a summary of the results of the study, together with the main conclusions and an outline of possible areas of future research.

It should be emphasised that it was not one of the aims of this study to examine the general pattern of cultural change in western Latvia during the period concerned. Although the chrono-typological scheme presented here, based mainly on the pottery, does appear to have some wider validity at a regional level, the elucidation of regional patterns would evidently require systematic study of several different sites in this area.

It should also be noted that certain major artefact categories from the site are not examined in the present study. Most significantly, no analysis has been conducted of the flint assemblage, and the assemblage of amber ornaments is only considered briefly, for the purpose of comparison with patterns observed in the pottery assemblage, retaining Vankina’s typological scheme. The author’s research on the Sārnate amber, presented elsewhere, is limited to a characterisation of the artefacts in terms of production stages, viewing the amber from the perspective of craft specialisation (Bērziņš 2003c), an area of study somewhat unconnected with the range of topics considered here, and hence not integrated into the present work. The artefacts of wood and bark cover a wide
functional range, and only the subset of material connected with fishing has been analysed here. Where other forms of organic objects are considered, in the spatial analysis and in the discussion of general activity patterns, the author relies on Vankina’s functional determinations. (See Bērziņš (2000b) for a discussion of the paddles and boat remains.)

1.2 A brief history of research on the Neolithic of the East Baltic

The eastern shore of the Baltic is one of those regions where pottery and polished stone tools were adopted much earlier than agriculture and stock-keeping, thus departing significantly from the general Mesolithic-Neolithic paradigm applied in much of Europe. In neighbouring regions, where this deviation from the general scheme is likewise observable, a variety of terms have been coined in order to describe pottery-using cultures that were not neolithic in the accepted economic sense. Thus, we have ‘forest Neolithic’, ‘sub-Neolithic’ (Gimbutas 1956, 11) or even ‘pseudo-Neolithic’ (Šturms 1970, 72) cultures. However, archaeologists working in the East Baltic have retained the term ‘Neolithic’ as a designation for the ceramic final stage of the Stone Age. In this scheme, the Mesolithic and Neolithic simply correspond to ‘aceramic’ and ‘ceramic’, respectively. In the author’s view, the nature and timing of the transition to agriculture and stock-keeping in this region are still not well enough understood to permit a general chronological division based on the adoption of food production.

The following brief overview of the research history thus covers the final, ceramic stage of the Stone Age in the East Baltic, known as the Neolithic, approximately 5500–1800 cal. BC. In terms of the climatic sequence, this is the Late Atlantic and Early Subboreal, while in terms of the development of the Baltic Sea Basin, it covers most of the Litorina Sea Stage, the earliest pottery appearing in the region several hundred years after the initial Litorina transgression. The brief account that follows is intended to provide a general background for the present study. Reflecting the traditional focus of research, the emphasis is on pottery sequences, while the history of research on socio-economic development and other topics is considered separately in the respective chapters of the thesis.
1.2.1 Cultures

Although Stone Age artefacts were collected and interpreted in the East Baltic already in the 19th century, it was not until the 1920s that systematic treatment of this material permitted the construction of a general cultural and chronological frame in Estonia and Latvia (Tallgren 1922; Šturms 1926), one that has continued to be refined up to the present day. The periodisation was initially based on cultural sequences synchronised with the Baltic Sea stages. In accordance with the general European scheme of that time, the adoption of pottery and ground stone tools was accepted as marking the beginning of the Neolithic, although it was soon recognised that, in this region, agriculture and animal husbandry begin at a later date (Šturms 1926, 15–26; Latviešu vēsture 1938: 41–42, 45–54). The three-age system was applied similarly in Lithuania, where Late Palaeolithic material had been recognised as well (Puzinas 1938). Applying cultural categories borrowed from research in neighbouring regions, Neolithic material was labelled as belonging either to the Comb Ware or the Corded Ware Culture.

Although in the 1930s, Eduards Šturms was already describing Neolithic pottery in western Latvia that in his view belonged to neither of these two wares (Šturms 1931, 1937), the turning-point came after the war, when Jaanits (1959) discussed the recently-discovered pottery from the Narva area in Estonia (‘Narva Ware’) and established from stratigraphic observations at the Estonian site of Akali that this pottery predated Typical Comb Ware. Based on the results of his excavation at Osa, Zagorskis (1967) was able to distinguish the Early Neolithic material of eastern Latvia, which he compared with the recently-excavated Estonian material. He identified many common traits features in the pottery, bone and flint inventory among the Early Neolithic sites of eastern Latvia and Estonia, which he viewed as belonging to a single cultural region, although he also noted differences, particularly in pottery decoration. Gurina (1967) reviewed the expanded corpus of material excavated in the post-war period and introduced the term ‘Narva Culture’, describing what she regarded as a major cultural entity encompassing the whole of the East Baltic, as well as the part of Northern Belarus belonging to the basin of the Western Dvina/Daugava.
Fig. 1. Map of the East Baltic region, showing the location of Sāmate and the other sites mentioned in the text.
Ever since the ‘Narva Culture’ concept was first advanced, different views have been propounded regarding the extent, duration and homogeneity of this cultural unit. The majority of researchers have supported Gurina’s view of a major cultural bloc, recognising between two and four variants within it, and its area has been expanded eastwards and north-eastwards to include part of the St Petersburg Region. (Loze 1985; Timofeev 1988, 207–210; Rimantienė 2005, Fig. 37; Girininkas, 1994, 13, Fig. on inside front cover).

In Latvia, an alternative view was put forward, namely that the concept of the Narva Culture should be restricted to the north-eastern part of the East Baltic (Latvijas PSR arheologija 1974, Fig. 8), and Zagorsksis stressed the differences, within this north-eastern region, between what he saw as localised pottery wares within the Narva Culture: Narva Ware in Estonia and Osa Ware in eastern Latvia (Zagorsksis 1973, 60–61, 65). In Latvia, the material from the south-western part of the East Baltic tended to be viewed as culturally distinct, something that Vankina, in particular, was very clear about. She regarded the material from Sārnate and other sites of the Baltic littoral (Zedmar and Röster Wiesen in the former East Prussia; Šventoji in Lithuania; Purciems, Lejascīskas, Siliņupe and Romi-Kalniņi in western Latvia; Loona on the Estonian island of Saaremaa) as representing a separate culture. She also emphasised the traits connecting this material with the Ertebølle Culture of the western Baltic (Vankina 1970a, 143–144; 1974, 49–50). The actual degree of similarity in terms of pottery and other cultural remains could not really be gauged in those days: because there was virtually no possibility of foreign travel, contact with western researchers, or access to the relevant literature, information about finds in southern Scandinavia and northern Germany was very limited.

From the northern part of the region, there is a great deal of pottery that exhibits a mixture of characteristics of Comb Ware and the ‘indigenous’ pottery wares. This ‘hybrid’ material has been variously regarded. In Estonia, pottery showing both Comb Ware and Narva Ware features is classed as Late Comb Ware, considered to have developed from Typical Comb Ware under the influence of Narva Ware (Kriiska 1995, 115). On the other hand, in eastern Latvia pottery with a mix of traits of these two wares has been named Piestipä Ware and regarded as having developed from the Early Neolithic Osa Ware, with certain elements borrowed from Typical Comb Ware (Zagorsksis 1973, 65; Latvijas PSR arheologija 1974, 38). Loze (1988a) uses the term ‘East Baltic Culture’, and Gurina (1996, 151) has described this material using the term ‘Post-Narva Culture’. Girininkas (1994, 94–95), from the Lithuanian perspective, sees the
Narva Culture as continuing to develop in the north-east as well, albeit with Comb Ware influence. Thus, there is no united view on the duration of the Narva Culture in Latvia and Estonia.

Since the 1960s, a clearer picture of the Neolithic sequence in Lithuania has also emerged. A separate Nemunas Culture was recognised in the earlier part of the Neolithic in southern Lithuania and neighbouring areas of Belarus, Poland and the Kaliningrad Region (Rimantienė 1992, 116). As regards the later part of the Neolithic, much new material has come to light on the Globular Amphora and Corded Ware Cultures in Lithuania, and on the Rzucewo or Bay Coast Culture, interpreted as having developed from a mixture of the Nemunas, Narva, Globular Amphora and Corded Ware populations (Rimantienė 1992, 123–135). The character of Corded Ware Culture presence and/or influence in Latvia and Estonia has also been intensively discussed in recent years (Lang 1998; Grasis 2002; Loze 2003; Kriiska 2003).

### 1.2.2 An agreed periodisation scheme

Fortunately, the different approaches to cultural attribution have not prevented the development of a generally-accepted system of Neolithic periodisation for the East Baltic. In this system, the Early Neolithic is taken to begin with the adoption of pottery (c. 5500–4900 cal. BC), the beginning of the Middle Neolithic is marked by the advent of the Comb Ware Culture (c. 4400–4150 cal. BC), even though there are few sites with evidence of this culture in the southern part of the region, and the Late Neolithic begins with the appearance of the Corded Ware Culture (c. 3200–2900 cal. BC). The beginning of the Bronze Age is placed at around 1800 cal. BC. The intervals in the cited dates reflect differences in the earliest dates for the relevant chronological markers, which are bound to be refined as additional dating is performed. (Kriiska 2001, Fig. 1; Anatanaitis-Jacobs & Girininkas 2002, Table 1; Arheoloģija un etnogrāfija 2003, Fig. on p 10).

Recently, Antainaitis-Jacobs and Girininkas (2002, 12–16, 19) have suggested that, as in Western Europe and other parts of the globe, the shift to an agricultural economy (rather than the adoption of pottery) should be used as the main defining signature of the Neolithic. Assessing the palaeoeconomic evidence from Lithuania, they conclude that, for Lithuania at least, the ‘substitution’ phase of the transition to farming might be regarded as having occurred in the time of the Corded Ware Culture (i.e., in the Late Neolithic in the traditional East Baltic
scheme), and that the consequently the ‘Neolithic’ in Lithuania might be considered to have begun only at this time. However, it seems that the evidence from Lithuania, and likewise from Latvia and Estonia, is actually too meagre, so far at least, to permit us to identify a chronological boundary that marks a clear transition to dependence on food production.

1.2.3 Research focuses

Although Baltic archaeologists working in the Soviet era were forced to denounce many earlier interpretations as misconceptions of ‘bourgeois’ archaeology, concepts of ethnicity were in fact largely inherited from pre-war research, reflecting early 20th century European archaeological theory. Baltic archaeologists generally did not venture theoretical discussion of such topics. Theoretical guidelines were set out by prominent Neolithic researchers in Russia, and these served to reaffirm and formalise the concept of a culture as equivalent to an ethnic group, with pottery as the foremost cultural marker and ‘ethnic’ indicator during the Neolithic. Thus, Foss (1952, 64–77) cites ethnographic findings that patterns of ornamentation are specific to particular tribes and kin groups, and finds here a theoretical basis for the idea that pottery ornamentation is the best source of archaeological evidence for distinguishing tribes and kin groups in the period before trade and crafts emerged. Gurina (1973, 14–15) considers that ‘Each Neolithic archaeological culture evidently corresponds to a group of kindred tribes, i.e. a collective of people, inhabiting a compact territory, speaking one language and related in terms of their origins.’ She stresses the importance of considering a range of cultural (i.e., ethnic) traits in distinguishing archaeological cultures: pottery, tool types and production methods. Pottery is again singled out as ‘the most expressive element of a culture’, but in regard to pottery Gurina stresses the importance of ‘studying in a comprehensive way the whole sum of data: form, fabric composition, decorative elements and patterns.’

Although most authors have avoided an automatic leap from pottery ware to archaeological culture and thence to ethnic group, interpretations of the Neolithic have generally tended to rely (explicitly or implicitly) on a concept of ethnic groups (‘tribes’) each represented by an archaeological culture – of which the most characteristic expression is a particular pottery ware (‘pottery type’).

However, Soviet archaeologists were also charged with the task of studying economic and social processes. At the theoretical level, researchers were required to adhere strictly to Marxist dogma, reaffirming the 19th century postulates of
Friedrich Engels on economic and social development in prehistory. At the empirical level, this meant an emphasis on economic and social interpretation of archaeological evidence. Vankina’s monograph on Sārnate (1970a) is an example of such a focus – using the artefactual evidence to present a picture of the hunter-fisher-gatherer economy, craft activities, building traditions, exchange systems, etc. This socio-economic emphasis in archaeological research during the Soviet era might be regarded in some ways as a parallel, but independent, development to the broadened interpretative framework of New Archaeology in Anglo-American research.

The years since the restoration of independence – now that the research environment is free from institutionalised ideological strictures and in open communication with European and Anglo-American archaeology – have been marked by re-examination of the valuable corpus of archaeological evidence accumulated during the Soviet era and earlier, testing novel approaches and offering new interpretations (e.g. in Latvia: Šnē 2002; Larsson & Zagorska 2006). The present work on Sārnate evidently forms part of such a re-interpretive trend. At the same time, in all three of the Baltic States, early prehistory seems to have attracted greater research interest during the past decade, and recent fieldwork has significantly augmented the archaeological source material. Relevant to the present study are various recent survey and excavation projects in western Latvia that have furnished new data on the Neolithic (Zagorska 1990; Grasis & Ziediņa 2002; Ziediņa 2003; Bērziņš 2004; Loze 2004, 2005, 2006).

1.3 History of research on the Sārnate site

1.3.1 Discovery and initial excavation

The old manor and village of Sārnate lies in the north-western part of the Kurzeme Peninsula of western Latvia, 2 km from the present coast (Figs. 2–4). Already in the 1920s, several stone axes and other implements had been found in the environs of the village. The Neolithic settlement itself, on the western fringe of Sārnate Bog, was discovered by local schoolmaster Jānis Drēbe during land drainage work in 1937 and 1938. He informed the Board of Monuments, which sent its inspector Kārlis Ošs. Drēbe showed him the find locations in the fields and wet meadows by the bog (report by A. Šmite, 13.07.1938; report by J. Ošs,
Eight separate areas (Dwellings A–H) were excavated by in the years 1938–1940 by Eduards Šturms (Figs. 5, 6; Šturms 1938–40), who at that time was head of the Jelgava Department of the State Historical Museum and in 1940 became Docent in Prehistory at the University of Latvia. Surveying the ploughed fields along the edge of the bog in 1939, Šturms found a total of 27 concentrations of finds, but only managed to excavate a small number of these before the outbreak of war. A description of the material is given in a brief paper, along with the tentative conclusion that it dates from the very end of the Neolithic or the Bronze Age (Šturms 1940). At the close of the war, Šturms ended up in Germany, along with many other refugees fleeing from the Soviets. After the war, he held academic posts in Germany and continued his research on prehistory, initially at the Baltic University established by the refugees at Pinneberg near Hamburg, and then at the Institute for Baltic Studies in Bonn. Palynological dating of the peat strata at Sārnate provided apparent confirmation that the site was of Bronze Age date (Dreimanis 1947), and so Šturms does not discuss it in his posthumously published monograph on the Neolithic of the Baltic (1970). Only a brief account of the evidence from Sārnate appeared at this time in German (Šturms 1948).

1.3.2 Post-war excavation and interpretation

It was clear that the Sārnate site still held enormous potential, and in 1949 excavation was resumed by Lūcija Vankina (Fig. 5), one of Šturms’ students and among the very few archaeologists still active in Latvia in the first years after the war. Most of the rest had either emigrated to the West or had fallen victim to persecution by the newly-established Soviet regime. Vankina headed the Department of Archaeology at the History Museum of the Latvian SSR (now the National History Museum of Latvia), and her work at Sārnate was one of the most important archaeological projects in the early years of the Soviet era in Latvia. Following nationalisation of the land, the meadows along the fringe of Sārnate Bog were put under the plough by the newly-established state farm. Sugarbeet, maize, barley and sunflowers were sown in the area of the Stone Age settlement. Drainage work had been completed in the area, and so ploughing and desiccation of the peat threatened to destroy the site.
Fig. 2. General present-day map showing the location of the Sārnate site in the north-western part of the Kurzeme Peninsula. The shaded area indicates land above 50 m a.s.l. The square marks the area shown in Fig. 3. The star marks the position of the Sārnate site.

Excavation took place under Vankina’s direction in the years 1949 and 1953–1959 (Fig. 8; Vankina 1970a, 10–14). She was faced with the problem of rescue excavation in an enormous area, much of it waterlogged, her difficulties compounded by the lack of trained staff and by the fact that the site now lay in the restricted sea-coast border zone of the Soviet Union, accessible only with permission from the border guards.
Fig. 3. Present-day location map, showing Sārnate Bog, the adjacent part of the Užava Valley and the Baltic Sea coast. The square marks the area shown in Fig. 4; the star marks the position of the Sārnate site.
To the eight dwelling places excavated by Šturms, Vankina added 30 more, giving a total of 38. She opened up larger excavation areas, and also extended some of the small areas excavated by Šturms. This gave a much clearer picture of the size and extent of structures and associated artefact concentrations. The excavated area reached a total of 2876 m².

The Bronze Age date for the site continued to be cited up to the 1950s, although the discovery of Comb Ware, too, at Sārnate indicated that it had been occupied already in the Neolithic (Vankina 1958, 183; 1959a; 1959b, 18–19).
When the first radiocarbon dates were obtained in the 1960s, the true antiquity of the site was finally confirmed (Lijva et al. 1965).

Vankina brought together all the evidence from the excavations by Šturms and herself in a monograph on the site in Russian, entitled Sārnate Peat Bog Settlement (1970a). In a separate paper (Vankina 1974), she presented an overview of the material from other sites in western Latvia with finds resembling those of the waterlogged dwellings at Sārnate.

In the monograph, Vankina gives a brief history of research and a treatment of the environmental context. This is followed by a description of all the dwellings excavated by Šturms and herself, where much of the text is taken word for word from the original excavation diaries. Then there are chapters describing the artefacts, mostly divided into broad functional classes: hunting weapons, fishing equipment, tools of primitive agriculture and gathering, tools for working various materials and household utensils, ancient art and cult objects, amber and amber artefacts, and pottery. A separate chapter deals with structural remains, and the book concludes with discussions of economy and contacts with neighbouring groups, chronology, and cultural affiliation. There are summaries in German and Latvian, and detailed tables listing the artefacts found in each dwelling.

Fig. 5. Eduards Šturms (1895–1959) and Lūcija Vankina (1908–1989) Drawings: A.Alksne-Alksnīte.
With its tables of artefacts and numerous drawings and photographs, the monograph has been very useful to later researchers for the purpose of comparative study and for generating interpretations of their own. Timofeev (1975, 20–22) has discussed the chronology and cultural attribution of the Sārnate material, giving his interpretation within the context of cultural development in the Neolithic of the East Baltic. Loze (1978, 9–10) has discussed the structural remains from Sārnate in an overview of Neolithic dwelling remains in the East Baltic. The Sārnate material, especially the pottery and amber finds, has been utilised extensively as comparative material by researchers interpreting other East Baltic Neolithic sites. Most importantly, the organic artefacts have provided the best comparative material for Rimantienė’s studies on the finds from the wetland sites at Šventoji in Lithuania (Rimantienė 1979; 2005).

The evidence from the site has been considered in some wider studies on economic prehistory (Dolukhanov 1979, 169–171; Zvelebil 1981, 139–140; 1994, Rowley-Conwy & Zvelebil 1989, 53, 55). A concise description in English, placing the site in its environmental context, is to be found in Murniece et al. (1999). Research by the present author is reflected in a number of Latvian and English articles on particular topics relating to the Sārnate site (Bērziņš 1997; 1999; 2000a; 2000b, 2002, 2003a, 2003b, 2003c, 2006a, 2006b, 2006c, Bērziņš & Dumpe 2005).

### 1.3.3 The collection

The corpus of finds from Sārnate constitutes one of the major collections at the Archaeology Department of the National History Museum of Latvia. The collection of artefacts includes:

- 10042 sherds of pottery;
- 511 flint tools and 5183 pieces of flint waste;
- 387 amber ornaments, 175 pieces of unworked amber and 2799 pieces of amber waste (Vankina 1970a, Tables 1–6);
- 514 whole or fragmentary stone objects, mostly sinkers;
- 168 identifiable whole or fragmentary wooden artefacts, most numerous among which are paddles (36), nut-cracking mallets (23) and ladles (18);
- 152 bark objects, mainly various forms of net floats;

---

1 A 9683, A 11415–11428, A 11580.
– some pieces of string and fragments of a net;
– 15 pendants and 11 other objects of bone, tooth and antler.

Also preserved are various samples recovered in the course of excavation: animal bone, charcoal, nut-shells and pointed tips of posts. It should be added that, so far as we know, soil sieving was never practiced at Sārnate: all the material was hand-collected.

The unpublished excavation reports are kept in the departmental archive (Šturms 1938–40; Vankina 1950, 1969, 1970b–f, 1971), as are Vankina’s excavation diaries and various specialist reports: species lists for bone and wood, a laboratory report on the pottery, and petrological determinations of stone objects.

The state of preservation of the organic artefacts in large measure reflects the development of field and laboratory conservation methods at the museum: thus, the later finds, from 1953 onwards, tend to be in much better condition than the earlier ones. The organic objects were impregnated with alum, which unfortunately forms a thick surface coating and obscures potentially useful features, such as tool marks and signs of wear. Starting in the 1990s, the organic objects, originally impregnated with alum, have been undergoing re-conservation: the alum is being removed and the objects freeze-dried after impregnation with polyethylene glycol, resulting in an improvement in their appearance and revealing the grain and original surface of the wood. However, at the time of study, very little of the material had yet been re-conserved.

A number of the most interesting finds are on permanent display at the museum: the excavation of Sārnate remains one of the most important research projects ever undertaken by the museum and holds a special place in the development of Latvian archaeological research.
2 The approach to the study

2.1 Division into dwellings

2.1.1 The initial concept

In his excavation at Sārnate, Šturms opened up separate small excavation areas at locations where surface finds had been collected. Vankina adhered to a similar strategy, but increased the size of the excavated areas. The result is that, although the 2876 m² excavated altogether represents a considerable area, it is constituted of a large number of relatively small non-contiguous excavation areas (Fig. 9). Vankina justified this excavation strategy as a suitable method for rescue archaeology on such a large site with very limited resources, considering the uneven distribution of the artefactual material across the site. In her view, the occupation layers and finds were concentrated around the hearths of the dwellings. She did in fact make some attempt to test this notion, excavating long trenches between some of the dwellings in the south-western part of the site, and the paucity of material between the dwellings appeared to confirm her view of the situation. (Vankina 1970a, 13). Nevertheless, we cannot be sure that Vankina’s excavation strategy has given us a full picture of the site. Because the excavated areas are small in relation to the total site area, we can guess that a large amount of cultural material is still in the ground. There are probably more dwellings, and perhaps also concentrations of material (e.g. rubbish dumps) not associated with structural remains.

As a logical result of the excavation strategy and of the view that the artefacts formed concentrations in association with structural remains, the ‘dwelling’ came to be established as the principal contextual unit. The term ‘dwelling’ (Latvian mītne, Russian žilisše), in the sense used by Vankina, can be defined as a concentration of artefacts associated with the structural remains of a single house, these remains lying within one excavation area or two or three closely adjacent areas. Most of the dwellings were denoted by letters (A–Z), while the dwellings in the north-eastern part of the site, considered to represent a different cultural group, were denoted by numerals (1–15). The division into dwellings is the basis for the tabulation of artefacts in Vankina’s monograph (Vankina 1970a, Tables 1–6), and in fact much of the artefactual material (particularly the mass finds, such
as flint and amber debitage, and potsherds) is documented simply as deriving from one dwelling or another, lacking more specific provenience.

The better-preserved dwellings in the waterlogged part of the site (K, M, N, O, T and Y) had as their main feature a hearth, lying within an approximately rectangular or square house contour marked by rows of posts, often with another central row of posts marking the ridge-line of the roof (Vankina 1970a, 126–131). Almost all of the houses with a clearly identifiable contour had an internal hearth, and none had more than one indoor hearth.

![Image](image-url)

Fig. 6. Eduards Šturms (at centre in the white cap) excavating Dwelling F at Sārnate in 1939 (Šturms 1938–1940).

### 2.1.2 Formalising the concept

In reassessing the ‘dwelling’ concept, we may start by proposing that each of these single-hearth dwellings (e.g., Dwelling N, shown in Fig. 7) can reasonably be assumed to be the abode of a small social unit or ‘household unit’. Furthermore, if the position of the hearth has not changed, we may presume that there was no extended hiatus in the occupation of this particular location: it seems very unlikely that the hearth would have been established anew on precisely the same spot. Thus, a concentration of artefactual remains in association with a
single hearth can be assumed to represent the material culture of one household unit accumulated during a limited time interval. Accordingly, such single-hearth dwellings can be regarded as meaningful units of study in intra-site analysis. (It does not follow, however, that each dwelling was occupied by a different household group: a household group could have abandoned one house and built another at a nearby location, and so we may have, among the excavated dwellings, cases of successive habitation at a slightly different spot by a very similarly constituted group of people.)

But what is meant by remains ‘in association’ with a hearth? It should be explained that sealed contexts are uncommon on this site. Apart from a minor proportion of artefacts documented as actually having been found within the hearth layers, the association of artefacts with hearths and dwelling structures is for the most part not a definite relationship. There are spreads of material in and around hearths and structural remains, but it is by no means certain that all of this material relates to the particular hearth or house in question.

However, because so much of the material has been recorded simply as deriving from one dwelling or another, we must of necessity adhere to Vankina’s division into dwellings as the basic units for intra-site comparison. Comparative analysis of artefacts from the different dwellings can serve to test whether the division into dwellings reflects past social realities. If it is true that most of the artefactual remains from one particular dwelling represent the material culture of one household unit, then we can expect clear-cut differences between artefactual remains from different dwellings.

We can extend the single-hearth principle to concentrations of artefacts associated with a hearth, even where no building remains are present. House remains might be absent in the dryer areas of the site because of poor preservation of organics, or they might be absent because the particular hearth was in fact located out of doors. Whichever is the case, we might still assume that a concentration of artefacts in association with such a hearth represents the material culture of a particular social unit deposited during a limited time interval. Thus, for analytical purposes, such concentrations are also classed as ‘dwellings’, even if we cannot be sure that there was ever a house structure present. In view of these considerations, a term such as ‘occupation unit’ might be regarded as more appropriate, but, for the sake of convenience, the term ‘dwelling’ has been retained. The study of hearths and house remains (Chapters 7 & 8) has, in fact, shown that all the hearths in the part of the site with organic preservation do have associated structural remains of dwellings, which suggests that the absence of
house remains in association with hearths in the part of the site without organic preservation is likely to be simply the result of non-preservation.

In some cases, we have indications of the presence of a house, but no identifiable hearth. Thus, the remains of posts in the southern part of Vankina’s Dwelling I, now distinguished as a separate dwelling (I₂), clearly indicate the presence of a house, but in this case no hearth was identifiable. In this particular case, it is probably because the house was only partly excavated: see Section 7.2). In the drier part of the site, where no organic material was preserved, in many cases a concentration of artefacts is associated with a spread of sand that does not have recorded features (charcoal, ash) confirming the presence of a hearth.

Fig. 7. Plan of Dwelling N (Vankina 1970, Fig. 67).

2.1.3 Minor adjustments

Careful study of the excavation reports has shown that certain adjustments should be made to Vankina’s division into dwellings in order to bring it into line with the ‘single-hearth dwelling’ model outlined above. In some cases, Vankina has lumped together material from two nearby – but clearly separate – scatters of artefacts as a single dwelling. To the extent that the limits imposed by the recording practices permit, it is desirable to split each such ‘composite dwelling’
into two or more separate dwellings. In this manner, for example, Dwelling I has been split into I_2 and I_3, while Dwelling P has been split into P_a, P_b, and P_c.

The principle employed here is that, wherever possible (as far as the limitations of the excavators’ recording practices allow), we should split dwellings, where there is reason to believe that they might represent different occupation events.

As already mentioned, more than one of the excavated dwellings could have been occupied by the same social group, for example if the house was abandoned because it had fallen into disrepair, or if the occupants left the site only to return again and build a new house at a slightly different location. Similarly, a particular hearth with an associated artefact spread, but with no house remains, might be an outdoor hearth used by the same household group that occupied an excavated nearby house. It may be possible to identify such cases, where more than one ‘analytical dwelling’ represents the same social group, if the artefactual remains from two different dwellings are stylistically very similar.

The assumptions on which this model rests begin to break down only in those few cases where structural remains are associated with more than one hearth, or where two sets of house remains have been found close together. In these cases as well, some adjustments need to be made to Vankina’s division into dwellings.

If there is more than one hearth associated with structural remains of indeterminate configuration, there are two likely possibilities. Either (a) one of the hearths is the internal hearth of the house and the rest are adjacent outdoor hearths, or (b) the remains derive from two or more superimposed separate periods of occupation, with or without a hiatus in occupation. The occurrence of two separate occupation events at almost the same location might be confirmed if the artefactual material can be clearly divided into two groups that differ stylistically. This has in fact been done by Vankina for Dwelling 6. She found typological differences between the material from the north-eastern part of this elongated spread of sand and that obtained in the south-western part. Consequently, in the present study this corpus of material has been divided and ascribed to two separate dwellings, 6ZA and 6DR. The poorly-delimited spread of structural remains of Dwelling F was associated with three hearths, but the artefactual remains seem stylistically homogeneous, so for the purposes of site-level analysis, Dwelling F is still considered a single dwelling, although the number of occupation events represented here cannot be determined. (The presence of several hearths is taken into account in the spatial analysis of Dwelling F presented in Chapter 8.)
If there are two nearby hearths and/or house structural remains with two corresponding spreads of artefacts, it is sometimes problematic to delimit one spread of artefacts from another, and so it is difficult to assign artefacts found in the area between the two dwellings to one dwelling or the other. In such cases, the artefacts in question are considered to constitute a separate ‘inter-dwelling finds unit’, which is treated as equivalent to a dwelling for the purposes of comparative analysis. For example, Unit F/K represents material from the south-eastern extension of the excavation area of Dwelling F, which actually lies between Dwellings K and F. The question of the attribution of these artefacts to one dwelling or another can only be resolved through analysis of the material itself.

In the south-western part of ‘Dwelling A’, here classed as A_{DR}, Vankina interpreted the stratigraphy as indicating two separate occupation layers, one above the other, apparently separated by a layer of tree roots (Vankina 1970a, 21, 141). However, the original documentation (Vankina 1970c, 7–10) does not actually seem to provide clear evidence of two separate layers, and consequently no such distinction is made in the present analysis.

In spite of these adjustments, the division into dwellings used in the present work corresponds in large measure to Vankina’s scheme.

Table 1 provides a full list of dwellings, along with finds units that are treated as equivalent to dwellings, and explains the additional subdivisions that have been made in order to adjust Vankina’s division of dwellings to the model of the single-hearth dwelling. Figure 8 is an overall site plan, showing the location of the dwellings. Dwellings B and C, and v‘Hearth 3’, do not appear on the plan, since their precise location is unknown. (Šturms’ documentation proved insufficient for Vankina to identify their location.)
Fig. 8. Lūcija Vankina with the local people who worked on the excavation in 1956 (Vankina 1969, Fig. 32).

Table 1. Revised division of dwellings and separate excavation areas at Šârnate.

<table>
<thead>
<tr>
<th>Dwellings</th>
<th>Year(s) of excavation</th>
<th>Excavated area, m²</th>
<th>Organic preservation*</th>
<th>Notes on division of dwellings, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1953</td>
<td>18</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1953, 1954</td>
<td>86</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1957</td>
<td>84</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1957</td>
<td>38</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1957</td>
<td>49</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>6ZA</td>
<td>1957</td>
<td>23</td>
<td>–</td>
<td>NE part of Dwelling 6 in Vankina’s system, recognised by her as a separate dwelling from 6CR (Vankina 1970a, 82–83)</td>
</tr>
<tr>
<td>6CR</td>
<td>1958</td>
<td>15</td>
<td>–</td>
<td>SW part of Dwelling 6 in Vankina’s system, recognised by her as a separate dwelling from 6ZA (Vankina 1970a, 82–83)</td>
</tr>
<tr>
<td>7</td>
<td>1958</td>
<td>28</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1958</td>
<td>22</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1959</td>
<td>20</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1958</td>
<td>36</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Dwelling</td>
<td>Year(s) of excavation</td>
<td>Excavated area, m²</td>
<td>Organic preservation*</td>
<td>Notes on division of dwellings, etc.</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>1959</td>
<td>32</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>12ZA</td>
<td>1959</td>
<td>44</td>
<td>–</td>
<td>Material associated with the sand layer in the NE part of Vankina’s Dwelling 12</td>
</tr>
<tr>
<td>12V</td>
<td>1959</td>
<td></td>
<td>–</td>
<td>Material associated with the sand layer in the central part of Vankina’s Dwelling 12</td>
</tr>
<tr>
<td>12DR</td>
<td>1959</td>
<td></td>
<td>–</td>
<td>Material associated with the hearth in the SW part of Vankina’s Dwelling 12</td>
</tr>
<tr>
<td>13</td>
<td>1959</td>
<td>20</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1959</td>
<td>9</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>15ZA</td>
<td>1959</td>
<td>42</td>
<td>–</td>
<td>Material associated with the sand layer in the NE part of Vankina’s Dwelling 15</td>
</tr>
<tr>
<td>15DR</td>
<td>1959</td>
<td></td>
<td>–</td>
<td>Material associated with the hearth in the SW part of Vankina’s Dwelling 15</td>
</tr>
<tr>
<td>A0A</td>
<td>1938–40</td>
<td>62</td>
<td>+</td>
<td>Material associated with the hearth and structural remains in the SE part of Vankina’s Dwelling A</td>
</tr>
<tr>
<td>A0R</td>
<td>1954</td>
<td>70</td>
<td>+</td>
<td>Material associated with the hearth and structural remains in the SW part of Vankina’s Dwelling A (‘A1’).</td>
</tr>
<tr>
<td>A2A</td>
<td>1959</td>
<td>56</td>
<td>+</td>
<td>Material associated with two hearths and structural remains in the NE part of Vankina’s Dwelling A. Since there are two hearths, the material may represent more than one period of occupation.</td>
</tr>
<tr>
<td>B</td>
<td>1938</td>
<td>6</td>
<td>–</td>
<td>Exact location within the site unknown (between the River Sārnate and the Sārnate-Semba road).</td>
</tr>
<tr>
<td>C</td>
<td>1938</td>
<td>4</td>
<td>–</td>
<td>Exact location within the site unknown (between the River Sārnate and the Sārnate-Semba road)</td>
</tr>
<tr>
<td>D</td>
<td>1939</td>
<td>25</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>1939</td>
<td>25</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1939, 1956</td>
<td>96</td>
<td>+</td>
<td>Three hearths found – may represent more than one period of occupation</td>
</tr>
<tr>
<td>G</td>
<td>1939, 1940, 1956</td>
<td>83</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1940</td>
<td>20</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>IZ</td>
<td>1949, 1956</td>
<td>126</td>
<td>(+)</td>
<td>Initially recorded as ‘Trench II.’ Material associated with the hearth in the N part of Vankina’s Dwelling I. Since documentation does not permit all the artefacts from IZ and ID to be separated, the two are considered as one unit for the purposes of artefactual analysis.</td>
</tr>
<tr>
<td>Dwelling</td>
<td>Year(s) of excavation</td>
<td>Excavated area, m²</td>
<td>Organic preservation*</td>
<td>Notes on division of dwellings, etc.</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>I₀</td>
<td>1949, 1954, 1956</td>
<td>+</td>
<td></td>
<td>Material associated with the structural remains in the S part of Vankina’s Dwelling I. Initially recorded as ‘Trench II.’</td>
</tr>
<tr>
<td>J</td>
<td>1953</td>
<td>26 (+)</td>
<td></td>
<td>Initially recorded as ‘Trench III.’</td>
</tr>
<tr>
<td>K</td>
<td>1949, 1954</td>
<td>141 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>1953</td>
<td>42 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M₀</td>
<td>1953, 1957</td>
<td>154 (+)</td>
<td></td>
<td>Material associated with the hearth and structural remains in the southern part of Vankina’s Dwelling M. Since the documentation does not permit all the artefacts of this dwelling to be separated from those of M₂₀ and M₂₁, the three are considered as one unit for the purposes of artefactual analysis.</td>
</tr>
<tr>
<td>M₂₀</td>
<td>1957</td>
<td>(+)</td>
<td></td>
<td>Material associated with the hearth in the NE part of Vankina’s Dwelling M.</td>
</tr>
<tr>
<td>M₂₁</td>
<td>1957</td>
<td>(+)</td>
<td></td>
<td>Material associated with the hearth in the NW part of Vankina’s Dwelling M.</td>
</tr>
<tr>
<td>N</td>
<td>1955–1956, 1958</td>
<td>161 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>1956</td>
<td>120 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₂₀</td>
<td>1956</td>
<td>42 (+)</td>
<td></td>
<td>Material from excavation area a of Vankina’s Dwelling P, where a hearth was found</td>
</tr>
<tr>
<td>P₂₁</td>
<td>1956</td>
<td>37 (+)</td>
<td></td>
<td>Material from excavation area b of Vankina’s Dwelling P, where a hearth was found</td>
</tr>
<tr>
<td>P₂₂</td>
<td>1956</td>
<td>18 –</td>
<td></td>
<td>Material from excavation area c of Vankina’s Dwelling P, where a hearth was found</td>
</tr>
<tr>
<td>R₂</td>
<td>1958</td>
<td>116 (+)</td>
<td></td>
<td>Material associated with the hearth in the N part of Vankina’s Dwelling R. Since the documentation does not permit all the artefacts of this dwelling to be separated from that of R₂₀, the two are considered as one unit for the purposes of artefactual analysis.</td>
</tr>
<tr>
<td>R₂₀</td>
<td>1958</td>
<td>(+)</td>
<td></td>
<td>Material associated with three hearths in the S part of Vankina’s Dwelling R. Since there are three hearths, the material may represent more than one period of occupation.</td>
</tr>
<tr>
<td>S</td>
<td>1959</td>
<td>85 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>1953–1955</td>
<td>126 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>1959</td>
<td>56 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1959</td>
<td>42 –</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>1953</td>
<td>36 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1958</td>
<td>100 (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling</td>
<td>Year(s) of excavation</td>
<td>Excavated area, m²</td>
<td>Organic preservation*</td>
<td>Notes on division of dwellings, etc.</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------</td>
<td>-------------------</td>
<td>----------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Y</td>
<td>1958</td>
<td>72</td>
<td>+</td>
<td>Material from excavation area a of Vankina’s Dwelling Z, where a hearth was found</td>
</tr>
<tr>
<td>Zₐ</td>
<td>1959</td>
<td>40</td>
<td>(+)</td>
<td>Material from excavation area b of Vankina’s Dwelling Z, where a hearth was found</td>
</tr>
<tr>
<td>Z₉</td>
<td>1959</td>
<td>40</td>
<td>(+)</td>
<td>A surface artefact cluster identified by Šturms, but not marked on his plan. It is not identifiable with any of the excavated dwellings.</td>
</tr>
<tr>
<td>Hearth 3</td>
<td>(1939)</td>
<td>–</td>
<td>–</td>
<td>Material from a trench 1 m wide connecting Dwellings G and I₀</td>
</tr>
<tr>
<td>G/I₀</td>
<td>1954</td>
<td>7</td>
<td>–</td>
<td>Material found between the structural remains of Dwelling F and those of Dwelling K</td>
</tr>
<tr>
<td>F/K</td>
<td>1953, 1954</td>
<td>38</td>
<td>+</td>
<td>Material found between the structural remains of Dwelling F and those of Dwelling K</td>
</tr>
<tr>
<td>K/M₀</td>
<td>1953, 1957</td>
<td>85</td>
<td>+</td>
<td>Material found between the structural remains of Dwelling F and those of Dwelling M₀</td>
</tr>
<tr>
<td>Trench I</td>
<td>1949</td>
<td>28</td>
<td>+</td>
<td>Not considered a separate dwelling.</td>
</tr>
</tbody>
</table>

* Artefacts or structural remains of wood, bark or bast: + present; (+) very limited; – absent.
Fig. 9. General site plan: dwellings with and without preserved organic remains.
2.2 **Analytical strategy: a theoretical approach**

2.2.1 *‘Cultural grouping’ and ‘cultural analysis’*

An ethnographer studying the inhabitants of a remote Alaskan village, surrounded by mountains and forests, or an island in the Pacific, has the luxury of pre-defined boundaries isolating the human group under study. By contrast, an ethnographer investigating human society in a less isolated area will inevitably face the problem of delimiting the ‘relevant community of interest’, appropriate to the research questions being addressed. Likewise in archaeology, if we wish to discover structure in the archaeological data that we can interpret in terms of the way people lived at a particular place and time, then we need, as a first stage, to isolate a corpus of archaeological material that relates to some meaningful human group.

Although there seems to be a widespread awareness that archaeological research generally proceeds in these two separate stages, the issue tends not to be considered explicitly. Archaeological interest generally tends to focus either on arranging the material into culturally significant groups (identifying ‘cultures’, ‘culture groups’, etc. – the province of traditional ‘culture-historical’ archaeology), or else on the study of patterning within a set of material taken as representing one particular meaningful cultural group (intra-assemblage studies of the kind that have come to the fore since the advent of New Archaeology). In other words, some archaeologists are interested in identifying cultures and traditions, while others are interested the internal workings of such cultures and traditions. The former kind of study might be termed ‘cultural grouping’, the latter ‘cultural analysis’. The two rarely tend to be combined, and so there has been little consideration of how they mesh together.

The issue has been brought up in reflections on the nature of typological study. Namely, it has emerged that typological studies undertaken at each of these two research stages are guided by different underlying ideas. Here we will turn to American theory on archaeological typology from the 1980s and early 1990s (after which the topic seems to have vanished from the agenda of theoretical archaeology, although it was by no means exhausted), and to the work of Klejn (1982) in Russia, who, although he presents a somewhat different standpoint, follows a similar line of reasoning.

The essential idea is that there are different kinds of typology and different kinds of types appropriate to different purposes. In the first stage, ‘cultural
grouping’, where we are identifying cultures and establishing cultural sequences (traditional ‘chrono-typological’ study), the archaeologist employs types that are distinguished with reference to the whole corpus of material. Typological distinctions may be imposed on the material more or less arbitrarily. Mats Malmer, for example, quite consciously adopted such an approach in his research on the Late Neolithic of Sweden: his main concerns were that types should be unambiguously defined and that they should be ‘useful’ for the study of chronological and cultural conditions (Malmer 1962, 6, 56–57). Alternatively, types may be recognised on an intuitive basis: thus, important as a tool in many, many typological studies is the distinction of types on morphological grounds, grouping the material on an empirical-intuitive basis according to forms that are regarded as distinct. Or, types may be empirically extracted by some technique of statistical clustering applied across the whole corpus of material. Patterns of co-occurrence of such ‘culture-historical’ types (or attributes) within a range of assemblages, however they may be derived, provide the basis for grouping those assemblages into sets of assemblages, each set being regarded as representing a shared cultural tradition. Depending on the scale at which we are working, we might in this way recognise ‘culture groups’, ‘cultures’, ‘variants of cultures’, etc. In ‘cultural grouping’, the criterion for evaluating typological schemes is their usefulness as ‘cultural markers’ that contribute to the construction of schemes of cultural development.

Once the corpus under study has been divided into sets of material relating to different cultural traditions, another kind of study (‘cultural analysis’) can proceed, and types of a somewhat different nature may be distinguished. Namely, having isolated a set of material that can be considered as deriving from a relatively homogenous cultural tradition, we are in a better position to discover structure within the data that may be regarded as reflecting patterns within that particular cultural tradition. Here we are dealing with ‘cultural’ or ‘emic’ types – types that can be considered to have had some significance with respect to the lives of the makers and users of the artefacts, who lived within this particular tradition. (In terms of behavioural archaeology, they ‘represent a pattern of behavioural choices’, Dunnell, 1986, 180.) Read (1982, 63) explains: “… a type refers to a specific cultural system. Within this context the type is distinguishable at the level of categories within a cultural system. When several systems are the source, however, the separate artefact groupings of these systems may not be distinguishable.” Similarly, Klejn (1982, 264) sees that “it is only possible to
identify cultural types from among empirical and constructed types under one condition, namely that we proceed from archaeological cultures”.

Whether we are engaged in ‘cultural grouping’ or ‘cultural analysis’, we may choose to apply quantitative techniques. Starting with the pioneering work of Spaulding (1953), a variety of formal, quantitative techniques have been applied in the latter kind of study, with the aim of identifying types that can be considered to have had some salience within one particular culture. These include both ‘attribute association’ techniques, seeking out non-random associations between attributes (originally the $X^2$ test was employed, later refined by applying multivariate or log-linear analysis), and ‘object clustering’ techniques, grouping objects (note: individual objects at this stage, rather than assemblages) on the basis of similarity scores (cluster analysis, using a variety of algorithms) (Dunnell 1986, 178–190).

Quantitative techniques are attractive for a number of reasons: they can prove more powerful tools for discovering structure in the data than traditional ‘eyeballing’ of the material, and moreover the process of grouping material is standardised, even ‘automated’ to a certain degree, freed from certain kinds of personal bias and potentially repeatable. At the same time, although structure is empirically discovered in the data, the kinds of structure we discover and our interpretation of it will partly depend not only upon the particular mathematical technique applied, but also upon the selection of input attribute classes (Dunnell 1986, 180, 193). Thus, any jumble of attributes input to a multivariate analysis might reveal structure in the data, but we can only expect to discover structure that makes sense to us is if we define and select our input attributes on the basis of some pre-understanding of their potential cultural significance.

2.2.2 Patterning at different scales

It is also important to appreciate that whenever we seek to discover patterning in the material, rather than arbitrarily dissecting the material (regardless of whether we are engaged in ‘cultural grouping’ or ‘cultural analysis’), the kind of patterning we can distinguish also depends in large measure on the scale at which we try to distinguish it. Thus, from an ethnographic perspective, we might start with assumptions about the appropriate scale. Are we seeking ‘family-scale’ patterns, ‘community-scale’ patterns or patterning common to larger-scale human groups?
However, in archaeology, we tend not to be presented with sets of material directly interpretable in social terms, and so the issue of scale has a specifically archaeological dimension. In the realm of ‘cultural analysis’, attempts have been made to justify on theoretical grounds an appropriate scale of archaeological study for discovering patterning in human culture. Dunnell (1986, 181) defends Spaulding’s idea that typological study be restricted to a single assemblage or a single occupation (‘component’) at a site: “Since behaviour patterns are transactional phenomena like those treated by ethnographers, the aggregate of objects should be similarly bounded. Assemblage or component is as close an approximation to a community or set of interacting peoples as could be obtained from the archaeological record.”

Cowgill (1990, 68) sets out at greater length considerations that suggest the importance of studying patterning in the material relating to small human groups:

“… within a single community, over a relatively short time, makers and users of artefacts have the opportunity to be aware of differences. They may feel that variation in some properties is unimportant, but, with regard to the properties they think are important, they will be conscious of similarities and interested in differences. One kind of interest is in maintaining standards. If one’s society shares an idea of what a certain object should be like, there are reasons to avoid objects that differ too much from that idea … At the same time, it is unsatisfactory for the makers/users if the different standards are not noticeably different. For example, it is unlikely that distinct concepts of ‘small’ and ‘large’ projectile points will exist unless the majority of points that are produced with the intention of making them ‘small’ are, in fact, noticeably smaller than those intended to be ‘large’. That is, if the ‘small/large’ contrast was important to the ancient artisans, it is unlikely that they will have made many points that they, themselves, could not easily sort as ‘small’ or ‘large’. The only way that I can imagine to make such sorting feasible is to avoid making many points of intermediate size. Such avoidance is detectable to us today, provided that, in tabulating relative frequencies of different point lengths, we take care to study a collection that reasonably represents the objects produced by a set of artisans who shared fairly similar standards; that is, an assemblage, as Spaulding has repeatedly argued.”

Whether or not we agree with this line of argument, in ‘cultural analysis’ it does seem best to proceed from the bottom upwards: to focus initially on the smallest sets of material that we can distinguish as representing separate human groups,
provided that they furnish a sufficient sample of material. In this way we can expect to reduce as far as possible the ‘blurring’ that can arise if we lump together material that represents a mix of different traditions. If we wish to draw conclusions about patterning common to larger human groups, we can compare the results we obtain from the analysis of several different small-scale groups. Cowgill (1990, 74–75) describes a procedure for this kind of comparative analysis.

### 2.2.3 Spheres of culture

Apart from studying patterns of human culture at various scales (meaning the relative size of the human community under consideration), archaeologists are also interested in particular spheres of human activity, and they tend to divide the corpus of material remains in accordance with such interests. Commonly, they focus on patterns relevant to the shaping of particular materials (considering the set of artefacts made from that particular material: ‘the flint’, ‘the pottery’), i.e. particular ‘industries’. Thus, we have Clarke’s (1978, 492) definition of an industry as a ‘a set of single-material artefact-type assemblages from a continuous space-time area, taxonomically linked by the mutual technological affinities’. However, they also tend to divide cultural remains according to other criteria, frequently cross-cutting raw materials. Thus, we have sets of cultural remains relevant to particular economic, social or ideological fields of activity (‘fishing gear’, ‘house remains’, ‘ornaments’, ‘items of prestige’).

This kind of initial division of the material seems to be shunted aside in definitions of an archaeological culture such as Clarke’s: for him, a culture is a ‘polythetic set of specific and comprehensive artefact-types which consistently recur together in assemblages within a limited geographical area’ (Clarke 1978, 247). On the contrary, it seems much more appropriate to proceed, in the initial stage, ‘cultural grouping’, from a consideration of traditions relating expressly to particular kinds of physical materials or to particular spheres of human activity. Thus, we may view an archaeological culture as representing a consistently recurring combination of traditions relating to particular materials (i.e., industries) or spheres of activity. This seems more in accord with traditional approaches to the culture concept, certainly within our region.

It seems preferable to be even more specific about cultural traditions: thus, we might consider, where possible, attributes and types that relate to particular aspects of the treatment of particular materials. We have attributes that relate
specifically to pottery decoration, and we may focus on these alone, distinguishing different traditions of pottery decoration. And if we do so, then we should not over-generalise in formulating our conclusions. Thus, if we are able to distinguish groups of vessels characterised by different decoration, this can only be regarded as evidence of different traditions of pottery decoration: it is an insufficient basis for postulating differences in overall pottery production traditions, since other aspects of production, such as fabric preparation, vessel construction, surface finishing etc., which might give a different pattern, are not being considered. On the other hand, if variables reflecting several different aspects of pottery production are found to co-vary, then we may reasonably postulate the existence of different overall production traditions.

In a similar vein, Stilborg (1997, 26) maintains that a holistic perspective on ceramic material is needed in order to find ceramic traditions, emphasising coherence as the key element in the delineation of a ceramic tradition. ‘The use of the same clay type/same clay bed … or the non-random use of different clay qualities for different ceramic products; the use of the same tempering material, but with an orderly, proportional differentiation in amount and fineness according to the size and type of a vessel, and finally systematic relationships between shape elements, vessel types and vessel sizes may all in different combinations characterise a ceramic craft tradition’.

Similarly, Brazaitis (2002, 52) defines a pottery style as ‘a set of technological, morphological and decorative features exhibited by the pottery vessels belonging to it’.

A similar idea is implicit in a study of Funnel Beaker vessel shapes and decoration by Gebauer (1988), where the results of five separate correspondence analyses of decorative designs on vessel rim, neck and basal zones, as well as decoration techniques and vessel shapes, were compared to produce an overall grouping.

If there are different traditions of production, this does not automatically mean that there will be corresponding traditions of artefact use. Although pottery, for example, would have been made to serve specific technical, social and ideological needs, which will to a considerable degree determine the characteristics of the pottery (see Stilborg 1997, 25), pottery vessels could have been made in significantly different ways, but used in the same manner, or vice versa, and this needs to be studied separately.

In cases where groups of morphologically similar or functionally equivalent objects can be reliably distinguished from the outset, the archaeologist will tend
to focus on each group separately (‘the flint scrapers’, ‘the ceramic bowls’, ‘the net sinkers’). The variables used also tend to be specific to particular materials, objects of particular morphology or objects having a particular function: e.g. ‘temper material’ relates to all pottery, ‘concavity of the base’ relates specifically to trapezoidal pendants, and ‘form of the blade’ relates to spearheads. We may have good reason to combine the results of the study of functionally or morphologically related objects to draw wider conclusions, even if they are made from different materials. Thus, we might observe that, for example, a particular tradition of net float forms coincides with a particular tradition of sinker forms, and suggest that this is evidence for an overall tradition of fishing-net production and use.

Caution in generalising from our results should also be exercised at a higher level of grouping: we cannot assume, a priori, that a cultural tradition with respect to one kind of material or one specific sphere of human activities can, by itself, serve to identify an archaeological culture. Researchers often seem to assume that the study of one particular category of material serves better than others, and is itself virtually sufficient, for definitive cultural grouping of the material, e.g. pottery in the Neolithic, metal ornaments in the Iron Age. While it may prove in the end that consideration of other categories of material is simply redundant for the purpose of grouping material into cultures, it cannot be assumed at the outset that this is so. A counter-example is presented by Lang (2005): he considers the distribution of different pottery groups, burial customs and metal artefact types across the whole of the East Baltic region in the Roman Iron Age and finds that each category of material exhibits a different distribution pattern. It is concluded that “‘archaeological cultures’ are ... deeply artificial and often misleading formations, hardly appropriate in any prehistoric study” (Lang 2005, 24). Voicing similar concerns, Räähälä (1996, 117) claims, with regard to the study of Comb Ware in Finland, that “total confusion is caused when the concepts ‘culture’, ‘ceramic group’ and ‘people’ are used interchangeably.”

However, just because co-variation of different classes of material of the kind interpretable as providing evidence of archaeological cultures may not be observable in a specific time period with a specific set of cultural data, it does not follow that no such co-variation will be identifiable at any place or time in prehistory. In any case, it is certainly not essential, either for the purpose of building up a general cultural-chronological framework, or for the next stage, the search for intra-cultural patterning, that we confirm the theoretical model of a culture as a stable combination of traditions. But if we do find that the groups of
assemblages distinguished on the basis of cultural remains deriving from one sphere of human activity (e.g. pottery production), coincide with groups of assemblages distinguished on the basis of cultural remains deriving from another sphere of human activity (e.g. architectural tradition), then we do seem to have some basis for suggesting that we are dealing here with a wider-ranging cultural tradition, one that spans several different spheres of human activity and might indeed be termed ‘a culture’. Of course, we must consider the chronological and spatial range of the set of assemblages under study, and assess whether our ‘culture’ has any spatial breadth or time depth. (We may be dealing with what is, in spatial and/or temporal terms, a very restricted phenomenon.)

Evidently, a word of explanation is required in order to situate this theoretical discussion. It has very largely been restricted to the field of archaeological methodology, examining the techniques that are, or could be, applied by archaeologists in order to identify patterning in the data. In the author’s view, these techniques can best be put to use if there is a sound knowledge of how they work. In any case, from the application of pattern-seeking techniques, entities that we know as types, traditions and cultures may or may not emerge. On the other hand, to look at the interpretation of such entities in anthropological or philosophical terms would mean entering a much wider arena of debate. Exciting and illuminating as the wider debate on culture may be, it is not an area for us to venture into within the scope of this work.

2.2.4 Kinds of attributes and types

Finally, some words about the kinds of attributes and types considered at the different stages of study. We are evidently able to employ some or all of the same nominal variables at the ‘cultural grouping’ and ‘cultural analysis’ stages: the difference is that in the first case we apply them in grouping assemblages and in the second case in grouping objects or identifying non-random attribute combinations. Higher-order variables, namely ordinal and interval variables, obtained from the measurement of particular objects, evidently cannot be directly applied at the ‘cultural grouping’ stage, where we are grouping assemblages: some form of data reduction is needed to facilitate this – which will inevitably entail a loss of information. Thus, there may be a temptation to break down interval variables to obtain nominal variables (e.g. length measurements into ‘long’ and ‘short’), but if we do this at a point when we are still dealing with material that represents a mix of cultural traditions, we risk losing significant
information or confusing the analysis. The ‘cultural analysis’ stage, when we are dealing with material regarded as culturally homogenous, provides a much better framework for seeking patterning in ordinal and interval variables.

Although, as described above, a culturally mixed corpus of material does not present the best conditions in which to seek to identify culturally significant types, it seems that those types that are empirically discovered at the ‘cultural grouping’ stage may be retained into the ‘cultural analysis’ stage of study. This evidently applies to types distinguished on the basis of clear morphological differences, etc. Thus, if, in a corpus of ceramic vessels, it is possible to distinguish clearly between pots and bowls at the initial stage, when we are still dealing with a corpus of material from a mix of cultural traditions, then, *a fortiori*, the pots and bowls can be held to be salient as culturally significant types within particular cultural traditions distinguished within this corpus (in those traditions, of course, whose ceramic repertoire includes these particular forms). At the same time, once we have distinguished the different ceramic traditions, we are in a better position to scrutinise each particular vessel form within each particular tradition to see whether further subdivision is possible: thus, at this stage, we may examine whether the pots in one tradition are further subdivisible on the basis of size, morphology, etc.

The same appears to be true of objects that we have identified at the outset as having had clearly distinct functions. We may take into account evident functional differences right from the beginning of the study, although when we come to analysing one particular cultural tradition, we may be in a position to make further functional distinctions among a set of objects originally regarded as functionally equivalent.

At a practical level, we do need a strategy for identifying those artefact forms or traits likely to serve our purpose in the ‘cultural grouping’ stage of study: those that are likely to reflect variation between – rather than within – different cultural traditions. Here we may draw on the experience gained in previous research, using those variables that have previously proved suitable for studying inter-cultural variation. For example, in the case of Neolithic pottery, the most obvious attributes to choose might be those that have traditionally been used to differentiate pottery-making traditions in the Neolithic of this region, such as pottery fabric, surface texture and the form of stamp used for impressed decoration. Another logical approach would be to employ types or nominal variables that exhibit large differences in abundance between assemblages.
2.3 Analytical strategy: application to the Sârnate material

As explained in Section 2.1, the basic contextual unit for the archaeological finds at Sârnate is the dwelling or occupation unit. The assemblage of material from each dwelling is regarded as reflecting the cultural patterning of a very limited, close-knit social group during a relatively short period. Since the material from the site is already divided fairly neatly into smaller assemblages, there might seem to be no need for ‘cultural grouping’, and, in accordance with the methodological considerations outlined above (Section 2.2.2), we might wish to proceed immediately with a ‘cultural analysis’ of the material from each dwelling, and then compare the results. However, most of the dwelling assemblages do not furnish a sufficiently large sample of material for quantitative analysis. And we are in any case interested in a more general grouping of the material, in order to obtain an overall picture of the corpus and consider it in a wider regional context. Accordingly, the first step will be a ‘cultural grouping’ study: to group the assemblages on the basis of attributes and types serving as ‘cultural markers’. Following this, the set of archaeological material from each identified group of dwellings will be analysed, in order to identify patterning common to the human group represented by the material from that group of dwellings. We will evidently be dealing here with patterns relating to a higher level of social interaction, above the level of the individual household.

In this study, the Sârnate dwellings are initially grouped on the basis of their pottery assemblages (Chapter 3). For a number of reasons, this class of material seemed the most appropriate one to begin with: in the first place, potsherds have been found in sufficient numbers in most of the dwellings to permit quantitative analysis; secondly, we may draw on a wealth of previous research in identifying attributes that may be expected to exhibit inter-cultural variation; and, thirdly, because schemes of cultural development during the Neolithic are already to a very large degree pottery-based, new findings can readily be viewed in the context of previous research. However, while the focus on pottery is indeed a traditional one for the period and region in question, this is not to say that the author agrees with the idea of setting pottery on a pedestal as a kind of cultural indicator par excellence for the Neolithic. Consequently, in order to test whether the cultural patterning identifiable in the pottery is indicative of patterning at a more general level, extending to other spheres of human activity, a comparative study is also undertaken, using a similar quantitative method, on another class of material, namely on the corpus of amber ornaments (Chapter 4). Then, in Chapter
5, there follows an analysis of each pottery group, and a comparison between the groups. The fishing gear and the structural remains of hearths and houses come into consideration at a later stage of the research (Chapters 6–8).

Of course, although the Sārnate material may turn out to be informative about regional-level patterns of cultural change, we certainly cannot assume that the material from the dwelling assemblages at this one site gives a representative picture of such regional developments. The ‘household assemblages’ at this one site, that we are arranging into cultural groups, may best be viewed as representing small snippets of time and place. In order to obtain a clearer picture of the regional pattern, we would be best advised, instead, to conduct this kind of grouping on a corpus of material consisting of assemblages from a number of sites of this same period across the region concerned, and in that case, we might obtain a somewhat different pattern. Thus, although we might hope that our cultural grouping of the Sārnate material also provides evidence about patterns at the regional level, it is, first and foremost, an aid in analysing the cultural material from this one site.

Finally, it should perhaps be made clear that, while previous research on the Neolithic of this region has included interpretation of the material in terms of ethnic groups or ‘tribes’ (see Section 1.2.3), this kind of interpretation does not fall within the scope of the present study.

2.4 Statistical methods

The extensive use of statistical methods is one of the major innovations in the present study, contrasting starkly with Vankina’s predominantly intuitive and qualitative analysis and with the dominant mode of analysis of archaeological material not only in the Baltic countries, but more widely as well.

Recent decades have seen a gradual incorporation of more complex statistical techniques as a normal part of archaeological analysis and a growth of literature dealing expressly with mathematics and statistics in archaeology (Doran & Hodson 1975; Fletcher & Lock 1991; Baxter 1994; Shennan 1997). A wide range of statistical packages are available that bring even complicated multivariate techniques to the archaeologist’s fingertips. It seems that, with a bewildering variety of possible methods available for use, it is the lack of familiarity with statistical theory among archaeologists with an education in the humanities that constitutes the major barrier to the wider application of statistics in archaeology.
The archaeologist begins with only a partial understanding of the cultural significance of the data collected from an archaeological assemblage. For example, while previous studies of Neolithic pottery in the East Baltic region have made extensive use of decoration as an indicator of cultural-chronological regularities, the significance of variation in many other features of pottery is poorly understood. This means that it is impossible to know beforehand exactly which attributes of the material will reflect the cultural phenomena that are of interest in the study. Accordingly, the strategy is one of characterising each artefact with respect to a wide range of criteria and then using exploratory statistical techniques to reduce the data to a form where it can be inspected for archaeologically useful structure (Baxter 1994, 1). Scanning the data ‘by eye’ is not sufficient to reveal latent structure within large volumes of data, where structure depends on the strength and pattern of associations between variables.

At the same time, multivariate methods such as correspondence analysis can only be expected to produce useful results if the variables included in the analysis are appropriate to the problem at hand. This requires that prior knowledge of the significance of different variables be applied in the formulation and selection of variables for analysis. (See Shennan 1997, 218.)

At a later stage of analysis, statistical tests may be used to ascertain the significance of observed patterns.

In the East Baltic, statistical analysis has remained largely the province of physical anthropologists (whose findings have, however, been extensively used by prehistorians). Exploratory statistical analysis has been utilised in very few published archaeological studies in this region. Exceptional in this regard is Vasks’ (1991, 97–100) application of a technique developed by Genning and Borzunov (1975) in order to compare pottery assemblages from several Bronze Age and Early Iron Age hillforts in central Latvia, which he separated into two groups. Larsson (2006, 276–277) presents a correspondence analysis of animal species used for tooth pendants found with the graves of the Mesolithic-Neolithic cemetery at Zvejnieki in Latvia.

The author was not able to find any examples of the use of statistical tests on archaeological material in the East Baltic region: archaeologists have limited themselves almost exclusively to the calculation and comparison of percentages and means.
2.4.1 Univariate methods

For interval variables, histograms and cumulative frequency curves were used to visually study the shapes of distributions, in order to assess normality and identify polymodal distributions. Summary statistics – the arithmetic mean and mode – are cited.

2.4.2 Bivariate methods

For interval variables, the creation of a bivariate plot was the first step in studying the relationship between two variables, important for identifying non-linear relationships.

Correlation was the main statistical measure used to study relationships among nominal and interval variables. The correlation coefficient (r) is used to measure the strength of association between interval variables (Fletcher & Lock 1991, 105–110; Shennan 1997, 139–144). A special case of the correlation coefficient, point biserial correlation, is used to measure the strength of association between a nominal variable and an interval variable (Edwards nd, 72–73). In both cases, the significance of the correlation coefficient is determined from a table of critical values. For correlation, the distributions of interval variables should approximate to a normal distribution, and this was tested using the Kolmogorov-Smirnov One Sample Test for Normality (Fletcher & Lock 1991: 99).

The coefficient φ, another special case of the correlation coefficient, is used to measure the strength of association between two nominal variables. In this case, the significance test is X², which is calculated quite simply from φ (X²=nr²) (Edwards nd, 68–72, 96–98). Significant values of φ were identified in correlation matrices, but for small samples, X² is inappropriate, so Fisher’s exact test (Agresti 1990, 59–62) was used as a supplementary test of association between pairs of nominal variables that showed significant φ values. The two-tailed P-values for Fisher’s exact test are cited.

Correlation was performed using the correlation statistical analysis tool of the ‘Microsoft Excel’ package, which can automatically create a correlation matrix for a large number of variables. Significant values can then be extracted from the matrix. Other statistical calculations were performed using the ‘Microsoft Excel’ add-in programme ‘Xlstat’. 
Kendall’s rank correlation or Kendall’s $\tau$ (Fletcher & Lock 1991, 122–125; Shennan 1997, 145–147) was used to test for association between pairs of interval variables in cases where the distribution of one of the variables does not approximate to a normal distribution, since in such cases the use of the correlation coefficient would be inappropriate. The Mann-Whitney test (Fletcher & Lock 1991: 88–89; Shennan 1997, 65–68) was used as a test of difference to compare a nominal variable with an interval variable that has a distribution not approximating to a normal distribution, i.e. in cases where point biserial correlation would have been inappropriate.

Thus, various correlation techniques were used to identify statistically significant associations from among a very large number of possible relationships between pairs of variables – an exploratory technique accompanied by statistical testing. In citing statistical results, the sample size ($n$) and two-tailed probability ($p$) is given throughout. The null hypothesis of no association between the variables was rejected in cases where a two-tailed $p$-level of <0.05 (5% level of significance) was obtained.

### 2.4.3 Ternary diagrams

Ternary diagrams were used to compare assemblages on the basis of three variables that sum to 100 percent (Shennan 1997, 311–312). In such a diagram, each side of the triangle represents a percentage scale, and the value of each variable is read on the appropriate scale. For example, in Fig. 14 the pottery assemblages of the dwellings are compared on the basis of percentages of the three different types of exterior finish: smooth, striated and undulating. (Vessels with indeterminate surface finish are excluded.) Dwelling 3 lies exactly at the corner marked ‘Smooth’, and so has only smooth-walled vessels. Assemblages along on the sides of the triangle have two of the possible three types of surface finish. Dwelling 2, located on the side of the triangle lying between the ‘Smooth’ and ‘Striated’ corners, has 55% striated vessels and 45% smooth-walled vessels, no vessels having an undulating surface. In the assemblages distributed within the area of the triangle, all three types of surface finish occur. Thus, in Dwelling ADR, not far from the centre of the triangle, 45% of vessels are striated, 33% are undulating and 22% are smooth-walled.

Ternary diagrams were created using the ‘Ternplot’ programme, made available on the internet by D. Marshall (undated).
2.4.4 Correspondence analysis

Correspondence analysis was used extensively as an ordination method suitable for studying data consisting of counts or presence/absence of nominal categories (Shennan 1997, 308). This technique has been popularised in recent decades as a method for distinguishing groups within the material and for seriation, alongside principal components analysis, which may be regarded as more suited to continuous data (Madsen 1988, 7–27; Baxter 1994, 100–139; Shennan 1997, 308–345).

The author has preferred to use correspondence analysis where some form of cluster analysis may also have been applied because the former demonstrates more explicitly the relationships between variables that determine grouping of the material.

Correspondence analysis was performed using the ‘Microsoft Excel’ add-in programme ‘Xlstat’.
3 Pottery: study methods and cultural grouping

3.1 Introduction

3.1.1 Background to the pottery

In his brief comments on the porous pottery he recovered at Sārnate, Šturms (1940, 60–61) remarks on the resemblance to Comb Ware and to the køkkenmødding (i.e. Ertebølle) pottery of the western Baltic. However, taking into account the stratigraphic sequence at Dwelling C of the Purciems settlement, where he had found similar pottery overlying pottery he regarded as Comb Ware and Corded Ware, he concluded that the Sārnate finds could not predate the Late Neolithic. The quality of workmanship exhibited by the wooden artefacts and the discovery of a bronze axe nearby both suggested to him that the site was in fact Bronze Age. The results of pollen analysis, published some years later, appeared to confirm this (Dreimanis 1947).

Vankina’s excavations provided much new material. In addition to dwellings with the porous pottery already recovered by Šturms, which she named ‘Sārnate Ware’, Vankina also discovered dwellings with Comb Ware, which was very familiar from other sites. She divided the dwellings into two groups in accordance with the pottery classification: in keeping with Šturms’ system, the dwellings with Sārnate Ware were designated by letters (A–Z), while the dwellings with pottery she classed as Comb Ware were numbered (1–15). The pottery collection was characterised on a dwelling-by-dwelling basis (Vankina 1970a, 114–124), and provided a framework for sorting the Neolithic pottery from other sites in western Latvia (Vankina 1974). Sārnate provided the first radiocarbon dates for Sārnate Ware and for the Neolithic of western Latvia as such. The five dated samples (Table 2, dates TA-24, TA-26, TA-265, Bln-769, Le-814), all from the dwellings with Sārnate Ware, firmly placed this material in the Neolithic, putting to rest the Bronze Age theory once and for all (Vankina 1970a, 139–140). No radiocarbon dating was undertaken of samples from the dwellings with Comb Ware: instead, considering the age range of Comb Ware generally accepted at the time and the mutual influences detectable in the pottery, it was regarded as partly contemporaneous and partly later than the Sārnate Ware (Vankina 1970a, 140–
141). It has since become apparent that Comb Ware in the East Baltic is earlier than was thought in Vankina’s day (see Section 3.3.5).

Mainly utilising Vankina’s publications, other authors, such as Timofeev (1975, 20–23), Rimantienė (1979, 144–147; 2005, 46, 50) and Girininkas (1994, 95–101, 126–131), have tried to correlate the wares distinguished at Sārnate with material from their own study areas and fit them into wider regional schemes.

### 3.1.2 Aims and structure of the pottery study

In the present study on Sārnate, pottery plays a major role in ‘cultural grouping’ and is subsequently investigated in detail from the perspective of ‘cultural analysis’. The reasons for such a major focus on pottery have already been set out in Section 2.3. It should be added that the pottery from Sārnate is particularly attractive for study since a large proportion of the material is relatively less fragmented, compared with pottery from many contemporaneous sites in the region, providing more information about vessel morphology. Also, traces of use alteration are preserved on a large part of the Sārnate corpus, owing to the good preservation conditions and gentle cleaning after recovery.

In utilising the pottery for ‘cultural grouping’, i.e., grouping the dwellings on the basis of different traditions of pottery production (wares), we are addressing once again the chrono-typological aspects that were studied by Vankina, applying new data and new methods, and comparing our conclusions with hers. This is the main subject of the present chapter, preceded by an introduction to the methods of data collection and the pottery attributes considered in the study. The results of our ‘cultural grouping’ are placed within the regional context of Neolithic pottery. This chapter is followed by a brief examination of amber and other classes of material, broadening the frame of the ‘cultural grouping’ study (Chapter 4).

Chapter 5 is devoted to ‘cultural analysis’ of the pottery, i.e. internal analysis of each group in turn, considering each as a sample of a particular pottery ware, along with a comparison of the different wares. The final sections of this chapter cover more general issues relating to pottery production and use.

### 3.2 Data collection

Out of the total of 53 dwellings, 47 produced pottery, there being none at all from Dwellings 9, 11, 12V, 12DR, 13 or 15ZA, or from Trench 1. Three separate finds units, not clearly assignable to any of the dwellings, also included pottery (F/K,
G/I and K/M D), and there was pottery among the cluster of surface finds recorded as Hearth 3.

In this re-analysis of the Särnate pottery, the main focus is on rim sherds (numbering 1201). There are two reasons for this. First, it was clear at the outset that the overwhelming majority of vessels have decoration on the rim, while exterior decoration tends to be sparse or absent in much of the assemblage. Thus, in order to obtain a maximum of information without spending a great deal of time examining mass material, the body sherds from most of the assemblage were excluded from study. Body sherd data has been presented in tabular form by Vankina (1970a, Tables 4, 5).

However, the study does include an examination of all the body sherds from the numbered dwellings (1–15 DR) in the north-eastern part of the site. This is material that Vankina regarded as mostly Comb Ware. Pottery preservation was poor in this area of the site, evidently a consequence of the relatively dry conditions. Several of these dwellings produced very few rim sherds or none at all, while decorated body sherds occur much more frequently than in the rest of the collection. Bearing in mind these conditions, it was felt that adequate characterisation and analysis of the pottery from these dwellings was only possible if body sherds were also considered. Accordingly, a separate data table was created, including both rim and body sherd data for these dwellings.

There are very few vessel bases (12 were identified), most of which could not be assigned to particular vessels identified on the basis of rim sherds. The characteristics of vessel bases were recorded in a separate data table.

Much more information can be obtained from vessels that can be physically or graphically reconstructed. There are several published vessel reconstructions (Vankina 1970a, Figs. LVI–LVIII, LXXI, LXXIII, LXXIV). Apart from vessels that can be reconstructed to a large extent, there are also a number of vessels whose upper body only can be reconstructed. This is possible if there is a sufficiently long section of rim to permit the rim sherd to be correctly oriented in relation to the plane of the mouth, enabling an accurate profile of the rim and upper body to be drawn.

Thus, four data tables were created:

1. vessels, based on rim sherd analysis (total: 393 pots and 18 bowls, from Dwellings A DA–Zb and 1–15 DR: data summarised in Table 3, Appendix 1, Tables 8, 9);
2. bases (total: 12);
3. all sherds – rims, body sherds and bases (total: 2721, from Dwellings 1–15DR; data summarised in Appendix 1, Table 10);
4. vessels with correctly oriented rim profiles, a subset of the vessels considered in 1 (total: 56).

### 3.2.1 Quantification

In recording the rim-sherd data, the basic unit is the ‘vessel equivalent’, represented by one or more rims deriving from the same vessel and clearly distinct from other vessel rims found in the same dwelling. This is a ‘minimum number of vessels approach’, such as are widely used in pottery studies (Rice 1987, 292). This particular variant of the ‘minimum number of vessels’ – based entirely on rim sherds – had been used by other researchers (e.g., Jaanusson 1981, 47) and was suggested by the nature of the material.

In several dwellings, certain clusters of sherds were identified as belonging to particular vessels already at the time of excavation, and were packaged and documented as such. A quantitative measure based on sherd number or weight would have ignored this important information. Since some vessels were represented by a high number of sherds or a high total weight of sherds, chance factors could lead to over- or underestimation of the importance of particular pottery attributes, depending on whether they were present or absent on the well-represented pots. Such chance factors could have a major impact on the results of analysis, especially because of the small size of assemblages from the individual dwellings at Särnate.

A ‘minimum number of vessels’ approach, while avoiding this source of error, does have its own problems. A subjective element is unavoidable with this technique (Rice 1987, 292). Based on previous experience and appreciation of the pottery manufacturing process, the researcher must judge whether two rim sherds are sufficiently alike to be regarded as definitely attributable to the same vessel. If the vessel has been formed irregularly, one section of the rim may differ quite markedly from another, which could lead the researcher to mistakenly attribute to two or more different vessels rim sherds that actually derive from the same vessel. Conversely, if, for example, the potter has made two or more vessels almost identical in overall form, surface finish, rim form and decoration, then it will be virtually impossible to distinguish the rim sherds of these vessels, and they are likely to be attributed to a single vessel.
However, the character of Neolithic pottery from this region serves to reduce this source of error. Impressed decoration is found on the majority of rim sherds, and the impressions vary considerably in form, orientation, spacing and position on the rim. Thus, variation in rim decoration, along with the shape of the rim, greatly facilitates the grouping of rim sherds deriving from the same vessel. Because the pottery assemblages from the individual dwellings are generally not very large, the rim sherds from a particular dwelling can be compared quite easily.

In summary then, for small assemblages of heterogeneous material – as is the case for rim sherds at Sārnate – estimation of minimum number of vessels seems a good technique for quantification. For more homogenous material or with a large assemblage, some other quantitative measure, based on sherd number of weight, would have had to be used instead.

For the body-sherd analysis of the numbered dwellings, sherd number had to be used as the quantitative measure, in view of the absence of diagnostic features (poor preservation, and lack of variety in decoration) and because of the size of the assemblages, particularly that of Dwelling 3.

Bases were considered separately, as they usually could not be related to particular vessels as identified from rim sherds.

### 3.2.2 Attributes and measurements recorded on the pottery

The author’s investigation of the pottery was limited to macroscopic characteristics: petrographic microscopy and physico-chemical analysis were beyond the scope of this study. However, three sherds from Sārnate were subject to petrographic and physico-chemical analysis in the 1960s in the frame of a characterisation study of prehistoric ceramics from Latvia (Vītols & Vītiņš 1962; Birzniece & Vītiņš 1963), and some thin and polished sections have recently been examined by Ole Stilborg of the Laboratory for Ceramic Research at the University of Lund (Dumpe et al. forthcoming).

The pottery attributes and measurements are listed in the following sections, grouped according to the stage in the manufacture and use of the vessel that they relate to. These features were recorded for all vessels (identified in the study of rim sherds), unless otherwise indicated.
3.2.3 Fabric preparation

The great majority of vessels at Särnate originally had organic matter or shell in the fabric. The organic matter has mostly burnt away, while the shell has evidently dissolved in the acid conditions of the bog. In either case, when recovered archaeologically, the pottery fabric is porous. The presence of various forms of pores was recorded:

- **platy pores**, indicative of shell that has been dissolved in the acid conditions,
- **elongate pores**, presumably indicating plant matter, and
- **granular (approximately equiaxial) pores**, which could indicate seeds, dissolved limestone fragments, etc.

For vessels with mineral inclusions, the size and roundedness of particles was considered. The following classes of mineral inclusion were distinguished:

- **sand** (Ø=0.05–0.09 cm),
- **fine gravel** (Ø=0.1–0.19 cm),
- **coarse gravel** (Ø>0.2 cm),
- **fine crushed rock** (Ø=0.05–0.09 cm),
- **medium-grade crushed rock** (Ø=0.1–0.19 cm), and
- **coarse crushed rock** (Ø=>0.2 cm).

The quantity of inclusions was not estimated. Such estimates are problematic for fabric with platy pores, which characterises much of the Särnate material. The quantity of mineral inclusions could more easily have been calculated, and this might be an important contribution to future study of that part of the assemblage where mineral inclusions are relatively more common.

At a more general level, the record of inclusions and pores was used to divide the material according to three different kinds of pottery fabric:

- **porous**,
- **mineral-tempered**, and
- **with both pores and mineral temper**.

3.2.3.1 Forming techniques

*Coiling technique.* In cases where coil junctions were visible, or where the orientation of platy pores revealed the vessel building technique, this was recorded. In studies on Neolithic pottery from this region, considerable attention
has been given to the method of coil joining, as determined mainly from the
color of breaks along coil junctions. In studying the Neolithic pottery of the
Baltic Sea region, researchers have distinguished two basic methods of joining the
coils:

1. **U-technique.** The coil junction observed in a vertical break is rounded, in the
   shape of an upturned letter ‘U’. This shape of coil junction has been observed
   in Narva Ware and in Neolithic pottery from Scandinavia (Gurina 1967, 34;
   Zagorsksis 1973, 57; Loze 1975, 59; 1983, 94; Hulthen 1977, Fig. 15;
   Rimantienē 1979, 120, Fig. 95; Kriiska 1996, 380). A variant of this
   technique, the so-called ‘H-technique’, with fingernail impressions at the coil
   junction, is characteristic of Ertebølle pottery (Andersen 1975, 57; Koch
   Nielsen 1987, 109–111);

2. **N-technique.** The coil junction when seen in a vertical break is oblique. The
   coils are flattened before application and are laid on from the inside of the
   vessel with some vertical overlap between the new coil and the one below.
   This technique allows the two coils to be pressed together more firmly than
   with the U-technique. This form of coil junction has often been observed on
   Narva Ware and Comb Ware (Gurina 1967, 34; Zagorsksis 1973, 57; Loze
   1975, 59; 1983, 94; Kriiska 1996, 380; Rimantienē 1979, 120, Fig. 95), and
   also occurs on Ertebølle pottery, although in southern Scandinavia it is more
   characteristic of Funnel Beakers (Andersen 1975, 58; Koch Nielsen 1987,
   109–111).

Pottery specialist Baiba Dumpe has approached the question of coiling from the
perspective of experimental work. She emphasises that thick cylindrical coils are
suited for application in the U-technique, being modelled upwards into a flat band
after application. On the other hand, the N-technique makes use of coils flattened
into lamellae before application. According to her experiments, N-technique is the
faster of the two. (Dumpe 2003, 114–116).

The appearance of the coil junction actually depends essentially on the
placement of the next coil of clay (regardless of whether it is cylindrical or flattened)
in relation to the previous one: if a new coil is added directly on top of the previous
one, then a U-shaped junction results, whereas if there is some overlap between the
coils, then an N-shaped junction will result. Although this is traditionally regarded as
a technologically important difference, in some cases it may simply reflect variation
in individual working practices, and indeed it has been observed in Early Neolithic
material that coil junctions on the lower body tend to be more oblique, while on the
vertical part of the body the coils have generally been added directly one over the other. (Dumpe et al. forthcoming).

It is also important to note that subsequent scraping or trimming of the vessel, which involves removing part of the original thickness of the wall, can markedly alter the appearance of the coil junction, leading to erroneous assessment of the coiling technique (Dumpe, pers. comm.).

*Wall thickness.* For rim sherds, the thickness of the vessel wall was measured 3 cm below the top of the rim. This point of measurement was chosen because the everted rim or other rim elaborations, which may affect the rim thickness, do not extend this far below the top of the rim. A similar approach to rim thickness measurement has been adopted by Jaanusson (1981, 63): it is a suitable approach for studies focussing on vessels as distinguished on the basis of rim sherds.

Of course, the wall could vary in thickness down the vessel profile, so a series of thickness measurements should ideally be obtained for each vessel (Hulthén 1974, 11). In order to prevent sagging due to increased weight, taller vessels generally need to have thicker walls. This difference will be most noticeable in the lower parts of the vessel and may not influence the wall thickness of rim, neck and upper body sherds (Stilborg 1997, 136).

Although in view of the research approach adopted in this study, no systematic data was collected on the thickness of lower-body sherds, a small number of measurements were made on the thickness of the lower body in cases where lower-body sherds could be identified as deriving from particular vessels distinguishable on the basis of their rims. In no case was any major difference found between the wall thickness just below the rim and the thickness of the lower body.

*Surface finish.* The finish of the inner and outer surface of the vessel was recorded as smooth, striated or undulating. An undulating surface, with approximately vertical shallow troughs and ridges, is a distinctive and quite common characteristic of the exteriors of Neolithic pottery from the region.

3.2.3.2 *Rim form*

Pottery researchers are always coming up against the question of how best to characterise and classify upper body and rim forms. Consistent classification of vessel and rim forms is essential, wherever this characteristic is to be used in comparative studies.
A relatively successful and widely applicable scheme for classifying the rim and upper body of pottery vessels encountered in the East Baltic Neolithic is that developed by Rimutė Rimantienė (Types I, C, CS and S), originally used to analyse the Šventoji collection (Rimantienė 1979, Fig. 95; 2005, Fig. 20), and subsequently applied more widely by Lithuanian archaeologists for characterising assemblages and for regional comparisons.

There are, however, certain problems associated with the practical application of this system. It seems the main problem concerns the vessels with a direct rim. Type I indicates vessels with a vertical upper body, while Type C refers to vessels whose upper body curves inwards. In other words, it is a distinction between restricted versus unrestricted vessels. However, it is only possible to determine whether the vessel really is restricted in those cases where the rim sherd can be correctly oriented with respect to the plane of the vessel mouth. In practice, more often than not, the rim sherd cannot be correctly oriented, and thus Type I cannot be routinely distinguished from Type C.

Using Rimantienė’s classification, a certain loss of information occurs because, within Type I, the variants are distinguished on the basis of the character of the lip – whether it is rounded (I₁) or flat (I₂), while, within Type C, Variant C₁ includes all inward curving rims without thickening, regardless of whether the lip is rounded or flat. Variant C₂ and Type CS include vessels with inward curving walls and oblique (inward-facing) flat lips, but there is no appropriate form for straight-sided vessels with an oblique lip.

Such problems arise mainly because Rimantienė developed her system for the specific purpose of classifying the Šventoji material, and has thus included only those forms occurring in the Šventoji pottery.

In order to facilitate precise classification of rim forms at Särnate and comparison with other assemblages, the author has developed a typological scheme based on somewhat different principles. It is hoped that this classification may prove useful in studying material from other sites and indeed might be applied to hand-formed pottery from other periods. With this in mind, it covers a very wide range of rim morphology. After all, the range of simple forms that can be obtained by manipulating the upper coils of clay added to the vessel is not unlimited, and this means that consistent description should be possible even across regional and chronological boundaries.

In classifying vessel rims according to this system of forms, particular attributes of the rim are first recorded separately, and then the combination of the
attributes present determines the classificatory division that the vessel rim falls into.

**Overall rim profile.** First, the general form of the rim is recorded: is it everted? (As already mentioned, it is often impossible to separate restricted from unrestricted vessels, so this attribute is not used.) An everted rim is defined as a continuation of the vessel wall above a clear change in angle within the upper 3 cm of the vessel wall, if the part of the wall that lies above the change in angle is of similar thickness to the wall of the vessel body. On the other hand, if the wall begins to narrow into a wedge-shape immediately above the change of angle, then this feature is instead considered an outwards-projecting or everted lip on a direct rim (see below).

It should be emphasised that this classification relates expressly to rim forms, and does not take into account the overall form of the vessel, although there is evidently a fairly close correspondence between the form of the rim and the form of the upper body: everted rims usually occur on restricted vessels, lending the vessel an S-shaped profile, while direct rims may be found on both restricted and unrestricted vessels.

**Width of everted rim.** For vessels with everted rims, the width of the inner face of the everted rim was measured.

**Orientation of the everted rim in relation to the body (everted rims only).** The orientation of the inner surface of the rim, as viewed in profile, in relation to the inner surface of the vessel body, was estimated as: (1) steeply sloping, (2) sloping at a 45-degree angle, (3) gently sloping or (4) perpendicular (Fig. 10: A).

**Rim-body transition (everted rims only).** For vessels with everted rims, the character of the change in angle between the inner surface of the vessel body and the inner surface of the everted rim was determined. There are two alternatives: curved transition or sharp angle.

**Lip shape.** Next, the lip is characterised. It may be rounded, tapering or flat.

**Lip projecting/thickened (flat and rounded lips).** The lip may be projecting/thickened on the inside or outside.

**Lip orientation (tapered lips only).** Of course, tapered lips cannot have any thickening: instead they can be straight, everted or turned inward, with respect to the line of the wall of the vessel body or everted rim.

**Width of lip (flat lips only).** For flat lips, the width of the surface of the lip is measured.

**Orientation of the lip in relation to the body (flat lips only).** The orientation of the surface of the flat lip, as viewed in profile, in relation to the inner surface of
the vessel body or everted rim is estimated as (1) steeply sloping, (2) sloping at a 45 degree angle, (3) gently sloping or (4) perpendicular (Fig. 10: B).

Fig. 10. Pottery attributes and measurements. A – orientation of the everted rim, as viewed in profile, in relation to the inner surface of the vessel body: 1 – steeply-sloping; 2 – sloping at 45°; 3 – gently sloping; 4 – perpendicular. B – orientation of the flat lip in relation to the inner surface of the vessel body or everted rim: 1 – steeply-sloping; 2 – sloping at 45°; 3 – gently-sloping; 4 – perpendicular; C – measurements on rim impressions: a – length of impressions; b – width of impressions; c – angle of the long axis of the impressions in relation to the line of the vessel rim.

Rim type/subtype. Based on the states of the above-described attributes, rims may be classified according the following typological scheme, which has three hierarchical levels: basic forms, types and sub-types (Fig. 11):

I – direct rim (wall straight or inward-curving):

   Ia – lip rounded:
   Ia1 – not thickened or projecting;
   Ia2 – thickened or projecting outside;
   Ia3 – thickened or projecting inside;
   Ia4 – thickened or projecting outside and inside;

   Ib – lip tapered:
   Ib1 – straight lip;
   Ib2 – everted lip;
   Ib3 – lip turned inward;

   Ic – lip flat, perpendicular to vessel wall
   Ic1 – not thickened or projecting;
   Ic2 – thickened or projecting outside;
   Ic3 – thickened or projecting inside;
   Ic4 – thickened or projecting outside and inside;
Id – lip flat, oblique (facing inwards) in relation to the vessel wall:
Id1 – not thickened or projecting;
Id2 – thickened or projecting outside;
Id3 – thickened or projecting inside;
Id4 – thickened or projecting outside and inside.

S – everted rim:
Sa – everted rim curved on the inside at the transition to the body:
Sa1 – lip rounded;
Sa2 – lip tapered;
Sa3 – lip flat;
Sb – everted rim angled on the inside at the transition to the body:
Sb1 – lip rounded;
Sb2 – lip tapered;
Sb3 – lip flat.

The vessel subtypes in this classification correspond to the following types in Rimantienė’s scheme: Ia1=Rimantienė’s I1; Ic1=I2; Id1=C1; Id3=C2; Id4=CS1 and CS2; Sa1, Sa2 and Sa3=S1; Sb1, Sb2 and Sb3=S2. The remaining forms have no exact equivalent in Rimantienė’s classification.

All of the rim types occur in the Sārnate material. However, some of them are rare, and some of the sub-types have not been observed at all. For example, Type Ib and its subtypes (tapered lips) are much more characteristic of the Early Neolithic pottery of Eastern Latvia, and occur very rarely at Sārnate.

‘Crenelation’ or vertical undulation of the lip, a feature that can result from the impression of long stamps (see Section 3.2.2.5), and horizontal undulation of the lip, resulting from manipulation of the lip between the fingers (Section 5.1.1), are features duly noted but not considered within the classification of rim forms described above, since they do not affect the general form of the rim and lip as seen in profile.
3.2.3.3 Vessel size and morphology

*Rim diameter.* For vessels assumed to be cylindrical, if a rim sherd includes an arc of the rim of sufficient length and if it can be correctly oriented in relation to the plane of the vessel mouth, then the diameter at the rim can be determined with the help of a special template (Rice 1987, Fig. 7.9).

3.2.3.4 Decoration

The pottery is decorated with pits and various kinds of stamp impressions, as well as incised lines. Separate records were made of the decoration on the exterior surface, on the lip and on the inner face of the everted rim, the latter two being grouped together for the purposes of analysis as rim decoration. *Pits* and *fingernail impressions* require no further comment, but various special forms of impressed decoration need some explanation:

*Knot/plait impressions.* ‘Knot’ and ‘plait’ impressions of various forms are common (Fig. 30: 1; Vankina 1970a, Fig. LIX: 8, 12; Fig. LX: 1, 2, 12, etc.). Although they show a considerable range of diversity, they could not be systematically classified, since their morphology tends to be quite indistinct and
they are often filled with organic residue or soot. The decorating technique is discussed in Section 5.2.1.

![Fig. 12. Striated rim sherd decorated with tooth impressions and pits, and with a drilled hole. Dwelling N. A 11419: 82. Image: N.Grasis.](image)

**Tooth stamp.** A common form of impressed decoration, described by Vankina as ‘fine teeth’ (Figs. 12, 25; Vankina 1970a, Fig. LXIX). The tooth stamp impression consist of a row of 4–8 small lenticular or linear marks, with a total recorded length of up to 2.9 cm, evidently made with some sort of comb-like serrated implement, but distinct from the rectangular-toothed comb impressions that characterise Comb Ware. Where the impressions are shallow, the teeth of the stamp appear as short lines, but where the impression is deeper, each tooth has left a boat-shaped depression. As discussed in Section 5.2.1, the kind of stamp used to make these impressions remains a mystery.

**Impressed bars.** The ‘bars’, 0.5–1.8 cm long, were made using some sort of rectangular stamp (Fig. 42: 1; Vankina 1970a, Fig. LXX).

**Comb impressions.** True comb impressions often occur on the pottery of the group of dwellings in the north-eastern part of the site, which has been classed as Comb Ware. Unfortunately, as already mentioned, the surfaces of sherds from these dwellings are badly degraded, and it was often impossible to distinguish between comb and wound cord impressions. In cases where definite comb impressions were observed, they were classified according to the scheme of
Kokkonen (1978, 37) into four length/width groups (in a different order to Kokkonen’s):

1. short and narrow (length: <2.5 cm; width: <0.2 cm);
2. short and wide (length: <2.5 cm; width: >0.2 cm);
3. long and narrow (length: >2.5 cm; width: <0.2 cm);
4. long and wide (length: >2.5 cm; width: >0.2 cm).

Rim decoration, found on a very large proportion of vessels, was subject to particular scrutiny. The following features were recorded:

- **Length of rim impressions** (Fig. 10: C, a).
- **Width of rim impressions** (Fig. 10: C, b).
- **Angle of rim impressions.** The angle of the long axis of the impression in relation to the line of the vessel wall (Fig. 10: C, c). The significance of this measurement is difficult to interpret, and it was not employed in further analysis, apart from the identification of a zigzag arrangement of impressions on the rim.
- **Crenelated lip.** Vertical undulation of the lip because long stamps (usually plaits) have been deeply impressed into it, which is quite a common feature (Vankina 1970a, LIX: 8, 12; LX: 1, 2, 12 etc.).

The decorative designs on vessel surfaces could usually be characterised only in general terms, because of the fragmented state of the material. The following basic design patterns were recognised:

- **Single horizontal row.** A single horizontal row of impressions, made using a single form of stamp.
- **Multiple rows with one stamp.** Two or three horizontal rows, using only a single form of stamp.
- **Multiple rows with alternate stamps.** Two or more alternating horizontal rows of impressions of different stamps (for example the most common form of comb and pit decoration of Typical Comb Ware).
- **Undulating lines.** One or more undulating horizontal lines.
- **Zigzags.** One or more horizontal zigzags.
- **Lozenges.** In one or more horizontal rows.
- **Herringbone.** In one or more horizontal rows.
- **Complex designs.** More elaborate designs that do not correspond to any of the above patterns. (Usually the whole design cannot be reconstructed.)
3.2.3.5 Firing characteristics

Colour profile. The only systematically recorded attribute indicative of firing conditions is the colour profile of the vessel wall. The oxidised (red/yellow) or unoxidised/reduced (grey) state of the fabric was recorded separately for the interior surface, the core of the wall and the exterior surface.

Three kinds of commonly-occurring colour profiles are more readily interpretable in terms of oxidation conditions: 1) both surfaces and centre oxidised; 2) dark core, both surfaces oxidised; 3) both surfaces and core dark. Occasionally, vessels with a light colour on one surface were recorded, but these are not considered because such a profile is difficult to interpret in technical terms.

It is important to mention that the colour of the pottery fabric seems to be in some measure determined by the conditions of preservation, since it was observed that pottery from the waterlogged part of the site generally showed a dark core in the vessel wall, while pottery from the drier areas of the site tended more commonly to be light yellow throughout. Evidently, the preservation conditions in the drier part of the site have promoted oxidation of the fabric. This factor partially seems to mask colour differences that might result from differences in fabric constituents and firing conditions, so fabric colour was not one of the basic features considered in grouping the dwelling pottery assemblages.

It should also be borne in mind that the colour profile of the vessel walls can be altered by exposure to heat during the use-life of the vessel.

For a certain proportion of vessels, the colour profile of the wall could not be determined. (Fresh breaks were not made, the colour profile being determined from existing breaks.)

3.2.3.6 Use alteration and repair

The study of alteration features on pottery vessels resulting from their use provides direct evidence of pottery function. Archaeological, ethnoarchaeological and experimental study has begun to reveal the interpretive potential of patterns of sooting, organic residue and various kinds of attrition (cracking, spalling and pitting) on pottery vessels (e.g. Van Diest 1981; Hally 1983; Koch Nielsen 1987; Skibo 1992; Bērziņš & Dumpe 2005).
The presence of deposits on the outer and inner surfaces was recorded for all vessels. The intensity of soot and other residues on the outer surface was assessed in terms of the presence/absence of two attributes:

1. layer of residue on outer surface;
2. residue on outer surface not forming a separate layer.

Similarly, organic residue on the inner surface of the vessel was recorded in terms of two attributes:

1. layer of residue on inner surface;
2. residue on inner surface not forming a separate layer.

Surface residues and other features were recorded in more detail on those vessels for which properly oriented profiles could be drawn, noting features such as pitting, spalling and fine cracks on the exterior or interior surfaces, and permeation of the vessel wall by the vessel contents (filling of pores and colour alteration).

**Drilled perforations.** The presence of drilled holes in vessel walls, made after firing, was recorded for all vessels. Such features, known on pottery from various parts of the world, are usually taken as evidence of repair (‘crack-lacing’), though it has also been suggested that such holes they may have been for threading cords to hang the vessel or, in certain cases where such perforations are abundant, for straining the contents of vessels used as colanders (Vankina 1970a, 116).

### 3.3 Grouping of dwelling pottery assemblages

Grouping of the dwellings in terms of their pottery was based on attribute counts (Appendix 1, Tables 8, 9) created using the vessel data. Since the vessels were identified solely from a study of the rim sherds (see Section 3.2), it excludes Dwellings 6DR, 7, 8, 10, 12ZA, 14, 15DR and P₀, which produced body sherds only. Also, as noted in Table 1, in three cases the documentation did not permit separation of the pottery assemblages obtained from dwellings originally regarded as constituting a single dwelling, but now split into two or three separate dwellings. Accordingly, for the purposes of the pottery study, they must be considered as single units. Thus we have I₁/I₀, M₀Z₀/M₀Z₀ and R₂/R₀.

In accordance with the considerations discussed in Section 2.2.3, it seems advisable, even at the ‘cultural grouping’ stage, to treat separately vessel forms that are unequivocally distinguishable at the beginning of the study. In this case,
we already have Vankina’s distinction between two quite different vessel forms: round pots and oval bowls (Vankina 1970a, 118–119). Accordingly, to reduce the possibility of obscuring patterning in the material, our ‘cultural grouping’ of the pottery is based only on one of the two vessel forms, the round pot, which constitutes the bulk of the material. The oval bowls, far fewer in number, come into consideration after the material has been grouped on the basis of the round pots.

As a basis for grouping the dwelling pottery assemblages, the following analyses were undertaken on the vessel data (Appendix 1, Tables 8, 9):

1. grouping according to fabric (ternary diagram);
2. grouping according to exterior surface finish (ternary diagram);
3. grouping according to rim form (correspondence analysis);
4. grouping according to impressed rim decoration elements (correspondence analysis).

The final, overall grouping takes into consideration the results of all four analyses.

3.3.1 Grouping in terms of fabric

Three general classes of pottery fabric are recognised:

1. porous (i.e. organic/shell tempered);
2. mineral-tempered; and
3. porous with mineral temper as well.

The relative frequency of round pots with these three mutually exclusive classes of fabric can be represented in a ternary diagram (Fig. 13), showing only dwellings with at least five vessels whose fabric class could be determined. Excluded from this analysis are a small proportion of vessels showing a dense fabric without mineral temper or pores.

As can be seen, porous fabric is the dominant class. A large proportion of dwellings have exclusively porous pottery, and many have a minority of vessels with porous-mineral fabric. Only Dwellings 3 and S have mineral-tempered vessels, and in fact in Dwelling S there is only a single vessel of this kind. Even in Dwelling 3, porous fabric and porous-mineral fabric are the dominant classes.
3.3.2 Grouping in terms of exterior surface finish

Fig. 14 shows, in the form of a ternary diagram, the relative proportions of round pots with three different kinds of exterior surface finish – smooth, striated and undulating – in dwellings with at least five vessels.

It can be seen that the majority of dwelling pottery assemblages are dominated by vessels with a striated surface. Two groups of dwellings with mixed
surface finish can be distinguished. The first includes dwellings where the vessels with a striated exterior predominate, but with a minority of vessels (14–24%) with a smooth surface. This group includes Dwellings G, M_{ZA}/M_{ZM}/M_{D} and S. The second group includes dwellings with a majority of vessels with a striated surface, but with up to 32% of vessels with an undulating surface. These include A_{DA}, F, I_{Z}/I_{D}, K, L, N, X and Y. Dwellings A_{DR} and A_{ZA} lie between the two groups. Three dwellings – P_{b}, T and Z_{b} – have only vessels with striated surfaces. Two dwellings – 2 and W – have a high proportion of smooth-walled vessels, while Dwelling 3 differs from the rest in having smooth-walled vessels only.

Fig. 14. Ternary diagram of the composition of the dwelling pottery assemblages in terms of the percentages of vessels with smooth, undulating and striated exterior finish (including only those dwellings that have at least five vessels with determinable surface finish).
3.3.3 Grouping in terms of rim form

Correspondence analysis was applied in an attempt to group the dwellings according to counts of the more common rim sub-types: 1a1, Ic1, Ic2, Id1, Id2, Id3, Id4, Sa1, Sa3, Sb1 and Sb3. Included in the analysis were dwellings with at least five pots corresponding to these sub-types (Fig. 15). The absolute numbers of vessels belonging to the various sub-types were compared. The remaining dwellings, with less than five vessels of the listed rim form sub-types, are included as ‘supplementary values’. These are shown in the scatterplot, but the data from them are not used in the mathematical processing that determines the arrangement of the factorial axes.

The first two factorial axes together reflect 67% of total inertia – a reasonably good representation of the relationships between the attributes (Appendix 2, Table 11). The most frequent sub-types, Sa3 and Id1, account for 38% and 31% respectively of inertia in the first axis. In the second axis, Sb1 and Sb3 sub-types account for most of the inertia – 39% and 31% respectively (Appendix 2, Table 12).

In the scatterplot, two groups of dwellings can be seen, as well as outliers. The first group, on the left hand side of the diagram, is associated with Sub-Types Id1, Id2 and Id3, i.e. direct rims with a flat lip slanting inwards. It includes Dwellings 1, 2, 3, 4, 6A, E, 12/13, M2/M5/M8, P, R2/R3 and W, as well as Unit K/M. Dwellings 5 and D are also fairly close to this group.

The second group, at bottom right, is associated with Sub-Types Sa1 and Sa3, i.e. everted rims angled on the inside at the transition to the body. It includes Dwellings ADA, ADR, AZA, G, H, K, N, O, U, X, Y, Zb and Hearth 3, along with Unit F/K. Possibly, two sub-groups can be identified here: Dwellings K and G, along with Hearth 3, characterised by rim Sub-Type Sa1 (rounded lip) may be separated from the rest of this group, characterised by Sub-Type Sa3 (flat lip).

Dwellings C, F, J, P, and Z, with a mixture of rim forms, lie between the two mentioned groups. Of these, F and P lie closer to the group on the right hand side of the diagram.

Dwellings L, S and V might be considered as forming a separate group, characterised by Sub-Types Sb1 and Sb2 (everted rim angled on the inside at the transition to the body).
Fig. 15. Correspondence analysis of dwelling pottery assemblages according to rim form sub-types, first two factorial axes.
3.3.4 Grouping in terms of rim decoration

Correspondence analysis was also applied in order to group the dwellings according to counts of the most frequent forms of impressed rim decoration elements on the round pots: pits, tooth stamp, bars, knot/plait, comb/wound cord and fingernail impressions (Fig. 16). The first two factorial axes together account for 81% of total inertia (Appendix 3, Table 13). 66% of inertia in the first axis is determined by comb/wound cord. Knot/plait and fingernail impressions account for 16% and 14% respectively. On the second axis, tooth stamp has the greatest influence on the position of the dwellings, accounting for 63% of inertia, with bars giving another 25% (Appendix 3, Table 14).

The dwellings with less than five vessels with the listed rim decoration elements are again included as ‘supplementary values’ shown in the scatterplot, but not affecting the results of the analysis.

At bottom left in the diagram there is a very tight group: dwellings characterised by knot/plait or pit decoration on the rim. It includes Dwellings ADA, ADR, AZA, C, F, G, K, L, N, O, Pb, S, T, U, V, X, Y, Zz and Zb, as well as Units F/K, K/M and G/I. Dwelling 2 also lies close to this group. Above this group there appears a more scattered group: dwellings characterised by tooth stamp and bars. It includes Dwellings D, H, IZ/ID, MZA/MZR/MD, Pa, RZ/RD and W.

Dwelling 3, characterised by comb or wound cord and fingernail impressions on the rim, is isolated from the rest, while Dwelling 5 lies in the middle, between Dwelling 3 and the large group on the left.

Comparison of the two correspondence analyses shows that the grouping of dwellings according to rim form very largely coincides with that obtained by considering rim decoration.
Fig. 16. Correspondence analysis of dwelling pottery assemblages according to stamp forms used for rim decoration, first two factorial axes.
3.3.5 Overall grouping

The results of the grouping in terms of temper, exterior surface finish, rim form and rim decoration were combined in order to derive an overall grouping of the dwelling pottery assemblages. The grouping in terms of surface finish, rim form and rim decoration is shown in Fig. 17, omitting temper for clarity. Three major groups of dwellings may be distinguished:

1. Dwellings characterised by pots with comb/wound cord decoration on the rims and direct rims with inward-slanting flat lips (Type Id). Of these, only Dwelling 3 is clearly set apart from the other groups in the above-described analyses: it is quite distinctive in terms of vessel fabric, surface finish (smooth finish only) and rim decoration (comb/wound cord). Dwelling 5 may also be grouped with Dwelling 3 in terms of temper, surface finish, rim form and rim decoration (Appendix 1, Tables 8, 9; Figs. 15, 16). Dwellings 1 and 6ZA share the same vessel rim sub-types and fabric (Appendix 1, Table 8), besides which we may note that the body sherds from Dwellings 1 and 6ZA characteristically have comb/wound cord decoration (Appendix 1, Table 10). The three sherds from Dwelling 4 may also be included in this group, since one has exterior decoration of comb or wound cord impressions (Appendix 1, Table 10). Several other dwellings that only produced body sherds may also be included in this group. These include: Dwellings 8 and 10, which have body sherds with wound cord or comb impressions, Dwelling 7, which has mineral-tempered sherds, and Dwellings 12ZA and 15DR, where sherds with both pores and rock temper predominate (Appendix 1, Table 10).

2. Dwellings characterised by pots with inward-slanting direct rims with flat lips (Type Id) and tooth stamp or bar decoration on the rim: D, IZ/ID, M2A/M2B/M2C, P, RZ/RD and W. Apart from one vessel with an undulating surface from IZ/ID, the vessels from these dwellings all have striated or smooth exterior surfaces. Dwellings E and 2 correspond to this group in terms of rim form, but to the next group, Group 3, in terms of rim decoration. We may include them in Group 2, since among the body sherds from these dwellings, there is a considerable proportion with tooth stamp decoration (Appendix 1, Table 10; Vankina 1970a, Table 4).

3. Dwellings characterised by pots with everted rims curved on the inside (Type Sa), having pits or knot/plait impressions on the rim, and with a striated, undulating or smooth surface: Dwellings ADA, ADR, AZA, G, K, N, O, T, U, X,
Y and Zₚ as well as Unit F/K. Dwelling F, with a mixture of rim forms, can best be included in this group because of the high frequency of undulating exteriors, characteristic of part of this group. Pₚ, likewise has a mix of rim sub-types, but shows the characteristic knot/plait and pit rim decoration of this group. Hearth 3, with one Sa1 vessel, is also included in this group.

Attempts were made to further divide these groups. The attempted subdivision of Group 1 is described in Section 3.3.7. Also, further correspondence analyses were undertaken on Group 3, in an attempt to subdivide it, but no distinct sub-groups could be discovered, so the grouping procedure stopped here.

The vessel assemblages from Dwellings C, H, J and Zₚ, and likewise Units G/I0 and K/Mₚ, cannot be assigned to one of the groups, since they show a mixture of characteristics. Three other dwellings, L, S and V, might be regarded as

Fig. 17. Diagram showing the overall grouping of dwelling pottery assemblages according to exterior finish, rim form and rim decoration stamp.
constituting a separate small groups, characterised by everted rims angled on the inside at the transition to the body (Type Sb).

Dwelling 6DR, which produced only body sherds, is also closest to Group 2, considering the sparse decoration and the high proportion of porous sherds (Appendix 1, Table 10). However, the form of elongate impressions on the body sherds of vessels from this dwelling could not be ascertained due to poor preservation, so the dwelling is not included in any group. Dwellings 14 and Pc likewise had body sherds only, and these lack characteristic features enabling the dwellings to be assigned to one of the groups.2

The three groups of dwelling assemblages correspond in large measure to Vankina’s division of the material into Comb Ware and two phases of Sārnate Ware. The pottery from most of the numbered dwellings was regarded by Vankina as Comb Ware. She included in the Early Phase of Sārnate Ware the material from Dwellings A, F, J, K, N, T, X, Y and Z, where vessels with everted or straight walls occur. In the Late Phase she included Dwellings 2, D, E, I, M, R, P and W, where the vessels have inward-slanting lips thickened or projecting on the inside, and where decoration with bars and tooth stamp occurs. (Vankina 1970a, 114–124, 137–141; 1974, 39).

Since the dwelling pottery assemblages form separate groups, rather than a series, and since there are no vertical stratigraphic relationships between the assemblages, there is no possibility of using typological seriation or vertical stratigraphy to determine the chronological sequence of the groups. Instead, we have to rely on the radiocarbon dates and on ‘horizontal stratigraphy’ (i.e. the location of the dwellings within the site).

There are eight radiocarbon dates for the Sārnate dwellings (Table 2; Fig. 18). Five of the datings were performed in the 1960s, and these all relate to pottery assemblage Group 3 and some of the ungrouped dwellings. Three of these datings are for animal bone, wood and charcoal samples collected at the time of excavation, in one case (TA-26) using material from two different dwellings. Another sample was connected at the time of pollen sampling in 1968, i.e. nine years after the excavation had finished. This sample – wood from the cultural layer in the area of Dwellings N, S and L – was subdivided and submitted for dating to two laboratories (Bln-769 and Le-814). (Vankina 1970a, 138–139).

2 There are slight differences between the grouping of dwellings, as presented here, and the original grouping presented in Bērziņš 2003b.
Recently, two AMS dates have been obtained for Group 2. The dated material is organic residue on the inside of body sherds decorated with the tooth stamp from Dwellings I_D and M_D.  

These dates indicate that Group 2 predates Group 3. Since the two groups appear quite distinct, they may be given the status of separate pottery wares: Group 2 will be referred to as Early Sārnate Ware, and Group 3 as Late Sārnate Ware.

It is important to note that this sequence is the reverse of Vankina’s scheme: Early Sārnate Ware corresponds to her ‘Late Phase’, while Late Sārnate Ware is equivalent to her ‘Early Phase’ (Vankina 1974, 39). In her time, Vankina only had radiocarbon dates for the dwellings with Sa and Sb rims (i.e., Group 3 or Late Sārnate Ware), and she assigned a later date to the dwellings with tooth stamp or bars and Id rims, which showed Comb Ware influence, since at that time Comb Ware was viewed as a relatively late phenomenon, of the mid- to late 5th millennium BP (Vankina 1970a: 137, 140–141).

In view of the much earlier dates now obtained for Comb Ware (see below, this section), Early Sārnate Ware showing the influence of the former could have been made from this time onwards, and indeed the date of 3960–3780 cal. BC for the sherd from Dwelling M_D is in accord with such an idea. The sample sherd belongs to a vessel decorated on the outside with several rows of lozenges of tooth stamp impressions, supplemented in the uppermost row with pits (Vankina 1970a, Fig. LXXIV: 4), a design clearly betraying Comb Ware influence.

The case of the sample sherd from Dwelling I_D is not so clear. The sherd cannot be assigned unequivocally to one of the vessels distinguished on the basis of rim sherds, and in any case this particular dwelling has not produced any pottery that shows an unmistakable Comb Ware influence. Indeed, the date of 4365–4265 cal. BC is very early for Comb Ware influence to have been possible, even considering the new dating evidence (described below), and we may well be dealing here with material that predates the appearance of Comb Ware in the East Baltic region. This date is close to the earliest date for a ceramic layer in the coastal region of western Lithuania, south of the study area. This date, 4500–4250 cal. BC (5530±110 BP, Vs-808) has been obtained for a layer at Dakeriškė 5 with pottery classed as Narva Ware (Iršėnas & Butrimas 2000, 135). From eastern Latvia, there are much earlier dates for layers with pottery: 5620–5370 cal. BC (6533±120 BP, Ri-272) at Osa and 5470–5220 cal. BC (6350±60 BP, TA-1746) at

---

3 A 11416: 42; A 11417: 313.
Zvidze (Zagorskis et al. 1984; Loze 2006, 36–37). It is quite possible that future research will lead to the clear identification of a pre-Comb Ware horizon in western Latvia as well.

Table 2. Radiocarbon dates from Sārnate settlement. Calibrated according to OxCal version 3.10, using the atmospheric curve after Reimer et al. (2004).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dwelling group</th>
<th>Material</th>
<th>Lab. code</th>
<th>$^{13}$C value vs. PDB</th>
<th>$^{14}$C age BP</th>
<th>Calibrated age BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling I$_0$</td>
<td>Early Sārnate Ware (Group 2)</td>
<td>residue on potsherd with tooth impressions (A 11416:42)</td>
<td>Ua-33828*</td>
<td>-29.2‰</td>
<td>5480±40</td>
<td>4365–4320 (47.3%)</td>
</tr>
<tr>
<td>Dwelling M$_0$</td>
<td>Early Sārnate Ware (Group 2)</td>
<td>residue on potsherd with tooth impressions (A 11417:313)</td>
<td>Ua-15984*</td>
<td>-27.4‰</td>
<td>5065±75</td>
<td>3960–3780 (68.2%)</td>
</tr>
<tr>
<td>Dwelling T/V</td>
<td>Late Sārnate Ware (Group 3) / ungrouped</td>
<td>animal bone</td>
<td>TA-26</td>
<td></td>
<td>4700±250</td>
<td>3750–3000 (68.2%)</td>
</tr>
<tr>
<td>Dwelling S</td>
<td>ungrouped</td>
<td>wood</td>
<td>TA-265</td>
<td></td>
<td>4630±70</td>
<td>3620–3600 (2.0%)</td>
</tr>
<tr>
<td>Dwelling R$_2$/R$_0$</td>
<td>?</td>
<td>charcoal</td>
<td>Tln-2916</td>
<td></td>
<td>4570±65</td>
<td>3500–3460 (7.5%)</td>
</tr>
<tr>
<td>Dwelling N, S and L</td>
<td>Late Sārnate Ware (Group 3) / ungrouped</td>
<td>wood</td>
<td>Le-814</td>
<td></td>
<td>4510±110</td>
<td>3370–3080 (61.5%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bln-769</td>
<td></td>
<td>3630–3580</td>
<td>3540–3330 (52.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3220–3180 (3.5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3160–3130 (2.7%)</td>
<td></td>
</tr>
<tr>
<td>Dwelling Y</td>
<td>Late Sārnate Ware (Group 3)</td>
<td>charcoal</td>
<td>TA-24</td>
<td></td>
<td>4490±250</td>
<td>3550–2850 (68.2%)</td>
</tr>
</tbody>
</table>

*AMS date, corrected in accordance with $^{13}$C value.
The dates for Late Sárnate Ware together cover a long chronological span, and moreover they are all from the early days of radiocarbon dating. Accordingly, they may be suspected to be much less accurate than the recently obtained dates for Early Sárnate Ware. On the other hand, since the samples include a variety of materials and were dated by three different laboratories, we might consider that there is unlikely to be any systematic bias affecting all five dates. Additional AMS dates would evidently be very useful for determining more precisely the age of the Late Sárnate Ware.

Fig. 18. Plot of calibrated radiocarbon dates from Sárnate.
Another new date (conventional) has been obtained from charcoal in one of the hearths of Dwelling R2/R3 (it is not known which hearth it derives from). Although the pottery associated with at least some of the four hearths here has been assigned to Early Sārnate Ware, the radiocarbon date for the charcoal is relatively late, corresponding to the previously-obtained dates for Late rather than Early Sārnate Ware. It is possible that the particular hearth producing the dated charcoal actually relates to the period of occupation represented by Late Sārnate Ware. Because of the inadequate contextual data for the pottery and charcoal from this excavation area, interpretation of this radiocarbon date is very problematic and it is not considered in the analysis.

Because of the lack of organic material suitable material for sampling, there are no radiocarbon dates for the Comb Ware group at Sārnate. However, there is new dating evidence from other sites in the region, indicating that cultural traits associated with Typical Comb Ware appeared much earlier in the East Baltic region than had previously been thought. A series of dates have now been obtained for a group of collective burials at Zvejnieki Cemetery in northern Latvia that show distinctive characteristics shared with Typical Comb Ware graves at Kolmhaara and other sites in Finland and Karelia (Zagorska 2006, 99–102, Table IV; Edgren 2006). The earliest of these dates is 4450–4340 cal. BC (Burial 277, 5545±65 BP, Ua-19810), the latest being 3970–3800 cal. BC (Burial 225, 5110±45 BP, Ua-5986). Evidently, characteristic traits of the Typical Comb Ware Culture (and presumably the pottery itself) appeared in the East Baltic much earlier than had previously been thought. In agreement with this is a single date of 4230–3810 cal. BC (5190±95 BP, Tln-2922) from the Comb Ware settlement of Piedāgi in northern Kurzeme. The new dates concur better with the Finnish dates for Typical Comb Ware, although even in Finland the current evidence concerning the date of appearance of this ware is somewhat contradictory: recent AMS dating of birch bark pitch on pottery has not produced dates as early as the previous ones, which are based on shore displacement chronology and charcoal samples (Pesonen 1999, 193).

In conclusion, at least two phases of occupation may be distinguished at Sārnate, represented by the dwellings with Early Sārnate Ware and those with Late Sārnate Ware. The dwellings with Comb Ware may tentatively be regarded as representing a third, separate phase of occupation: these dwellings clearly

---

4 All dates calibrated according to OxCal version 3.10, using the atmospheric curve after Reimer et al. (2004), 1σ single ranges.
predate Late Sārnate Ware, but their chronological relationship to Early Sārnate Ware is not entirely clear. In the author’s opinion, there is unlikely to have been any significant chronological overlap between the occupation of this site by the two groups, otherwise we would expect much more evidence of interaction, such as the borrowing of specific, diagnostic techniques. For example, although the Early Sārnate Ware clearly imitates the designs of Comb Ware decoration, actual comb or wound cord impressions are almost entirely absent, the tooth stamp being used instead – which is presumably not what we would expect, had there been intensive, direct interaction between the two groups at the site.

The great majority of the pottery bowls at Sārnate are connected with Late Sārnate Ware. The dwellings of this phase produced 16 whole or fragmentary examples, while there are none at all from the dwellings with Early Sārnate Ware. One more bowl was found in Dwelling Zα, a dwelling not clearly associated with any group, and the base of another was found in Dwelling 3.

The dwellings belonging to the different chronological phases form rows that are thought to have run parallel to the former lakeshore, approximately in a SSW–NNE direction (Fig. 19). In the SSW part of the site, one row consists of dwellings with Early Sārnate Ware (I1/I1, E, MZA/MZB/MD, D, R2/RD, and W). Running approximately parallel to this row is another row about 10–30 m to the east of the first, consisting of dwellings that produced Late Sārnate Ware (G, F, K, U, N, ADR, ADA, AZA and T). In the central part of the site, the picture is less clear, while in the NNE part, there is a row of dwellings with Comb Ware (8, 12ZA, 3, 6ZA, 5, 7, 15DR, 4 and possibly 10). Considering that several dwellings that produced no pottery (13, 11, 12DR, 12V and 15ZA) also seem to form part of this row, these, too, might possibly be included in the Comb Ware group. The row of dwellings with Late Sārnate Ware might be viewed as continuing in the central and NNE part of the site, although the dwellings here (Pb, O, X, Zb and Y) are more widely spaced.

The occurrence of parallel rows of dwellings in the SSW part of the site most likely reflects the retreat of the lakeshore in an eastward direction between the time when the dwellings with Early Sārnate Ware were inhabited up to the time of occupation of the dwellings with Late Sārnate Ware. A similar retreat can be inferred from the relative position of the rows of dwellings with Comb Ware and Late Sārnate Ware in the NNE part of the site. Presumably, since the water level in the lake had fallen, and/or the shore zone of the lake had become overgrown, the inhabitants built houses further to the east, so as to remain close to open water.
A somewhat different view of the Sārnate pottery has been suggested by Timofeev (1975, 21–22, Fig. 2: A). He presents data from Vankina’s published tables in graphic form, creating a kind of typological series from the dwellings with Sārnate Ware. Applying the relative chronology set out by Vankina, he perceives a gradual reduction in the number of sherds with an undulating surface, paralleled by an increase in the number of sherds decorated with tooth stamp and bars. The present author is not in agreement with these ideas. First, as indicated above, in the light of the new evidence, the chronological sequence should be reversed. Also, the present author does not see evidence of a gradual transition from one group to the other. The analyses above seem to show that Sārnate Ware at the Sārnate site forms clearly separable phases, with very little material that might indicate a transition from one phase to the other.

The possibility cannot be ruled out that there was in fact a gradual transition in the Neolithic pottery of western Latvia from one phase to the other, but this could only be established from a systematic study of pottery from a range of sites across the region, something that is beyond the scope of this work. Although the grouping and chronological ordering of the pottery from Sārnate evidently does shed light on the regional pattern of development, the main aim here is to provide a basis for ‘cultural analysis’ of the material from this particular site.
Fig. 19. Site plan with dwellings grouped according to pottery wares.
3.3.6 Regional context

That the chronological sequence at Sārnate does reflect the general direction of development of pottery in western Latvia during this time has been established from a re-examination of the stratigraphic sequence at Purciems Dwelling C on the north-eastern coast of the Kurzeme Peninsula, which Šturms excavated in the 1930s, the same one that provided him with a stratigraphic column for chronological ordering of pottery wares in western Latvia (Šturms 1940, 60).

Dwelling C at Purciems had two occupation layers, separated by a sand layer devoid of archaeological material. The pottery assemblages from the two occupation layers differ considerably. The lower layer has mainly Types Ia and Id rims, Type Sa occurring much less frequently. The vessel rims are decorated with pits and plait impressions. Exterior decoration includes tooth stamp, sometimes also wedge-shaped impressions and pits. Impressed lines forming herringbone patterns also occur.5 (Šturms 1937b; Vankina 1974, Fig. 5)

In the upper layer of this dwelling, Sa, Sb and Id4 rims predominate. The few Sub-Type Id1 rims in this layer occur on miniature pots. Rim decoration overwhelmingly consists of plait impressions, with occasional pits and bar or fingernail impressions. Exterior decoration consists of knot/plait impressions, impressed lines and pits. From this layer there are also sherds with an undulating surface, which do not occur in the lower layer.6 (Šturms 1937b; Vankina 1974, Fig. 4)

The observed differences between the lower and upper layers of Purciems Dwelling C largely parallel the differences between Early and Late Sārnate Ware at Sārnate. Thus, at Purciems, as at Sārnate, tooth stamp and the rim Type Id (except for Sub-Type Id4) are relatively early features, while the rim Type Sa and surface undulation are late features. As at Sārnate, knot/plait decoration is more characteristic of later pottery, although it does occur in the early material too.

Considering that the differences between the two pottery wares at Sārnate are paralleled at Purciems, it appears we are dealing not with a pattern of chronological change restricted to Sārnate, but rather with a regional chronological sequence.

Very important comparative material comes from the Šventoji sites on the Lithuanian coast. Unfortunately, as with Sārnate, there are not enough

---

5 A 10741: 3; A 11079: 13, 110–114, 123.
6 A 10741: 5; A 11079: 1, 3–6, 24, 96.
radiocarbon dates for the Šventoji sites. Rimantienė based her chronology for Šventoji not only on radiocarbon dates, but also on pollen sequences, and in fact to a large degree on analysis of the pottery.

The sequence at Šārnate, from direct to everted rims, corresponds in general terms to the sequence traced by Rimantienė at the Šventoji sites. At Šventoji, the earlier sites (1B and 2B) have predominantly vessels with Type I (11–22%) and Type C rims (45–52%), corresponding to Types 1a, 1c and 1d in the present classification, with a small percentage of vessels with rim Type CS (9–22%) (i.e., Sub-Type Id4 in the present classification) and Type S (15–24%) vessels. In the middle group (Sites 3B and 23) the number of vessels with Type S rims increases markedly (48–58%), particularly with regard to Variant S2 (corresponding to Type Sb in the present classification). There are a small number of vessels with Type CS rims (13–18%), many of these belonging to the specific Variant CS2, while the proportion of vessels with Type I rims has fallen (20–23%). In the late group (Site 26) the proportion of vessels with Type I (3%) and Type C rims (6%) is considerably reduced, and instead there is a marked increase in the percentages of vessels with rim Types CS (35%) and S (56%). In particular, Types CS2 and S2 become much more common. (Rimantienė 1979, 144, Fig. 121; 2005, 45–46, Fig. 22).

A. Girininkas regards the transition from vessels with a vertical or incurving upper body to everted vessels as a general feature of the South-Western Group of Narva Ware (Girininkas 1994, 128). Vankina’ sequence at Šārnate, where she regarded vessels with an everted rim as the earlier form, was hard to fit into this general scheme of Narva Ware development. With the Šārnate sequence reversed, the pattern observed here is now in better accord with the regional scheme.

The development of decoration seems to show a different picture. Only the reduction of ornamentation from Early to Late Šārnate Ware corresponds to the overall pattern at Šventoji. Here, knot/plait impressions are characteristic of the early sites, and thus occur with rim Types I and C. Such impressions are found on 60–74% of all the decorated rims of early group vessels. In the middle group, the proportion of vessels with this kind of rim decoration falls to 25–30%, and remains approximately the same for the late group (22%). Pits on the rim are most characteristic of the middle group. In the early group, pits are found only on 5–11% of vessel rims, this figure rising to 38–53% in the middle group, and falling slightly to 37% in the late group.

Even though the focus of this study is on the material from the Šārnate site itself, rather than on cultural development at the regional scale, some comment is
evidently required as to the relationship between Early and Late Sārnate Ware and
the concept of Narva Ware. The author is not opposed to the idea of regarding
both Early and Late Sārnate Ware as forming part of such a broad regional
traditional of shell- and organic-tempered pottery. However, Narva Ware sensu
lato encompasses such a broad spectrum of material that it begs subdivision into
more specific units (e.g. the distinction of styles within the Narva Ware of eastern
Lithuania in Brazaitis 2002).

3.3.7 Attempted sub-grouping of the Comb Ware

As can be seen from the above account, most of the dwelling pottery assemblages
included in the Comb Ware group actually have few rim sherds or none at all (in
contrast to Dwelling 3, which has rim sherds from an estimated 62 vessels). Thus,
the above analysis, based solely on rim sherd data, excludes much of the Comb
Ware material. Accordingly, it is useful to consider the total sherd data collected
for this part of the Sārnate corpus (see Section 3.2 and Appendix 1, Table 10), in
an attempt at further grouping of the Comb Ware assemblages. Indeed, Vankina’s
work suggested that the Comb Ware material is heterogeneous and might be
further sub-divisible (Vankina 1970a, 137–138).

With this aim, ternary diagrams were created from the data on temper and
decorative elements.

Fig. 20 shows the proportions of three fabric classes: porous, mineral-
tempered, and with a combination of pores and mineral temper. (The proportions
calculated here are based on total rim and body sherd numbers, unlike in Figs. 13
and 14, where the proportion of vessels is used.) The is considerable variation
among the Comb Ware dwellings in terms of temper. Thus, in Dwellings 7 and
10, sherds with mineral temper only predominate; Dwellings 1, 5, 12ZA and 15DR
have predominantly sherds with both pores and mineral temper; Dwellings 3, 4,
6ZA and 8 have predominantly or exclusively porous sherds.
Fig. 20. Ternary diagram of the composition of pottery assemblages in the dwellings with Comb Ware in terms of the percentages of sherds with porous fabric, mineral-tempered fabric and a combination of pores and mineral temper.

Grouping on the basis of decorative elements is complicated by the fact that much of the material is poorly preserved, and the exact form of the stamps used for the impressed decoration is commonly indeterminable. In such a situation, the simplest, most readily identifiable differences in decorative element have been considered: elongated stamps (comb, wound cord, bars, etc.) versus short stamps (round and oval pits, triangles, C-shaped stamps, etc.). Thus, Fig. 21 shows the proportions of sherds with three kinds of impressed decoration: sherds with elongated stamps only, sherds with short stamps only, and sherds with a combination of elongated and short stamps. It was thought that the distinction between elongated and short stamps might be sufficient, in a situation where a high proportion of the stamped impressions are not clearly identifiable, for separating groups within the material, particularly when we consider that the absence of elongated stamps (i.e., comb stamp) is regarded as a diagnostic feature.
distinguishing Late from Typical Comb Ware in Finland (Äyräpää 1930, 183). However, no distinct groups can be identified in the plot.

Fig. 21. Ternary diagram of the composition of the pottery assemblages in the dwellings with Comb Ware in terms of the percentages of sherds decorated with elongated stamps, with short stamps and with a combination of elongated and short stamps.

Neither is there any obvious grouping when the two plots are compared: there does not seem to be any stable relationship between the character of the fabric and the general character of the stamps used for decoration.

Vankina (1970a, 137–138) found significant differences between the pottery from the upper and lower layers of Dwelling 3 and suggested that these reflect a chronological difference. Careful study of the original excavation reports, the text of Vankina’s monograph and even labels on boxes permitted only part of the pottery from this dwelling to be provenanced to one or other layer (Appendix 1,
Table 10). When comparing the part of the material for which the stratigraphic position could be established, certain differences were indeed observed between pottery from upper and lower layers, but these differences are not particular marked. In the upper layer, decoration with bars has been used more frequently. Importantly, however, no major difference was seen in pottery fabric between the upper and lower layer. A mixed fabric with both mineral temper and pores is the predominant fabric class throughout the material, with a minority of exclusively porous or exclusively mineral-tempered sherds.

It is concluded that, although the pottery assemblages grouped as Comb Ware show considerable variation, there is insufficient evidence for distinguishing subgroups among the dwelling pottery assemblages included in this group.

### 3.4 Summary and conclusions

Statistical analysis of the dwelling assemblages of round pots has permitted most of the dwellings at Särnate to be grouped into three major units, distinguishable in terms of fabric, exterior surface finish, rim form and decoration. The chronological sequence can partly be determined on the basis of the radiocarbon dates and is in accord with stratigraphic and typological evidence from other sites in the region.

Thus, in the period 4365–3780 cal. BC, the site was populated by a group making pottery that has been named Early Särnate Ware (Dwellings 2, D, E, I/II, MZA/MZR/MD, Pa, RZ/RD and W). The vessels are generally porous, characteristically with Type Id rims and striated or smooth exterior surfaces. Tooth or bar decoration on the rims is characteristic. Some of the pottery motifs clearly show Comb Ware influence, although it is important to note that comb or wound cord impressions are virtually absent. On present evidence, there is no reason to believe that this group occupied the site concurrently with the makers of Comb Ware, although this cannot be ruled out.

At a still undetermined time – evidently after c. 4400 cal. BC – the NNE part of the site was inhabited by people making Comb Ware (Dwellings 1, 3, 4, 5, 6ZA, 7, 8, 10, 12ZA and 15DR). The fabric of the vessels in this rather heterogeneous group has pores or mineral-temper, or a combination of both. Characteristic is a smooth exterior surface, a direct rim with an inward-slanting flat lip (Type Id), and comb or wound cord decoration on the rim.

During the period 3750–2850 cal. BC, the site was occupied by people who made pottery designated as Late Särnate Ware (Dwellings A1A, ADR, A2A, F, G, K,
N, O, Pₚ, T, U, X, Y, Zₐ and Hearth 3). The fabric of the pots is porous, and most commonly striated, although vessels with an undulating surface are also frequent, and the latter kind of surface finish is characteristic of the group. Everted rims curved on the inside (Type Sa) are also characteristic, as are knot/plait impressions. Another characteristic of this group is the presence of a second, distinct vessel form – the oval bowls.

The pottery assemblages from 13 dwellings and separate groups of material (Dwellings 14, 6ₚʳ, B, C, H, J, L, Pₚ, S, V and Zₐ; Units G/Iₐ and K/Mₐ) could not be assigned with confidence to any of these three groups, while six dwellings (9, 11, 12ᵥ, 12ₚᵣ, 13 and 15ₐₐ) have produced no pottery at all.

The results of this study generally confirm and elaborate on the conclusions drawn by Vankina (1970a, 1974), though the chronological sequence has been rearranged. Although the main motivation for grouping the dwellings in terms of their pottery was that of providing a basis for ‘cultural analysis’ of the material from this particular site, the grouping and chronological ordering of the pottery from Sārnate evidently also provides information about the general pattern of pottery development in western Latvia during the Middle Neolithic.
4 Amber ornaments and other classes of material: broader consideration of the groups of dwellings

4.1 Amber ornaments

A brief examination of the corpus of amber ornaments has been undertaken in order to assess whether the groups of dwellings identified on the basis of the dwelling pottery assemblages relate only to pottery, or whether they are indicative of patterning at a more general level, extending to other spheres of human activity. For this purpose, the amber ornaments were classified into basic forms, types and sub-types (Figs. 22, 23), on the basis of the morphological attributes considered by Vankina, generally following her typology (Vankina 1970a, 107–111, Table 6). Figurines and other unique ornament forms, as well as pieces of indeterminate form (fragmentary or unfinished), have been excluded from the analysis.

A correspondence analysis was undertaken of all the taxa of amber ornaments. Dwellings that had less than five ornaments, and likewise ornament forms represented by less than five examples were included as ‘supplementary values’. They appear in the scatterplot, but were not included in the mathematical processing that determines the arrangement of the factorial axes.

The first two factorial axes together reflect 58% of total inertia (Appendix 5, Table 16). Even though these first two factors do not account for a very high proportion of total inertia, we see a pattern of distribution of the amber ornament forms that corresponds at least in part to the grouping of dwellings on the basis of their pottery assemblages (Fig. 24). Thus, in this characteristic horseshoe-shaped distribution, the dwellings with Late Sârnie Ware appear mostly at the top right, the dwellings with Early Sârnie at the bottom and the dwellings with Comb Ware scattered throughout.

From Fig. 24 and Appendix 5, Table 17, we see that barrel-shaped beads (ambe-bar) and discoidal beads (ambe-disc), as well as trapezoidal pendants with a concave base and angular or rounded margins (ampe-trca, ampe-trcr) are particularly characteristic of Dwelling 3 (Comb Ware); circular button-shaped beads of biconical cross-section (ambb-bico), rectangular button-shaped beads (ambb-rect) and trapezoidal pendants with a straight base and angular or rounded margins (ampe-trsa, ampe-trsr) are characteristic of the dwellings with Early Sârnie Ware; and irregular
(ampe-irre) and rounded pendants (ampe-round) are especially prevalent in the Late Särnate Ware dwellings. These results are in general agreement with Vankina’s assessment of the distribution of the various forms of amber ornaments in relation to the pottery groups. She, too, observed differences in the character of the amber ornaments not only between the groups of dwellings with Comb Ware and Särnate Ware, but also between the two phases of Särnate Ware (Vankina 1970a: 111–112).

Fig. 22. Common amber ornament forms at Särnate. 1 – droplet-shaped pendant; 2 – discoidal bead; 3 – cylindrical bead; 4 – barrel-shaped bead; 5 – biconvex button-shaped bead; 6 – flat-convex button-shaped bead; 7 – trapezoidal pendant with straight base; 8 – trapezoidal pendant with concave base; 9 – rounded pendant; 10 – irregular pendant; 11 – ring (Vankina 1970, Figs. LI: 5; LI: 19; LII: 1; XLIX: 23; LI: 12; XLVIII: 16; XLIX: 3; LI: 11; XLIII: 9; XLV: 5; LI: 9).

Of course, the amber ornaments actually deserve much more thorough examination. As has been done with the pottery, a wider range of attributes and measurements could be considered, relating to methods of processing, size and proportions of the ornaments, use-wear, etc., thus providing a much firmer
foundation for ‘cultural grouping’ of the amber and also enabling a comprehensive ‘cultural analysis’. However, such tasks are beyond the scope of the present work. Evidence for occupational specialisation in amber-working at Sārnate has been the subject of a separate study (Bērziņš 2003c), and Neolithic amber from the East Baltic and neighbouring regions evidently still holds great potential as a source of evidence regarding resource procurement, craft production, exchange and regional interaction.

<table>
<thead>
<tr>
<th>Basic form</th>
<th>Type</th>
<th>Sub-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubular bead</td>
<td>Cylindrical (amb-e-cyl)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barrel-shaped (amb-bur)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal (amb-disc)</td>
<td></td>
</tr>
<tr>
<td>Button-shaped bead</td>
<td>Circular</td>
<td>Biconvex (amb-bc-o)</td>
</tr>
<tr>
<td></td>
<td>Oval (amb-oval)</td>
<td>Flat-convex (amb-fo)</td>
</tr>
<tr>
<td></td>
<td>Rectangular (amb-rec)</td>
<td></td>
</tr>
<tr>
<td>Trapezoidal</td>
<td></td>
<td>Straight base, rounded margins (amb-prfms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins (amb-prasa)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, rounded margins (amb-prfms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins (amb-prasa)</td>
</tr>
<tr>
<td>Pendant</td>
<td>Drop-shaped/elongate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rounded (amb-red)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triangular (amb-tri)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irregular (amb-irr)</td>
<td></td>
</tr>
<tr>
<td>Disc/ring (am-disc/am-ring)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 23. Typological scheme of amber ornaments.
4.2 Other classes of material

Of course, a parallel study of the flint inventory would also be very useful for assessing the character of cultural variation among the dwellings. However, study of the flint would evidently have to proceed from a comprehensive technical
analysis (in this case, Vankina’s typology is unlikely to prove adequate), and this is beyond the scope of the work. Here we may simply cite Vankina’s conclusions regarding differences in terms of the flint inventory. Thus, sickle-shaped flint knives, scrapers on long blades, tools on long blades retouched along both sides, as well as round and thick scrapers were only found in the dwellings with Comb Ware, where flint was altogether much more abundant (Vankina 1970a:101; Table 3).

Because certain forms of wooden objects are preserved in considerable numbers in the dwellings with Early and Late Sārnate Ware and in several of the unclassified dwellings, they also offer potential for typological study and comparison with the pattern of pottery variation. There is some evidence of differences the forms of paddles found in the dwellings with Early Sārnate Ware and the dwellings with Late Sārnate Ware. Thus, the only three paddles from dwellings with Early Sārnate Ware are ‘flame-shaped’, with a distinctly narrowed tip (Vankina 1970a: 93, Fig. X: 5, 6). This form does not occur among the large number of paddles recovered from the dwellings with Late Sārnate Ware. Other commonly-occurring wooden artefact forms might also be expected to reveal such patterns of variation, but no such study has been undertaken.

Thus, the character of variation among the amber ornament assemblages, and likewise the patterns suggested by the limited evidence regarding the flint artefacts and paddles, to a large degree parallel the pattern of assemblages that emerges from the pottery study. In view of this, and because the pottery grouping is based on a very thorough investigation and shows a much clearer and more consistent pattern than the amber, it seems appropriate to use the groups of dwellings based on their pottery assemblages as the basis for ‘cultural analysis’ of various other classes of cultural material – not just pottery, but also fishing gear, hearths and structural remains (Chapters 6–8).

---

7 Dwelling 11416: A 11416: 38, 29; Dwelling M5: A 11417: 274.
5  Pottery: cultural analysis and comparison

Having grouped the dwelling pottery assemblages, we are now in a position to undertake a ‘cultural analysis’ of each group in turn, compare the groups and draw some general conclusions.

In line with the ideas proposed by Rye (1981, 3), the characteristics relating to production, use and discard of a pottery vessel may be described in terms of a sequence that begins with the provision of raw materials and ends with the archaeological deposition of the vessel (or recycling of the materials) after final discard at the end of its use-life. The sequence can be taken to include the following stages:

1. Production:
   a) fabric preparation
   b) forming techniques and morphology
   c) surface treatment
   d) decoration
   e) firing

2. Use and discard:
   a) use
   b) repair
   c) secondary use
   d) discard and deposition

It is important to note that this is only a general framework, and should not be regarded as rigidly sequential. For example, although decoration is considered after vessel forming, part of a vessel may actually be decorated before forming work on the vessel is completed. Based on experimental work, it has been suggested that Neolithic pottery vessels must have been built up in stages, performing the surface texturing, and in some cases decoration too, of each successive wall section before continuing to build up the vessel wall (Dumpe 2003, 116).

Next, attention is given to characteristics that are specific to the pottery assemblages of particular dwellings within the group, and the treatment of each pottery group closes with a brief survey of assemblages exhibiting similar characteristics at other sites in the region.
Each pottery group has been subject to comprehensive statistical analysis, with the aim of systematically characterising the material and identifying patterning within the group. In the search for patterning, relationships between all pairs of variables have been examined, using appropriate correlation methods and statistical testing (see Section 2.4.2). For identifying statistically significant relationships between the nominal variables, a correlation matrix was created, and the statistically significant values extracted from this matrix. Relationships between nominal and interval variables, and between pairs of interval variables were studied using the appropriate correlation methods and statistical tests, as described in Section 2.4.2. Only those relationships are mentioned in the text where the null hypothesis of no association between the variables was rejected, obtaining a two-tailed p-level of <0.05 (5% level of significance).  

5.1 Comb Ware (Dwellings 1, 3, 4, 5, 6ZA, 7, 8, 10, 12ZA and 15DR)

The group of ten dwellings with pottery regarded as Comb Ware produced rim sherds from an estimated 74 vessels. In fact, Dwelling 3 alone provided the bulk of this material – 62 vessels. Several of the dwellings (7, 8, 10, 12ZA and 15DR) had no rim sherds at all, and have been included in this group on the basis of a study of the body sherds. The poor state of preservation of the pottery from these dwellings must be emphasised: it is highly fragmented and with eroded surfaces, evidently a consequence of the soil conditions in this part of the site. Because of its poor condition, the Comb Ware from Sārnate is of limited usefulness as source material.

It should be noted that a minute amount of material classifiable without any doubt as Comb Ware has also been recovered from the dwellings with Early or Late Sārnate Ware assemblages. Thus, Vankina (1970a, 123–124, Fig. LXXX: 1–5) identified five Comb Ware body sherds among the assemblages from Dwellings D, MΔ, X, Y and Z. We may add three vessels from Dwelling 2, one with comb impressions on the exterior, one with wound cord on both rim and exterior, and one with wound cord on the exterior, as well as four body sherds.

---

8 Because of the slight differences between the grouping of dwellings, as presented here, and the original grouping presented in Beržinš 2003b, the statistical results also differ in some cases from those given in the earlier work.
with wound cord.\textsuperscript{9} There is also one vessel from Dwelling F with wound cord impressions on the rim.\textsuperscript{10}

### 5.1.1 Production

**Fabric preparation.** As described in Section 3.3.7, the Comb Ware at Sărnate is a heterogeneous group in terms of non-plastic inclusions. In the group as a whole, and within individual dwellings, there is a mix of fabrics: porous fabric (i.e. shell or plant temper), mineral tempered-fabric and fabric with both pores and mineral temper. The proportions of the different fabric classes differ greatly between dwellings. It should be noted that the mineral temper is always in the form of angular grains, i.e., crushed rock, not sand, and is present in various grades, from fine to coarse.

47\% of all vessels showed platy pores that may be interpreted as evidence of shell temper. Elongate and granular pores were also commonly observed, suggesting that plant temper, too, was used.

**Forming techniques and morphology.** As regards the method of building up the vessel body, there is only evidence of the N-technique in this group: some examples of sloping coil joints were observed in the material from Dwelling 3.\textsuperscript{11} Wall thickness (3 cm below the lip) has a range of 0.4–1.1 cm, with a mode of 0.7 cm and a mean of 0.72 cm.

88\% of the vessels in this group (65 out of 74) were recorded as having direct rims. The most commonly occurring rim type in the Comb Ware assemblages is Id – direct rims with a flat lip slanting inwards. Among these, the most common sub-type is Id1 – direct rims with no thickening. Dwelling 3, the only one with a large number of vessels, also had Sub-Ty pes Id2 (thickened or projecting on the outside) and Id3 (thickened or projecting inside). Also common in this dwelling are Types Ia (rounded lip), Ib (tapered lip) and Ic (flat lip perpendicular to vessel wall). The flat lips have a width ranging from 0.6 to 1.9 cm, with a mean of 1.06 cm. There are only two everted rims. In seven cases (10\%), the rim form could not be determined.

Statistical analysis of the vessel data revealed several associations between fabric characteristics and aspects of the rim form. Thus, Fisher's Exact Test

\textsuperscript{9} A 11417: 155.
\textsuperscript{10} A 11415: 292, 324.
\textsuperscript{11} A 11422: 237k, 237o.
showed positive associations between rounded lips and all three forms of pores: platy pores (n=74; p=0.024), elongate pores (n=74; p=0.006) and granular pores (n=74; p=0.006). This test also showed a positive association between direct rims thickened or projecting on the inside and the presence of coarse crushed rock in the fabric (n=74; p=0.023). At the same time, there is a negative relationship between the presence of elongated pores and direct rims thickened or projecting on the outside (n=74; p=0.016). Such relationships could conceivably be taken as evidence that within the pottery tradition the fabric composition was being adapted for making different forms of vessels. However, they could also indicate the presence in the material from these dwellings of pottery belonging to two different traditions. As will be seen in the discussion in this section on decoration, and in Section 5.1.2, there is further evidence supporting the latter possibility.

A distinctive feature observable on part of the material from Dwelling 3 is a kind of horizontal undulation of the rim, created by means of alternate finger impressions on the inside and outside (see Loze 2006, Fig. 29: 1, 2 for a reconstruction of the technique by pottery specialist Baiba Dumpe).

One round vessel base (1.2 cm thick) was identified in the material from Dwelling 3.12 Vankina mentions three bases: two pointed and on rounded (Vankina 1970a, 122).

Because of the highly fragmented character of the material, there is practically no data on vessel size, so that, apart from saying that the vessels had direct rims and rounded bases, there is not much we can ascertain about overall vessel morphology from the Comb Ware at Särnate. Presumably, the vessels conformed to the general range of morphology shown by better-preserved Comb Ware assemblages at other sites.

Dwelling 3 produced two fragmentary miniature vessels, one of which is decorated with rows of fine crescent impressions,13 the other having square pits.14 A small fragment of a third miniature vessel seems to have comb and pit impressions.15 Sherds of a slightly larger vessel from this dwelling, 9 cm in diameter, have an exterior design consisting of both large and small pits, and

---

12 A 11422: 62.
13 A 11422: 313r.
14 A 11422: 327i.
15 A 11422: 313r.
some kind of elongated stamp on the rim.\textsuperscript{16} From Dwelling 5 there is a rim sherd of a vessel 6 cm in diameter.\textsuperscript{17}

In Dwelling 3, the base of an oval bowl was also found.\textsuperscript{18}

\textit{Surface treatment.} Smooth exterior and interior surfaces only were recorded, apart from two vessels from Dwelling 3, which had a striated interior.\textsuperscript{19} At the same time, for a large proportion of the material the surfaces were eroded, making determination impossible.

\textit{Decoration.} 72\% of the rim and body sherds have exterior decoration. If we take the figures for vessels (represented by rim sherds from Dwellings 1, 3, 4, 5 and 6ZA), then we find that 73\% have exterior decoration and 88\% have decorated rims.

Frequently encountered elements of impressed decoration include pits, comb and wound cord impressions, all of which occur on both rims and exteriors, as well as ovals and bars, which have been found on exteriors only, and fingernail impressions, which have been observed only on rims.

The depth of pits in the exterior decoration of Comb Ware vessels was recorded: the depth varies between 0.2 and 0.9 cm, with a modal value of 0.6 cm and a mean of 0.53 cm (n=38). These values are considerably higher than in both Early and Late S\rhnate Ware, and it seems that the depth of pits is another feature distinguishing Comb Ware from the other two groups.

The deep pits on Comb Ware at S\rhnate, as elsewhere, are very often impressed into the vessel exterior so that they almost pass through the vessel wall, producing a corresponding hump on the interior surface. This feature is evidently of considerable technological importance. The clay still had to be very plastic at the time this deep impressed decoration was made, which strongly suggests that the decoration was applied in stages, as the wall was built up. This feature was not observed in either Early or Late S\rhnate Ware.

Because of the erosion of pottery surfaces, comb impressions are in many cases difficult to distinguish from wound cord. Definite comb impressions could be identified only on pottery from Dwelling 3. In the cases where complete impressions were observable, most were short (<2.5 cm) and fairly wide (>0.2 cm). Short and narrow comb impressions were also found, but long ones were rare.

\textsuperscript{16} A 11422: 327t.
\textsuperscript{17} A 11424: 69.
\textsuperscript{18} A 11422: 252.
\textsuperscript{19} A 11422: 62, 179.
The most common decorative motifs in the Comb Ware material from Sârnate are motifs very familiar from Comb Ceramics at other sites. They are amply illustrated in Vankina’s monograph (Vankina 1970a, Figs. LXXXII–LXXXVIII). The most frequent motifs include:

- a single or double horizontal row of pits;
- a horizontal band of diagonal comb impressions in parallel with a horizontal row of pits;
- an open (unbordered) lozenge of comb or wound cord, a horizontal band of such lozenges, or a horizontal row of such lozenges in parallel with a horizontal row of pits;
- a herringbone arrangement of comb impressions forming a horizontal band.

In this section, relationships have already been described that connect fabric composition with vessel rim and lip form. In fact, it has been found that the character of the stamps used also has a statistically significant relationship to the character of the fabric. Namely, when only vessels with clearly identifiable comb or wound cord were considered, Fisher’s Exact Test showed that the presence of platy pores is associated with the presence of wound cord, rather than comb (on the rim or exterior) \((n=25; p=0.012)\). In other words, the vessels with shell temper are much more likely to be decorated with wound cord impressions than with comb.

There are also relationships linking the decoration and the form of the lip. Thus, Fisher’s Exact Test showed that, among the vessels with impressions on the rim that can be clearly identified as comb or as wound cord, vessels with flat lips are associated with the former \((n=25; p=0.050)\).

Also, among all the vessels in this group, Fisher’s Exact Test showed a positive association between the presence of direct rims with rounded lips (Type Ia) and the presence of pits in the decoration of the rim or exterior \((n=74; p=0.022)\).

These form-decoration relationships seem to furnish more evidence, in addition to the fabric-form relationships, presented earlier in this section, for the presence of two separate pottery groups in the assemblages classed as Comb Ware.

**Firing.** Out of a total of 74 vessels showing one of the main three kinds of firing profiles, 28 (all but one of these are from Dwelling 3) were recorded as having a dark core in the wall and light-coloured surfaces, a condition suggesting that there was only a brief period of oxidation during the firing process. Thirty-
one vessels are light-coloured throughout, a higher proportion than in Early or Late Sârnate Ware. Only four vessels were dark throughout. It may be that oxidation during firing was more complete in the Comb Ware group, i.e. firings were longer or at higher temperatures. The higher degree of oxidation may also be explained in terms of a smaller amount of organic matter in the Comb Ware (Rye 1981, 114–118). However, post-depositional effects cannot be excluded: the difference may reflect differences in preservation conditions. Namely, the Comb Ware comes from the dryer part of the site.

5.1.2 Use, repair and discard

Use. Because of the poor conditions of preservation, there is little direct evidence as to the function of the Comb Ware at Sârnate. In the rim-sherd data, only 13 vessels (17%), all from Dwelling 3, had some residue on the interior, and only in one case did it constitute a separately distinguishable layer. Seven vessels (9%), likewise all from Dwelling 3, had sooting on the outside, and again only one had a distinct layer of soot. The relative paucity of such indications, compared to the pots of both Early and Late Sârnate Ware (see Sections 5.2.2 and 5.3.1.2), may reflect real differences in pottery function, but could also be explained by the relatively poor state of preservation of the Comb Ware material. In this connection, Vankina (1970a, 124) makes an important observation suggesting that the difference cannot be put down simply to a difference in preservation. Namely, organic residue, prevalent on the Early and Late Sârnate Ware, is absent on those few sherds of Comb Ware found in the dwellings with pottery assemblages generally consisting of Early or Late Sârnate Ware, i.e. buried under the same conditions. So, there is some evidence of a real difference in function.

There are also some statistically significant relationships between fabric and use-alteration traits, as well as relationships linking decoration and use-alteration.

For the rim sherd data, Fisher’s exact test showed a positive association between the presence of coarse crushed rock and the presence of residue on the interior, whether it forms a separate layer or not (n=74; p=0.020).

This same test also indicated an association between use-alteration characteristics and the particular form of stamp – comb or wound cord – used to make elongated impressions. Thus, when considering only the vessels with identifiable comb or wound cord decoration, wound cord, rather than comb, was associated with the presence of exterior sooting, either forming a separate layer or not (n=25; p=0.050), and likewise with the presence of residue on the interior.
(n=25; p=0.031). The association between the use of wound cord and the presence of surface accretions is even stronger when we consider the presence of any residue at all on the vessel exterior or interior (n=25; p=0.005).

Putting together all the evidence of relationships between particular characteristics of the fabric, the form of the rim and lip, the kind of stamp used for the decoration and the presence of surface accretions resulting from pottery use, we may in fact distinguish, within the Comb Ware group (and within the assemblage from Dwelling 3 in particular), two sub-groups of pottery vessels, groups that were not distinguishable at the initial stage of grouping the dwelling assemblages (Section 3.3.7). One of these groups more commonly has porous fabric (i.e. organic or shell temper), rounded lips, decoration with wound cord and residues indicative of use over a fire. In the other group, exclusively mineral-tempered fabric is more common, as are flat lips; the comb stamp is characteristic of the decoration and surface accretions are virtually absent.

It seems that we are evidently dealing with more than one pottery tradition here. How should we explain the occurrence of two different pottery groups in the material from a single dwelling? Are we dealing with a mixed human group that included members practicing quite different traditions of pottery manufacture and use? Perhaps the occupation of this dwelling extended over a long period, during which significant cultural change took place? The possibility should also be considered that one group represents locally-made vessels, while the other consists of non-local pottery. One could speculate that the locally-made vessels were used for cooking, while the non-local pots were reserved for some kind of ‘higher-status’ functions, especially if they had not been made as cooking vessels and were perhaps not particular suitable for this purpose. A clay provenience study could shed more light on this question, but this remains a task for future research. Whatever the case, it seems that the apparently unimportant substitution of wound cord for the comb stamp actually betrays a more fundamental difference between two traditions of pottery manufacture and use.

The above-described division of the material into two sub-groups would account for most of the observed relationships. However, the association between coarse mineral temper and rims thickened or projecting on the inside, and between this same kind of temper and interior residue, seem to be reflecting factors of a different kind – perhaps coarser temper and thickened (i.e. stronger) rims were used specifically for cooking vessels. Unfortunately, there is practically no vessel diameter data, so it not possible to check the possibility that coarse temper and thickened rims are associated with larger vessels.
The differences between these two suggested sub-groups parallel some of the differences between the two main groups of Middle Neolithic pottery in eastern Latvia. Here, researchers have identified Comb Ware (generally rock-tempered), as well as shell-tempered pottery showing a strong Comb Ware influence, apparently contemporaneous with Comb Ware, and remaining in existence longer (named ‘Piestina Ware’ by Zagorskis). It seems particularly significant that on the Comb Ware of eastern Latvia, comb impressions are only rarely substituted by wound cord impressions, while on the shell-tempered pottery, wound cord impressions are more common (Zagorskis 1967, 110, 112, 124; Loze 1988a, 58, 63, Figs. 31, 37). Moreover, according to Zagorskis (1967, 109, 122), organic residue is rarely found on Comb Ware, while the shell-tempered pottery from eastern Latvia generally has a layer of crust on the inside or outside.

**Repair.** In contrast to Early and Late Sārnate Ware, no drilled perforations that might be viewed as evidence of crack-lacing were found in the Comb Ware. Neither was there any evidence of repairs using pitch, such as are observed in Finnish material (Pesonen 1999, 192–193; Leskinen 2003, 27), although in view of the poor preservation conditions, this should not be seen as indication that repairs using pitch were not being made.

**Discard and deposition.** Comb Ware sherds were found mainly in the extensive sand layers around the hearths (Vankina 1970a, Figs. 136, 140), but the documentation regarding find context does not provide any additional information about pottery use and discard.

### 5.1.3 Characteristics of the pottery assemblages of particular dwellings

As noted in the preceding sections, there is considerable variation among the pottery assemblages of the dwellings included in the Comb Ware group (Appendix 1, Tables 8–10), and the features specific to particular dwellings deserve some mention.

In **Dwelling 3**, which provided the bulk of the material (62 vessels; 1961 sherds), pottery with pores only is most common, but mixed fabric (pores + mineral temper) and mineral-tempered pottery also make up a significant proportion of the material. This dwelling is actually the only one where true comb impressions were identifiable, in addition to wound cord impressions. The most common form of comb impression was the short, wide form. As described in Section 5.1.2, two different pottery traditions seem to be represented in the
material from this dwelling, distinguished not only by the use of comb or wound cord decoration, but also by differences in fabric composition, vessel form and function.

The majority of sherds from Dwellings 1, 6-Za and 8 are either porous or have a mixed (porous + mineral-tempered) fabric, and wound cord impressions predominate in the material from these dwellings. On the basis of such shared traits, these dwelling assemblages might tentatively be regarded as constituting a sub-group.

Most of the sherds from Dwelling 1 (88%) have both pores and mineral temper. There is a high percentage of sherds with pits (75%). Wound cord impressions are common, as are indeterminate impressions of wound cord or comb. The absence of definite comb impressions suggests that in fact all the ambiguous elongated impressions may in fact be wound cord.

Somewhat similar is the pottery from Dwelling 6-Za. Out of 27 sherds, 14 are porous and 12 have mixed fabric. Seven sherds have pits, four have wound cord impressions, and another three have either wound cord or comb.

Dwelling 8 produced only four sherds, all of them porous with wound cord impressions. Perhaps this material can be grouped together with Dwellings 1 and 6-Za.

The material from Dwelling 5 is somewhat different. Over half of the 194 sherds have mixed fabric, practically all the rest having mineral temper. Pits are common, as are oval impressions, while comb/wound cord impressions are absent altogether, as far as can be determined.

The remaining dwellings (4, 7, 10, 12-Za and 15DR) had small numbers of sherds, with very little evidence regarding the decoration.

5.1.4 Regional context

The poorly-preserved ceramics of this group are difficult to classify within the existing typological schemes of Comb Ceramics, and it is not clear whether there is much to be gained from pigeon-holing this material according to schemes created for other areas (Finland, Estonia, eastern Latvia).

Vankina generally classified the pottery from the Sārnate dwellings denoted by numerals as Typical Comb Ware, with the note that a certain proportion of the sherds from these dwellings might belong to the later style of Typical Comb Ware or to Late Comb Ware (Vankina 1970a, 123).
In terms of decoration, at least part of the pottery from Dwelling 3, where the presence of true comb impressions is confirmed, certainly does correspond to Typical Comb Ware, and, considering the relatively sparse decoration and the common occurrence of lozenge-shaped motifs, it might be classed as belonging to the Ka II: 2 style (Äyräpää 1930, 183; Räihälä 1996, 98; Leskinen 2003, 10). On the other hand, much of the fabric even in this part of the material is porous, not mineral-tempered, as one might expect for Typical Comb Ware. In terms of the pottery scheme based on studies in the Lower Narva area of northern Estonia, much of the Comb Ware from Sărnate might be classed along with the earlier group of Late Comb Ware: geometric decoration following the traditions of Typical Comb Ware, but with porous fabric (Kriiska 1995, 113).

In this respect, the Comb Ware at Sărnate contrasts with the material classed as Typical and Late Comb Ware from the island of Saaremaa (Naakamäe, Loona and Undva sites, material kept in the Estonian Institute of History), where shell temper has not been found and where mineral temper occurs instead (sometimes pores from limestone). We may note that the same kind of difference in the fabric between the two areas is seen already in the pottery from earlier periods. Thus, mineral temper only is present in the Early Neolithic pottery from the Kõnnu site on Saaremaa, while shell and organic temper predominates in the Early Neolithic material from Latvia and the northern part of Lithuania. This seems to support Vankina’s (1970a, 141) suggestion that the widespread practice of using shell temper may have spread to the Comb Ware tradition as well. With regard to Finnish material, various researchers have similarly concluded that tempering material should not be seen as an attribute characteristic of a particular pottery style, viewing it instead as a technical feature or a local phenomenon (references cited in Leskinen 2003, 12).

If the use of organic and shell temper in Comb Ware can be regarded as a local trait, this still leaves the question of the dating of this porous Comb Ware: is it a later phenomenon, as it apparently is in northern Estonia, or should it be regarded as approximately contemporaneous with rock-tempered Typical Comb Ware? Some light is shed on this matter by a recently-obtained radiocarbon date for charcoal from a hearth associated with Comb Ware that mostly has both mineral inclusions and platy pores, at the site of Piedāgi, about 45 km further north-east along the coast (Fig. 1).20 This date, 4230–3810 cal. BC (5190±95 BP, Tln-2922), is not far behind the earliest dates for Typical Comb Ware in the East.

---

20 Material from the excavation directed in 2002 by Egīta Ziediņa.
Baltic (see Section 3.3.5), suggesting that Comb Ware tempered with a combination of shell and mineral material is indeed quite an early phenomenon in this area.

The evidence from Sārnate itself also seems to provide some support for this. Although some of the dwellings of this group had mostly mineral-tempered Comb Ware, while others had mostly porous material, and some had a mix of both, for all the variation in pottery temper and decoration, these dwellings, except for Dwelling 1, all lay quite close together, clearly forming a row (Fig. 19). This seems to indicate that, although perhaps not exactly contemporaneous, the dwellings of this group spanned a fairly brief chronological interval, during which the overall settlement pattern did not change. It follows from this that the heterogeneity of the pottery assemblage is interpretable in terms of synchronic variation or short-term change.

As already noted, true comb impressions were identified only in the material from Dwelling 3. The material from Dwellings 1, 6ZA, and 8 (and part of the pottery from Dwelling 3) showed impressions of wound cord instead, as well as a high proportion of unclear impressions that could be wound cord or comb. Impressions interpreted as having been made using a stick wound with cord have commonly been observed on Comb Ware across a wide region: on the east coast of the Kurzeme Peninsula at Purciems D and E (Vankina 1970a, 122), and Ģipka B (Loze 2006, 69), as well as in other parts of Latvia (Zagorskis 1967, 110, 112; Vankina 1970a, 122; Loze 1988a, 58, 90), Estonia (Gurina 1967, 84) and Karelia (Pankrušev 1978, 31–33).

The characteristic horizontal undulation seen on some of the rims from Dwelling 3 has also been observed at Ģipka B (Loze 2006, 64, Fig. 29: 1, 2).

The general paucity of organic residues and sooting on the Comb Ware from Sārnate, is in accord with observations on Comb Ware from other areas. Thus, as already mentioned, Zagorskis (1967, 109, 122) notes the rarity of organic residue on Comb Ware from eastern Latvia, in contrast to shell-tempered pottery from the same region, which generally does have a layer of crust on the inside or outside. Likewise, organic crust is not very common on Typical Comb Ware from Finland, although it seems to be somewhat more prevalent on vessels belonging to the later style of this ware (Edgren 1982, 50; Leskainen 2003, 28).

The Comb Ware at Sārnate constitutes a heterogeneous and, for the most part, poorly preserved corpus of material. A clearer picture of the development of Comb Ware in the Kurzeme Peninsula could emerge from a detailed analysis and comparison of other, better-preserved and more homogenous Comb Ware
assemblages in the region, such as Ģipka B (Loze 2006, 58–72) and Piedāgi (Ziediņa 2003, 7–8).

5.2 Early Sārnate Ware (Dwellings 2, D, E, IZ/ID, MZA/MZR/MD, P, RZ/RD and W)

The pottery assemblages grouped together as Early Sārnate Ware include rims from an estimated 69 vessels, the largest quantity of material coming from Dwellings 2 and MZA/MZR/MD.

5.2.1 Production

*Fabric preparation.* The main tempering material in Early Sārnate Ware was evidently crushed shell, which has dissolved, leaving characteristic platy pores. Pores of this form were observed in 80% of Early Sārnate Ware vessels. The morphology of the pores shows that plant temper was also used.

Small amounts of mineral temper were present, in conjunction with pores, in the fabric of 11 vessels (16%) from Dwellings 2, IZ/ID, RZ/RD and W. In all cases, this is angular material classed as crushed rock, of all different grades. This mineral material is not present in sufficient quantity to be regarded as technically significant, but since it would have had to be specially prepared, it can be regarded as a deliberate inclusion. It may be that the addition of a small quantity of mineral matter to the fabric was perceived as important by the potters.

*Forming techniques and morphology.* The coil junctions, in the rare cases where they can be observed, tend to be oblique, but not markedly so, suggesting some form of N-technique, but without extensive overlapping of coils (Fig. 25: 2). There is only a single clear example of U-technique, from Dwelling D (Fig. 25: 4). The rarity of sherd breaks along coil junctions and the rare occurrence of visible coil junctions in vertical breaks may in themselves be taken as indications that N-technique was generally used (Dumpe 2003, 116).

Two vessel bases have been found: one is pointed, with a thickness of 1.1 cm, the other more rounded with a maximum thickness of as much as 2.0 cm.\(^{21}\)

The wall thickness 3 cm below the lip ranges from 0.5 to 1.6 cm, with a mode of 0.8 cm. The mean value is 0.73 cm, almost the same as for Comb Ware.

The occurrence of particular rim sub-types was one of the main criteria for distinguishing this ware. Characteristic is the Id rim type, of which the most commonly occurring sub-type is Id1 – rims with an oblique (inward-slanting) lip, but not thickened. The flat lips range in width from 0.6 to 2.5 cm, with a mean of 1.17 cm, figures corresponding approximately to those obtained for the Comb Ware group.

Judging from the rim profiles and some vessels from Dwelling M \( _D \) that could be at least partly reconstructed (Fig. 29; Vankina 1970a, Fig. LXXIV: 4, 5), the Early Sārnate Ware vessels were unrestricted (i.e., with the maximum diameter at the mouth), or slightly restricted. Vessel proportions can be judged only approximately: the vessel height was evidently about the same as the maximum diameter, or slightly greater.

Excluding one miniature vessel, the vessel rim diameter ranges from 15 cm up to 40–45 cm. It is calculated that the largest pots would have held up to about 30 litres (see Section 5.7.4).

Fig. 25. Early Sārnate Ware. 1 – vessel base, Dwelling M\(_{ZA}\)/M\(_{ZR}\)/M\(_D\) (A 11417: 313); 2–4 – vessel rims, showing the orientation of platy pores and coil junctions. Drawing: A. Bērziņa.

Although the rim diameter could be calculated for only a small sample – 14 vessels (excluding two vessels with everted rims for clarity), some impression of the size distribution may be gained. A diagram of rim diameters (Fig. 26) gives a weak indication of bimodality, suggesting the possible existence of two size classes: small vessels of around 15–20 cm rim diameter, and larger vessels of 30–40 cm diameter. This pattern may in fact be due to the large influence of Dwelling M\(_{ZA}\)/M\(_{ZR}\)/M\(_D\), which contributes six of the rim diameter measurements. When only the rim diameters for this particular dwelling are plotted (Fig. 27), the bimodal pattern is clearer, suggesting that at least here we have two distinct size
classes, but because of the very small sample size, no firm conclusions are possible.

Fig. 26. Vessel rim diameters: Early Sārnate Ware, all Dwellings. Black – everted rims; grey – direct rims. The length of the bar represents the error interval in calculating the rim diameter.

Fig. 27. Vessel rim diameters: Dwelling MZA/MZR/MD.

A plot of rim diameter against wall thickness 3 cm below the rim for the small sample of vessels where rim diameter could be calculated (Fig. 28) suggests a positive correlation. Kendall’s rank correlation also showed a strong positive correlation between the rim diameter and the wall thickness (n=12; τ=0.646; p=0.003). As already mentioned, thicker walls are needed for taller vessels, so the greater wall thickness of larger-diameter vessels seems likely to relate to their greater height.
There is very small miniature vessel from Dwelling 2, decorated with pits and reminiscent in form of the rest of the pottery belonging to this ware (Vankina 1970a, Fig. LXXXI: 3). 22

Surface treatment. The most common form of exterior and interior surface finish is striation, recorded on 42% of vessel exteriors and 39% of interiors. Smooth-walled vessels are also fairly common: 25% of vessels were found to have smooth exteriors, and 19% were found to be smooth on the inside (Appendix 1, Table 8). Only one vessel was recorded as having an undulating outer surface. (The exterior finish was indeterminable for 32% of the vessels, while the exterior finish was indeterminable for 42%, mainly because the surface was obliterated by residue.)

Decoration. Early Sārnate Ware was found to have slightly more exterior decoration even than Comb Ware: 81% of vessels are decorated on the exterior. Most frequently, there are several horizontal rows of impressions. Lozenge,
herringbone or more complex designs are also common. Tooth stamp and bar impressions are characteristic decorative elements of this group.

The tooth stamp, used to produce a row of very fine lenticular or linear ‘teeth’, was evidently some sort of comb-like serrated implement (Fig. 12). The overall length of the impressions varies from 1.3 to 2.9 cm, with between 4 and 8 ‘teeth’. The width is 0.1–0.2 cm. Judging from the shape of the individual ‘teeth’, which are linear if the stamp has been impressed lightly, and lenticular if a deeper impression is made, the stamp is likely to be a naturally occurring object (perhaps slightly adapted) with a series of ‘boat shaped’ denticulations, rather than a humanly-shaped stamp. Stamps made by notching a straight edge tend to have square or rectangular teeth, rather than the kind of boat-shaped teeth impressed here. An appropriately notched freshwater mussel shell was used by the author to make very narrow comb impressions, but did not produce the rows of tiny lenticular ‘teeth’ occurring at Särnate.

A characteristic feature (completely absent in Late Särnate Ware) is the lozenge motif in the exterior decoration (Fig. 25: 1), such as also occurs on Comb Ware (although the form of the stamp is different).

64% of vessels are decorated on the lip, most commonly with pits, knots/plait, tooth stamp or bar impressions. Occasionally, the tooth impressions are arranged in a zigzag on the rim, as is sometimes the case with comb impressions in the Comb Ware group.

In this group, knot/plait impressions occur rarely, and are only found on the lip. They vary in length from 0.5 to 1.5 cm, with a mean of 1.33 cm (n=9). The width is 0.4–0.6 cm. In describing very similar impressions on the pottery from the Šventoji sites in Lithuania, Rimantienė refers to the shorter ones as knot impressions, and the longer ones as impressions of a plaited cord (Rimantienė 1979, 124, 126). Vankina (1970a, 115), too, notes that they resemble impressions of coarse cord. Attempts to replicate such impressions using various plaited cords, sticks wound with cord and animal molar teeth, showed that the effect can best be reproduced using a short plait of bast or similar material, similar to a piece found in Dwelling H (Vankina 1970a, Fig. XXXVI: 3). Pottery specialist Baiba Dumpe (pers. comm.) considers such impressions to have been made in a similar technique to that used for the surface finish and decoration of early textile-impressed pottery, namely by applying a piece of braided rope (see Dumpe 2006).

The pits in the exterior decoration tend to be shallower than on Comb Ware: the depths of pits on 28 vessels were recorded, and these very between 0.1 and 0.4 cm, with a mode of 0.2 cm and a mean of 0.24 cm.
For Early Särnate Ware, the Mann-Whitney Test showed that vessels with knot/plait decoration on the rim tend to be larger (n₀=10, n₁=4, p=0.024), and that rim decoration in general is more frequent on large vessels (n₀=5 n₁=9, p=0.01). However, these test results should be treated with circumspection because of the small sample sizes.

**Firing.** The majority of vessels have a colour profile of oxidised surfaces and a dark core, which suggests that firing was brief and took place in oxidising conditions, or else that the vessels were exposed to oxidising conditions during cooling (Rye 1981, 114–118).

### 5.2.2 Use, repair and discard

**Use.** Of all the Early Särnate Ware pots, 45% have at least some exterior sooting, indicating use over the fire, and 36% have at least some organic residue on the inside. This presents a contrast with the Comb Ware group, where surface accretions are rarer. If the material from Dwellings M₂A/M₂B/M₂D and I₂/I₁₀ only is considered, where preservation conditions are the best, then the proportion of vessels with exterior sooting rises to 77% and the proportion of vessels with interior residue increases to 50%. This indicates that most vessels were in fact placed over the fire.

It should be mentioned that even the largest vessels commonly have soot on the exterior, showing that they were heated over a fire. In fact, the Mann-Whitney Test showed that vessels with sooted exteriors tend to be of greater diameter than those not sooted on the outside (n₀=4, n₁=10, p=0.012). Again, the small size of the sample means that the result should be treated with caution. This relationship might be seen as an indication that large vessels in particular served as cooking pots, but experimental evidence suggests that larger cooking vessels are more likely to accumulate soot at the rim because of their height, whereas on smaller cooking vessels the soot is more likely to be burnt away (see Section 5.7.9).

Fisher’s Exact Test showed that a layer of residue on the interior is positively associated with striation on the exterior (n=69, p=0.003). Presumably, most of these vessels also have a striated interior finish, concealed by the residue. Striation of the vessel surface may have had some positive effect in relation to cooking (see Section 5.7.5). On the other hand, it may be simply have served as a quick way of removing surface irregularities after vessel forming. Perhaps the more laborious technique of smoothing the surface was reserved for vessels to be
used for non-cooking purposes, where the appearance of the vessel was deemed more important.

*Repair.* Drilled perforations, thought to be crack-lacing holes, occur on 9% of vessels. Fisher’s Exact Test showed a positive association between drilled perforations and the presence of tooth stamp decoration on the lip (n=69; p=0.047). This test also showed a positive association between the perforations and the presence of two or more rows of decoration on the rim and lip (n=69, p=0.006). Perhaps this indicates that repairs were more commonly undertaken on the more elaborately decorated vessels, in consideration of the greater effort that had gone into their manufacture.

*Discard and deposition.* In Dwellings M₁₀ and I₁₀, there were concentrations of sherds interpreted as the remains of vessels left behind, either intact or broken, when the dwelling was abandoned (Vankina 1970a, 34; Vankina 1970b) (see Section 5.7.11).
5.2.3 Characteristics of the pottery assemblages of particular dwellings

There are differences between the dwelling pottery assemblages with regard to fabric composition and ornamentation, which might represent stylistic features characteristic of individuals or small groups. Thus, a proportion of the pottery from Dwellings 2 and IZ/ID is made of fabric with both pores and mineral temper.
A zigzag arrangement of impressions on the rim is seen only on vessels from Dwelling M/Z/MZ/MZD. Particularly characteristic of Dwelling E is rim decoration of pits, while vessels from Dwelling I/Z/ID commonly have knot/plait impressions on the rim. The vessels from Dwelling W rarely have any decoration on the rim.

5.2.4 Regional context

Many features observable on Early Sārnate Ware can be explained in terms of the influence of Comb Ware. This is most clearly seen in the zigzag arrangement of rim stamps and the lozenge motifs in the exterior decoration. There are similarities in other features, as well: the presence of mineral temper in addition to pores in the fabric of some of the Early Sārnate Ware vessels and the occurrence of smooth vessel surfaces. On the other hand, the direct rim with an inward-slanting flat lip (Type Id) and the pit decoration are features often observed in the Middle Neolithic pottery of western Lithuania – outside the area of Comb Ware influence. The very early radiocarbon date for a sherd from Dwelling I/D (see Section 3.3.5) suggests that some of the pottery included in this group may pre-date the advent of Comb Ware in this region.

As mentioned in Section 3.3.6, similar pottery occurs in the lower layer of Purciems Dwelling C. Also corresponding to Early Sārnate Ware is much of the pottery from Siliņupe on the south-western shore of the Gulf of Riga. The material from Vankina’s excavations at Siliņupe in 1954 includes pottery with a mix of rim forms (direct rims apparently more prevalent in the material from the lower layers). Decorative elements include tooth stamp, wound cord, bars, pits, incised lines and occasional plait impressions (Vankina 1974, Fig. 7).23

The pottery recovered in the course of excavation by Zagorska at the same site in 1988 and 198924 also corresponds to Early Sārnate Ware. The rims are almost exclusively direct with a flat lip (Types Ic/Id), and the vessels are richly decorated on the rim and surface with fingernail impressions, tooth stamp, impressed lines, pits and bars. As at Sārnate, the designs show pronounced Comb Ware influence. Lozenge and herringbone patterns are common, as are rows of tooth stamp impressions and pits. Knot/plait impressions were not observed, nor was the undulating exterior finish characteristic of Late Sārnate Ware.

23 A 11385, A 11399.
24 VI 292.
Among the Šventoji sites, rim forms approximately equivalent to the Id rim type characteristic of Early Sārnate Ware (Rimantienė’s Variant C2) are most commonly found in material from Site 2 (Rimantienė 2005, Fig. 22). In terms of rim decoration, too, Early Sārnate Ware can best be compared with Šventoji Sites 1 and 2. Knot/plait and pit impressions, as well as wedge/bar impressions occur, although it must be noted that pits are comparatively rare at Šventoji. The main difference lies in the complete absence at Šventoji 1 and 2 of the tooth stamp impressions that are so characteristic of Early Sārnate Ware. At both of the mentioned Šventoji sites, as with Early Sārnate Ware, surface ornamentation is common (in contrast to Late Sārnate Ware and Šventoji Sites 3 and 23). Knot/plait impressions quite often adorn vessel exteriors in the material from Šventoji 1 and 2 (Rimantienė 2005, Fig. 24), while in Early Sārnate Ware they are only found on rims. Resemblances can also be seen with the assemblage from Šventoji 6, where there are also many vessels with direct rims, and here the exterior decoration consists mostly of pits, while knot/plait impressions, along with wedge/bar impressions, are somewhat more common on the rims (Rimantienė 2005, Fig. 24).

Tooth stamp decoration is frequent in the material from Šventoji 26, but the pottery here differs from Early Sārnate Ware in terms of the high proportion of everted rims (Rimantienė 2005, Figs. 22, 24). Site 26 is regarded as being comparatively late, a conclusion based on pollen analysis and on the general trajectory of pottery development (Rimantienė 1979, 13).

5.3 Late Sārnate Ware (Dwellings A0-1, A0R, A0Z, F, G, K, N, O, P, T, U, X, Y, Zb, Unit F/K and Hearth 3)

The group of pottery assemblages classed as Late Sārnate Ware constitutes by far the largest group within the Sārnate collection: rims from an estimated 207 round pots, as well as 16 oval bowls. The grouping of pottery described in the Chapter 3 was based on a study of the round pots alone, but in this section each of the two vessel forms is given separate treatment.
5.3.1 Round pots

5.3.1.1 Production

Fabric preparation. 71% of Late Sārnate Ware round pots had platy pores indicative of shell temper. The shell itself has been preserved only in a few sherds from Dwelling G.25 Elongated pores, most likely from plant temper, were rarely observable.

In addition to pores from shell or plant temper, the fabric of pots from several dwellings has sparse inclusions of fine or coarse gravel or crushed rock. The occurrence of mineral matter is significantly less common than in Early Sārnate Ware (16 vessels or 8%). Gravel could be a natural admixture, occurring in cases where clay preparation has not been so fastidious, while crushed rock would seem to represent a deliberate inclusion.

Such small amounts of mineral matter in the fabric could not have significantly altered the behaviour of the fabric in pottery manufacture or use, although the makers of the pottery presumably saw it as being important in some way. Only one vessel, from Dwelling A,26 which is otherwise not out of place among the Late Sārnate Ware material, had a considerable amount of fine and medium grade crushed rock in addition to pores.

Thin-section analysis of a sherd from Dwelling K (Birzniece & Vītiņš 1963) revealed the presence of pores from dissolved shell fragments, as well as the charred remains of small seeds. Thin sections of two sherds, from Dwellings O and Y, have been studied by Ole Stilborg of the Laboratory for Ceramic Research at the University of Lund. In addition to oblong voids evidently from the shell temper, he found small plant fragments, including fragments of seeds (none of which appear to be cereal grains), as well as larger voids that could also derive from plant fragments (Dumpe et al., forthcoming).

Near the hearths of Dwellings G and Y, large lumps of blue-grey clay were found, regarded as raw material for pottery making (Vankina 1970a, 118).

Forming techniques and morphology. The coil junctions, in the rare cases where they are visible, virtually all indicate the use of N-technique, often with considerable overlap of the clay coils.

---

26 A 11580: 162.
The wall thickness 3 cm below the rim has a range of 0.5–1.2 cm, a mode of 0.8 cm and a mean value of 0.79 cm. Although the walls are on average somewhat thicker than those of Comb Ware and Early Sārnate Ware pots, it seems that this difference may relate mostly to the difference in the form of the rim. Namely, the point of measurement, 3 cm below the rim, is fairly close to the position of the transition from the line of the vessel wall to the everted rim (everted rims being characteristic of this group in particular), and the wall thickness measurements may reflect a slight thickening of the wall in the vicinity of the wall-to-rim transition, rather than indicating the general thickness of the vessel body.

Late Sārnate Ware was distinguished largely on the basis of the characteristic everted rims curved on the inside, with a flat lip (Sub-Type Sa3), found on 47% of the pots of this phase. Sub-Type Sa1, distinguished by the rounded lip, makes up another 10%.

In this phase, direct rims are much less common, although, as indicated above, they occur on a large proportion of vessels in Dwelling F.

The Late Sārnate Ware material includes several pointed bases (Fig. 30: 4–6, 8; Vankina 1970a, Fig. LXXV: 3–10). The point, when viewed in section, has an internal angle of around 120°. The maximum thickness of the base, at the point, reaches 1.1–1.8 cm. From Dwelling G, there is a flat base of diameter 4.8 cm (Fig. 30: 7).

There is more data on the sizes and proportions of Late Sārnate Ware pots than on those of Early Sārnate Ware. The smallest vessels have a rim diameter of 10 cm (truly miniature vessels are absent in this group), while the largest have a diameter of 50–60 cm. Most commonly, the rim diameter is around 30–35 cm. The everted rims are 0.7–3 cm wide, the inner face of the rim oriented 40–90° to the plane of the vessel mouth, and these vessels have a more or less pronounced shoulder (Figs. 37, 38).

The pots with Ic and Id rims do not attain such large dimensions, the largest recorded rim diameter being 40 cm. These vessels were evidently widest at the mouth, or else slightly wider at the middle.

The same vessel base forms – pointed or pointed-projecting, and occasionally flat as well – all occur in the Šventoji pottery, the flat bases being more common on the late sites (Rimantienë 1979, 145).

Looking at the vessel size distribution, as measured by rim diameter (Fig. 31), we see a characteristic bell-shaped curve approximating to a normal distribution, apparently with no indication of different size classes. A weak impression that the pots from individual dwellings might in fact form size classes
comes from the graph for Dwelling $A_{DA}$ (Fig. 32), perhaps indicating two, or even three size groups (around 20 cm, around 30 cm and around 40 cm). The small size of the sample from this dwelling precludes any firm conclusion, and it should be noted that graphs of this kind for other dwellings did not show any pattern that might indicate a divergence from a normal distribution (Figs. 33–36).

In the study of bivariate relationships within Late Sămnite Ware in this and the following sections, the focus is on pots with the rim Type Sa – the commonest rim type in this phase, representing 58% of the pots in this group. By restricting the bivariate statistical analysis to this rim type, an attempt is made to exclude some of the complexity in the data, increasing the likelihood that clearly interpretable patterns will emerge.

Fig. 30. Late Sămnite Ware. 1 – knot and plait impressions; 2, 3 – vessel rims, showing coil junctions indicative of N-technique; 4–8 – vessel bases (Dwelling $A_{DA}$, A 11415: 73; Dwelling G, A 11415: 362; Dwelling G, A 11421: 42; Dwelling G, A 11415: 459; Dwelling G, A 11415: 357). Drawing: A. Bērziņa.
First, the relationships among variables characterising vessel size and morphology are considered. In contrast to Early Sârnate Ware, Kendall’s rank correlation showed no significant relationship between rim diameter and wall thickness for Late Sârnate Ware vessels of rim Type Sa (n=38; τ=0.104; p=0.354). Although width of the everted rim tends to increase along with the rim diameter, the correlation coefficient showed no significant relationship between these two variables either (n=42; r=0.222; p=0.158).

Fig. 31. Rim diameters of pots: Late Sârnate Ware, all dwellings. Black – everted rims; grey – direct rims.
Fig. 32. Rim diameters of pots, Dwelling ADA.

Fig. 33. Rim diameters of pots, Dwelling F.

Fig. 34. Rim diameters of pots, Dwelling G.

Fig. 35. Rim diameters of pots, Dwelling K.
Fig. 36. Rim diameters of pots, Dwelling Y.

On the other hand, statistically significant relationships were observed linking the variables describing the form of the lip and the morphology of the vessel. A positive correlation was observed between flat lips and wider everted rims of Type Sa vessels (point biserial correlation: $n=113; r=0.191; p=0.044$). The form of the lip is possibly also related to the steepness of the everted rim: the Mann-Whitney Test showed that steeper everted rims tend to occur with flat lips ($n$(rounded lips)$=3$, $n$(flat lips)$=16; p=0.024$), while more gently sloping everted rims occur rounded lips. However, this result is inconclusive because of the small sample of vessels with rounded lips.

Surface treatment. Characteristic of this ware is an undulating exterior surface, although in fact it occurs much less commonly than striation, which is found on the interior and exterior of most pots. Smooth-walled vessels are rare, in contrast to Comb Ware and Early Sārnate Ware. Thus, 56% of all the pots of this ware have striated exterior, 14% have undulating exterior surfaces and 6% have smooth exteriors (24% are indeterminate). 62% of the vessels are striated on the interior, and 6% are smooth (32% are indeterminate). There are no recorded undulating interior surfaces.

The undulating exterior surface, consisting of vertical or slightly oblique shallow troughs and ridges, must have been formed when the clay was still quite plastic. In the view of Baiba Dumpe (pers. comm.), the troughs and ridges came about when the clay was drawn upwards or downwards with the fingers in bonding the coils and forming the vessel (c.f. Rye 1981, 72). That the troughs came about during the forming process can be seen from some body sherds of Dwelling S (a dwelling not actually considered part of this group and treated separately in Section 5.5.11). Here, troughs and ridges are visible on the oblique contact face of the coil junction (Vankina 1970a, Fig. LXXV: 1, 2).27 A similar feature has been observed on the coil junctions of Typical and Late Comb Ware from the Lower Narva area in Estonia, and on Early and Typical Comb Ware in Finland, by Kriiska (1996, 380). If

---

27 A 11580: 162, 198.
the troughs and ridges are not obliterated by surface finishing, they remain visible on the exterior of the vessel. Vankina (1970a, 115) observes that in some cases smoothing of the vessel surface in a partly dry state seems to have made the troughs narrower and more pronounced.

Fig. 37. Late Sārnate Ware, profiles of pots. 1–5, 8, 9 – Dwelling F; 6, 7, 10–12 – Dwelling K. A 11415: 257, 323, 254, 253, 255; A 11418: 81/82; A 11416: 112; A 11415: 252, 258; A 11416: 91, 86/131, 110.

A small number of body sherds from Dwellings G and T have poorly visible textile impressions on the exterior, in some cases virtually obliterated by striation (Vankina 1970a, 120, Fig. LXXIX: 4–7). Pottery with textile impressions, known in Latvia as Early Textile-Impressed Pottery and dated to the Late Neolithic, has been studied in eastern Latvia (Loze 1979, 88–91; Dumpe 2006), noting that pottery with similar kinds of surface texture is also present at sites elsewhere in the south-eastern and eastern Baltic (Loze 1979, 90). Sherds with textile impressions have been found at all of the Narva Culture settlement sites at Šventoji (Rimantienė 1979, 78, Fig. 62). Textile-impressed pottery is also known at Loona, a site on Saaremaa with pottery that exhibits strong similarities to the material from Dwellings L, S and V at Sārnate (see Section 5.5.12).

---

28 A 11415: 341–342; A 11417: 258.
Lavento and Kriiska regard the early textile-impressed pottery from Estonia as having been textured by impressing woven or ‘needle-netted’ fabric (Kriiska, Lavento & Peets 2006, 26). Dumpe, studying similar material from eastern Latvia, questions the idea that such textures could have been obtained by pressing fabric against the pottery surface. She suggests, on the basis of experimental work, that they were instead created by rolling across the surface some kind of plaited or knotted cord (Dumpe 2006, 78–81).

Whatever the actual technique used, we seem to be dealing here with an early expression of a tradition of pottery-texturing that became very widespread in regions further to the north and east during the Bronze Age.

Decoration. Only 37% of all the round pots are decorated on the exterior. The decoration is relatively sparse and rarely forms more than a single horizontal band (in contrast to Comb Ware and Early Sārnate Ware, where designs of several horizontal bands or more complex designs are common). By contrast, decoration on the rim is present on 88% of vessels – much more frequently than on Early Sārnate Ware. The rim decoration and the small amounts of exterior decoration evidently required relatively little effort and skill, compared with building and shaping the vessel (in contrast to Early Sārnate Ware and Comb Ware, where decoration of the body of the vessel itself constituted a major task within the manufacturing process). This rather suggests that the main consideration was performance and durability of the vessel in use, rather than appearance.

Comparing the two phases, we see that in Late Sārnate Ware tooth stamp and bar decoration is very rare, and decoration with pits is also much less common, while knot/plait impressions are more common.

Systematic measurements were obtained for the knot/plait impressions on the rim, which measure 0.6–1.7 cm in length, with a mean of 0.90 cm, i.e., shorter on average than those of Early Sārnate Ware. However, they are no longer restricted to the lip: in this group, such impressions are also common on the everted rim and the vessel exterior. As already noted in Section 5.2.1, these impressions are likely to have been made using some kind of plaited or braided stamp, perhaps similar to that which was occasionally used to texture the surface. On several vessels in Dwellings A, ADR and Unit F/K, this same kind of stamp seems to have been rolled along the flat lip of the rim, giving a continuous textured surface, a texture similar to that found on Early Textile-Impressed Pottery (Baiba Dumpe, pers. comm.).

29 A 11415: 1, 2, 4, 13, 38; A 11418: 81–82, 157.
As in Early Šārnate Ware, the pits of the exterior decoration tend to be shallow: the depths of pits on 14 vessels were recorded, and these vary between 0.1 and 0.4 cm, with a mode of 0.2 cm and a mean of 0.22 cm.

At least one pot, from Dwelling G30 had a row of only four pits on the inside just below the lip. Similar short rows of pits have been found on some vessels at Šventoji, and are interpreted by Rimantienė as non-decorative, with the suggestion that they may have been marks indicating the ownership or function of the vessel (Rimantienė 2005, 333).

Incised lines, usually on the exterior, sometimes on the rim are occasionally found on only on Late Šārnate Ware, whereas they are absent on Comb Ware and Early Šārnate Ware.

Firing. As in Early Šārnate Ware, the majority of the round pots (62%) have a colour profile of oxidised surfaces and a dark core. Only a small proportion of pots, 10%, show colour profiles with an oxidised core (2% were dark throughout and in 26% of cases the colour profile could not be determined). This suggests that firing was generally in oxidising conditions, but too brief for the core to be oxidised, or that exposure to oxidising conditions was only during cooling (Rye 1981, 114–118). The proportion of vessels with an oxidised core is lower than in Early Šārnate Ware: it is not clear whether this reflects real differences in firing technique or fabric, or differences in preservation conditions in particular dwellings.

5.3.1.2 Use, repair and discard

Use. 80% of Late Šārnate Ware pots have at least some exterior sooting, indicating that they were placed on the fire, and 50% have at least some interior residue. These figures are approximately the same as for those dwellings with Early Šārnate Ware that had good conditions of preservation, namely Dwellings 1/1 and M2A/M2B/M2D (Section 5.2.2). Thus, there seems to be no foundation for postulating any major difference in the function of the pots between the two phases. It should be underlined that, as with Early Šārnate Ware, even the largest vessels commonly have sooted exteriors.

Mention should also be made of some relationships connecting the character of decoration and use alteration features among Late Šārnate Ware pots with Type Sa rims. Fisher’s Exact Test showed a very strong positive association between a

---

30 A 11415: 460.
layer of residue on the vessel interior and the presence of decoration on the everted rim (n=128; p=0.0009), and also with the presence of knot/plait impressions on the exterior (n=128, p=0.006). Thus, it seems that the character of the decoration relates in some way to the specific use of the vessel, but no clear explanation can be offered for these patterns. An alternative explanation for the relationship between decoration on the inside of the everted rim and the presence of a layer of organic residue could be that the impressed decoration, providing a rougher interior surface, acted to increase the adhesion of the vessel contents to the surface and so increased the tendency for a layer of organic residue to form.

For vessels with Type Sa rims, organic residue on the interior showed a negative correlation with the rim diameter (point biserial correlation: n=43; r=-0.372, p=0.014). Various interpretations can be offered for this relationship. It may be that smaller vessels really were used for particular cooking processes that tend to produce organic residue. However, this relationship might also be explained in terms of the distance from the heat source. Vessels with the upper part of the vessel lower down, closer to the fire (as it is for smaller vessels) should more commonly have residue on the interior in the region of the rim and shoulder, where the presence/absence of use-alteration features was recorded (see Section 5.7.9).

Repair: 9% of the pots in this group have drilled holes, regarded as evidence of crack-lacing (the same percentage as in Early Sārnate Ware). Drilled holes were found on all different sizes of pots, from 15 to 42 cm rim diameter. Among all the pots with Type Sarims, Fisher’s Exact test showed that the presence of drilled holes is positively associated with a decorated exterior surface (n=128; p=0.037) and with pits in particular (n=128; p=0.018). This seems to indicate that more effort was made to repair decorated vessels, in consideration of the increased effort or skill applied in the production of decorated, as opposed to undecorated vessels.
Secondary use. Providing the only clear example of secondary use of ceramics at Sārnate is a large rim sherd from Dwelling F with a trough-like depression in the exterior surface, the surface of the trough being covered in parallel striations. The everted rim is also abraded opposite the trough. The sherd was evidently used to grind a relatively soft material. Interestingly, some sort of residue has been deposited in the trough produced by the grinding.

---

31 A 11415: 259.
Apart from this, in at least one case (Dwelling Y), an extensive thick layer of sherds was present inside the dwelling (Vankina 1970a, 73) – a possible example of the recycling of sherds as flooring.

**Discard and deposition.** For Late Sārnate Ware, there is evidence in the documentation of discard patterns suggesting that vessels broken during use on the hearth were sometimes left there (Dwellings N and X), and there were finds of more or less intact vessels that may have been left behind when the dwelling was abandoned (Dwelling N) (Vankina 1970a, 47, 68, Fig. 111; Vankina 1970d).

### 5.3.2 Bowls

The dwellings with Late Sārnate Ware have produced a total of 16 whole or fragmentary bowls. None occur with Early Sārnate Ware. Part of a bowl was also found in the ungrouped Dwelling Zα. Another fragmentary bowl was found in Dwelling 3. If we discount the last two as exceptional cases, then the oval bowls may be regarded as a characteristic vessel form of Late Sārnate Ware.

The dwellings with Late Sārnate Ware have produced three bowls that can be reconstructed almost entirely, three halves of bowls, and various-sized fragments of another 10 bowls. Table 3 summarises data on the dimensions, ornamentation and state of preservation. Information about the find context, obtained from the excavation reports, is also given. The best-preserved bowls are illustrated in Fig. 39. Drawings of some of the bowls have also been published by Vankina (1970a, Fig. LVI: 2, 3, Fig. LXXVII: 1–5).

#### 5.3.2.1 Production

**Fabric preparation.** Eleven of the Late Sārnate Ware bowls were accessible for detailed study, and platy pores indicative of shell temper were observed in the fabric of eight of these. Although no attempt was made to record the size of the pores, the bowls do seem to have had finer shell temper than the round pots. In the remaining cases, no non-plastic inclusions were to be seen: perhaps finely comminuted shell has been used, leaving little visible trace.

**Forming techniques and vessel morphology.** In several cases, oblique coil junctions indicative of N-technique were observed (Table 3; Fig. 30: 3).
<table>
<thead>
<tr>
<th>Dwelling No.</th>
<th>Accession No.</th>
<th>Dimensions (cm)</th>
<th>Decoration</th>
<th>Preserved part, remarks</th>
<th>Find context</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOA</td>
<td>A 11415: 26</td>
<td>l. w. h.</td>
<td></td>
<td>Indistinct impressions on rim. Fragment. Coil junction: N-technique.</td>
<td>Inside structure, immediately south of hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11415: 159</td>
<td>l. w. h.</td>
<td></td>
<td>Rim decoration? Fragment. Coil junction: N-technique.</td>
<td>Unknown</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11418: 124</td>
<td>l. w. h.</td>
<td></td>
<td>Elongate impressions on rim. Intact.</td>
<td>Unknown</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11415: 327</td>
<td>l. w. h.</td>
<td></td>
<td>Elongate impressions on rim. Large fragment. Coil junction: N-technique.</td>
<td>In hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11415: 354</td>
<td>l. w. h.</td>
<td>&gt;3</td>
<td>Elongate impressions on rim. Large fragment. Coil junction: N-technique.</td>
<td>Unknown</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11415: 354</td>
<td>l. w. h.</td>
<td>&gt;3</td>
<td>Elongate impressions on rim. Large fragment. Coil junction: N-technique.</td>
<td>Unknown</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11416: 87</td>
<td>l. w. h.</td>
<td>Intact</td>
<td>Textile or plait impressions on rim.</td>
<td>South edge of hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11416: 123</td>
<td>l. w. h.</td>
<td>&gt;5</td>
<td>Indistinct impressions on rim. Fragments. Sand adhering to outer surface.</td>
<td>Next to wall of structure, 4 m north-west of hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11420: 34</td>
<td>l. w. h.</td>
<td>Intact</td>
<td>Elongate impressions on rim. Intact. Sand adhering to outer surface.</td>
<td>Inside structure, in the layer of nut-shells, 2.5 m south of hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11420: 37</td>
<td>l. w. h.</td>
<td>Half</td>
<td>Impressions on rim. Half.</td>
<td>Inside structure, immediately north-east of hearth.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11420: 36</td>
<td>l. w. h.</td>
<td>~5.5</td>
<td>Exterior decorated with rows of pits. Rim decoration? Fragment. Sand adhering to outer surface.</td>
<td>Unknown.</td>
</tr>
<tr>
<td>AOA</td>
<td>A 11420: 36</td>
<td>l. w. h.</td>
<td>~4</td>
<td>Rim decoration? Fragment. Sand adhering to outer surface.</td>
<td>Unknown.</td>
</tr>
<tr>
<td>T</td>
<td>A 11419: 257</td>
<td>l. w. h.</td>
<td></td>
<td>Elongate impressions on rim. Half, restored.</td>
<td>Near wall, 5 m south-east of hearth.</td>
</tr>
<tr>
<td>X</td>
<td>A 11427: 34</td>
<td>l. w. h.</td>
<td></td>
<td>Impressions on rim. Rim intact, base missing.</td>
<td>In nut-shell layer 1 m south of hearth.</td>
</tr>
<tr>
<td>Y</td>
<td>A 11428: 40</td>
<td>l. w. h.</td>
<td></td>
<td>Impressions on rim. Fragments. Coil junction: N-technique.</td>
<td>Sand layer of hearth.</td>
</tr>
</tbody>
</table>
Fig. 39. Oval bowls. 1 – Dwelling N; 2 – Dwelling T; 3 – Dwelling ADR; 4 – Dwelling Za; 5 – Dwelling K. A 11420: 34; A 11419: 257; A 11418: 124; A 11580: 99; A 11416: 87. Shading: see Fig. 38.
Because of the relatively small size of the bowls, compared with the majority of round pots, and the relatively low degree of fragmentation, the overall morphology of the bowls is much easier to assess. All the bowls from Sārnate are oval in plan, and rounded (semi-oval) when viewed in longitudinal and cross-section, with thin walls and, in contrast to the everted rims characteristic of the round pots in this group, they have simple rims without thickening (Sub-Types lc1 and Id1). Given the small size of the bowls, compared with the round pots, it is no surprise that they have thinner walls; wall thickness (as measured 3 cm below the lip) showed a range of 0.6–0.9 cm and a mean value of 0.69 cm (n=10).

Most commonly, the sides and ends of the bowls are the same height. One bowl differs from the rest in having a markedly flattened base.32 The reconstructed bowls are 11–22.5 cm long, 6.5–14 cm wide and approximately 3.5–6.5 cm high. The length:width ratio varies from 1.4:1 up to 2:1 (Fig. 40). The bowls can be divided into three groups in terms of length and width. One such group consists of three large bowls with a length of around 20 cm and a width of 10–14 cm.33 A bowl from Dwelling Y34 might also be included in this group, although only the width can be determined. These large bowls differ markedly among themselves in terms of height. In addition to the large bowls, two medium-sized bowls have been found, with a length of around 15 cm and a width of around 8 cm,35 while both bowls from Dwelling G are markedly smaller, only about 11 cm long.36

Surface treatment. Most bowls are striated both outside and inside, but the striation is much fainter than on the pots. No evidence was found of undulating surfaces.

Decoration. At least 13 of the bowls had decoration on the flat lips. In most cases this consists of indistinct ‘knot’ impressions, while both bowls from Dwelling G have oblique incisions. The rest of the bowls probably had rim decoration, but this is obscured by a layer of organic residue. Exterior decoration, in the form of curving parallel lines of pits, was found on one bowl, from Dwelling O, only fragments of which are preserved.

---

32 A 11416: 87.
33 A 11416: 87; A 11418: 124; A 11419: 257.
34 A 11428: 40.
35 A 11420: 34; A 11427: 34.
36 A 11415: 354.
5.3.2.2 Use and discard

*Use.* In describing the Sārnate bowls, Vankina (1970a, 118) notes that the rims tend to be covered in black residue, while the base is clean. She observes that the bowls are most commonly found near the hearths in layers of nut-shells, which might suggest that they were used in cooking, for example as pans. However, she remarks that the small size of these vessels makes this unlikely, and she inclines towards the idea that they would have been filled with animal (seal) fat and used for indoor lighting. Rimantienė, too, considers that the majority of oval bowls from Šventoji and Nida would have been fat-burning lamps (2005, 53; 1996b, 163), although she suggests that bowls without residue might have served other functions – in particular, salt production at Nida (1989, 78–79, 144).

Mathiassen (1935) was the first to conclude that oval bowls of a similar form in the Ertebølle Culture had been used as fat-burning lamps. This idea has been evaluated in the course of a series of experiments on replica bowls, undertaken by H. Van Diest (1981). She found that the use of bowls as lamps did indeed produce the patterns of sooting and burnt residue consistent with those observed on Ertebølle and Rosenhof bowls. The archaeologically recovered bowls show analogous traces of burning to experimental bowls that were used as lamps:
- a strongly burnt black zone around the rim, with a thick layer of crust on the inside, caused by the flame of the lamp. This zone is wider on the inside than on the outside;
- a light-coloured surface on the base of the bowl both inside and outside. On the interior, this light-coloured area forms where the surface of the clay is protected from the flame by the wick laid along the base of the bowl and by the fat. The basal surface outside is protected because, during use, the bowl was slightly embedded in a soft surface such as sand;
- burnt residue on the upper exterior, caused by spilling of the contents.

Some of the archaeological examples have a black zone all the way around the rim, while others are burnt only at the ends, close to the position of the wick.

Systematic study of the Sārnate bowls confirms Vankina’s observation that burnt residue occurs only along the rims. The distribution of residue and other surface characteristics is shown in Fig. 39. The pattern of use alteration is largely consistent with the pattern observed in the experiments by Van Diest, so it is concluded that the Sārnate bowls, too, would have been used as lamps. Some bowls have only a little sooting along the rim on the inside and outside, while others have a thicker layer of organic residue on the inside along the rim, on the flat lip and in places on the outside too. The varied intensity of organic residue and sooting can be explained in terms of differences in the duration and intensity of use. It is important to note that bowls of different sizes show similar a similar pattern of sooting and burning, so it would seem that their function was essentially the same, regardless of size differences.

The remains of a moss wick are preserved on a bowl of similar form with an analogous pattern of burnt residue, found at the Rzucowo Culture site of Nida (Rimantienë 1989, 144).

A network of fine cracks was observed on certain parts of the interior and exterior of the base, a feature that could have formed if there was a considerable thermal gradient between the inner and outer surface of the lamp (Rice 1987, 363). This could presumably have come about if the lamp was placed on a cold surface while it was hot. Another characteristic feature is the apparently ‘dense’ fabric of the bowls. It appears that the molten fat has penetrated the wall of the vessel, filling the pores. In some of these cases, there is sand adhering strongly to the exterior of the bowl. This could have occurred if fat penetrating the walls or

---

37 A 11416: 87; A 11418: 124; A 11419: 257; A 11415: 354.
38 A 11416: 123; A 11420: 34; A 11428: 40; A 11580: 99.
trickling down the outside the lamp came into contact with the sand in which the lamp was embedded. A similar effect, though much more pronounced, was observed in the course of experiments with rendering fat in a round pot (see Section 5.7.9.3).

A lamp reconstructed by Van Diest, using seal blubber for fuel (135 cm$^3$) and a moss wick, burned for 5½ hours, while a lamp filled with tallow (150 cm$^3$) lasted 4¾ hours. In addition, it was possible to extend the time of burning, provided that the lamp was re-filled before all the fat had been consumed. The form of the lamps also permits them to be lit at both ends. Most of the Sārnate lamps exceed the dimensions of those used in Van Diest’s experiments, and accordingly the volume is significantly greater. For example, the bowl from Dwelling T$^{39}$ has a volume of 380 cm$^3$ if filled to the rim, but if filled to 1.5 cm below the rim, then the volume of fuel is 180 cm$^3$. The volume of other, deeper lamps is considerably greater than this, so if similar fuel was used, they could have burned without refilling for many hours.

The pattern of organic residue and sooting on the Sārnate bowls differs entirely from that observed on the pots. Considering this pattern of use-alteration, it is hard to envisage that they could have been used for frying or for other sorts of cooking over the fire. Of course, we cannot exclude the possibility that the bowls were used for some additional purpose, apart from lighting, which was not connected with fire (serving food etc.), but it should be mentioned that there are no bowls without at least a minimal amount of sooting along the rim.

The data in Table 3 show that most of the lamps were found either in the hearth itself or next to the hearth, or else next to the outer wall of the house. The concentration of lamp finds near the hearth suggests that they were used for functions directly connected with the hearth, or else related to work performed in the vicinity of the hearth. For example, lamps may have provided lighting for craft work and other activities undertaken after dark, particularly in winter in the warmth of the fireside. They could have been conveniently placed in the sand along the edge of the hearth. The lamps may have served as a means of maintaining the fire and rekindling the hearth. Presumably, they also provided a convenient way of carrying fire to other locations.

As regards the Ertebølle pottery bowls, B. Hulthén (1980) suggests that they could have provided light for night-time eel-spearing, and in this connection she observes that the lamps are more characteristic of coastal sites than inland  

$^{39}$ A 11419: 257.
habitations. Ertebølle sites have also produced a number of fragments of eel clamps, and both of these artefact forms remained in use in the Rosenhof Group, which succeeded the Ertebølle Culture, suggesting that they may have been functionally related. She sees a possible analogy with eel-spearing at night, using a lantern or other light source, as practiced in the recent past along the shore of the Baltic in southern Scandinavia and northern Germany. Both artefact forms – ceramic bowls and eel clamps – are also represented at Sārnate, as they are at Šventoji (see Section 6.1.6), so the hypothetical connection between the clamps and lamps might be extended to the east coast of the Baltic.

At the Rzucewo Culture site of Nida, long bowls were found, some of which had sooting and burnt residues, while others were clean. The latter, characteristically having pointed ends and transverse striations or rilling on the inside of the base, are regarded by Rimantienė as vessels for performing the final stage in evaporating seawater to obtain salt. She sees the rilling of the inner surface as having the function of concentrating salt in the rills (Rimantienė 1989, 78–79, Fig. 144).

Girininkas (1994, 235–236) focuses on the possible symbolic significance of the bowls: he views the elongated bowls of the Early and Middle Neolithic in the East Baltic as symbolising boats, connected in particular with the belief that the dead were ferried from the world of the living to the world beyond. In the ornamentation of the bowls from Žemaitiškė 3B and Osa, he identifies floral designs and relates these to spring rituals.

In summary, although bowl-shaped ceramic vessels may have had a variety of uses in the East Baltic Neolithic, assessment of the use-alteration features strongly suggests that the Sārnate bowls were indeed blubber lamps. At the same time, it is not altogether clear whether these lamps should be seen as general-purpose lighting, or whether they played a more specific role, such as that suggested by Hulthén.

**Repair.** At least one bowl, from Dwelling A_{DA}, had a drilled perforation suggesting repair by crack-lacing.

**Discard and deposition.** Bowls used as lamps would have been subject to much less stress than cooking pots and so would probably have had a longer use life, a factor that could explain their relatively low frequency in the archaeological assemblage.

Bowls (and other small vessels), after they had fallen into disuse, instead of being thrown out, could have become covered by layers of refuse within the
dwelling. This is suggested by the context of bowls in Dwellings N and X, which were found in layers of nut-shells (Vankina 1970d; 1970f).

5.3.3 **Characteristics of the pottery assemblages of particular dwellings**

As noted above, correspondence analysis of the corpus of Late Sārnate Ware round pots failed to identify any sub-groups within this group. However, there are individual attributes exclusive to or particularly characteristic of a single dwelling or a small number of dwellings, attributes that presumably reflect the traditions of families or other small groups, or even individual variation in pottery production. Features of this kind include: the Sb rim type, characteristic of Dwelling G; the Ic rim type, already mentioned as characteristic of Dwelling F; the Sa1 rim sub-type, more common in Dwellings F, G and T; the presence of two or more rows of impressions on the lip and everted rim, which is characteristic of several dwellings (especially Dwelling ADR); widely-spaced stamps on the rim, the distance between successive stamp impressions exceeding the width of the impressions (Dwellings F, G, N, P, and T); the crenelated lip, very common in Dwelling ADR; and fingernail impressions, characteristic of Dwelling N.

5.3.4 **Regional context**

Pottery corresponding to Late Sārnate Ware has been found at Lejascīskas near Lake Zebrus, south of the Gulf of Riga (Vankina 1974, Fig. 2). It also occurs in the upper layer of Purciems Dwelling C, where vessels with everted rims (Types Sa and Sb) predominate, direct rims generally being found on miniature vessels only. Vessel lips are usually decorated with plait impressions, occasionally with pits, bars and fingernail impressions. Exterior decoration includes knot/plait impressions, impressed lines and pits. Sherds with an undulating surface occur, this feature being absent in the lower horizon.

Among the Šventoji sites, the closest to Late Sārnate Ware are sites of the middle group – 3B and 23 – characterised by a fairly high proportion of everted rims, sparse exterior decoration and sometimes also an undulating surface finish. Differences are seen in rim decoration: at Sārnate, knot/plait impressions are the

---

40 A 11420: 34; A 11427: 34.
most common, while at Šventoji pits are more prevalent (Rimantienė 2005, Figs. 22, 24).

Along with the round pots, oval or boat-shaped pottery bowls are already present in the very earliest ceramic assemblages of the East Baltic, perhaps even predating the appearance of oval bowls in the Ertebølle Culture of the south-western Baltic. Thus, they occur at Osa and Zvidze in eastern Latvia (Zagorskis 1973, Fig. 1: 2–3; Fig. 3; Loze 1993, Fig. 11: 9), at Kääpa in southern Estonia (Jaanits 1965, 14) and at Narva in north-eastern Estonia (Gurina 1967, 173). Indeed, their presence has been cited as one of the distinguishing features of the Narva Culture. By contrast, they are absent in the Sperrings and Comb Ceramics of the north-eastern Baltic region, and they apparently disappear in Estonia and Latvia at the same time as strong Comb Ware influences appear in the material from this region. In this regard, their absence in the Early Sārnate material at Sārnate, with its evident Comb Ware influence, is consistent with the general pattern. Since oval bowls do not occur in the ceramics of the Dnieper-Donets Culture either, or in other Early Neolithic cultures of south-eastern Europe, they might be regarded as a western characteristic (Edgren 1982, 37, 72), representing a link between the Narva Culture and the southern and south-western parts of the Baltic Sea region.

Along southern and eastern coast of the Baltic, the bowls remain in use longer: they are present in the material regarded as belonging to the South-Western variant of the Narva Culture (Rimantienė 2005, 51–53), in the Rosenhof Group (Van Diest 1981, 301) and in the Rzucewo Culture of the Late Neolithic (Rimantienė 1989, 143–144). In the Late Neolithic, elongated bowls seem to spread eastwards again: flat-based forms are present at Lake Lubāna (Loze 1979, 82, Fig. XXXVIII).

In terms of form, the bowls of Late Sārnate Ware at Sārnate exhibit the closest resemblance to those found on the settlements classed as belonging to the Narva Culture at Šventoji (Rimantienė 1979, Fig. 112: 12–14; 2005, Fig. 214, Fig. 258: 1–4), and those of the Rzucewo Culture pottery at Nida (Rimantienė 1989, Fig. XX: 1). The flat- and round-lipped bowls represented here differ from the Early Neolithic bowls of eastern Latvia and Estonia, which, like the round pots of the Early Neolithic pottery, tend to thin out at the rim (Zagorskis 1973, Fig. 1: 3; Loze 1988a, Fig. LX: 1–3). A bowl from Silinupe on the coast of the
Gulf of Riga, dating from the Middle Neolithic, also has a thinned rim (Vankina 1974, Fig. 8).41 Absent at Sārnate are boat-shaped bowls with pointed ends, such as have been found (along with oval bowls) at Osa (Zagorskis 1973, Fig. 1: 3), at the Šventoji sites (Rimantienė 2005, Fig. 165) and at Nida (Rimantienė 1989, Fig. XVIII: 2). Neither are there very shallow, thick-walled bowls, such as have been found on Ertebølle sites (Mathiassen 1935, 144, Fig. 19), nor the very long, narrow bowls characteristic of the Rzucewo Culture (Rimantienė 1989, Figs. XVII, XVIII: 1, XIX: 1).

5.4 Comparison between the pottery wares

Table 4 summarises the characteristic features of the round pots of the three different wares identified in the pottery at Sārnate. Apart from the differences in fabric, exterior surface finish, rim forms and rim decoration that were used to group the dwelling pottery assemblages, the wares differ in several other respects as well. The proportions of pots having rim and exterior decoration also vary between the wares: the relative paucity of exterior decoration on Late Sārnate Ware is particularly obvious. Apart from the use of comb and wound cord impressions on the Comb Ware, almost entirely absent in the rest of the material, the Comb Ware is also characterised by deeply-impressed pits. The character of the decorative designs on the exteriors of the pots also differs between wares. And there is a difference relating to repair practices: evidence of crack-lacing in the form of drilled perforations is absent on the Comb Ware. For both Early and Late Sārnate Ware, there is evidence that crack-lacing was more commonly undertaken on pots with relatively elaborate decoration, suggesting that greater efforts were made to maintain vessels in use if they were decorated.

There appear to be other differences between the wares as well, although the characteristic features are observable only in a small number of cases. Thus, there is one clear example of a coil break indicating use of the U-technique in Early Sārnate Ware, while in the other two groups only evidence of the N-technique has been observed. The few recovered bases of pots also seem to indicate differences in form. The difference in mean wall thickness of round pots between Late Sārnate Ware and the two other wares may not be meaningful in itself, but may in fact arise due to differences in the rim form (see Section 5.3.1.1)

41 A 11399: 45.
It may be significant that the positive correlation observed in Early Sărnate Ware between rim diameter and wall thickness has not been found in Late Sărnate Ware round pots with Type Sa rims. This might be taken as an indication of alternative methods of strengthening large vessels: in Early Sărnate Ware, large vessels may have been strengthened by providing them with thicker walls, while in Late Sărnate Ware this may not have been necessary, since the everted rim would have provided greater strength.

While there is practically no vessel size evidence for the Comb Ware, in both Early and Late Sărnate Ware, the round pots most commonly have a rim diameter of about 30–35 cm. On the other hand, there is a difference between the latter two groups in terms of the maximum vessel size: for Early Sărnate Ware, the rim diameter is up to 40–45 cm, while for Late Sărnate Ware it is 50–60 cm. The data on the Early Sărnate Ware provides some indication of a bimodal vessel size distribution, with two different size classes: smaller pots with a rim diameter of around 15–20 cm, and larger vessels of 30–40 cm rim diameter. In the much larger sample of rim diameter measurements for the Late Sărnate Ware pots, no such pattern was detected, the vessel size distribution seemingly approaching a normal distribution. There is tentative evidence of the existence of two or even three separate size classes of round pots in the material from Dwelling A_03A, but, once again, the sample is too small.

The percentages of round pots with sooting and interior residue are not given in Table 4, because a simple comparison between the groups on this basis would be misleading. Thus, the high proportion of Late Sărnate Ware pots having preserved use-alteration traces of this kind, the somewhat lower proportion of such traces on Early Sărnate Ware and the comparative paucity of such evidence on the Comb Ware may be at least partly accounted for by the differences in preservation conditions in the dwellings of the different groups. However, in Section 5.1.2, above, some evidence is presented indicating that the differences in use-alteration do reflect real functional differences between Comb Ware, on one hand, and Early and Late Sărnate Ware, on the other.

The oval bowls, interpreted as lamps, are characteristic of Late Sărnate Ware. On the other hand, both Comb Ware and Early Sărnate Ware include miniature round pots, which have not been found with Late Sărnate Ware.
Table 4. Summary table of characteristics of the round pots of the three pottery wares.

<table>
<thead>
<tr>
<th></th>
<th>Comb Ware</th>
<th>Early Sámate Ware</th>
<th>Late Sámate Ware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric</td>
<td>Various (most commonly combined shell and mineral temper)</td>
<td>Shell and plant temper, occasionally sparse mineral inclusions</td>
<td>Shell and plant temper, rarely sparse mineral inclusions</td>
</tr>
<tr>
<td>Coiling technique</td>
<td>N-technique?</td>
<td>N-technique, occasional U-technique</td>
<td>N-technique</td>
</tr>
<tr>
<td>Mean wall thickness (3 cm below lip)</td>
<td>0.72 cm</td>
<td>0.73 cm</td>
<td>0.79 cm</td>
</tr>
<tr>
<td>Common rim forms</td>
<td>Id1, in Dwelling 3 also la1, lb1, lc1–2; undulating rim</td>
<td>Id1 (predominant), Id2–4</td>
<td>Sa3 (predominant), Sa1, in Dwelling F: lc, ld</td>
</tr>
<tr>
<td>Base forms</td>
<td>Round</td>
<td>Pointed, round</td>
<td>Pointed, occasionally with a projecting point, or flat</td>
</tr>
<tr>
<td>Exterior surface finish</td>
<td>Smooth</td>
<td>Striated, smooth</td>
<td>Striated, undulating, rarely smooth</td>
</tr>
<tr>
<td>Interior surface finish</td>
<td>Smooth</td>
<td>Striated, smooth</td>
<td>Striated, rarely smooth</td>
</tr>
<tr>
<td>% of vessels with exterior decoration</td>
<td>73%</td>
<td>81%</td>
<td>37%</td>
</tr>
<tr>
<td>% of vessels with rim decoration</td>
<td>88%</td>
<td>64%</td>
<td>88%</td>
</tr>
<tr>
<td>Common exterior decoration elements</td>
<td>Deep pits (up to 0.9 cm), producing a hump on the interior surface, comb/wound cord</td>
<td>Shallow pits (0.2–0.4 cm), tooth stamp, bars</td>
<td>Shallow pits (0.2–0.4 cm), knot/plait impressions</td>
</tr>
<tr>
<td>Common rim decoration elements</td>
<td>Comib/wound cord, pits, fingernail impressions</td>
<td>Pits, tooth stamp, knot/plait impressions, bars</td>
<td>Knot/plait impressions, pits</td>
</tr>
<tr>
<td>Characteristic exterior designs</td>
<td>Alternating horizontal bands (i.e. comb and pit)</td>
<td>Lozenge, herringbone and complex designs on surface; zigzag on lip</td>
<td>–</td>
</tr>
<tr>
<td>Drilled perforations (crack-lacing)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5.5 Pottery from the remaining dwellings and finds units

Described in this section is the pottery from 13 dwellings and separate clusters of finds that cannot be definitely included in any of the three above-described pottery wares. However, the pottery assemblages from Dwellings L, S and V might be viewed as constituting a separate small group.
5.5.1 Dwelling 6\textsubscript{DR}

No rim sherds were found in Dwelling 6\textsubscript{DR}, but, judging from the predominance of porous fabric without mineral temper among the body sherds, and from the small proportion of decorated sherds, the pottery from this dwelling seems more likely to correspond to Early Sārnate Ware than to Comb Ware. The decoration consists mainly of elongate impressions, but because of poor preservation, the actual form of the stamp cannot be determined.\textsuperscript{42}

5.5.2 Dwelling 14

This dwelling produced only a single body sherd, of porous fabric.\textsuperscript{43}

5.5.3 Dwelling B

This dwelling produced only one rim sherd, the fabric of which has platy pores. The form of the rim is indeterminate, and the decoration on the lip (knot impressions?) is badly worn.

5.5.4 Dwelling C

The material from this dwelling includes rim sherds from three large pots and a miniature vessel. One of the large vessels has an Ic4 rim, the second has a similar rim, but with a slightly outwards-sloping lip, while the form of the third is indeterminate.\textsuperscript{44} The miniature vessel, with a direct rim and rounded lip, has a rim diameter of about 5 cm (Vankina 1970a, Fig. LXXIV: 1).\textsuperscript{45} Two of the large vessels have plait impressions on the lip, while the miniature vessel has pit ornamentation on the exterior, and these features provide no positive criterion for allocating the dwelling to either Early or Late Sārnate Ware. The closest similarity seems to be with Dwelling F, which is grouped with Late Sārnate Ware.

\textsuperscript{42} A 11425: 78.
\textsuperscript{43} A 11580: 55.
\textsuperscript{44} A 11415: 222.
\textsuperscript{45} A 11415: 225.
5.5.5 Unit G/I_D

Pottery found in the area between Dwelling G (Late Sârânte Ware) and Dwelling I_D (Early Sârânte Ware) includes rim sherds from a shell-tempered vessel with an Id4 rim, and ornamentation consisting of plait impressions on the rim and pits on the exterior.46 These characteristics are not sufficiently diagnostic to decide whether it should be included in Early or Late Sârânte Ware.

5.5.6 Dwelling H

Represented in this dwelling was a single round pot with an Sa3 rim decorated with bar impressions, again belonging to either Early or Late Sârânte Ware.47

5.5.7 Dwelling J

Ic1 rims from one pot were found in this dwelling.48 The fabric is porous, and the flat rim is decorated with continuous (rolled?) textile impressions, along with a row of indeterminate impressions on the outer angle, and the exterior also has two rows of plait impressions. The exterior is striated, and the interior undulating/striated. Most probably it relates to Late Sârânte Ware.

5.5.8 Unit K/M_D

This group of material found between Dwellings K and M_D includes rims from two shell-tempered pots: one of these has a striated exterior, an Ic1 rim and pits on the rim and exterior, the other having a smooth exterior surface, a striated interior, and an Id2 rim decorated with knot/plait impressions.49 There is insufficient evidence to decide whether it should be grouped with Dwelling M_D (Early Sârânte Ware) or with Dwelling K (Late Sârânte Ware).

---

46 A 11418: 85.
47 A 11415: 482.
48 A 11147: 197.
49 A 11421: 63a.
5.5.9 Dwelling L

The distinguishing characteristic of the pottery from this dwelling (Fig. 41), is the predominance of the Sb rim type – everted rims angled on the inside at the transition to the body (Fig. 41: 3, 4), a type that is rarely found in the major pottery groups. Such a rim form might be seen as having some functional significance: it would have prevented the spillage of liquids more effectively than the Sa rim form, with a gradual transition from body to everted rim (Stilborg 1997, 139).

It may be noted that three vessels (17%) from this dwelling have small amounts of coarse crushed rock in addition to pores.

Pits are the main form of rim and exterior decoration. Vessel surfaces are striated in almost all cases. There are three vessel bases from this dwelling, two of them more or less rounded, the third pointed.

Fig. 41. Profiles of pots, Dwelling L. A 11417: 172, 188, 189, 194.

5.5.10 Dwelling Pc

This dwelling produced only 28 porous body sherds: nine with bar impressions, three with pits and 16 undecorated (Vankina 1969).

5.5.11 Dwelling S

Predominant in the pottery from this dwelling (Fig. 42) are vessels with rims of Type Sa and Sb, the latter being of limited distribution, as noted above.

One out of the nine vessels is tempered exclusively with fine crushed rock, while two others have occasional coarse rock fragments in addition to pores from shell or plant temper. Thus, altogether a third of vessels have some mineral temper.

Fig. 42. Vessels from Dwelling S. A 11580: 198, 200. Shading: a – organic residue/soot not forming a separate layer; b – organic residue/soot forming a separate layer. Drawing: A.Bêrziņa.

There are some breaks along the oblique coil junctions of vessels from this dwelling, indicative of the N-technique of vessel building, with troughs observable on the face of the joint (Vankina 1970a, Fig. LXXV: 1, 2). These are thought to have been impressed with the fingers, and one vessel from this dwelling shows fingernail impressions on a coil junction face. It seems these features came about when the clay coil was drawn with the fingers after application to bond it with the previous coil (see Section 5.3.1.1).

The rims are decorated with pits and knot/plait impressions, while exterior decoration includes pits, bars, tooth stamp and other impressions. The exterior is

---

52 A 11580: 194.
usually striated, undulating surfaces being absent. Overall, a certain resemblance with Dwelling L can be seen.

Thin-section analysis of two sample sherds from this dwelling, undertaken by Ole Stilborg, indicated the presence of voids remaining from plant matter and bone fragments, in addition to the voids from the shell (Dumpe et al. forthcoming).

5.5.12 Dwelling V

Only two vessels are represented: one has a Sub-Type Sa3 rim, while the other has Sub-Type Sb3. Both have small amounts of coarse crushed rock in addition to pores. The pottery from Dwelling V thus closely resembles that of Dwelling S.

Similar to the characteristic pots of rim Type Sb from Dwellings L, S and V are vessels from the Loona site on Saaremaa. Although most of the Loona pottery has mineral temper (including limestone), it shows very close resemblances in terms of rim form and decoration to the pottery from these particular Sārnate dwellings. Typical of the Loona pottery are Sb rims with plait impressions on the everted rim and on the exterior (Jaanits 1965, Fig. 17: 4, 5). There are three Middle/Late Neolithic radiocarbon dates for Loona, which give a total 1σ range of 3020–2470 cal. BC, i.e. post-dating the latest dates obtained at Sārnate. As noted by Vankina (1974, Fig. 2: 7, 8), pottery exhibiting similar features has also been found at the Lejasčǐskas site.

5.5.13 Dwelling Zₐ

The round pots from Dwelling Zₐ show a diversity of rim forms: two vessels with Ia1 rims, a rare form among the other dwellings, as well as two vessels with Ic1 rims and a single vessel with an Sa3 rim. The vessels are striated both outside and inside, and the rim decoration consists mainly of plait impressions, while exterior decoration is altogether quite rare.

53 A 11580: 111.
54 4270±75 BP (Ua-4824), 4050±80 BP (Ua-4825) (Lougas 1997, 16); 4165±90 BP (Hela-751) (Kriiska, Lavento & Peets 2005, 6). Calibrated according to OxCal version 3.10, using the atmospheric curve after Reimer et al. (2004).
55 A 11580: 67, 72, 89–91.
The assemblage from this dwelling also includes half of an oval bowl with somewhat raised ends (Fig. 39: 4),\textsuperscript{56} which was found near the wall of the structure, 1 m south-west of the hearth. The bowl is estimated as having been about 22 cm long and 6 cm high.

The evidence from this pottery assemblage is not sufficiently clear to indicate whether it should be included in the Early or Late Sărnate group.

\subsection*{5.6 Individual sherds of Corded Ware}

Several sherds of Corded Ware, as well as a large part of the lower body and base of a Corded Ware vessel, were identified by Vankina (1970a, 119–120). This material was re-examined in collaboration with pottery specialist Baiba Dumpe, and in most cases Vankina’s identification is confirmed.

There are sherds of Corded Ware from the upper hearth layers and ploughsoil of Dwellings T and X (Vankina 1970a, LXXVIII: 1, 3).\textsuperscript{57} In view of their stratigraphic position, they might conceivably be explained as deriving from a later occupation in the vicinity.

On the other hand, the lower body and flat base of a Corded Ware pot (Vankina 1970a, LXXVIII: 7),\textsuperscript{58} found in the cultural layer of Dwelling N, in the vicinity of a number of other artefacts and at a similar depth, probably relates to the time of occupation of this dwelling.

The status of part of another flat base, from Dwelling G (Vankina 1970a, LXXVIII: 6),\textsuperscript{59} is unclear, while a body sherd from Dwelling P\textsubscript{b} (Vankina 1970a, LXXVIII: 2)\textsuperscript{60}, also published as Corded Ware, should evidently be discounted from the list of Corded Ware finds. The ‘decoration’ on this sherd, somewhat imaginatively rendered by the illustrator of Vankina’s monograph, is more likely to be a trowel mark from the time of excavation.

The area around Sărnate is actually quite rich in Corded Ware/Rzucewo Culture finds: a number of battle axes have been collected in the surrounding area (Mürniece \textit{et al.} 1999, Fig. 3), and a small site with Mesolithic and Rzucewo Culture material has recently been excavated at Celmi, 3 km north of the Sărnate.

\textsuperscript{56} A 11580: 99.
\textsuperscript{57} A 11419: 258; A 11427: 26.
\textsuperscript{58} A 11419: 33.
\textsuperscript{59} A 11415: 459.
\textsuperscript{60} A 11421: 15.
site – in the dunes near the edge of the northern tract of Sārnate Bog (Grasis 2002; Grasis & Ziediņa 2002).

Since some of the dates for the dwellings with Late Sārnate Ware are not much earlier than the dates for the first appearance of the Corded Ware Culture in the East Baltic (Antanaitis-Jacobs & Girininkas 2002, 10–11), it is possible that there was indeed some interaction with the people of this culture.

5.7 General issues relating to the pottery

5.7.1 Clay

No clay provenience study has been undertaken on the pottery from Sārnate. Vankina (1970a, 118, 126) assumed that the pottery was made from the ‘blue clay’ found underlying the peat layer at the site itself. When potter Baiba Dumpe sampled this source for the purpose of making replicas of vessels from Sārnate for experimental work, she found material that was insufficiently plastic (too coarse-grained) for making pottery.

When the material underlying the site proved unsuitable, Dumpe turned to a source of limnoglacial clay about 1 km north-west of the site (Fig. 103). The blue-grey clay without inclusions collected here was also found to be somewhat silty and not very plastic, but, tempered with strongly decomposed peat, it was successfully used for making experimental vessels (Bērziņš & Dumpe 2005, 10).

Thin-section analysis of four sherds from Dwellings O, Y and S, undertaken by Ole Stilborg, showed that medium-coarse to coarse, non-calciferous clay had been used, in most cases are unsorted, meaning that it contains a relatively high proportion of sand. The clay of all the samples is rich in mica and fairly rich in iron oxide. (Dumpe et al. forthcoming).

5.7.2 Non-plastic inclusions

The addition of non-plastic materials to the pottery fabric can serve to improve the workability of highly plastic clays, reduce the drying time of the vessel and make it more resistant to cracking during drying and firing (Rye 1981, 31; Skibo et al. 1989, 127, 136). The particular kind of non-plastics used, as well as the quantity, size and shape of these inclusions, also have very important effects on
the functional characteristics of pottery vessels, as will be discussed in this section.

As indicated by the presence of characteristic platy pores, all of the main pottery wares represented at Särnate were most commonly tempered with crushed shell. The calcareous shell itself has dissolved in the acid conditions at the site, leaving platy pores with marks of the shell growth rings. The pores tend to be oriented parallel to the vessel walls. Shell fragments are still present in a few sherds from Dwelling G. Identification of mollusc species has not been attempted, but the form of the impressions indicates that freshwater mussel shells were probably used. Shell temper in Narva Ware from sites along the lower course of the River Narva have been identified as *Unio tumidus* and probably also *Anodonta cygnea* (Kriiska 1996, 374, 377). Shell temper in Neolithic pottery from the Lake Lubāna area has been recorded as *Unio sp.* (Loze 1988a, 48).

Judging by the thinness of the platy pores in the pottery at Särnate, the shell would almost certainly have been burned before it was crushed and added to the fabric. Unburned mussel shell would have left thicker pores (up to 0.15 cm), corresponding to the original thickness of the shell, and such thick platy pores were not observed. Prior burning of the shell at about 500 °C has the effect of converting the aragonite structure of the shell to calcite, with two important advantages. In the first place, the resulting material is very friable and may be crushed with minimal effort (Steponaitis 1984, 83). The author was able to confirm this in an experiment with freshwater mussel shells. In a ‘green’ state, the shells could be crushed only by hammering, which produced sharp, thick splinters. When they were added to clay, the resulting fabric was decidedly uncomfortable to work with. By contrast, burned mussel shells were easily crushed, since they readily split into very thin laminae, reminiscent of mica flakes, which do not cut the potter’s hands. Secondly, conversion to calcite involves expansion in volume, and it seems preferable that this conversion should take place in the course of preliminary heating of the shell, before it is added to the fabric, rather than during the firing of the vessel, since in the latter case it could increase the risk of damage to the vessel wall (Steponaitis 1984, 83).

Shell-tempered pottery features prominently in sequences of ceramic development in eastern North America, and this has prompted a considerable amount of research into the physical properties of shell-tempered pottery. So long as the firing temperature is kept low enough to avoid the decomposition of the calcite高层
(otherwise, it will subsequently shatter the fabric in a process known as lime spalling), limestone or burned shell temper presents the advantage of low thermal expansion, similar to that of the clay itself, in contrast to mineral tempers such as quartz, which exhibit much higher thermal expansion (Rye 1976, Fig. 3). Vessels tempered with burned shell or limestone should thus be more resistant to rapid changes in temperature, i.e., thermal shock.

There are also benefits provided by the platy structure of shell (in contrast to a ‘blocky’ tempering material such as limestone). Temper consisting of platy fragments, such as shell, (and likewise temper consisting of fibrous fragments) helps to dissipate energy in the course of crack propagation, in other words, it improves the toughness of the fired fabric. This is because of the deflection and bifurcation of the crack at the interfaces between such elongated inclusions and the clay matrix, and because such inclusions are more effective than angular or rounded fragments at bridging cracks and so stopping them from propagating. This increased toughness is important in relation to both mechanical and thermal stress (Tite et al. 2001, 312, 315). Moreover, because in the course of forming and finishing the fragments will tend to be forced into a position parallel to the wall, they form a barrier against crack propagation across the width of the wall (Shepard 1956, 27; Steponaitis 1984, 112).

In the course of studies on pottery from the Mississippi Valley of the eastern United States, a distinction has been made between ‘fine shell’ and ‘coarse shell’ fabrics, with the observation that the amount of shell temper and the particle size has a relationship to the form of the vessel. There is evidence that this coarse shell/fine shell difference, too, might have a technological basis. The experimental observations made by Steponaitis (1984, 94–108) suggest that fine shell-tempered pottery was more resistant to mechanical stress, while coarse shell-tempered ware, although not as strong initially, would have been more resilient as cooking ware in that it would have retained more of its initial strength even after severe thermal shock. The experiments by Bronitsky & Hamer (1986, 96–97) seem to confirm this idea: they found that larger amounts of coarse burned shell temper increase resistance to thermal shock (although it should be pointed out that, since they fired their shell-tempered experimental briquettes at the relatively high temperature of 800 °C, the shell temper would have been at least partly decomposed). Tite et al. (2001, 304, 315) present a discussion of the factors responsible for such findings: with greater amounts of non-plastics, the propagation of cracks is more readily arrested, providing greater toughness and consequently also greater thermal shock resistance. Studying shell-tempered pottery from the Lower Mississippi Valley, Teltser (1993, 538) observed corresponding differences in vessel use, as reflected in
reduction/oxidation patterns on excavated sherds: it appears that coarse-shell pastes were used for cooking vessels in preference to fine-shell pastes.

There is some evidence of a course-shell/fine-shell distinction in the Sārnate material, too. In his analysis of polished sections of sample sherds from Sārnate, Ole Stilborg has, on the basis of the estimates of temper amount, combined with measurements of the size of the largest grains, tentatively distinguished of two temper quality groups – one with a lower amount (5–15%) and smaller grain size (0.23–0.29 cm) and the other with more (15–20%) and larger inclusions (0.59–0.62 cm). Moreover, this difference was found to coincide with a difference in the thickness of the vessel wall: 0.6–0.7 cm and 0.8–0.9 cm, respectively. In Stilborg’s opinion, this is a feature to be expected in an established pottery tradition striving to use the most efficient and workable fabric in relation to the size of the vessel. At the same time, this idea remains hypothetical until confirmed by statistics based on a larger sample. (Dumpe et al. forthcoming).

The author’s observation that the Late Sārnate Ware bowls tend to have finer shell temper than the round pots may be a further indication that the potters did indeed adjust the fabric to suit the kind of vessel they were making.

In the light of the evidence discussed above, shell (especially when present in large amounts and in the form of coarse particles) comes across as a particularly appropriate tempering material for low-fired vessels that are to withstand the repeated heating and cooling to which cooking vessels are exposed, although the presence of such large amounts of temper is likely to reduce the strength of the vessels. In the case of the Eastern Woodlands of North America, the supplanting of quartz- and grog-tempered pottery by shell-tempered wares has been explained as a logical progression resulting in the gradual improvement of cooking vessels (Steponaitis 1984, 112–113). This line of reasoning might also be applied to the East Baltic region: the dominance of shell as a tempering material in the low-fired Neolithic pottery of this region might be seen as resulting from a process of technological development in a situation where the driving concern was to produce durable vessels for cooking.

The presence of large, platy inclusions in the fabric, such as coarse shell temper, will also affect the character of the decoration. With this kind of temper, deeply impressed decoration of the kind commonly seen on Comb Ware, and likewise incised linear decoration, are difficult to execute, because the temper fragments obstruct the tool or tend to be dragged by it, marring the decorative effect. Shallow impressed decoration, such as is usually found on Early and Late Sārnate Ware, is easier to execute on vessels with this kind of fabric.
The presence of very small amounts of coarse mineral temper in some of the Early and Late Sărnate Ware does not appear to be of any technological significance. The inclusion of such material may have been thought by the potters to improve the properties of the fabric, or the motivation might have been altogether quite different.

Pottery tempered with crystals of crushed granitic rock – mainly feldspar, along with quartz and mica – can be fired at higher temperatures, above the limit for shell or limestone, thus obtaining harder, stronger ceramics. There is evidence from other sites that Comb Ware was indeed fired at higher temperatures (see Section 5.7.7), so the use of crushed rock for tempering this ware has a logical basis.

Because feldspars and micas have relatively low coefficients of thermal expansion, they serve as inert tempering materials (Rye 1976, Fig. 3; 1981, 35). Quartz, on the other hand, has a very high coefficient of thermal expansion, compared to low-fired clay (Rye 1976, Fig. 3), and so the presence of quartz sand or crushed quartz crystals actually increases thermal stresses. However, it seems that quartz temper does play an important positive role in high-fired pottery. It has been shown to contribute to energy dissipation (toughening) during fracture, acting to prevent the catastrophic propagation of cracks, apparently the result of an extensive network of microdamage formed in the course of drying and firing. For pottery fired at 950 °C, the optimum amount of quartz is apparently 20 % by volume (Kilikoglou et al. 1998, 273–274).

In all of the pottery groups at Sărnate, the shapes of pores and impressions on pore surfaces show that fibrous plant temper was often used as well. Charred organic matter was sometimes observed in the pores. Charred inclusions of plant fibres, thought to be grass stems, were identified in a sample sherd examined by Vītols and Vītiņš (1962).

Organic temper such as plant matter is largely burnt out during firing, leaving quite large pores. It is thought that grass temper added to the Sărnate vessels and burnt away during firing would have improved the resistance of cooking pots to repeated thermal stress by increasing porosity, since pores provide an elasticity in the body that allows for sudden expansion of the materials (Rye 1981, 34; Rice 1987, 230) and if the pores were large, open and connected they would also have increased thermal conductivity (Rice 1987, 368), enabling the contents of the vessel to be heated more quickly and presumably reducing thermal stresses in this way, too.

Porous vessels are also significantly lighter and thus more portable. Of course, increased porosity also means that the vessels will be more permeable. This can
mean not only the loss of part of the contents, but can also drastically reduce the heating effectiveness. Because of this, cooking vessels and vessels used for boiling or storing liquids may require some additional waterproofing after firing (Skibo et al. 1989, 127, 131). This issue is taken up in Section 5.7.9.4.

5.7.3 Wall thickness and vessel morphology

The wall thickness figures for the round pots of all the pottery groups at Särnaate (as measured 3 cm below the lip) are fairly similar: for Comb Ware, the range is 0.4–0.11 cm, with a mean of 0.72 cm, for Early Särnaate Ware the range is 0.5–1.6 cm, with a mean of 0.73 cm, and for Late Särnaate Ware the range is 0.5–1.2 cm, with a mean of 0.79 cm.

Because of differences in the recording system, these figures are not directly comparable with those obtained by other researchers, who generally give sherd thickness, which evidently gives a mix of the possible variation in thickness from rim to base. Systematic recording of sherd thickness has been undertaken by Gurina and Kriiska on pottery assemblages from the Lower Narva area of north-eastern Estonia. Gurina reports that Narva Ware at Narva Riigiküla II and III mainly has a wall thickness of 0.6–0.7 cm, while Comb Ware has a range of 0.8–1.0 cm at Narva Riigiküla I and 0.6–1.2 cm at Riigiküla II (Gurina 1967, 32, 47, 48, 84). Kriiska gives the following sherd thickness measurements: 0.5–1.5 cm (mean: 0.8 cm) for Narva Ware from Narva Joaoru, 0.5–1.9 cm (mean: 1.0 cm) for Typical Comb Ware from Lommi and 0.4–1.9 cm (mean: 1.2 cm) for Late Comb Ware from Kudruküla (Kriiska 1995, 70, 79, 88, Figs. 7, 10, 18). Thus, Gurina’s, and particularly Kriiska’s, data indicate that both Typical and Late Comb Ware vessels, at least in north-eastern Estonia, tend to be thicker-walled than Narva Ware.

Against this background, all the pottery wares at Särnaate (including the Comb Ware) might be described as relatively thin-walled. It seems that some method of thinning the walls after coiling would have been used for the thin-walled vessels at Särnaate and elsewhere in the region: either beating (although no characteristic marks of this technique were observed), or scraping to remove excess clay (see Section 5.7.5). The wall thickness evidently reflects the influence of a number of factors: the size of the particular vessel, the character of the fabric, the technique of forming and finishing, and the intended function(s). In any case, the relative thinness of the walls of vessels at Särnaate would have contributed to their suitability as cooking vessels. Thus, cooking vessels should have thin walls of
uniform thickness, reducing thermal gradients and thus increasing resistance to thermal stress (Rice 1987, 369). For other purposes, thick-walled vessels may have their advantages: lower permeability, which is important for storage of liquids, and greater resistance to mechanical stress, which is desirable if the vessels are used for processing operations (Rice 1987, 227–228).

Graphic reconstructions have been created for several Early and Late Sārnate Ware vessels, and vessels from the ungrouped Dwelling S (Figs. 29, 38, 42). Reconstruction of the lower body is largely conjectural: the shape of the lower body and the height of the vessel have been estimated, taking into account the curve of the preserved part of the body, the angle formed at the apex of the preserved bases (not from the same vessels), as well as the form of reconstructed vessels from Šventoji (Rimantienė 1979, Figs. 94, 108; 2005, Fig. 21). In consequence, the vessel height estimates given in Table 5 are very approximate. Nevertheless, as far as can be ascertained from the very small sample of reconstructed vessels, it does seem that vessels with everted rims were markedly taller, in relation to their maximum diameter and rim diameter, than vessels with direct rims.

The early pottery from this region of Europe, including the Sārnate material, generally displays very simple body contours, a characteristic that would have reduced the risk of damage, both thermal and mechanical, since it is the edges, corners and thickened areas of a vessel that are particularly vulnerable to thermal fracturing. For this reason, most cooking pots have rounded bases and simple body contours (Rye 1981, 27; Rice 1987, 369). At the same time, thickening of the lip with a bolster or flange strengthens the rim against mechanical breakage (Rice 1987, 241). Thus, in terms of morphology, with their simple body forms and thickened or everted rims, the vessels of all the pottery groups at Sārnate would have been relatively resistant to both thermal and mechanical stresses.

The general pattern of development of pottery rim forms in the East Baltic region during the Neolithic might be viewed in a technological light, reflecting a succession of different approaches to the problem of how to increase the mechanical strength of the upper body. From this perspective, the earliest pottery vessels may be characterised as lacking any kind of rim-strengthening feature (direct rims with rounded or tapered lips, not thickened). From the beginning of the Middle Neolithic, flat rims thickened on the inside and/or the outside appear very widely, a development perhaps associated with Comb Ware influence in the East Baltic region, and one that would have had the effect of increasing the mechanical strength of the upper body, perhaps permitting larger vessels to be made. At Sārnate, this is seen in
the Comb Ware and Early Sārnate Ware. The later part of the Middle Neolithic witnesses the appearance of vessels with an everted rim, as in Late Sārnate Ware. This may be seen as an alternative rim-strengthening feature, which, considering its pattern of distribution, might be viewed as connected with influences from the south or south-west.

5.7.4 Vessel size and volume

Vessel volume was calculated from the graphic reconstructions of six vessels (Table 5; Fig. 43), using the ‘summed cylinders’ method (Rice 1987, 221–222, Fig. 7.8). Bearing in mind that the shape of the lower body of the vessels, and consequently the height, can only be gauged approximately, the volume estimates, too, should be regarded as very approximate. However, the general shape of the vessels is such that most of the volume is contained within the upper body, so the error connected with inaccuracy in reconstructing the lower body is not as great as it would be, were a greater part of the volume contained within the lower body.

The volume of the vessel when filled to 90% of the height is intended to give a more realistic estimate of the practical capacity than the volume to the lip. The results suggest that vessels with an everted rim have a larger capacity than vessels of comparable rim diameter, but with a direct rim, at least for the small sample calculated here. This difference is connected with the greater estimated height of the vessels with everted rims. Thus, the volume of two medium-sized vessels with an everted rim and rim diameters 34 and 40 cm was calculated as 21.4 and 31.5 litres, respectively, while a vessel with a direct rim and a rim diameter of 40–45 cm would have held 28.6 litres. A medium-sized vessel with a direct rim and a rim diameter of 35 cm has a low estimated capacity of 9.9 litres, evidently because its body has been reconstructed as being less convex, closer to a conical shape. At the lower end of the range, two vessels with direct rims and a rim diameter of 20 cm have capacities of around 3 litres.

The results of volume calculation thus give some idea of the relationship between rim diameter and vessel capacity. However, these figures are very far from precise: even small errors in assessing rim diameter or vessel shape are likely to cause considerable miscalculation of the capacity.

In both Early and Late Sārnate Ware, vessels most commonly have a rim diameter of about 30–35 cm, which, if we can judge by our few volume reconstructions, corresponds to a volume of around 10–25 litres. The largest Early Sārnate Ware vessel has a rim diameter of 40–45 cm, corresponding to an
estimated volume of around 30 litres, while in Late Särnate Ware, the largest recorded vessel has a rim diameter of 50–60 cm, which would have given a much greater capacity.

There is practically no rim diameter data and no information about overall vessel form for the Comb Ware group, and consequently no evidence regarding vessel volume.

<table>
<thead>
<tr>
<th>Dwelling Accession number</th>
<th>Rim form</th>
<th>Rim diameter (cm)</th>
<th>Estimated maximum diameter (cm)</th>
<th>Estimated height (cm)</th>
<th>Estimated ratio max. diam./height</th>
<th>Estimated volume to lip (l)</th>
<th>Estimated volume to 90% of height (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 11417: 314 Id3</td>
<td></td>
<td>40–45</td>
<td>40–45</td>
<td>36</td>
<td>1.18</td>
<td>33.7</td>
<td>28.6</td>
</tr>
<tr>
<td>MA 11417: 315 Id3</td>
<td></td>
<td>30–35</td>
<td>30–35</td>
<td>24</td>
<td>1.35</td>
<td>11.7</td>
<td>9.9</td>
</tr>
<tr>
<td>MA 11417: 304 Id1</td>
<td></td>
<td>20</td>
<td>20</td>
<td>17</td>
<td>1.18</td>
<td>3.6</td>
<td>3.0</td>
</tr>
<tr>
<td>S A 11580: 200 Id1</td>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>1.0</td>
<td>4.5</td>
<td>3.9</td>
</tr>
<tr>
<td>S A 11580: 198 Sb3</td>
<td></td>
<td>30</td>
<td>34</td>
<td>37.5</td>
<td>0.9</td>
<td>23.6</td>
<td>21.4</td>
</tr>
<tr>
<td>K A 11416: 112 Sa3</td>
<td></td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>1.0</td>
<td>34.6</td>
<td>31.5</td>
</tr>
</tbody>
</table>

Fig. 43. Graph of vessel rim diameter against estimated volume when filled to 90% of height (I – vessels with direct rims; S – vessels with everted rims).
5.7.5 Surface striation

Some of the kinds of surface finish observable at Särnate have been covered in previous sections. The unusual ‘undulating surface’ characteristic of Late Särnate Ware, consisting of troughs and ridges, has been considered in Section 5.3.1.1. Textile impressed surfaces, likewise observed on Late Särnate Ware, albeit very rarely, have also been treated in Section 5.3.1.1.

Striation is a much more widely represented type of surface finish, commonly found vessel exteriors and interiors in both Early and Late Särnate Ware groups. Indeed, it is very widespread in the region during the Neolithic and Bronze Age, and a variety of suggestions have been made as to the kind of tool used. Vankina (1970a, 115) considered that the striated surface on the Särnate pottery had been obtained using some kind of hard, serrated object, such as a flint flake or bone tool. Gurina (1967, 173) suggests that the striated surface on Narva Ware was created using a comb stamp. Bobrinskij (1978, 228) found that striated pottery surfaces could be replicated by texturing with cereal stalks, whereas smoothing of the vessel surface with the fingers, with fabric or with a wooden knife leaves a different texture. Jaanusson (1981, 43–44) concluded from experiments that striae on Late Bronze Age vessels at Hallunda, Sweden, could have come about not from actual striation, but as a result of enveloping the pottery in grass. Vasks (1991, 40–41), studying striated Late Bronze Age pottery from Latvia, supports the view that a fairly hard tool would have been used for striation, and he suggests a flint flake or a bunch of twigs. Noting variation in the character of the striations even on material from the same phase at the site, he suggests that a variety of methods were used concomitantly.

On the basis of her experimental work, Baiba Dumpe rejects outright the idea that a striated finish could have been obtained by wiping with grass or twigs: grass tends to wipe away too much of the clay, while twigs catch the flat particles of temper, pulling them out of the fabric and leaving pits. Evidently, a hard notched tool would have been used instead (Dumpe et al. forthcoming).

It should be added that the character of striation will be markedly influenced by the condition of the fabric: even a soft instrument will leave deep striae on the vessel if it is textured immediately after coiling, but leather-hard clay requires a harder instrument for striation.

Striation of the surface might be viewed as a labour-saving method of removing irregularities and obliterating small cracks in the surface, which would have been a major task, considering the great surface area of the large pots.
In recent work on Neolithic pottery, this kind of texture has come to be interpreted as a feature indicating that the vessel walls were thinned by scraping. Observing on Narva Ware from eastern Lithuania a distinctive kind of deep striation only present on thin-walled vessels, Brazaitis (2002, 53) suggests that it represents a method of thinning the vessel walls by scraping with a serrated tool (an alternative to beating), an idea that may well apply to Sārnate Ware too. In replicating Osa Ware from eastern Latvia, Dumpe found that the notched edge of a shell could have been be used for scraping, as could a bone comb. Bone combs suitable for this purpose have been found at the Late Neolithic site of Abora. At Osa, the character of the impressions and the striations shows that the same tool would have been used both to create impressed decoration and for scraping the surface to remove irregularities, refine the vessel form and thin the walls (Dumpe et al. forthcoming). In the Sārnate material, too, it is quite possible that the tooth stamp, and perhaps the tool used to make the ‘plait’ impressions, also served as striating tools.

In her replication work, Dumpe (2003, 116) has also used the edge of a mussel shell in its natural state (i.e., not serrated) for scraping. It was found to be very suitable for this purpose and leaves a slightly striated surface, the striations being caused mainly by the dragging of hard inclusions across the surface of the clay. The character of the striations relates to the degree to which the clay has dried and hardened at the time of striation, more pronounced striations being formed in softer clay.

It has been suggested that a striated surface texture will affect the heating properties of cooking vessels. An uneven exterior – striated, for example – has more surface area to absorb heat from a fire, so this should contribute to faster heating (Rice 1987, 232). On the other hand, there is experimental evidence that surface texturing does not significantly improve heating effectiveness (Schiffer 1990, 378–379).

From the point of view of durability, pottery intended for heating should in theory have a very smooth surface, since surface imperfections will be propagated below the surface with heating and cooling (Rice 1987, 369). However, experimental evidence suggests the opposite: shallow texturing of the exterior (less than 0.05 cm in depth) may reduce spalling when the vessel is heated repeatedly heated and cooled, and deep texturing (0.1–0.15 cm in depth) evidently has a more pronounced effect on thermal shock resistance, indicated by a reduction in both spalling and cracking (Schiffer et al. 1994, 205–208). These
findings suggest that striation of the exterior might have contributed to thermal shock resistance, particularly if the surface was deeply textured.

Of course, a rough exterior surface also provides a more secure grip (Rice 1987, 232). At the same time, a textured interior evidently increases the adherence of organic residue from the vessel’s contents, something that may or may not be desirable (see Section 5.7.9.4).

5.7.6 Decoration

Just like the other characteristics of the pottery, the general character of the pottery decoration, and the differences between the pottery groups in terms of decoration, may be viewed from a practical pottery-making perspective. In the first place, the kind of stamp used to make impressed decoration clearly influences the work input. Compared with decoration consisting of individually impressed small pits, the use of an elongate form of stamp – comb, tooth or wound-cord – can be seen as a labour-saving approach, since each impression of an elongate stamp covers a much larger surface area. This means that partial decoration of the surface with pits or with other simple, small impressions, as is generally the case with Late Sârnate Ware, can be regarded as equivalent – in terms of time and labour invested in the work – to decorating the entire surface of a vessel using some kind of elongate stamp, as is commonly seen on Comb Ware and sometimes on Early Sârnate Ware. Certainly, this is a difference that should be borne in mind when comparing different pottery wares in terms of the amount of decoration.

The use of particular stamp forms also involves an element of special knowledge. Thus, it is not clear precisely what form of stamp was used to make the plait impressions found on Early and Late Sârnate Ware, and the distinctive row of boat-shaped impressions constituting the ‘tooth stamp’ has so far proved impossible to replicate. The knowledge of what tool to use in order to obtain these distinctive forms of impressions evidently had to be learned as part of the tradition. Potters not privy to this knowledge, but wishing to replicate the technique, are likely to use a different tool, producing impressions that may bear a superficial resemblance, but will be distinguishable on close inspection.

Finally, differences in the amount and character of decoration might also have been influenced by an idea of what the vessel would look like once it came into use. Judging from the frequent presence of exterior sooting, the Early and Late Sârnate Ware pots were evidently used mostly for cooking, and little attention may have been given to decorating the exterior of vessels intended for this
purpose, since the makers were well aware that any decoration would soon become hidden under a layer of soot. On the other hand, if the Comb Ware vessels were generally used for other purposes, not involving exposure to fire, then the effort of decorating them was more worthwhile, since it could be assumed that the rich exterior decoration would retain its original prominence while in use (unless, of course, the vessels were used partly or fully embedded in the ground as storage containers, as Edgren (1982, 71) has suggested).

While the above-described factors may be thought to have influenced the character of decoration, we still have very little understanding of the significance attached by the makers of the pottery to decoration as such, and to particular elements and motifs. There are no readily identifiable representations on the pottery from Sārnate. The only motif that apparently representing a feature of the natural world is the hexagon or honeycomb pattern incised on a vessel from Dwelling F; a similar pattern is engraved on a very small hoe-like tool from Dwelling N (Vankina 1970a, Fig. XL, Fig. XLI: 1)62, and is found on some of the pottery figurines from Ģipka on the east coast of the Kurzeme Peninsula (Loze 2006, Fig. 81: 3) and the Åland Islands (Nuñez 1986, Fig. 6).

However, it does seem likely that at least some of the pit decoration on Late Sārnate Ware was also representational, even though whole motifs cannot be traced because the material is too fragmented. The pottery from the Narva Culture sites at Šventoji, which, as described above, shows many similarities to Early and especially to Late Sārnate Ware, includes several examples of pit decoration constituting non-symmetrical, apparently representational motifs that Rimantienė interprets as images of animals, humans and fishing gear (Rimantienė 2005, Figs. 50, 121, Fig. 163: 1, 4, Fig. 211: 3–8). Representational motifs have also been observed in the patterns of decoration with small pits on Early Neolithic pottery from eastern Latvia, especially on the oval bowls (Zagorskis 1973: Fig. 3; Loze 1988a: 40–41).

It seems that a clearer understanding of pottery function and of the context in which it was made and used could open up new avenues for interpreting pottery decoration. For example, the idea that storage is likely to have been an important function of Comb Ceramic vessels provides the basis for the suggestion that at least some elements of decoration on Comb Ceramics may have been meant as protection of stored goods against spoilage (Nuñez 1990, 39). At Sārnate, on the other hand, since the evidence indicates that a large proportion of the Early and

62 A 11418: 81; A 11419: 62.
Late Sārnate Ware vessels were used as cooking vessels, we might guess that the decoration could relate in some way to this function.

A view of decoration (and other features of pottery) as non-verbal communication (Holm 2000) also seems very useful, but is bound to remain somewhat abstract, unless grounded in an understanding of the context of manufacture and use. What are the functional and social contexts in which the pottery could serve as a medium of non-verbal communication? And how do these contexts vary between cultures? In the end, we come back to the need for a better understanding of the pottery vessels as ‘tools’ for particular activities. These activities then need to be placed in a wider economic and social context.

5.7.7 Firing

Since no remains of Neolithic kilns have been found in the region, we may assume that some kind of open firing was practiced, either on flat ground or in a pit (Mikšaitė 2005, 66–67; Bērziņš & Dumpe 2005, 10). Compared with kiln firing, open firings tend to be relatively brief, generally achieve relatively low temperatures and give the potter less control over the process.

In open firing, a bed of fuel is usually prepared on the ground, the pottery to be fired is placed over the fuel and more fuel is placed on and around the pottery. Apart from the main fuel, presumably wood, a quicker-burning material such as grass or reeds may be added around the sides and top, creating a covering blanket of ash to hold in the heat from below and protect the hot pots from the wind. Open firings are characterised by a very rapid rise in temperature, the maximum temperature usually being attained at or just after the fuel covering the pile of pots has been consumed. Following this, the temperature falls, rapidly at first and then more slowly. The maximum temperature attained is largely a function of the kinds of fuel used, its size, quantity and position in the firing. In the process, the vessels are subjected to considerable thermal shock because of rapid heating but a high temperature is maintained only for a short time. (Rice 1987, 153–157).

Before the vessels come into contact with the fire, they need to be preheated in some way to evaporate at ambient temperatures the moisture that remains after drying (Rice 1987, 152–153, 156; Holstein 1973, 79). Unless the vessel is

63 Mikšaitė (2005, 68) relates firing experiments with a temporary kiln-like structure of straw and clay built over the pottery and fuel. However, to the author’s knowledge, there is no evidence from Neolithic contexts in the region that such a method was actually used. (Fragments of fired clay from the structure would be expected.)
sufficiently warmed in advance, spalling is likely to occur when the vessel first comes into contact with the direct heat of the fire.

Experimental work has underlined the importance of preheating, and a variety of methods have been used to achieve gradual warming in the initial stage. In the pit firing experiments by Mikšaitė (2005, 66–67), this stage lasted two to three hours, during which the burning fuel, around the edges of the pit, was not permitted to come into contact with the pottery, in the centre. Valerij Zinkevich at the Museum of Traditional Culture in Braslav, Belarus, has experimentally developed a method of open firing that minimises damage in the early stages of firing (Dumpe et al. forthcoming). Using only dry branches of deciduous wood, the fire is built up in a ring around the vessels, gradually bringing the ring of fire closer to the vessels. The vessels are then heated from above and from the sides until the required temperature is reached, which is gauged from the colour of the vessels. Initially, as the organic matter in the fabric begins to smoulder, the vessels blacken. As the temperature rises further, the organic matter in the surface layer of the fabric is burned out and the pottery turns an ash-grey colour. A red glow will also be visible if the light is not too strong. Finally, the vessels are covered in ash and the burnt-out earth. This method has been successfully applied by Dumpe in experimental work replicating Osa Ware vessels: although labour-intensive, it was found to be very effective, in that spalling was eliminated. Another measure to reduce the initial thermal shock is to use slow-burning fuel, such as pine cones (e.g. Bērziņš & Dumpe 2005, 10).

It is very important for the potter to gauge the firing temperature on the basis of the colour of the vessels. Underfired vessels will become soft and collapse when exposed to moisture. As regards shell-tempered ware, it is just as important to avoid overfiring. If exposed to a temperature of more than about 750 °C, a temperature readily achievable in open firings, the ceramic structure will become unstable because of calcite decomposition, as described above.

The colour profile of the vessel wall provides some evidence of the firing conditions. As described above, the majority of both Early and Late Šârnate Ware vessels were recorded as having light-coloured (oxidised) surfaces and a dark core. This implies that they were exposed to oxidising conditions at some stage of the firing process, but not for long enough to oxidise the organic matter in the core of the vessel wall. This would appear to indicate either: a) brief firing in oxidising conditions, too brief to oxidise the wall to the core, or b) firing in reducing or neutral conditions, followed by removal of the vessel so that it is allowed to cool in an oxidising environment (Rye 1981, 114–118). The higher
proportion of vessels in the Comb Ware group with walls oxidised throughout could indicate that there was less organic matter in the fabric of these vessels, or that oxidation during firing was more complete, or this could be due to post-depositional oxidation, since the Comb Ware comes from the dryer part of the site.

Alteration of the pottery in the course of use can obscure firing evidence to some degree: thus, the part of a cooking vessel exposed to the flames of the hearth is likely to become oxidised on the outside (see Section 5.7.9.2). However, this does not account for oxidation of the interior surface, and in any case the colour profile of the wall was recorded on rim sherds, so it reflects the conditions to which the rim and upper body were exposed – the part of the vessel least likely to have undergone oxidation from direct exposure to flames during cooking.

Occasionally it was possible to observe on Late Sărnate Ware various characteristic forms of damage that could have come about in the course of firing, although in fact some of these are equally likely – if not more likely – to have resulted from repeated thermal shock to vessels used as cooking pots. These features include:

- **Spalling.** This phenomenon occurs at temperatures up to about 300 °C and is especially likely to occur during firing if the walls are thick and have not dried completely beforehand (Rye 1981, 114). However, spalling can also result come about during the use-life of the vessel, if it is used for cooking (Schiffer 1990, 378–379; Skibo 1992, 134–135). There are spalls on some of the Late Sărnate Ware vessels and the vessels of Dwellings L and S.

- **Firecracks.** When heating is too rapid prior to decomposition of the clay minerals, mainly between about 300 and 500 °C a network of fine cracks may be formed on the surface, sometimes with a hexagonal structure (Rye 1981, 111). Firecracking is quite common on the outside of Late Sărnate Ware vessels, and is particularly frequent on the bases of both pots and bowls. This suggests that the cracking is more likely to have resulted from rapid heating and cooling of the base of the vessel during use.

- **Star-shaped cracks.** A series of crack lines radiate from a common centre. The effect occurs mainly on the exterior surface. Such cracks are caused by the expansion of a mineral grain within a densely packed fabric during rapid heating (Rye 1981, 113–114). This effect has been observed on the interior and exterior of Late Sărnate Ware.
Dunting cracks. When a vessel is cooled very rapidly, heat is lost most quickly from the rim, placing the rim in tension and possibly leading to a dunting crack. The crack is wider at the rim than at its lower end (Rye 1981, 114). There are some possible examples of dunting cracks in Late Sārnate Ware.

Lime spalling, a form of damage, initiated by heating above the temperature where calcite decomposition begins, has not been positively identified in the Sārnate material, although it may well have been a problem for the potters. As described above, this process can continue during the use-life of the vessel. At Sārnate, since the shell itself has dissolved in the acid conditions, lime-spalls are difficult to identify.

In the 1960s, estimates of the firing temperature of sample sherds from Sārnate were obtained, based on the content of CO₂ and organics, and on thermogravimetric measurements. One sherd (dwelling of origin not recorded) was considered to have been fired at a temperature not exceeding 600 °C (Vītols & Vītiņš 1962), while two more, from Dwellings K and L, were estimated as having been exposed to 400–500 °C and approximately 400 °C, respectively (Birzniece & Vītiņš 1963). Ethnographic studies of open firings have generally recorded temperatures up to 600–850 °C, but there is considerable variation, and temperatures of as much as 900 °C are not uncommon (Rice 1987, 156–157).

Firing temperature estimates have been obtained for pottery from various other Neolithic sites in the East Baltic. Kalm has concluded that Narva Ware from the Narva and Narva Riigiküla sites was fired at around 800 °C. The firing temperature of Late Comb Ware from the Lonmi and Narva sites could be determined approximately: between 820–850° and 1080–1100 °C (Kalm 1996, 385–396). Relatively lower estimates of firing temperature are cited by Zagorskis (1967, 109, 122) for pottery from eastern Latvia: around 500–600 °C, or in certain cases up to 700 °C for Comb Ware at Iča, and even lower temperatures, 400–500 °C (or in some cases 600–700 °C), for Piestoja Ware (Zagorskis 1967, 109, 122).

Higher firing temperatures do produce a stronger fabric: for a high-fired ceramic to crack, atomic bonds must be broken, requiring a relatively large amount of energy. But if sufficient energy is present, then the resulting crack will travel quickly and unstably, and energy dissipation may not be sufficient to arrest the crack. By contrast, the cracking of low-fired fabrics involves the separation of clay platelets, which is initiated at lower stresses. However, this smaller amount
of energy is more easily dissipated in the course of crack propagation, and the crack thus tends to be arrested. In other words, the vessel, though not as strong, will be tougher, and consequently also more resistant to thermal shock. (Tite et al. 2001, 304).

This means that, if the main functional requirement was for ceramics to withstand the repeated thermal shock to which cooking vessels are exposed, then a low firing temperature may actually have been most appropriate. Quite apart from the need to keep the firing temperature of shell-tempered pottery low in order to avoid lime-spalling, there may not have been any technological motivation to increase the firing temperature.

5.7.8 Knowledge and skills, time expenditure and seasonality of production

The ability to prepare a suitable fabric is a crucial aspect of the knowledge constituting a pottery-making tradition. The basic forming techniques can be learned quickly, but experience is needed to make vessels of even wall thickness and regular shape. As seen above, the impressed decoration also required special skills and insider knowledge.

The amount of work needed for forming, finishing and decorating depends, of course, on the size of the vessel. Smoothing and finishing can take much more time than the preparation and application of clay coils (DeBoer & Lathrap 1979, 120–121), and in this light, striation and other kinds of texturing may have had an important role as fast methods of obliterating or concealing surface imperfections. As discussed in Section 5.7.6, the amount of work involved in decorating with impressed stamps depends not only on the amount of decoration, but also on the kind of stamp being used.

Of course, the most demanding and risky part of pottery production is firing, which needs experience and good powers of observation. Even so, open firing is largely an uncontrolled process, and its success is to a considerable degree subject to chance and the weather. With shell-tempered wares, the risk of over-firing represents an additional concern.

Finally, bearing in mind the discomfort of working with wet clay in cold conditions, and the dependence of drying time on temperature and humidity, it might be suggested that pottery-making is likely to have been more of a summer activity, although it could conceivably have been practiced indoors by the hearth at all times of the year. That pottery-making did take place by the fireside is
suggested by finds of large lumps of clay, interpreted as raw material for pottery making, near the hearths of Dwellings G and Y (Vankina 1970a, 118).

5.7.9 Pottery use

5.7.9.1 Introduction

Although rather overshadowed by the focus on pottery as a cultural and chronological marker, studies on the function of prehistoric ceramics go back a long way (e.g. Mathiassen 1935; Linton 1944). Nevertheless, it is only fairly recently, with a shift in general concerns in archaeology and the advancement of analytical methods, that this theme has attracted wider research attention. The study of ‘pots as tools’ (Braun 1983) relies on two main kinds of evidence: indirect evidence, pertaining to the intended function of the vessel, and direct evidence of vessel function (Rice 1987, 232).

Indirect evidence, relating to intended function can be obtained by assessing the ways in which particular properties of the ceramics in question affect their suitability as ‘tools’ for various purposes. Overall vessel form can give an idea of the function or range of functions a vessel would have been suitable for (Rice 1987, 224–226). This kind of functional interpretation of ceramic forms has long been applied by archaeologists on a largely intuitive basis, and in recent decades more rigorous, statistically based studies of form-function relationships have also appeared, utilising ethnographic parallels (e.g. Smith 1988). At the same time, experimental work has also begun to reveal how fabric composition, in particular the porosity, and the material and shape of coarse inclusions, influences the mechanical and thermal properties of pottery (Steponaitis 1984; Bronitsky & Hamer 1986; Skibo et al. 1989; Kilikoglou et al. 1998; Tite et al. 2001). In some measure, this also applies to surface texture (Schiffer 1990; Schiffer et al. 1994; Tite et al. 2001) and firing temperature (Tite et al. 2001). Wall thickness and vessel form are evidently also very important in relation to mechanical and thermal characteristics (Rice 1987, 227–228, 369).

The context of pottery finds, namely their association with hearths, storage facilities and other features on residential sites, and/or their presence in grave assemblages, constitutes another a very important line of indirect evidence as to the functional role.
Direct evidence of vessel function, in the form of use-alteration, has recently become the subject of ethnographic and experimental work, with the aim of utilising the interpretive possibilities represented by patterns of use-alteration: sooting, surface oxidation, deposition of residues and damage such as striation, pitting, spalling and cracking (Van Diest 1981; Hally 1983; Skibo 1992). Much of this research has focussed on cooking and other processes involving exposure to fire, since this naturally tends to give very conspicuous use-alteration features. It should be said that this approach is in its early days: there is still a great deal to be discovered about the factors that influence the character of use-alteration features.

A second kind of direct evidence of vessel use involves morphological or chemical characterisation of the remains of the vessel contents (e.g. Mathiassen 1935; Andersen & Malmros 1985; Arrhenius 1987; Skibo 1992; Leskinen 2003). This kind of analysis is in some measure complementary to use-alteration studies, since the former mostly inform about the physical conditions to which a vessel was subjected in the course of use, but cannot give very clear evidence about what it contained.

The clearest picture of a tradition of pottery use can be obtained by pooling the various kinds of direct and indirect evidence (e.g. Gustavsson 1997, 92–99; Lesure 1998). In the present study, the emphasis is on direct evidence in the form of use-alteration, also considering the context of the vessels and the implications of the production technology. No analysis of residues from the vessel contents has been undertaken.

5.7.9.2 Evidence from the Sārnate pots

In the case of the Sārnate pottery collection, there is a great deal of direct evidence of use in the form of use-alteration features, particularly sooting on the exterior and organic residues on the interior. Since this, along with some contextual evidence, provides the clearest pointer to the function of a large proportion of the vessels, it is the logical starting point for an assessment of pottery use. The frequency of these features and their relationship to other characteristics of the vessels has already been examined in the treatment of the separate pottery groups, utilising the information in the data table of vessels (Sections 5.1.2, 5.2.2, 5.3.1.2 and 5.3.2.2). Examined in more detail were traces of use alteration on the subset of 56 vessels with correctly oriented rim profiles, which derive from the Early and Late Sārnate Ware groups and the ungrouped dwellings. The character and distribution of use-alteration features on these
vessels was comprehensively recorded, noting the thickness of exterior soot, the colour and thickness of residues, and the presence of various kinds of cracking and abrasion. The results of this more comprehensive study of use alteration are discussed in this section.

Relationships connecting the functional role of the pottery with vessel form, size, fabric, surface treatment and firing characteristics are considered at the close of this section. In the light of what we know about pottery use from the direct evidence, they permit an appreciation of the overall logic of the pottery technology.

The interpretation of the specific pattern of use-alteration observed on the oval bowls of Late Sārnate Ware has already been discussed in Section 5.3.2.2. As regards the round pots, the evidence of sooting and residue deposition (discussed for the individual groups in Sections 5.1.2, 5.2.2 and 5.3.1.2) provides sufficient indication that a high proportion of the round pots of Early and Late Sārnate Ware, including many of the largest vessels, were being heated over a fire. This does not exclude the possibility that some of these pots were used for other purposes as well, serving functions that have not left identifiable use-alteration features. As described in Section 5.1.2, sooting and organic residues are much less common on the material included in the Comb Ware group, and it seems that this reflects not just the poorer state of preservation of this part of the material, but also a real difference in the pattern of pottery use.

Careful study of particularly large sherds and partially reconstructable vessels from the Early and Late Sārnate Ware groups, and from the ungrouped Dwellings J, L, S, V and Zn, reveals patterns in the distribution of zones of sooting, residue deposition and oxidation across the vessel surface. Only in very rare cases can the profile be reconstructed from the rim right down to the base, and it is generally possible to obtain information only about patterns of deposition and oxidation on the upper body of the vessel – the neck and shoulder. Additional information can sometimes be obtained from markedly curved sherds that evidently derive from the belly of the vessel, and from the few vessel bases.

A characteristic pattern of sooting, organic residue and surface oxidation was commonly observed. There is a layer of sooting on the upper exterior of the vessels, and on the shoulder of vessels with an S-shaped upper body profile. Lower down, the soot layer thins out or disappears completely. In many cases, the exterior surface is oxidised from the shoulder down. Sherds from the belly of the vessel often also have an oxidised outer surface. The upper interior surface generally tends to be largely free of organic residue (most commonly with some dark brown
discolouration). This zone usually corresponds approximately to that part of the exterior covered in soot. Lower down, a layer of organic residue begins: a cracked, matte, usually dark brown layer with a fairly flat surface, which may attain a thickness of several millimetres. This tends to cover the interior of that part of the vessel which is unsooted or oxidised on the outside (Fig. 38: 2, 3). The pattern of residue formation is strikingly similar to that observed on Ertebølle pots from Tybrind Vig, with the difference that the deposits on the upper exterior of the Ertebølle pots apparently consist of food that boiled over, rather than soot (Andersen & Malmros 1985, 83–85, Fig. 6).

Many of the vessels of both Early and Late Sārnate Ware, and Dwellings L, S and Z, also show evidence of surface attrition, in the form of wear and pitting, particularly on the interior immediately below the rim, or on the inside of the neck of everted-rim vessels. In some cases, the striations have been worn away.

The pottery also exhibits a second kind of attritional damage that might relate to use. On the bases of several pots of Late Sārnate Ware, and pots from Dwellings L and S, hardly noticeable concentric horizontal striations were observed encircling the point of the base (Fig. 30: 5, 8; Fig. 42: 2). In one case it was discernable that the striations terminated about 4 cm above the apex of the base. These striations differ entirely from the striated surface finish commonly created on unfired vessels, and had evidently been formed by rotating the vessel on its axis while supported on its base.

In the light of the studies by Hally (1983, 10–12) and Skibo (1992, 157–162), the patterns of use alteration on the vessels from Sārnate would seem to indicate that they were placed quite low down on the fire, exposing the lower body to considerable heat, which prevented soot deposition and led to surface oxidation on the lower exterior. The oxidised outer surface and the layer of organic residue on the interior might be taken as evidence that the products being heated were fairly dry (Skibo 1992, 164–166). The interior pitting close to the rim seems to indicate repeated impacts, which have led to the dislodging of temper fragments from the vessel wall. Such pitting could have come about through stirring of the contents (Skibo 1992, 132–134).

There are divergences from this ‘typical’ situation. Small vessels (with a rim diameter of about 15–20 cm) sometimes have organic residue on the interior right up to the rim, and sometimes the exterior is also oxidised right up to the rim (Fig. 38: 2). By contrast, large vessels often have no organic residue on the interior of the

---

64 A 11415: 251, 357, 362; A 11417: 189; A 11421: 17; A 11580: 200.
shoulder or lower down. Such differences could be due not only to differences in the height of vessels, but may also indicate somewhat different uses.

Proceeding from a consideration of the pattern of use-alteration features and particular cases of vessel discard, and eliminating various alternative possibilities, it is possible to suggest to the specific cooking method for which these pots were used.

In the first place, the exterior sooting observed on a very large proportion of vessels indicates unequivocally that heat was applied from outside, ruling out the idea, suggested by Vankina (1970a, 118) and Rimantienè (1979, 120), that pot-boiler stones were used in cooking. Accordingly, it is necessary to consider the various methods that could possibly have been used to support the pot in or over the fire during cooking.

We may rule out the possibility that cooking vessels may have been suspended above the fire from cords either passing round the top of the vessel or threaded through drilled holes near the rim. Even supposing that the weight of the large pots when full could have been supported in such a manner, the possibility of this method having been used can ruled out by observing particular restored vessels on which the whole of the rim or a large part of it is preserved. For example, a restored vessel from Dwelling F, on which virtually the whole of the rim is preserved (Vankina 1970a, Fig. LVIII)⁶⁵ has a direct rim, slightly restricted. There is no neck around which a cord might conceivably have been tied so as not to slip off, and neither are there perforations on opposite sides that would permit the threading of a string for suspension. The vessel shows unmistakeable indications of having been heated from the outside – sooting and organic residue – but there was evidently no way of suspending it over the fire. Suspending cords could theoretically have been attached to a cord passed around the neck of vessels with everted rims, where the neck of the rim prevents slippage, but this should at least have left a ‘shadow’ around the neck, where the cord prevented soot accumulation – and there is no such evidence. In conclusion, cooking by suspension of pots above the fire may be ruled out.

A more likely method of supporting the cooking vessel, of which there are plenty of ethnographic examples (e.g. Skibo 1992, Fig. 4.12), would seem to be that of raising it above the fire on three or more stone supports. However, at Särnate, the excavation reports provide no evidence of stone arrangements that might be interpreted as pot supports, and indeed most of the preserved hearth structures in the

⁶⁵ A 11421: 40.
dwellings with Early or Late Särnate Ware have very few stones or none at all (see Section 7.5). Thus, the archaeological evidence does not support such an interpretation, either.

If the vessels could not have been supported or suspended above the fire, it must be concluded that they were placed directly in the hearth. It has been observed that such pointed-based vessels are quite stable when placed with the tip of the base supported in sand (Rimantienė 1979, 120), and it is suggested that the vessels would have stood in this way during cooking as well: supported on the pointed base in the sand and coals of the hearth. This means that the fire would have had to be built not below the vessel, but around it. There are no ethnographic parallels known to the author for this method of cooking, but it is a method previously suggested by archaeologists studying cooking pots with a pointed or small flat base in other areas. Thus, it has been suggested that the Ertebølle pots may have been used in this way, the pointed base ‘bored down’ into the coals (Brøndsted 1938, 113), and indeed Ertebølle vessel bases have been found in circumstances that strongly suggest this (Andersen & Malmros 1985, 81). The similarity, noted above, in the pattern of organic crust formation on the Ertebølle pots from Tybrind Vig and those from Särnate provides support for the idea that a similar method of heating was used. Likewise, Janzon (1974, 133) suggests that the conical Pitted Ware vessels of Gotland would have been suitable for precisely such a method of cooking: “The conical pot has therefore been assumed to be functional in that the fire can be built up round it to boil the contents thoroughly, in addition to which it can be left embedded in the hot ash of the fire and so kept warm or left to simmer.” There is a more distant parallel, too: Linton (1944, 371) suggests that the tall cooking pots, with pointed or small flat bases, from the northern regions of North America “were set directly in the fire, rather than supported over it”.

Finds in the hearths at Särnate of whole pots, apparently abandoned at the spot where they broke during the cooking process, seem to be in accordance with the suggested mode of use. In Dwelling X, a crushed, badly damaged pot was found in the centre of the hearth (Vankina 1970a, 68, Fig. 111). In Dwelling N, a layer of charcoal and ash filled an approximately 25 cm deep pit at the east end of the hearth, the base of which had been laid out with bark. Found in the pit were sherds of a vessel interpreted as having collapsed in the process of cooking (Vankina 1970a, 47).

The idea that early cooking vessels in the northern parts of North America were set in the fire, rather than supported above it, led Linton (1944, 371) to suggest a functional explanation for the overall vessel morphology common to
that area: “In this method of usage, the effectiveness of the pot depended upon the area of lateral surface, since this was the part of the vessel exposed to the flame. Tall pots, with long, gently outward-sloping sides were the most efficient. Shoulders or constricted necks, while they may help to conserve heat, represented a loss in the heating area and were rarely employed.” It seems that this principle may, at least in part, also account for the general morphology of early pottery in the East Baltic and neighbouring regions of northern Europe. In addition, Janzon (1974, 106) suggests that the wide mouths of conical vessels made it easier to retrieve cooked fish or hunks of meat, and skim off fat – appropriate to a mode of subsistence mainly based on hunting and fishing.

Analytical and experimental work by Arrhenius (1985; 1987, 115–116) has shown that seemingly charred, amorphous organic residues on pottery vessels do not necessarily indicate exposure of the vessel contents to heat: they may also have come about in the course of fermentation processes. It is pointed out that the porous structure of pottery is particularly suitable for the process of producing fermented porridges: the fermentation bacteria are transmitted by means of fermented residues clinging to the porous earthenware. The food crust on an Ertebølle vessel from Tybrind Vig, originally interpreted as boiled fish soup (Andersen & Malmros 1985, 91), has been analysed and reinterpreted as a fermented porridge (Arrhenius 1987, 115). In the case of Särnate, although the widespread occurrence of sooting on vessel exteriors indicates that a very large proportion of the vessels were used to heat the contents, this does not rule out the possibility that food processing involved a combination of boiling followed by fermentation, or that fermented food was simply being warmed for consumption. The production of fermented beverages cannot be excluded, either: some of these processes, such as the brewing of mead, also involve a combination of heating and fermentation (Gustavsson 1997, 97).

In contrast to the Early and Late Särnate Ware, sooting and interior residues are quite sparse on the pots of the Comb Ware group (see Section 5.1.2), an observation that has also been made about Comb Ware from eastern Latvia and about the Ka II: 1 style vessels of Finland. This suggests that there is a significant difference in pottery function between the groups.

Various characteristics of the pottery from Särnate, relating to its suitability for different purposes have already been discussed in Sections 5.7.2, 5.7.3, 5.7.5 and 5.7.7. Thus, several features observable on most of the pottery at Särnate, exhibited by both Early and Late Särnate Ware and partly also by the material included in the Comb Ware group, can be thought to have contributed to
properties important for cooking vessels. Thus the use of shell temper and the inclusion of organics, which would largely have burned away to leave pores, as well as the simple body contours, the relatively thin walls and low firing temperature are all likely to have contributed positively to thermal stress resistance. It is possible that surface striation also had a positive effect in this regard. Apart from this, porous fabric and thin walls would have improved heat conductivity. On the other hand, high porosity and thin walls would also have meant relatively high permeability, perhaps necessitating some kind of waterproofing measure.

The vessel size data relates to a different aspect of function. As discussed in Section 5.7.4, the pots of both Early and Late Särnate Ware show a considerable size range, and vessels of large capacity are represented in both groups. Thus, the largest Early Särnate Ware vessel has a rim diameter of 40–45 cm, corresponding to an estimated volume of around 30 litres. The largest Late Särnate Ware pot, with a rim diameter of 50–60 cm, would have had an enormous capacity. The use-alteration evidence indicates that some, if not all, of these large vessels were used for heat treatment of the contents. Whether or not this was the only mode of use, the presence of such large vessels clearly indicates a need for receptacles that could hold considerable quantities of food or non-food resources. It seems there are three possible explanations for this. The large vessels may have served as everyday cooking vessels for large groups of people (very large household groups?). Or, as seems more likely, they were needed for mass processing of seasonally available resources. The third possibility is feasting: cooking of food for unusually large gatherings of people, presumably also in a season of abundant resources.

Here we will leave the matter of high-capacity vessels for the moment: the question is further discussed in the light of economic evidence in Chapter 9. However, this issue brings us back to consideration of the physical properties connected with temper, wall thickness and firing temperature. Any vessel of large capacity, whatever its function, evidently needs to be sufficiently strong to resist the pressure of the contents against the walls. However, if the intended function is storage, transport or non-thermal processing of the contents, the pottery technology may be developed so as to maximise the strength of the vessels, without having to reckon with thermal requirements. This does not appear to be the case for most of the pottery at Särnate: the strength of the vessels would have been compromised by the presence of large amounts of shell temper, by the thin walls and by the low firing temperature (see Sections 5.7.2, 5.7.3 and 5.7.7), so
the presence of these features can be taken to indicate that the pottery technology was mainly geared to the production of cooking vessels.

These characteristics might be seen as contrasting, at least in part, with those observable on Typical Comb Ware across the region. The thicker walls and the use of mineral temper might be viewed as indicating a ceramic technology where strength, rather than thermal shock resistance, was the primary functional concern. This is in accord with the idea that Comb Ceramic vessels, particularly the large ones, were used as storage containers (Edgren 1982, 50, 55; Nuñez 1990, 38). The case of the part of the pottery at Särnate that has been classed as Comb Ware – heterogeneous in terms of fabric and mostly quite thin-walled – is particularly complicated. Various possible interpretations of this material have been discussed in Section 5.1.2. Both the character of the fabric and the paucity of sooting and residue suggest that this pottery tradition was not as strongly cooking-oriented as the Early and Late Särnate Ware, but because of the heterogeneity and poor state of preservation of this material, a more definite interpretation cannot be given.

5.7.9.3 The cooking experiments

Although the studies by Hally (1983) and Skibo (1992) provide a theoretical framework for investigating pottery use alteration, the relationships they postulate as existing between use-alteration features and the actual use of pottery vessels should be viewed with caution. In particular, it is not clear exactly how far their findings can be generalised to cover different pottery fabrics. It should be emphasised that Hally’s experiments involved industrially manufactured ceramics, while the Kalinga pots studied by Skibo were made from porous fabric and were always provided with an interior coating of resin to reduce permeability. At present, it is unclear if and how differences in pottery fabric and the associated functional attributes affect the character of use-alteration features. The Särnate vessels differ in terms of form and fabric from the vessels used in the experiments of Hally and Skibo, and there is no indication in this case as to whether any post firing treatment was applied to reduce permeability. The possibility must be considered that, in terms of functional characteristics and in terms of patterns of use alteration, the Särnate vessels differed significantly from the vessels used in the above-mentioned experiments.
Also, the hypothetical cooking method advanced with regard to the Sārnate vessels envisages the placement of the vessel in the middle of the fire, rather than above it, and this differs from the arrangements studied by Hally and Skibo.

These considerations prompted a series of experiments, in which a variety of foodstuffs were cooked in replica Sārnate Ware vessels, using the method of supporting the vessel suggested above, namely standing it on its pointed base in a bed of sand. The aim of this work was to test the practicality and efficiency of such a cooking method and to investigate the resulting patterns of pottery use alteration. The account of the experiments given here is summarised from a paper by Bērziņš and Dumpe (2005).

The cooking experiments were undertaken in collaboration with professional potter and pottery researcher Baiba Dumpe, who provided 10 replica vessels with shell and plant temper. These included vessels with direct and everted rims, in a variety of sizes, with a rim diameter of 17 up to 35 cm. The experiments themselves, lasting a week, were held in the summer of 2002 at the Open-Air Museum of the Coast, a branch of Ventspils Museum, conducted jointly by the author and Baiba Dumpe, and assisted by her husband Einārs Dūpīs.

The hearth used in the experiments was a reconstruction based on the hearth remains from the dwellings with Late Sārnate Ware (see Chapter 7). First, an elongated bed of white sand was created. Wooden rods were laid at intervals across the bed of sand, so as to form the base of a rectangular hearth measuring 1.7×1.0 m. Sheets of bark were laid lengthwise over the rods. The hearth structure was completed by covering the bark with another layer of sand, approximately 5–10 cm thick (Fig. 44).
Fig. 44. Experimentally tested cooking method, where the vessel is supported with its base in the sand of the hearth. a – sand; b – bark layer; c – poles. Drawing: A.Bērzeņa.

Variations of the proposed cooking method were tested. Most effective was the technique of first lighting a fire (mainly billets of black alder were used), allowing it to burn down and pushing the glowing coals aside, so that the vessel could be placed among them, the pointed base supported in the hot sand and coals. To maintain the fire, more wood was placed on top of the coals around the base of the vessel (Fig. 45). Bringing the contents of the vessel to the boil in this way was certainly not a problem, and if it started to boil over, the burning logs and hot coals were pushed further away from the vessel to reduce the heat. Food could also be cooked in a similar way in two or more vessels placed side by side, with burning wood between them (Fig. 46).

A variety of products were cooked. Although most of the specific foods used in the experiments would not have been available to the Stone Age inhabitants, it was considered important to use foods that varied widely in their nutritional composition, and to use a variety of methods of thermal processing, most important being the difference in moisture content. Thus, pork, chicken, nettle soup, vegetables (carrots and potatoes), eggs and even marine clams were processed by boiling. Broths were made of barley and wheat groats, buckwheat and beans: in these cases, the cooking process differs in that the food absorbs
much of the moisture. Marrows were cooked in a small amount of water, apples were cooked in their own juice and pork fat was rendered.

Fig. 45. Cooking experiment using a replica vessel supported with its base in the sand.

Before the vessels were put to use, their profiles were drawn and their volume measured. The condition of the vessel exterior and interior was recorded before and after use. A record was made of use-alteration features observable after each cooking episode.
A general pattern of exterior sooting was observed, one that corresponds in large measure to the pattern of sooting most commonly found on Early and Late Särnate Ware. Three horizontal zones were distinguishable on the vessel body. The lowermost zone corresponded to the point of the base, supported in the sand and coals of the hearth. This part of the vessel was generally protected from the flames and thus largely unaltered. In the second zone, covering all or part of the lower body, which was directly exposed to the fire, no soot was deposited, but the colour of the pottery surface was altered. Light areas of the surface, oxidised in firing, became slightly greyer from smoke and ash, while dark areas, reduced in firing, became light grey. The third zone, generally corresponding to the upper exterior of the vessel, away from the direct heat of the fire, was sooted matt black, preserving the original colour under the sooting: light (oxidised) or dark (reduced) (Fig. 47).
Fig. 47. Replica vessel used in cooking experiments. a – after firing, unused; b – after one cooking episode (boiling meat); c – after six cooking episodes (the last of which was boiling meat); d – after seven cooking episodes (in the last of which, wheat groats porridge was cooked, burned because the fire was too hot). Photos: B.Dumpe, V.Bērziņš.

These observations apply to boiling of both animal and plant foods and to cooking with a small amount of water. In view of the results of studies by Skibo (Skibo 1992, 164–166), it might have been expected that in heating dryer foods (e.g. making broth), the vessel wall would become hotter, thus creating a more extensive light-coloured patch free of sooting on the lower exterior. However, no
A significant difference was observed in exterior use alteration between vessels used for dry and liquid foods. This may be because liquid foods need considerable heat, while the cooking of dryer foods requires that, in order to prevent the food from burning, the cook will tend to reduce the heat by pushing aside the fuelwood. Thus, the heat supply will be varied to compensate for differences in the moisture of the vessel contents, as a result of which the temperature of the vessel wall will not vary so much and the pattern of exterior sooting will be somewhat similar. This suggests that the condition of the vessel exterior after use cannot in itself provide a clear indication of the moisture content of the products being heated.

Within the soot-free zone of the exterior, a band of soot deposition was observed along cracks where liquid was seeping through to the outer surface. Evidently, the seeping liquid cools the exterior, not permitting it to reach a sufficient temperature for the soot to burn away (Fig. 48).

Fig. 48. Replica vessel after cooking experiment, showing a band of sooting along a crack, where the surface had been kept cool during cooking by seepage of liquid.

It should be further noted that oxidation and sooting of the exterior surface largely reflects conditions during the final episode of use, since during the vessel’s exposure to heat, the use-alteration features from the previous cooking episode
are partly obliterated. We may question whether the observable features, mainly reflecting the final episode in the vessel’s use-life, are in fact representative of the ordinary use of the vessel. For example, the vessel may have been overheated during the final cooking episode, resulting in extensive burning of the contents and discard of the vessel. In such cases, the use-wear characteristics may give a misleading impression of the general pattern of use.

There were significant differences between the experimentally observed pattern of burnt residue and the patterns observed on the pots from Särnate. In those experiments where food was boiled, only a small amount of residue was deposited on the lower interior of the vessel, below the waterline. Residue tended to concentrate along the waterline, evidently resulting from the burning of particles floating on the surface (Skibo 1992, 151). A small amount of residue was also found above the waterline, on the interior of the rim. The amount of burnt residue on the upper body was evidently related to the size of the vessel: the upper body of a smaller and thus also comparatively shorter vessels will be more exposed to the flames, and this promotes the burning of residues on the upper body near the waterline. For larger, taller vessels, the upper body lies relatively higher above the heat source, in relatively cooler conditions, and so burning of residues is less likely to occur. After boiling fatty foods, such as meat, shiny brown or black residue from fat was observed on the vessel rim and the inside of the neck, as were runs of burnt food down the outside. This material had evidently been deposited in the course of stirring and removal of the vessel contents.

Somewhat surprisingly, a similar pattern was observed after the cooking of drier foods: so long as cooking proceeds correctly, only a small amount of burnt residue is formed on the lower interior of the vessel.

It seems that the interior residues formed in the process of cooking tend to be harder than the fabric itself, and since, with this kind of low-fired fabric, intensive scrubbing during washing is likely to result in serious abrasion or even breakage, it is impossible to clean all the residue from the interior after use. Thus, deposits gradually accumulate on the interior. Although the thick layer of residue seen on many of the vessels from Särnate was not observed experimentally, such a thick layer might have accumulated during a long period of use.

These experimental observations, in addition to demonstrating the practicality of the proposed cooking method, have provided much useful interpretive information about the use alteration of Särnate Ware. Although, no patterns were observed experimentally that would permit a clear indication of the moisture of the vessel contents, nevertheless, looking at the archaeological material from
Särnate, it seems clear that the vessels with a thick layer of residue on the lower interior (not replicated experimentally) must have been used to process a fairly dry food, presumably some kind of broth, that tended to burn on the vessel walls. Such a thick layer of residue may be thought to have accumulated gradually during the vessel’s use-life. More difficult to interpret are vessels with minor amounts of residue. The relative paucity of residue may be an indication that the vessel was used for boiling liquid foods or for other purposes that resulted in relatively little residue, but it could simply reflect the particular vessel’s relatively short use-life, during which little residue could accumulate (regardless of the character of the contents).

Differences in vessel size and shape are also very significant. Thus, exposure to heat at the vessel rim is influenced by the height of the vessel (affecting the distance of the rim from the heat source) and by the form of the vessel, since a pronounced shoulder, for example, protects the rim from direct heat. If, as in this study, attention is focused particularly on vessel rims, these factors are of major importance.

Given the preponderance of seal bones among the faunal remains (see Section 9.3.5.3), the rendering of seal blubber could be thought to have been an important function of the pottery vessels. Accordingly, an experiment in rendering fat was also undertaken (pork fat was used). A very distinctive pattern of use alteration was observed to result from this process, performed by gently heating the fat in a fairly porous vessel. No dark residue was produced on the interior of the vessel. At the same time, pronounced blackening of the outer surface was seen even on the part of the body exposed to direct heat, caused by seepage of the burning fat through the vessel walls. On the lower body of the vessel, the fat reaching the exterior became mixed with sand from the hearth, resulting in an exterior coating of fat and sand. The fat that had seeped through to the outside even caught fire several times.

Among the ceramics excavated at Särnate, sand adhering to the vessel exterior was never found on the pots, only on the bowls, interpreted as fat-burning lamps (see Section 5.3.2.2). Since seal hunting was evidently an important activity, seal fat rendering may well have been conducted at the site. However, since use-alteration features of the kind described have not been found on the round pots from Särnate, it is concluded that they were not used in this activity. Because the heating of fat in vessels of this kind evidently results in significant losses from seepage through the vessel wall, these vessels would seem to have been unsuitable for the purpose.
Another experiment was undertaken to test the idea that the concentric striations on vessel bases described in Section 5.7.9.2 could have come about from rotating the pot on its axis when full, with the point of the base supported in the sand layer of a hearth. A pot filled with 15 kg of sand and rotated in a bed of sand was found to have concentric rotations around the point of the base after just six rotations. It was concluded that the striations seen on the Sārnate vessels could have come about through rotation of the vessels during cooking – a form of manipulation that might have helped equalize heat supply to the vessel sides. This feature might thus be taken as additional evidence that the vessels were supported in the sand of the hearth for cooking. All the same, it is impossible to rule out entirely the hypothesis that such striations resulted from rotation of the vessel on a support during forming, as suggested by Gurina (1967, 173)

5.7.9.4 The question of permeability and sealants

Because of the low firing temperatures, the admixture of organic matter, which is burnt away on firing to leave pores, and the thin vessel walls, most of the pottery at Sārnate would have been fairly permeable. However, the experiments showed that, even if water from the vessel contents seeps through the wall during cooking, causing losses (the water level needs to be topped up) and cooling the outer surface, this does not mean that the contents cannot be brought to the boil (contrary to the findings in Skibo 1992, 167), although it evidently does increase fuel consumption. In other words, low-fired vessels tempered with shell or organics can be used as cooking pots without any post-firing treatment to reduce permeability.

This does not to exclude the possibility that some treatment of this kind was applied. There are certainly many ethnographic examples of the application of sealants after firing to reduce permeability (Rice 1987, 163) and of vessel preparation for use by first heating in it a food that fills the pores with an impermeable residue (Rye 1981, 26; DeBoer & Lathrap 1979, 117, 120). The build-up of food residue on the interior in the course of use would also have reduced the permeability of the vessel (and probably also increased its strength), so perhaps the users deliberately allowed thick crusts to accumulate inside their cooking vessels.

An interesting idea has been advanced by Vitols and Vitiņš (1962) in connection with the analysis of samples of low-fired prehistoric pottery from Latvia: “The raw material for the ancient wares was generally obtained from the
surface layers of clay, which generally contain up to 1% of organic matter. When such products are fired at low temperature, a process of dry distillation takes place in the core parts of the fabric, and the resulting tar products render the fired fabric hydrophobic, thus reducing water uptake.” This possibility, that a combination of organic-rich clay and low firing temperature may have been important for reducing permeability, evidently deserves consideration in future research.

5.7.9.5 The regional context of pottery use

Contextual and use-alteration evidence indicates that various early ceramic wares in the Baltic Sea region, made by people reliant mainly on wild resources, namely Ertebølle and Pitted Ware, and likewise the shell- and organic-tempered pottery of the East Baltic, including Early and Late Särnate Ware, mainly consisted of cooking vessels, and that a specific mode of heating was employed (possibly in combination with fermentation): the pot was stood on its pointed base in the middle of the fire, rather than above it. In approximately the same period, Comb Ceramics in the north-eastern Baltic, made by people also practicing food procurement, were apparently being used to a much greater degree for storage.

Two points may be added to this discussion of regional variation. In the first place, there is a growing body of evidence on the influence of design features (fabric, surface finish, wall thickness, vessel morphology and firing temperature) on the suitability of ceramics for various uses, evidence that can be applied in order to further our understanding of the ceramics of this region as ‘tools’ for a variety of purposes. In the preceding sections, characteristics of the pottery at Särnate have been considered in this light, although it must be said that our understanding of the technological significance of various features of earthenware pottery is still very incomplete.

Secondly, while some authors have emphasised the difference in functional requirements of pottery between groups dependent mainly on hunting and fishing, and those practicing agriculture and animal husbandry (e.g. Janzon 1974; Edgren 1982, 43), there also seem to have been differences among the different groups practicing food procurement in the Baltic Sea region and neighbouring areas in terms of the functional role(s) they allotted to pottery. The early pottery that we recover archaeologically can be seen as the material expression of cultural traditions relating to culinary and storage activities, and this evidence indicates that the traditions varied between different food procuring groups in the region. Since culinary practices and the storage of products relate to many different
aspects of economic and social life, this means that differences in pottery traits, ostensibly somewhat peripheral to the economic and social framework, may actually represent an archaeologically visible expression of very profound and less easily detectable differences in the way of life of various food-procuring groups in the region.

In the Middle Neolithic, the area of present-day Latvia evidently represents a zone of interaction, where we find both Comb Ceramics and shell/organic-tempered pottery, with evidence of the borrowing of traits between these. However, if the overall functional role of the ceramics does indeed differ, then the observed interaction would seem to imply much more than simply the borrowing of pottery traits. Rather, this is evidence of interaction crossing technological and functional boundaries, in other words, interaction at a much more fundamental level, which deserves comprehensive study and interpretation in the course of future research.

5.7.10 Pottery repair and secondary use

Quite common on both Early and Late Sārnate Ware, but absent altogether on the Comb Ware from Sārnate, are drilled perforations in the wall of the fired vessel.

Vankina (1970a, 116) considers the idea that perforations near the vessel rim may have served for moving or hanging the vessel, but expresses doubt as to whether a rim of about 2 cm width could have held the weight of a large pot, particularly when full, and she suggests that this is instead a repair feature. It does seem that the practice of repairing cracked vessels by drilling perforations on both sides of the crack and lacing them together (‘crack-lacing’) would account for most of the perforations. In the material classed as Narva Ware from Šventoji, there are finds of sherds with the remains of the string that was threaded through the perforations (Rimantienė 1979, 79, Fig. 63: 1, 4).

This method of repairing vessels, by tying them together with fibre threaded through drilled holes, was a very widespread practice, used not only in Northern Europe, but also, for example in Nubian pottery from North Africa (Nordstrom 1972, 48), among the Shipibo-Conibo of Peru (DeBoer & Lathrap 1979, 127) and in many other pottery traditions. In the East Baltic region, drilled perforations have been viewed as a characteristic feature of Narva Ware (Gurina 1967, 34, 173), although they do also occur on Typical Comb Ware (e.g., Leskinen 2003, 27).

Statistical analysis on the Sārnate material did not provide confirmation that larger vessels, which would have required more work to replace, were more
commonly repaired than smaller ones. On the other hand, in both Early and Late Sārnate Ware, there is evidence that more richly decorated pots were more likely to be repaired by crack-lacing (see Sections 5.2.2 and 5.3.1.2). It thus seems greater efforts were made to extend the use-life of vessels if they were decorated.

Interestingly, in several cases at Sārnate, sooting or organic residue was observed on the surfaces within the perforations themselves, apparently indicating that vessels had been placed on the fire even after the perforations were drilled. At the Middle Neolithic site of Piestīņa in eastern Latvia, several potsherds were found with a considerable amount of residue inside and outside and with charred plant fibres preserved in the perforations. The whole perforation had been plugged with this material (Zagorskis 1967, 128).

Crack-lacing might be viewed as an alternative method of repair to patching with birch bark pitch, which is commonly found on Typical Comb Ware, and occasionally on Late Comb Ware and Põlja Asbestos Ware in Finland (Pesonen 1999, 192–193; Leskinen 2003, 27). However, there is at least one example from Narva indicating that a combination of the two methods was used (Gurina 1967, 34).

Presumably, vessels repaired with birch bark pitch could no longer have been used for cooking, since the pitch would simply have melted. Likewise, one would think that perforations would themselves cause seepage of the contents and that the string used for crack-lacing would burn away. Perhaps the above-described example from Piestīņa is a solution to this problem: the repair holes are plugged with a suitable organic material, which becomes pyrolised in the course of cooking use and forms a durable seal. If the string passing between the holes was also protected in this way, it might still have been possible to use the vessel for cooking, at least if the repair work was done on the upper body, which is less exposed to heat.

The Sārnate collection includes an unusual vessel with several irregularly arranged perforations, interpreted by Vankina (1970a, 116) as a strainer. The use-alteration pattern is, however, similar to that found on cooking pots: a thin layer of soot on the upper exterior, with an oxidised lower exterior. The lower interior had a thin layer of residue in places. The base of the vessel was also preserved, exhibiting concentric striations and fine cracks. Only the large number of perforations distinguishes it from other vessels. It is clear that the vessel was placed on the fire, but the significance of the many perforations remains unclear – this, too, might actually be an example of major repair work. From Šventoji 1B there is a round vessel base with a number of perforations (Rimantienė 1979a,
129, Fig. 105), regarded as possibly deriving from a strainer. Unlike the Särnate ‘strainer’, the perforations on this piece had been made in the clay when it was still soft.

In a study of Iron Age pottery from Latvia, Cimermane (1976, 35) found that vessels belonging to various different wares had one or more perforations along the rim. She suggests that these served to provide air to the food if the vessel was covered with a lid.

Judging from these examples, it is quite possible that perforations in vessel walls actually served several different purposes.

Ethnographic accounts often mention the re-use of broken pottery for various purposes, and archaeological evidence of such practices is also sometimes observed. The only definite example from Särnate is that of a large Late Särnate Ware rim sherd from Dwelling F with a trough-like depression, evidently used for grinding (see Section 5.3.1.2). As described in the next section, potsherds may also have been re-used as flooring material.

5.7.11 Discard patterns

Since the distribution of potsherds within the excavated areas was not systematically recorded at the time of excavation, our main source of evidence regarding patterns of pottery discard is the text of the excavation reports, supplemented by the plans and the finds lists. There is somewhat better context information for those pots that were found largely complete, and for the bowls.

As described in Section 5.1.2, the Comb Ware was found mainly in the extensive sand layers around the hearths, but the documentation of sherd distribution does not provide any additional indication of discard and deposition patterns. There is more data for interpreting the discard patterns of Early and Late Särnate Ware, and some of the ungrouped dwellings. On this basis, the following kinds of refuse discard and deposition can be identified:

1. **Primary refuse**: artefacts discarded at their location of use (Schiffer 1987, 58). This includes vessels used for cooking that were evidently broken in the course of use and left in the hearth (Dwellings N and X; Vankina 1970a, 47, 68, Fig. 111). In these cases, the hearth remained in use, since the broken vessels are overlain by further hearth layers. One section of the separate potsherds found in the hearth itself and elsewhere within the limits of the house structure presumably also fall into this category: sherds from pots that
broke are likely to have remained at or near the location of breakage if this occurred in an area that was not regularly cleaned. Primary refuse deposition is particularly likely in a situation where thick layers of waste are allowed to accumulate during the time of occupation. Thus, two bowls, one broken and one intact, were found within layers of nutshells in Dwellings N and X (Vankina 1970d; 1970f).

2. **Secondary refuse:** artefacts discarded at places other than their location of use (Schiffer 1987, 58). In cleaning the living space, sherds tend to be swept or otherwise transported to the walls of the structure (DeBoer & Lathrap 1979, 128). This may account for some of the individual finds of small sherds. Concentrations of sherds outside the living area, sometimes associated with other kinds of artefacts, can evidently be regarded as dumps.

3. **De-facto refuse:** artefacts that, although still usable, are left behind when an activity area is abandoned (Schiffer 1987, 89). Best fitting the idea of vessels left behind are the whole (crushed) vessels and large parts of vessels recovered from Dwellings I_d, M_d, N and S. Almost all the pottery from Dwelling I_d belongs to a group of crushed vessels directly north-east of the dwelling structure, where wooden artefacts were also concentrated (Vankina 1970a, 34). In Dwelling M_d, crushed vessels and parts of vessels were found on the south-eastern side, beyond the limits of the structure (Vankina 1970b). There was also a group of crushed vessels on the south-eastern side of the hearth of Dwelling N (Vankina 1970d), and on the eastern edge of the sand layer of the hearth in Dwelling S (Vankina 1970a, 54–55).

There is also evidence in at least one case that potsherds may have been used as flooring over a limited area. Such may have been the purpose of the fairly thick and extensive layer of sherds found to the south of the hearth of Dwelling Y (Vankina 1970a, 73).

The evidence of deposition of ceramic refuse in and around the hearth seems to suggest a tendency to incorporate broken pottery into the structure of the hearth and the flooring of the surrounding area, rather than discarding it outside the house. This may be viewed as part of a wider practice of adding layers to the hearth itself and the surrounding floor area, rather than removing material. This midden-like accumulation had the effect of gradually raising the level of the surface of the hearth and the surrounding house floor, which may have been regarded as a positive effect in this low-lying, wet location.
There also seems to be a logical basis for the groups of pots interpretable as *de facto* refuse: since pottery is relatively difficult to transport, at least some of the vessels, even if they are still useable, are likely to have been left behind when the particular house, or the site as such, was abandoned.

Further consideration of the distribution of finds of more or less complete pots is given in Chapter 8, examining the pattern of distribution in relation to the overall spatial structure of the dwellings.

5.8 Concluding remarks on the pottery

This brings to an end the study of pottery from Särnate. In Chapter 3, on the basis of a variety of different characteristics, the dwelling pottery assemblages were grouped into three wares, Comb Ware, Early Särnate Ware and Late Särnate Ware, leaving a number of dwellings that could not be assigned with confidence to any one of these.

In Chapter 4, the pattern of variation among the dwelling assemblages of pottery was compared with the patterns of variation within other classes of artefacts, in particular the amber ornaments. The results provide some justification for using the pottery-based grouping of dwellings as the frame for ‘cultural analysis’ not only of the pottery itself, but also of various other kinds of cultural material, which will be undertaken in Chapters 6–8.

In the present chapter, each of the pottery wares has been analysed in detail, followed by a comparison of the wares. Finally, a variety of general issues relating to the pottery have been investigated, with an extensive discussion of pottery function.

Throughout this chapter, and especially in the discussion of particular aspects of ceramic technology, there has been a concern with ‘explaining the pottery’, rather than simply describing it. This is a move towards ‘ceramic ecology’, namely attempting “to relate the raw materials and technologies that the local potter has available to the functions in his culture of the products he fashions”, with the motivation that ceramic studies should “lead to a better understanding of the cultural context in which the objects were made and used” (Matson 1965, 202). Such ideas have certainly influenced pottery studies in nearby Finland and Sweden. At the same time, researchers in the East Baltic have hitherto seldom paused to ask why early prehistoric pottery is the way it is. Evidently, such questions have been regarded either as trivial or as unanswerable on the strength of the available evidence. In any case, the limited enquiry in this direction has
been totally overshadowed by the concentration of attention on the role of pottery as the paramount cultural-chronological marker in archaeology (as indeed it has been in many other parts of the world).

In the present study, too, pottery is utilised as a ‘cultural marker’ (Chapters 3 and 4), but this does not preclude enquiry into the technological significance of the observed characteristics. The technology can only really be appreciated if the focus is shifted to a view of pots as ancient ‘tools’, a viewpoint that has been brought to the fore in the final sections of this chapter. Such a perspective is essential for a study such as the present work, where the focus is strongly technological, environmental and economic, but even studies relating to the symbolic and ideological sphere (e.g. the interpretation of the symbolic content of decoration) should perhaps proceed from an understanding of the context of the pottery vessels within the particular cultural setting.

It seems quite evident that both Early and Late Sârnate Ware represent pottery traditions primarily oriented towards the production of low-fired vessels suitable for a specific mode of cooking in an open fire (or, at any rate, heating the contents, if we admit the possibilities that non-food resources were being processed, and/or that heat treatment was being combined with fermentation). As we have seen, from this point of view, we can find a logical basis for a whole range of characteristics common to these two wares. Given that certain of these features (shell temper, pointed bases, thin walls, etc.) are very widespread in the Neolithic pottery of the East Baltic (Narva Ware sensu lato), we can guess that this would have been the predominant mode of use of pottery in the region, even if we do not always have such clear direct evidence in the form of preserved use-alteration features.

The case of the Comb Ware group at Sârnate is more complicated, but perhaps will become clearer, once we obtain a better idea of what the interaction, observable across the region, between the makers of shell/organic-tempered pottery and the people making Comb Ceramics, means in technological terms. In other words, what was the effect on practices of pottery production and use when a tradition from the north, where pottery seems to have been used largely for storage, interacted with a more southerly tradition, where pottery was expressly cooking-oriented?

However, our present level of knowledge concerning the technological properties of low-fired earthenware vessels is still far from adequate. We can say that vessels with shell temper and thin walls, as at Sârnate, would have been resistant to thermal shock, and thus suitable as cooking pots, but this begs the
question as to why Ertebølle and Pitted Ware pots, apparently used in a very similar way, show quite different characteristics. Evidently, the whole story has not yet been told.

Many other questions generated in the course of this pottery study remain to be answered. Were the potters modifying the particle size and amount of shell in the fabric in making different kinds of vessels? What is the significance of the very small amounts of coarse mineral temper occurring, in addition to abundant voids from shell, in the fabric of some of the Late Särnate Ware vessels? Why are some of the cooking pots so large? Were there really separate size classes of Early Särnate Ware vessels, as suggested by the rim diameter and wall thickness data? How were the distinctive tooth stamp and knot/plait impressions actually made? What is the meaning of the associations observed in Early and Late Särnate Ware linking the occurrence of use-alteration traces (sooting and interior residue) with the character of the surface finish and decoration?

Some light could be shed on various issues through the application of additional research methods, which were beyond the scope of this study. Petrographic microscopy could be used on a larger scale, and a wide variety of mineralogical techniques could be applied, no doubt providing a great deal of additional information about the clay and temper. Microscopic examination of use-alteration features such as organic residues and pitting might reveal more about the character and formation of these traces. Chemical characterisation of the crusts could indicate the kinds of products that were being processed in the pots. The research potential of the corpus of pottery from Särnate is by no means exhausted.
6 Fishing gear

The economic importance of fishing in the Mesolithic and Neolithic of Latvia and neighbouring countries is attested by finds of fish bone and fishing equipment at many sites, by the location of settlement sites in the vicinity of potential fishing grounds, and by the findings of dietary studies on human skeletal material (Zagorska 2000; Loze 2001a; Eriksson, Lõugas & Zagorska 2003).

The location of the Sārnate site – on a former lakeshore – in itself suggests that fishing would have been an important activity here. The lake was shallow, with a muddy bed and evidently with a tendency to become overgrown, exhibiting similar characteristics to the present-day shallow lakes along the Latvian coast. It is likely that the lakeshore habitation lay near the former outlet of the River Sārnate, which linked the lake with the sea. Admittedly, the shoreline of the lake and the course of the river at the time of occupation are unknown, so the position of the site in relation to the lake and the river is not entirely clear.

While very few fish bones were found (see Section 9.3.2.1), and no bone artefacts connected with fishing were recovered (evidently, like the shell in the pottery fabric, the bone had been dissolved in the acid conditions), the site has produced a large collection of fishing gear components made of bark, wood and stone, constituting a rich source of evidence on fishing nets, as well as other kinds of equipment: eel clamps and screens for fishing structures. Indeed, because of the superb organic preservation, the Sārnate site has yielded one of the most important collections of early prehistoric fishing gear from the Baltic Sea region.

The Sārnate fishing gear has been concisely treated by Vankina in her monograph on the site, which includes a table of finds and illustrations of many of the artefacts (Vankina 1970a, 93–95, 133, 148–149, Tables 1–2, Figs. II: 3–6; XI–XVIII, XXI: 8–9, XXIV: 2). The Sārnate finds are also treated in a general paper on Stone Age fishing equipment from Latvia, by Zagorska (1991, 59–60).

The finds and original documentation have been studied anew and compared with a wide range of archaeological and ethnographic material, in order to obtain a more detailed and precise understanding of this major collection of fishing equipment.

All the artefacts connected with fishing were classified according to basic function (floats, sinkers, etc.), and the major functional categories were subdivided according to the form and method of use of the artefacts (e.g., unperforated floats, floats perforated at one end, etc.). Each of these functional classes is considered in turn in Section 6.1.
As with ‘cultural analysis’ of the pottery, set out in Chapter 5, the further sections of the present chapter are structured on the basis of the ‘cultural grouping’ of the dwellings in terms of their pottery assemblages (an approach explained and justified in Chapter 4). Thus, the fishing gear from each group of dwellings (dwellings with Comb Ware, Early Sārnate Ware, Late Sārnate Ware, and ungrouped dwellings) is considered in turn, permitting separate analysis of the ‘fishing toolkit’ used in each occupation phase and providing the basis for an assessment of the development of fishing practices over time.

Because of the nature of the material and the aims of the study, there was no need for the kind of comprehensive statistical treatment employed in the pottery study. However, in examining the collection, various measurements were made (dimensions of floats and sinkers, weight of sinkers), and basic statistical and graphic techniques have been applied to this numerical data.

The wooden artefacts from Sārnate relating to water transport – paddles and fragments of logboats – are not considered in this study, although they obviously do have a connection with fishing activities. These have been described by Vankina (1970a, 92–93, Fig. VIII: 2, Figs. IX, X), and have been separately discussed by the author in the context of travel and transport (Bērziņš 2000b).

6.1 Functional classification of the fishing gear

6.1.1 Floats

Particularly important is the collection of bark floats, the great majority of which were evidently used on nets. Floats have come to light in Latvia and neighbouring countries in the course of excavation at various Mesolithic and Neolithic sites, and as stray finds. However, the Sārnate collection stands out in terms of the number and variety of floats, providing a broad picture of this artefact category and revealing the range of technological and formal diversity. So far, the only comparable collection of early prehistoric floats from the Baltic region comes from the Šventoji sites.

Considered in this study are 125 pine bark floats, as well as two wooden objects resembling floats, and birch bark rolls (numbering at least 23), also regarded as floats.66 Floats of one kind or another have been found in all the

---

66 A small number of floats were unavailable for study, so there are minor differences from the statistics given in Vankina 1970a, Table 2.
dwellings where anaerobic conditions existed, ensuring the preservation of organic remains (Appendix 6, Table 18).

The pine bark floats were fashioned from pieces of bark up to 4 cm thick, such as may be obtained from the lower part of the trunk. Some are carefully worked and regular in form (possibly having been finished by grinding), while others are roughly hewn. Usually, it is the edges of the floats that have been the most carefully shaped, in many cases leaving the natural exterior and interior surfaces of the bark unworked. In some cases, suitably-sized broken pieces of bark were adapted as floats simply by perforating them, with no shaping whatsoever.

The pine bark floats (and wooden objects resembling them) were classified as unperforated floats and three different classes of perforated floats.

6.1.1.1 Unperforated pine bark floats

Unperforated floats, constituting the great majority of the bark floats (103 out of a total of 125) were sub-divided according to the form of the recesses cut into them:

- floats notched at the ends,
- floats with a longitudinal groove and
- floats with no notching or groove.

A further sub-division was made according to the shape of the float in plan, also recording the shape of the longitudinal and cross-section. Nine shapes in plan were distinguished and eight corresponding section shapes (Fig. 49).

![Fig. 49. Classification of bark float shapes in plan and in longitudinal/cross-section.](image)

Three grooved floats associated with the net find in Dwelling A_Dr have preserved birch bark binding (Fig. 71: 1, 9, 10). Remains of birch bark binding are also observable on some floats from Dwellings A_Da, G, K and T.67 Two floats from Dwelling A_Dr and one from Dwelling K have preserved remains of twine in their

---

67 A 11415: 36, 465; A 11416: 54, 87; A 11418: 120e, k, n.
grooves, while one float from Dwelling A_{DR} has a simple band of bast instead.\textsuperscript{68} The twine in the grooves of the floats is not of sufficiently diameter to be regarded as representing part of the headrope (floatline), which runs along the top of the net. Instead, the floats would have been attached by means of a separate string or band of bast passing along the groove or through the notches and tied to the headrope at both ends. With this mode of attachment, the floats could easily be removed for drying or replacement, and the number and spacing of the floats could be changed to suit the fishing conditions. Possibly, the groove or notches held the float securely enough even without the birch bark binding. The birch bark might instead have served to increase the buoyancy of the floats as required. Also, the birch bark may have been attached to enhance the visibility of the floats in the water, which is particularly important for towed gear such as seine nets.

The floats without any groove or notches are evidently finished floats, not semi-manufactured pieces, and could conceivably have been attached to the headrope by means of birch bark binding alone.

Small pine bark floats notched at the ends have been found in small numbers at other Neolithic sites in Latvia. Three come from the Lubāns Lowlands in the eastern part of the country: one was found in the Early Neolithic stratum at Zvidze (Loze 1988b, Fig. 1: 4), and two more derive from the Middle Neolithic site of Piestīņa (Zagorskis 1965, Fig. 4: 19). Another two notched pieces have been found on the Sīļņupe site in central Latvia (Zagorska 1991, 60).\textsuperscript{69}

A large number of longitudinally grooved or notched floats been recovered from the Narva Culture sites at Šventoji. The same shapes in plan are represented as at Sārmate: subrectangular with convex sides and straight ends (Shape 3), subrectangular with rounded corners (Shape 2) and biconvex (Shape 9) (Rimantienė 2005, Fig. 281: 3–5, 7, 10, Fig. 340: 1–10, 12–19). Šventoji Site 6 has produced a single example wound with birch bark (Rimantienė 2005, 390). Considerable numbers of small pine bark floats with notched ends (biconvex, oval, rhombic and rhombic with truncated ends) have also been found on the Neolithic sites of Žemaitiškė 1 and 2 near Lake Kretuonas in eastern Lithuania (Girininkas 1990, Figs. 39, 40). There are notched or grooved subrectangular floats with rounded corners and oval floats from the Šarnėlė Late Neolithic site in north-western Lithuania (Butrimas 1996, Fig. 8: 4–5). An immense number of large end-notched pine bark floats were found at Tuorsniemi near the town of Pori

\textsuperscript{68} A 11416: 54; A 11418: 120k, n.

\textsuperscript{69} A 11399: 99; VI 292: 158.
in western Finland (Luho 1954; Kauhanen 1974). It should be added that this find, now radiocarbon-dated to the Late Neolithic (Alhonen 1974, 10), had seal bones associated with it, and has been interpreted as a seal net, or, more precisely, as a long net wall, consisting of a large number of conjoined nets (Kauhanen 1974, 37; Forstén & Alhonen 1975, 153).

No direct ethnographic parallels have been found for the unperforated floats. However, in functional terms, they may be equated with a form of float found in Latvia and many neighbouring countries: elongated wooden floats attached at both ends by a string passing through perforations near the ends of the float, sometimes supplemented with perforations in the middle (Bielenstein 1918, Fig. 580; Benecke 1881, Fig. 168; Manninen 1931, 208–209, Figs. 198–201; Šulcs 1961, Figs. 11, 13). This mode of attachment to the headrope – at both ends – serves to prevent the floats from becoming entangled in the mesh of the net or in aquatic vegetation (Seligo 1926, 46, 68, 73). For this same reason, the floats tend to be smooth and rounded, without any sharp angles (Ligers 1942, 68; Eglītis, 1956, 343). The generally rounded forms of the floats from Sārnate and other Neolithic sites would have been appropriate in this regard.

6.1.1.2 Pine bark floats perforated at one end

The larger pine bark floats with a perforation at one end (nine in number) are characteristic of the dwellings with Late Sārnate Ware (Fig. 50). The six intact examples are 12.2–21.8 cm long, 5.9–11.0 cm wide and 1.3–4.1 cm thick. In all cases, the length markedly exceeds the width. Three are roughly worked and irregular, another two are rounded trapezoidal, with the perforation in the narrow end, and one is oval. The perforations are circular, 1.3–1.8 cm in diameter, at least in some cases evidently drilled rather than cut out.70

There are many Mesolithic and Neolithic parallels for such floats. The Mesolithic net from Antrea Korpilahti in Karelia had irregular, elongated floats perforated at one end (Pālsī 1920, Fig. VI: 22–24). One fragmentary Mesolithic example with a small perforation comes from Vis in northern Russia (Burov 1998, Fig. 6.5: 1). Among the net remains from Siivertsi in north-eastern Estonia was a fragmentary oval bark float with a small perforation at the end (Indreko 1948, 325–327, Fig. 79: 1).

70 A 11415: 319; A 11416: 61, 94; A 11418: 105; A 11421: 60; A 11580: 142, 157, 158, 159.
This kind of float is also well represented in Neolithic material. A large rounded trapezoidal pendant has been found at the Middle Neolithic site of Piestīna (Zagorskis 1965, Fig. 4: 20), and two small fragmentary bark floats perforated at the end come from Siliņupe.71 Small pine bark floats perforated at one end are also known from the Neolithic wetland sites of Šigir and Gorbunovo, east of the Urals (Èding 1940, Fig. IV: 5; Dmitriev 1951, Fig. 4: 17; Raušenbah 1956, Fig. 8: 4).

Rounded trapezoidal, elongated oval and irregular floats perforated at one end have been found at the Narva and Rzucewo or Bay Coast Culture sites of Šventoji (Rimantienė 2005, Fig. 33: 1, 2; Fig. 110: 15; Fig. 167; Fig. 181: 4; Fig. 222: 7). At the later Šventoji sites they are comparatively rare, and Rimantienė (1996a, 35) suggests that they were superseded by the more practical floats attachable at both ends, which were less liable to be torn off in use.

Fig. 50. Pine bark floats perforated at one end. 1, 3, 4 – Dwelling A₂K; 2 – Dwelling K; 5 – Finds Unit K/MO. A 11580: 159, 158, 157; A 11416: 61; A 11421: 60. Drawing: A.Bērziņa.

There is plenty of ethnographic evidence of elongated floats of various forms perforated at one end to receive a string for attachment, although in the recent past wood was more commonly used than pine bark (Manninen 1931, Figs. 169, 195; Sirelius 1934, Figs. 207–211).

6.1.1.3 Bark and wooden objects with an elongated central perforation

Nine objects with an elongated perforation at the centre have been grouped together on the basis of this feature, although they vary considerably in form and perhaps did not all serve the same function. Although Vankina counts them all as floats, research opinion is divided on the question of the function of objects of this form.

Two of the bark pieces are thicker than the rest. One of these, from Dwelling T is approximately oval in plan (Fig. 51: 11; thickness: 2.9 cm), while the other, from Dwelling K, is somewhat irregular (Fig. 51: 10, thickness: 3.9 cm).

Dwelling T also produced a thinner, approximately square piece with an elongated central perforation (Fig. 51: 12; thickness: 1.5 cm). This piece is unusual in that the long axis of the perforation is perpendicular to the grain of the bark.

Two fairly thin, irregularly-shaped pieces with an elongated perforation at the centre were found together, in the same metre square of Dwelling ADR (Fig. 51: 7, 8; thickness: 1.7 and 1.3 cm).

Dwelling K has also produced a fairly large subrectangular piece with an elongated perforation at the centre and a second, circular perforation at one end, as well as a longitudinal groove (Fig. 51: 6; thickness: 2.5 cm). This piece bears a resemblance to a less regular float from Dwelling N, with an elongated central perforation and a small round hole next to it, and with notching observable at one end (Fig. 51: 9; thickness: 2.1 cm).

Belonging to the net from Dwelling ADR is a small perforated oval float (Fig. 71: 11, thickness: 1.3 cm), similar in shape to the unperforated floats from the net. Like most of the other floats from this group of finds, it has a longitudinal groove, differing from the rest only by its elongated perforation. Fragments of twine are preserved in both sections of grooving. There is a similar, broken piece from Šventoji site 23: oval or subrectangular with a central perforation and a longitudinal groove (Rimantienė 2005, Fig. 340: 11).

Somewhat different from the bark objects with an elongated central perforation found in the dwellings with Late Särnate Ware is an unusual piece
from Dwelling L, in the shape of a hexagon or truncated rhombus, and with a large, rhombic perforation and notched ends (Fig. 51: 6).

Vankina has also included among floats a wooden board, approximately oval in shape, from Dwelling K, with an elongated central perforation and a notch at one end, which bears a resemblance to some of the pieces from this group, although it is larger and more carefully worked (dimensions: 18.2×12.3×1.7 cm. Vankina 1970a, Fig. XXIV: 2).72

Resembling the larger examples from Sārnate with an elongated central perforation are some oval or subrectangular pine bark objects from Šventoji Site 23 (Rimantienė 2005, Fig. 341: 1, 2). Somewhat different are two regular bark discs perforated in the middle, from Verete I Mesolithic site near Lake Lacha in northern Russia. These are analogous to perforated wooden discs from this same site (Ošibkina 1997, 118, Fig. 92).

Objects resembling the perforated wooden board from Sārnate have been found at several Mesolithic and Neolithic sites across a wide area, although all the known examples are smaller than the Sārnate piece. Dated to the Mesolithic is an oval wooden block with a circular perforation in the middle that comes from Tõrvala in north-eastern Estonia (Indreko 1948, Fig. 79: 2). There are several perforated wooden discs from the Mesolithic sites of Nižnee Verete and Verete I, northern Russia (Foss 1952, Fig. 23: 7; Ošibkina 1997, 118, Figs. 91–92). The Mesolithic site of Viš I has produced a decorated example with an elongated perforation at the centre (Burov 1998, Fig. 6.3: 4, Fig. 6.5: 6).

Circular or oval wooden blocks with an elongated or circular perforation in the middle have also been found in the Early Neolithic stratrum at Zvidze (Loze 1988b, Fig. 3: 3–7), at the Middle and Late Neolithic Šventoji sites (Rimantienė 2005, Fig. 110: 14, Fig. 113: 2, Fig. 126: 5, 7, Fig. 281: 11–14, Fig. 341: 13) and the Late Neolithic site of Žemaitiškė 2 near Lake Kretuonas in eastern Lithuania (Girininkas 1990, Fig. 44). Most significantly, Šventoji 2B has also produced a pole 1.25 m long, flat at one end and fitted with such a perforated wooden disc (Rimantienė 2005, Fig. 181: 6, Fig. 187: 2).

Various ideas have been expressed as to the function of these artefacts. Vankina classed all the bark and wooden items of this kind from Sārnate as floats (Vankina 1970a, 94). On the other hand, the wooden piece from Tõrvala has been regarded as an implement for beating the water surface to drive fish, on the strength of ethnographic parallels in eastern Estonia (Indreko 1948, 327, Fig. 80:

72 A 11416: 79.
3). One such fish-driving stick, fitted with a flat, subrectangular wooden board with a circular hole in the middle, bearing a very close resemblance to the Mesolithic and Neolithic examples, is held in the ethnographic collections of the National History Museum of Latvia.\textsuperscript{73} The find from Šventoji of such a wooden block fitted onto a pole strongly suggests that the wooden archaeological examples served the same purpose. In Rimantienė’s view, such an implement with a wooden block at the end may also have been used for poling a boat: when pushing against the soft bed of a muddy water-body, the wooden block would have prevented the pole from sinking into the mud (Rimantienė 2005, 82). She regards the bark objects with an elongated central perforation as functionally analogous, while Ošibkina (1991, 209–210) considers the bark discs to be floats.

Thus, there is good reason to regard the perforated wooden discs and blocks as having been used on poles for driving fish or for propelling boats. However, there is some doubt as to whether all of the mentioned pine bark objects of this kind would have been sturdy enough to have served for such activities. Two of the Sārnate pieces (Fig. 51: 10, 11) are indeed thick and correspond in form to the ethnographically-attested tips of fish-driving sticks, while the rest might be regarded as too thin and flimsy for such a function. Rather, they might have served as some kind of specialised floats. It is also possible that these objects were not connected with fishing or water craft at all, but were used in dry-land activities of some kind.

\textsuperscript{73} CVVM 16789.
Fig. 51. Pine-bark floats with a central perforation. 1, 2, 11, 12 – Dwelling T; 3, 4, 9 – Dwelling N; 5 – Dwelling L; 6, 10 – Dwelling K; 7, 8 – Dwelling AOX. A 11419: 86; A 11418: 104, 90; A 11417: 234; A 11419: 39, 38, 16; A 11417: 187; A 11416: 95, 57; A 11415: 115, 116. Drawing: A.Bėrziņa.
6.1.1.4 Small pine bark floats with a circular or square central perforation and notched ends

Three carefully-worked small oval or circular floats from Dwellings N and T (Late Särnate Ware) have a fairly small circular or square perforation in the middle and notched ends (Fig. 51: 1, 3, 4). Another similar piece from Dwelling T, with a circular perforation and notched ends, is in the shape of a rounded rhombus (Fig. 51: 2).

Similar rhombic floats with a circular perforation in the middle, but lacking notches, have been found at the Middle Neolithic site of Šventoji 23 (Rimantienė 2005, Fig. 340, 20–22). Rhombic floats with notched ends and a central perforation are represented in the Late Neolithic material from Šventoji (Rimantienė 2005, Fig. 110: 17).

The floats would have been attached to the headrope at both ends, like the unperforated floats, the perforation presumably serving as an additional point of attachment.

6.1.1.5 Birch bark rolls

The cylindrical rolls of birch bark, up to 14 cm long (Vankina 1970a, Fig. XIII: 1–3), were almost certainly also used as floats. Most are poorly preserved and fragmented, which makes it impossible to determine the original number or size of the rolls.

Birch bark rolls regarded as net floats have been found at the Neolithic sites of Siliupe,74 Šventoji 1B and 2B, Šarnelė (Rimantienė 1991, 73) and Gorbunovo (Raušenbah 1956, Fig. 8: 2–3).

Birch bark rolls were widely used as net floats in the recent past as well, as attested by ethnographic data from Latvia, Estonia, Finland and other countries. Birch bark can be made to roll up immersing it in boiling water. Such a bark roll could be threaded either directly onto the headrope or onto a separate short band that was attached to the headrope at both ends. The latter method alleviated the replacement of floats and permitted them to be removed in order to dry the headrope. (Manninen 1931, 195, 206–207, Figs. 182, 194; Sirelius 1934, Fig. 225; Ligers 1942, 63, Fig. 60; Vilkuna 1975, Fig. 136).

74 VI 292: 539.
A factor restricting the use of birch bark rolls as floats is their very limited buoyancy (Eglitis 1956, 334).

6.1.2 Sinkers

All the sinkers from Särnate are stone. They include 172 unworked pebbles and 154 pebbles notched to prevent the binding from slipping (Appendix 6; Table 18). A proportion of the sinkers have preserved remains of bast binding or birch bark wrapping.

Although most of the sinkers were evidently attached to nets, it is quite possible that some, particularly the heavier examples tied round with bast, were in fact used to weigh down or anchor other kinds of fishing gear: traps, bottom angling gear and possibly the ends of gill nets (Benecke 1881, Fig. 195; Bielenstein 1918, Fig. 581; Manninen 1931, Fig. 126; Sirelius 1934, Fig. 186; Ligers 1942, Figs. 47–48). The finds of groups of three large sinkers in Dwellings ADA and K may indicate some special function.

6.1.2.1 Unworked pebbles and pebbles wrapped in birch bark

The collection includes 58 small, unworked pebbles with partially or completely preserved birch bark wrapping, which enabled them to be attached to the net, as well as 108 similar-sized pebbles without any remains of wrapping (Appendix 6, Table 18; Fig. 71: 14–17). It is considered that the pebbles without wrapping also served as net sinkers, the wrapping simply having decayed. Groups or piles of such pebbles have been found (Fig. 83).

Generally used for this purpose were elongated pebbles of various kinds of crystalline rock, or sometimes dolomite, sandstone or slate. The main criterion for selection would evidently have been weight.

The pebbles were wrapped in a sheet of birch bark, tied at both ends with bast (Fig. 71: 12–13). Also preserved in several cases are one or more bands of bast connecting the two ends of the sinker (Fig. 71: 12). In two cases, twine has been used instead of simple bands of bast. It is clear that many of the sinkers had also been tied round the middle with bast (or in one case with twine), although in most cases the only evidence of this is in the form of impressions of the binding that remain on the birch bark. The binding around the middle presumably served to secure the bark wrapping, while the bast or string connecting the ends of the sinker would have been attached at both ends to the footrope.
Small pebble sinkers in birch bark wrapping have been found at Zvidze (Loze 1988b, Fig. 3: 1, 2), and from the Middle and Late Neolithic sites at Šventoji. The Šventoji sinkers most commonly also have twine connecting the ends of the sinker, and sometimes also bast binding, or at least the impression of such binding, around the middle (Rimantienė 2005, 69, Fig. 168: 3–5, Fig. 267). Similar sinkers – pebbles or lumps of clay in birch bark wrapping – have been found at the Neolithic site of Gorbunovo (Raušenbah 1956, Fig. 8: 7).

Piles of unworked pebbles, one consisting of 60 pebbles and the other of 100, were uncovered on the Late Neolithic Rzucewo Culture site of Nida on the Couronian Spit (present-day Lithuania). By analogy, these are considered to have been wrapped net sinkers, although no wrapping was preserved in this case (Rimantienė 1989, 66).

Pebble sinkers wrapped in birch bark and tied at both ends were in use in Latvia and Estonia in recent times (Manninen 1931, 146, 205; Šulcs 1961, 161). More commonly in the recent past, a cloth bag took the place of birch bark wrapping (Manninen 1931, Fig. 192; Cimermanis 1963, 102–103; 1973, 131, 135).

6.1.2.2 Unworked large stones tied with bast

Six unworked large stones found in the dwellings with Early and Late Sārnate Ware, four of them tied around the middle with bast, are also interpreted as sinkers (Fig. 53: 1). The much greater weight of these sinkers, compared with the previous group, along with the different mode of attachment, serves to set them apart as a separate functional group.

Unworked or split stone sinkers (without notching), tied with bands of lime bast or with twine made of bast, have been found on the Middle and Late Neolithic sites of the Narva Culture at Šventoji (Rimantienė 2005, Fig. 266: 6–9). Rimantienė (1979, 31) interprets the very largest of these as anchors. Uncovered at the Late Neolithic Šventoji Site 1A were the remains of a fish-trap, along with a large stone wound with birch bark, presumably used to weight it down (Rimantienė 2005, 244, Fig. 112: 3). Also, three unworked stones tied round with plant stalks and birch bark have been found at the Mesolithic site of Verete I in northern Russia (Osibkina 1997, 63–64, Fig. 40).
6.1.2.3 *End-notched pebble sinkers*

Representing the second most widespread group of sinkers, after the wrapped pebbles, are elongated, flat pebbles notched at the ends (Fig. 72: 4–6). In order to make such sinkers, suitably-shaped flat pebbles had to be collected, with edges thin enough to be notched by flaking. Such material is not universally available. Suitable pebbles may nowadays be found in the shingle along several stretches of pebbly beaches on the west coast of the Kurzeme Peninsula. Elsewhere along the coast and inland, such raw material is rare or completely absent. Used for the great majority of these sinkers (83%) were red, white, brown, grey or violet quartzite pebbles. Evidently, the quartzite shingle provided suitably-shaped pebbles, and quartzite is, of course, a rock type widely preferred for flaking. Other kinds of rock were occasionally used as well: medium-grained and fine-grained igneous rock (granite, etc.), gneiss and dolomite.

The sinkers found intact almost always have notches at both ends: there is only one piece with a notch at just one end, and another with an additional notch at one side.

It should be noted that, although end-notched sinkers were found in several dwellings with well-preserved organic remains, none of them had any remains of binding.

End-notched pebble sinkers, with an additional notch at one side, have been found in Dwellings C and E at Purciems.75 Other examples come from the Late Neolithic site of Abora I in the Lubāns Lowlands (Loze 1979, Fig. XXIII: 9–10).

Judging from the published material, end-notched sinkers are poorly represented at the Neolithic sites of Šventoji (Rimantienė 2005, Fig. 104), side-notched examples being much more common here. Some have a notch at one or both ends, in addition to the notches at the sides (Rimantienė 2005, Fig. 266: 2–3, Fig. 327). Some tens of end-notched pebble sinkers have been recovered at the Neolithic site of Kroodi in northern Estonia (Indreko 1956, 19–20; Jaanits 1991, 36). In the Nordic region, too, finds of this form of sinker indicate a wide area of distribution (Indreko 1956, 18–31).

Ethnographic evidence from Estonia indicates that end-notched pebble sinkers were suspended in a vertical position below the footrope of the net (Fig. 52: a). On the other hand, Sirelius (Fig. 52: b) gives an example of the attachment of end-notched flat pebble sinkers in a horizontal position along the footrope:

---

75 A 10079: 26; A 10081: 3.

234
such an arrangement was observed on potku nets for salmon, as used on the River Kemi in Finland. We may guess that the latter mode of attachment would in fact have been the one used in the Neolithic. This is a more logical arrangement for nets used in shallow waters, since only sinkers fixed tight against the footrope of the net will pull the wall of the net right down to the bed (Voinikanis-Mirskis 1956, 66). Sinkers suspended beneath the footrope are likely to leave a space between the net and the bed, giving the fish an escape route.

Fig. 52. Alternative modes of attachment of end-notched stone sinkers. Examples from Estonian and Finnish ethnographic material. a – Manninen 1931, Fig. 193a; b – Sirelius 1906, Fig. 234.

6.1.2.4 Side-notched pebble sinkers

The same principle of manufacture was used to make stone sinkers notched at the sides, which are much less common at Särnate – totalling 21 altogether. Once again, the main raw material is quartzite shingle.

While there is no evidence of the material used to attach the end-notched sinkers described in the previous section, the side-notched pieces are known to have been tied with bands of bast, as indicated by the remains of bast binding on two examples from Dwelling A_{DA} and one from Dwelling T (Fig. 53: 2–4). In two of these cases, the bast has been tied in a knot in the middle of one face of the stone, while in one case two knots are observable: one at each side by the notch. The different mode of attachment (and the greater weight, see Sections 6.3.2. and 6.4.2) may indicate that these sinkers served a different function from the end-
notched pieces: they may have been used not on nets, but on some other kind of fishing gear.

A flat side-notched stone sinker has been found with Burial 125 at Zvejnieki Cemetery near Lake Burtnieks in northern Latvia (Zagorskis 2004, Fig. 24: 5). The Mesolithic net find at Siivertsi in Estonia included small sinkers made from flat blocks of sandstone notched at the sides and tied with bast cord (along with one stone sinker perforated in the middle; Indreko 1948, 324–325, Fig. 79: 6).

Fig. 53. Side-notched and unworked large stone sinkers with preserved binding. 1 – Dwelling I; 2 – Dwelling T; 3, 4 – Dwelling A0A. A 11416: 43; A 11418: 97; A 11415: 67, 69. Drawing: A.Bērziņa.
Large numbers of side-notched stone sinkers come from the Middle and Late Neolithic sites of Šventoji (Rimantienė 2005, Fig. 104, Fig. 266: 1), sometimes with remains of binding made of bast or bast twine. The largest of these are regarded as anchors (Rimantienė 2005, 302). Various-sized pebbles notched at the sides have also been found at Nida (Rimantienė 1989, Fig. 36: 6, 8–12). Stone sinkers with two or more notches and bast binding have also come to light at the Late Neolithic site of Šarnelė (Butrimas 1996, 182, Fig. 9).

Ethnographic analogies for side-notched sinkers are also known: nets with such sinkers occur, for example, in the collections of the Ethnographic Open-Air Museum of Latvia.

6.1.3 End-sticks for nets

Dwelling K (Late Sārnate Ware) produced two wooden rods with a spherical knob at each end, One of these is made from ash, 53 cm long and carefully worked (Fig. 54: 3), while the other, 66 cm long, has been roughly hewn from hazel, with the bark still attached in the middle part, and seems to be unfinished (Fig. 54: 4).76

Very similar artefacts have been found on the Šventoji sites. There are intact examples from Sites 1B (70 cm long), 2/4A (71 cm long) and 23 (61 cm long), as well as fragments of such objects (Rimantienė 2005, 70, Fig. 178: 8, 9; Fig. 346: 1).

A fragment possibly from such an implement has also been found in the Early Neolithic stratum at Zvidze (Loze 1988a, 41, Fig. XXXVII: 7), and there are several similar examples from Gorbunovo (Èding 1940, Fig. I: 3; Raušenbah 1956, Fig. 10: 10).

These wooden rods have been interpreted as end-sticks used on seine nets (Vankina 1970a, 95, 133). End-sticks are attached at both ends of the seine in order to evenly distribute the strain of the towing warps and ensure the even progress of the seine as it is towed through the water (Fig. 54: 2). This could have been the function of the Neolithic examples. However, we know from the ethnographic record that certain other kinds of nets could also have sticks attached at the ends. In particular, end-sticks were present on set nets used for nearshore marine fishing along the East Baltic coast, serving to prevent the net from twisting under the influence of the wind and the motion of the sea (Fig.

---

76 A 11416: 72; A 11418: 66.
54: 1; Šulcs 1961, 161, Fig. 16). Hence, we cannot regard the finds of Neolithic end-sticks as unequivocal evidence that seine nets were in use.\(^\text{77}\)

**Fig. 54.** 1 - a set net, as used along the East Baltic coast in recent times (Heinemann 1905, Fig. 1); a seine net with a bag (Seligo 1926, Fig. 69); 1, 2 - end-sticks for nets, Dwelling K. A 11416: 72, A 11418: 66 (Vankina 1970a, Fig. XXI: 8, 9).

### 6.1.4 Netting and cordage

The remains of netting were found together with floats and sinkers in the eastern part of Dwelling A\(_{DR}\). Preserved were fragments of twine from the mesh of the net, with some knots, as well as pieces of larger diameter string. The net is

\(^{77}\) In earlier papers on the fishing gear from Striate (Bērziņš 2006b; 2006c), the author adhered to the accepted opinion that the Neolithic finds of end-sticks indicate the use of seine nets, but additional study of the ethnographic literature has revealed that this not necessarily so.
thought to have been in a folded state, since the twine formed several dense layers. The mesh size was indeterminable, since the twine was poorly preserved and very difficult to distinguish in the peat (Vankina 1970a, 22–23, Fig. XVIII: 1a, b).

Twine from the net is preserved in the museum collection on two small blocks of peat (Vankina 1970a, Fig. XVIII: 1b). The twine is about 1–1.5 mm in diameter, Z-plied from two twisted strands. The twine was made of plant fibre, but is in such a poor state of preservation that the material could not be securely identified even under the microscope, but bast is a likely possibility.

The net fragments found at Šventoji were made from lime bast twine (identified microscopically), twisted from two strands. Two of the Šventoji nets, with a mesh size of 2 and 6 cm, were made of twine comparable in diameter to the material of the Sārnate net, which proves that twine of such a small diameter can in fact be made from bast (Rimantienė 1970, 143–144; 1979, 27, Figs. 19, 20, 59–60). The Mesolithic net from Siivertsi, Estonia, is also thought to have been made of bast (Indreko 1948, 325). In more northerly areas, fibre from other plants was used. Thus, the twine of the Antrea net was made from willow bark (Luho 1967, 30), while that of the Mesolithic net from Vis I in northern Russia was twisted from rootlets and sedges (Burov 1998, 58).

The Sārnate net is one of two finds of Neolithic netting from Latvia: the other is a fragment of fine knotted netting from Abora I (Loze 1979, 79).

Rimantienė states that the Sārnate net, like those found at Šventoji, had been knotted using the weaver knot, otherwise known as the sheet bend (2005, 66–67; Fig. 175). The antiquity of this form of knot, nowadays used on fishing nets across most of the world, is attested by its use on the Mesolithic nets from Antrea Korpilahti (Pälsi 1920, Fig. 7) and Vis (Burov 1998, Fig. 6.5: 3, 4). This knot has also been found on a Neolithic net from Förstermoor in North Germany (Brandt 1970, 124). Unfortunately, the state of preservation of the Sārnate netting is such that the knots could not be characterised and Rimantienė’s interpretation could not be verified.

As already mentioned, the wrapped pebble sinkers and floats from Sārnate were sometimes attached by means of twisted strands, about 1 mm in diameter (bast?), instead of simple bands of bast. In three cases (one float and two sinkers), where the strands were better preserved, they were found to have been S-spun. It seems that only two bands of bast were twisted together in these cases. The twine

---

78 A 11418: m, n.
for the net, twice as thick, could have been made by plying two such strands in the opposite direction.

Fragments of string, which, admittedly, may have served other needs apart from fishing gear, have been found in Dwellings K and T. A string about 6 mm in diameter (Vankina 1970a, Fig. XVII: 3) from the hearth of Dwelling K was Z-plied from two bast (?) strands twisted in the opposite direction. Another 6 mm thick piece of string comes from Dwelling T. This was S-plied, also from two strands (Vankina 1970a, Fig. XVII: 6).

Lime bast cordage is well represented in the Šventoji material (Rimantienė 2005, 97), and is the material used for practically all of the cordage found on the fishing gear. The only other material identified on fishing gear is nettle fibre, spun into cords that were found attached to net mesh from Site 2/4 (Rimantienė 2005, 97). A cultivated fibre crop, namely hemp, was also in use at Šventoji in the Middle Neolithic: hemp seeds have been found at Šventoji 3 and 23, and there is a piece of hemp rope from Site 23 (Rimantienė 1979, 69; 2005, Fig. 339). However, there is no evidence of hemp cordage on the fishing gear. Although hemp gives finer, more pliable fibres, it may be that bast was regarded as superior to hemp for fishing equipment in particular because it is more resistant to rotting (Eglītis 1956, 32, 45).

In order to obtain bast, bark is cut from young lime trees in the spring or early summer, when it readily peels away from the wood. The sheets of bark are retted in standing water until the inner layer of bark, providing the best quality bast, becomes detachable (Bielenstein 1918, 575; Kalniņš 1944, 320). There is also ethnographic evidence that rope was made from ‘fresh’ (un-retted) bast (Virvju višanas piederumi 2003, 37). Lime bast is a light material, resistant to the effect of moisture, but because it is fairly coarse, in more recent times it has mostly been used for making rope, tying sinkers, etc. (Eglītis 1956, 45). There are ethnographic records of the use of lime bast rope in traditional fishing in the Kuršiu Marios lagoon and along the Latvian coast (Benecke 1881, 334; Virvju višanas piederumi 2003, 37).

---

79 A 11416: 84.
80 A 11417: 225.
6.1.5 Screens for fishing structures

In their accounts of the excavation work at Särnate, Šturms and Vankina describe six badly damaged objects of long pine laths, which they regarded as fish-traps. The collection of artefacts from Särnate includes bundles of laths or separate laths from three objects of this kind. Based on the evidence from these preserved remains, and from the descriptions, drawings and photographs of the objects in situ, the author has tried to form a clearer picture of the original appearance and function of the objects.

Four finds of this kind came to light in dwellings with Late Särnate Ware (ADR, G and K).

The first, found in the north-western part of Dwelling K, is described by Vankina as a conical fish-trap, consisting of preserved laths up to 2.5 m in length. Vankina writes that the mouth of the fish-trap was badly damaged, while the narrow end was better preserved. The laths had been bound together with bast in three places (Vankina 1970a, 93). Photographs taken at the time of excavation show a long bundle of laths (Fig. 55). The preserved remains of the object consist of a large number of pine laths broken into shorter sections and no longer bound together. The laths are 0.7–2.7 cm wide and 0.7–1.2 cm thick.\textsuperscript{81}

\textsuperscript{81} A 11416: 132.
Fig. 55. Remains of a lath screen (?) *in situ* in the north-western part of Dwelling K (Vankina 1950, Fig. 41).

Found at the southern end of Dwelling K were the remains of a second object of this kind. A drawing of the find shows the laths to have been at least 1.6 m long, with the remains of binding still present in a couple of places (Fig. 56). There are no preserved remains of this object in the museum collection.
Fig. 56. Remains of a lath screen (?) in situ in the southern part of Dwelling K (Vankina 1970c, Fig. IVa).

In Dwelling G there was a bundle of laths 90 cm long, consisting of about 40 laths (Šturms 1938–40). A small number of desiccated, broken laths are preserved. Another bundle of laths regarded as the remains of a fish-trap was found in the southern corner of Dwelling ADR. A plan of the find shows that the preserved sections of the laths were up to 60 cm long. (Vankina 1970c, Fig. XXX; Vankina 1970a, 21, Fig. 12).

One more similar find comes from Dwelling S (ungrouped). Here, in the western corner of the dwelling, a bundle of 1-m-long pine laths was found, also interpreted as a fish-trap (Vankina 1970a, 54, Fig. 85).

The sixth and last object of this kind was discovered between Dwelling M₀ (Early Särnate Ware) and Dwelling K (Late Särnate Ware), and could belong to either group of dwellings. This last piece was in fact the best-preserved example, although it was found broken in two Bast binding was found in two places on the

---

82 A 11415: 425.
laths of the largest section. Vankina (1970a, 93–94) writes that inside the outer, broader layer of laths there was a second, narrower layer of bound laths. This she regarded as the remains of the funnel of the fish-trap, which prevents fish from escaping once they have entered the trap.

Fig. 57. Remains of a lath screen found between Dwellings K and M₀, in situ (Vankina 1970e, Fig. 35).
Fig. 58. Part of the lath screen found between Dwellings K and M₀, showing bast binding (Vankina 1970e, Fig. 37).

Fig. 59. Preserved remains of the lath screen found between Dwellings K and M₀.

However, the photographs and drawings of the find in situ show only laths with binding. No features suggesting the mouth and funnel of a fish-trap can be identified (Fig. 57). The artefact collection includes separate ‘blocks’ from this object, which has been broken into sections, consisting of laths, measuring 1.3–2.1 cm in width and 0.6–1.3 cm, in several layers. Also preserved on the laths in some places are the bands of bast that served to fasten the laths together (Fig. 58).
In the preserved sections of the object, the laths were found to constitute as many as seven or eight layers (Fig. 59). In view of the presence of so many layers of laths, the object cannot be regarded as a fish-trap. A fish-trap with a funnel found in a flattened state should have no more than four layers of laths: two from the crushed outer body of the trap, and two more sandwiched between them, deriving from the funnel. Since the laths form a greater number of layers, this particular object must have had a different form and function. There is insufficient information about the other five objects of this kind, so they are difficult to interpret. Judging from the preserved fragments and the documentation, these objects do not seem to have had features indicating that they were fish-traps, and, since they seem to have been very similar to the best-preserved example, it is considered that they were probably not fish-traps either.

Moreover, ethnographic evidence indicates that the body of a lath fish-trap includes not only laths and binding material (roots, withies or bast), but also one or more hoops of thicker withies to which the laths are bound in order to form the body of the fish-trap. However, the documentation from Sārnate provides no evidence of withies together with the bundles of laths, and this, too, suggests that we are not dealing with the remains of fish-traps.

Objects interpreted as lath fish-traps have been found on several Neolithic sites in the East Baltic. In some cases, such an interpretation seems quite secure. Thus, at Abora I, a lath fish-trap was found, with a funnel resembling a basket made of withies (Loze 2001a, 36–38, Fig. 5). At Šventoji 2B, a lath fish-trap was found together with a cover for the opening, also made of laths (Rimantienė 2005, 71, Fig. 177). Other bundles of laths found at the Šventoji sites (Rimantienė 2005, 192, Fig. 112) and at the Late Neolithic sites at Kretuonas in eastern Lithuania (Girininkas 1990, 42), with or without binding material, are open to various interpretations. A cluster of laths was also found at Silūpu (Ilga Zagorska, pers. comm.). It seems that the interpretation of the widely known artefacts of laths from Sārnate as fish-traps has encouraged researchers to extend this interpretation to bundles of laths from other sites as well.

In seeking an alternative interpretation for the bundles of laths from Sārnate, we may consider ethnographic descriptions of moveable fishing structures that consist of screens made of long laths, bound together by means of bark, withies or roots.

One example is the katica, which was still used in the early 20th century in Lake Babīte in central Latvia and in the lower reaches of the River Lielupe (Fig. 60, right). It consisted of two heart-shaped chambers made of lath screens,
connected by a straight section of lath fencing. The device was placed so that the straight fence blocked a path habitually used by fish: they were forced to move along the straight fence until they ended up in one of the chambers and were trapped there, not being able to find the narrow entrance again. The fish were retrieved from the chamber using a scoop net.

A katica was built from separate screens of laths. In order to obtain the long laths, a straight piece of pine timber, free from knots, was required. Using a wedge, it was first split into several sections, which were then split with an axe into thin laths. The laths, about 2 m long, were sharpened to a point at one end and then bound together to form a screen, using withies or pine roots (Fig. 60, left). The finished screens forming the katica were driven into the bed of the fishing location, along with poles to which the screen was attached so as to support it in an upright position. The katica was suited for fishing in shallow, overgrown waters. It was erected in spring and left to stand until the late autumn. Sometimes, these fishing structures were also used in winter. (Trocigs 1940, 119–122; Ligers 1942, 33–44).

Fig. 60. Left: making a lath screen for a katica at Kalnciems on the River Lielupe (Ligers 1942, Fig. 17). Right: A katica as used in Lake Babite (Trocigs 1940, Fig. on p. 120).
Fishing structures resembling the Latvian *katicas* were used in the recent past in a very wide region. Structures based on a similar principle, but varying in layout, are described in ethnographic accounts from Finland, Sweden and Russia (the Finnish *katiska*, the Swedish *kattsa* and the Russian *kotcy*). The simplest versions consisted of a single heart-shaped chamber and one or two straight fences, while the most complex, labyrinthine examples extended over large areas (Sirelius 1906, 5, 26, 29, 153, 272, 285, Figs. 6–7, 44b, 55b, 216, 394–398, 441; Trocigs 1940, 124–125; Fedorov 1937, 63–66, Figs. 11, 12).

In Latvia and other countries, different kinds of fishing structures made of laths were also in use. Thus, fishing weirs made of laths were erected in the bays of Lake Lubāns, as well as in the mouths of rivers and in ditches around the lake, leaving gaps for placing fish-traps. Another form of lath fishing structure was erected in the small rivers of the Vidzeme region: an S-shaped double fence of laths was placed across the river, with an entrance at each end. The fish entered the gap between the two lath fences, but could not get out (Cimermanis 1963, 93, Fig. 9).

Finnish ethnographer Uuno Sirelius has given an extensive account of the small-scale fishing structures used by the Finno-Ugric Khanty and Mansi peoples.
of north-western Siberia. These structures, consisting of moveable screens of laths, and most commonly with fish-traps or chambers as catching devices, were erected on rivers in various seasons of the year (Sirelius 1906, 18, 23, 26, 45–47, 50, 51, 61, Figs. 31b, 36, 47b, 74, 79, 84, 93, 95, 114b, 116).

The remains of lath screens regarded as deriving from fishing structures have also been recovered archaeologically in Finland and Russia. In none of these cases is the original form of the fishing structure entirely clear.

The remains of lath screens from the Neolithic have been found in the Finnish region of Ostrobothnia, in Purkajansuo Bog by the River Ii, not far from the Neolithic settlement of Kierikki. In this case, the screens were found in a horizontal position, most commonly rolled up. The fishing structures are thought to have been dismantled in the autumn, and the materials sunk below the water level for the winter, to prevent the ice from breaking them up. The pine laths (about 1.7 cm wide and 1.0 cm thick) were bound together using strips of birch bark, in many cases attaching a narrow lath or withy as well. In those cases where the ends of the laths have been preserved, they are most commonly rounded at one end and cut obliquely at the other to form a wedge-shaped tip (Satu Koivisto, pers. comm.).

The remains of a fishing structure found near the Neolithic site of Plehanov on the bank of the River Oka in central Russia consisted of a semi-circular fence. The function of this structure was indicated by the presence of fish bones inside the fence. The fence was about 1 m high, and consisted of closely spaced pine laths and poles driven into the bed of the river. (Fedorov 1937, 61–66, Figs. 1–6; Fedorov 1953, 305, 307, Fig. 8).

In southern Russia, on the site of Podzorovo II by the River Voronezh, part of a fishing structure was recovered in a horizontal position, consisting of parallel laths measuring 1 cm in width, 0.5 cm in thickness and about 2 m in length. Evidently, the laths had once been fastened together, separated by gaps of 0.5–1.0 cm (Levenok 1969, 86, 88, Fig. 32).

Similar remains have come to light in northern Russia as well, at the find location of Marmugino I on the River Yug. The two fishing structures found here consisted of moveable ‘screens’, apparently made of three layers of laths. The laths were 0.5–2.5 cm wide, 0.5–0.8 cm thick and about 2.2 m long, fastened together with loops of withies (Burov 1969, 133–134, Fig. 50).

Lath screens could most easily be transported to the fishing location if they were rolled up (Fig. 61), and this is the way they were stored between fishing seasons. The bundle of laths found between Dwellings K and M₀ at Särnate may
be interpreted as a rolled-up screen of this kind, consisting of laths bound together with bast. This interpretation may be extended to the other bundles of laths from Särnate. The considerable length of some of the rolls supports this idea. It must be admitted that pointed ends needed to drive the screens into the bed of the fishing site have not been observed on the laths from Särnate, but this may be explained in terms of the fragmented condition of the material.83

Possibly also representing material for fishing structures are the birch poles, 2–3 m long and pointed at both ends, which were found stacked in the southern part of Dwelling S. Such poles may well have been driven into the bed of the lake as supports for fishing structures of lath screens (Vankina 1970a, 55–56, Figs. 85, 88).

6.1.6 Lateral arms of eel clamps

Recovered from the dwellings with Late Särnate Ware (A, G, K and N) were four unusually-shaped objects made of ash wood. Although Šturms (1940, 55) tentatively interpreted this form of object as a boomerang, an interpretation accepted by Vankina (1970a, 91), it is now clear, form the study of similar Neolithic finds at other sites along the Baltic coast, that these objects are evidently the lateral arms of clamps used specifically for spearing eels.

There are three very similar pieces, two of them whole, and the third fragmentary (Fig. 62: 2–4). These all have a thin blade, approximately 15 cm long and 4 cm wide, and a slightly thicker shaft, angled approximately 30° to the blade. There is a slight spur on the outside edge at the transition from the blade to the shaft. Two of the objects have an intact shaft – 21 cm long in both cases. One margin of the shaft is thick, with a flat facet, while the other is rounded. The shaft broadens into a foot, narrowing again at the very bottom.

The fourth piece (Fig. 62: 1) is somewhat different: the blade is slightly more curved, there is no spur at the transition to the shaft, and the shaft itself is shorter. In this case the shaft has no broadened foot, narrowing into a wedge instead.

Very similar wooden objects have been found at Šventoji, and on Ertebølle, Rosenhof and Funnel Beaker sites in coastal Denmark and North Germany. These finds have been discussed at length by Meurers-Balke (1981). Observing the similarity to recent iron eel clamps from the southern shore of the Baltic, which

83 At Šventoji, there is also evidence of screens of hazel rods, interpreted as barriers that channelled fish into traps made of netting (Rimantienė 2005, 73–74, Figs. 34, 36).
have a central prong and two lateral arms or ‘wings’, she concludes that the archaeological objects are components of clamps used for spearing eels. Meurers-Balke has reconstructed several of these objects (1981, 142–143, Fig. 13).  

Fig. 62. Wooden lateral arms of eel clamps from Särnate. 1 – Dwelling N; 2 – Dwelling K; 3 – Dwelling G; 4 – Dwelling A\textsubscript{dor}. A 11419: 58; A 11418: 59; A 11415: 384; A 11418: 147 (Vankina 1970a, Fig. II: 3–6).

\[84\] There is a poorly-preserved object of similar shape among the bog finds from Purkajansuo, northern Finland (No. P 1606). Like the pieces from Särnate, it has been interpreted as a boomerang, but seems more likely to be an eel clamp component (Satu Koivisto, pers. comm, 12.02.08).

251
Two whole heads of such clamps have come to light in Lithuania and Denmark, confirming Meurers-Balke’s suggested reconstruction. Best preserved is the head of an eel clamp from Šventoji 4 (Fig. 63). A 10-cm-long bone point has been driven into the square end of a wooden shaft to serve as the central prong, with a lateral arm attached on each side by means of wooden wedges and bast binding (Rimantienė 1995, 9–10, Figs. 2, 3; 2005, Fig. 37, Fig. 186: 5, Fig. 187: 1). The head of a clamp found on the island of Ærø in Denmark (Skaarup 1995, Fig. 3) is quite similar, but the prong is missing and the lateral arms have broken. It differs from the Šventoji find in that the binding is much longer, almost entirely sheathing the shaft sections of the arms. It is clear that the four objects recovered at Sārnate derive from eel clamps that would evidently have been quite similar to the complete find from Šventoji.

The pieces from Sārnate, like those from the southern Baltic, are made from naturally curved wood, using a piece cut from the base of a limb of a tree and the adjacent part of the trunk. A prepared section of the tree trunk and branch would have been split in two, permitting the manufacture of two mirror-image curved arms. The production method has been reconstructed utilising finds of semi-manufactured pieces from north German sites (Meurers-Balke 1981, 136–137, Figs. 7–9).

In the winter, eels living in the Baltic Sea or in the lakes and rivers, burrow into the mud and become inactive. Because of this, most alternative eel fishing methods become ineffective in the winter, and eel spearing can become an important activity, as indicated by ethnographic accounts. It seems that, since eels tend to migrate downstream with the onset of the cold, winter eel-spearing was
particularly important in coastal areas (Meurers-Balke 1981, 148). There is evidence that the spearing of eels through holes in the ice was a widespread activity in recent times along the coast of Germany and Sweden, as well as Latvia and Estonia. The method is productive because the eels tend to winter in schools: once the wintering place of such a school has been discovered, a rich catch may be obtained. Moreover, the eels tend to return to the same places, so fishermen who know the wintering-places are likely to obtain a good catch (Manninen 1931, 121–122; Ligers 1942, 22–23; Meurers-Balke 1981, 147–148).

The eel clamps are suitable for use only where the bed is soft, and the design is adapted for spearing eels concealed in the mud. The outward-curving arms of the clamp push the eel’s body towards the centre, where it is prevented from escaping by the spurs on the inwards-facing margins of the arms. The eel’s body is transfixed by the central spike. It is important that the lateral arms should come close together at the narrowest place, but they must be sufficiently flexible to allow the eel to become wedged in the gap between them. The binding that fixed the arms and prong to the shaft of the Neolithic eel clamp provided a degree of flexibility. (Meurers-Balke 1981, 145, 147, Fig. 16).

Eel spearing was also possible from a boat in ice-free conditions, in late autumn or early spring (Ligers 1942, 23). In summer, too, eels might be speared from a boat or by wading. In the daytime, their sleeping places are betrayed by ‘breathing holes’ in the mud. The fishermen could also use the method of intentionally disturbing the eels and then identifying their location from the bubbles that they produce while they conceal themselves in the mud once again. At night during the warm part of the year, when the eels become active, swimming eels may be speared by fishermen using a source of light (Meurers-Balke 1981, 148–149). As already mentioned in Chapter 5, Hulthén (1980, 3–5) has suggested that clay bowls filled with fat could have been used as lamps for night-time eel fishing.

According to Meurers-Balke (1981, 147), clamps of this kind are not suitable for spearing other species of fish: their form is adapted to the cylindrical body of the eel.

85 No ethnographic examples are known from the East Baltic of eel clamps of the kind used in recent times on the southern coast of the Baltic. However, in the East Baltic, a special form of leister was used for spearing eels, based on a similar principle. These leisters had alternating long, broad and short, pointed prongs, the latter having a barb at the tip. When the eel is speared, it becomes wedged between two of the longer prongs and transfixed by the short prong between them. (Benecke 1881, 408, Fig. 201; Manninen 1931, 117, Fig. 98–99; Ligers 1942, 21, Fig. 9. VII).
6.2 Fishing gear from the dwellings with Comb Ware (6ZA and 12DR)

The only preserved finds relating to fishing gear from the dwellings with Comb Ware are four end-notched sinkers. Also, a large pile of small, unworked pebbles was found in Dwelling 6ZA (Fig. 83; Vankina 1970a, 83, Fig. 83). These, and the many other small pebbles of this kind other parts of this same dwelling would probably have been wrapped in bark and used as net sinkers (none of these finds were collected). It should be noted that the other dwellings with Comb Ware generally also had relatively larger numbers of unworked stones than the dwellings of the other groups, and it may be that many of these were actually used as sinkers.

Hence, it is possible to say that both small, light pebble sinkers were in use in this phase of occupation, as were larger, heavier sinkers. Organics were not preserved in the dwellings of this group, for which reason floats are absent.

6.3 Fishing gear from the dwellings with Early Sārnate Ware (2, D, E, IZ/ID, MZA/MZR/MD, Pa, RZ/RD and W)

6.3.1 Floats

The pine bark floats from the dwellings of this group are all unperforated examples. In fact, they are all small examples with notched ends, and virtually all (10 out of 12) are subrectangular with rounded corners (Fig. 64). In both longitudinal and cross-section, too, they are generally rectangular or subrectangular. In terms of dimensions, these floats fall within quite narrow limits (Fig. 65), being 5.9–10.5 cm long (mean length: 7.5 cm), 2.4–3.4 cm wide (mean width: 3.0 cm) and 0.9–1.7 cm thick (mean thickness: 1.4 cm).

86 In previous publications on the fishing gear from Sārnate (Bērziņš 2006a; 2006c), some stone sinkers from Dwellings 6za and 12do were also included in the group of dwellings with Comb Ware, but these two dwellings have now been removed from the group and are treated as ungrouped.
The only other floats were birch bark rolls, at least five of which were found in the dwellings of this group.

Since both kinds of floats represented in this group would have had relatively low buoyancy, it seems there was no requirement within the fishing technology of this period at Särnate for larger floats providing more buoyancy. At the same time, in view of the small size of the sample, it is possible that we are obtaining only a partial picture of the range of variation among the floats of this group.
6.3.2 Sinkers

The great majority of sinkers from this group of dwellings are unworked pebble sinkers (28 pieces). They have a maximum dimension of 3.7–7.7 cm and weigh 19–71 g (mean weight: 34.7 g). Twelve have partially or completely preserved birch bark wrapping. The bimodal distribution suggested by the histogram for the small unworked pebbles of this group (Fig. 65) can perhaps be explained in terms of the small sample size.

In addition, to the small, unworked pebbles, four much larger unworked stones were found in Dwelling 1D, three of them tied round the middle with bast (Fig. 53: 1). Two of these stones were available for study: they weigh 352 g and 493 g.

The assemblages from the dwellings with Early Särnate Ware include only five end-notched sinkers, and it is entirely possible that these few examples actually belong to the cultural material from the nearby dwellings with Late Särnate Ware, which produced much greater numbers of sinkers of this kind. Recovered as surface finds in the area of Dwelling MZM/MD were two much larger side-notched sinkers, weighing 432 g and 1098 g.

![Histogram of weights of small, unworked pebble sinkers from dwellings with Early Särnate Ware.](image)

---

87 A 11416: 40, 41, 43, 47.
88 A 11415: 514, 519.
6.3.3 Screens for fishing structures

The dwellings of this group have not produced any finds of bundles of laths interpretable as the remains of screens used for the construction of fish fences, but the example found between Dwellings M₁₀ and K could belong to this period of occupation. Apart from this, there were spreads of long laths constituting structural layers in the hearths of Dwellings E and M₁₀. As described above, long, regular laths can only be obtained by careful splitting of straight-grained, knot-free timber, and it is inconceivable that such material would have been prepared for the simple purpose of creating the basal layer of a hearth structure. Rather, the use of this material in the hearth layers almost certainly represents the secondary utilisation of worn-out fishing gear. Therefore, we may conclude that the fishing gear of this occupation phase included lath screens used to build fishing structures.

6.3.4 Fishing methods

Not much can be said about the kinds of net fishing gear used during this phase of occupation. Neither the small, unperforated floats, nor the wrapped pebble sinkers are diagnostic of particular kinds of nets, since such components can be used on a great variety of gear, including seines, double-stick nets, spiral nets or gill nets. The larger stones wound with bast could also have served a variety of needs, and the few end-notched sinkers may not be representative of the fishing gear of this phase.

Evidently, fish were also caught during this period by means of fishing structures built of lath screens.

---

89 Of course, we cannot absolutely exclude the possibility that these long lathes had originally been made for use in some dry-land activity, rather than as fishing gear components.
6.4 Fishing gear from the dwellings with Late Sărnate Ware
(Dwellings A\textsubscript{DA}, A\textsubscript{DR}, A\textsubscript{ZA}, F, G, K, N, O, P\textsubscript{b}, T, U, X, Y, Unit F/K and Hearth 3)

6.4.1 Floats

The pine bark floats from the dwellings of this group show much greater variety in terms of form and size than those of the dwellings with Early Sărnate Ware, although this may in part be due to the larger size of the sample.

The unperforated floats from this group of dwellings are much more diverse than those of the previous group (Appendix 6, Table 19). Only in this group do we find floats with a longitudinal groove (Fig. 71: 1–4, 6, 8–10). There are 35 grooved floats, or 49% of the total number of unperforated floats. Almost as many are notched at the ends (32 pieces, or 44%), while three floats have no groove or notching. Both the grooved and notched floats include a variety of forms. They are most commonly subrectangular with rounded corners in plan (Shape 2), with the corresponding shape represented in longitudinal and cross-section. Likewise often occurring and characteristic of this group of dwellings are oval floats (Fig. 71: 1–2, 4–9), usually plane-convex in longitudinal and cross-section (Shape 5). Also quite common are floats with straight sides and rounded ends (Shape 4). The dwellings of this group also produced three floats of unusual form, without any groove or notches, two of them biconvex in plan (Shape 9) and one corresponding to Shape 7.

Looking at the distribution of different forms of unperforated floats in the dwellings of this group, it does not seem to be the case that particular float forms are characteristic of particular dwellings. Instead, the dwellings with a large number of floats generally have a range of different forms. The unperforated floats from this group of dwellings are 4.2–10.5 cm long, apart from three particularly long and wide pieces (Fig. 67). The mean length – 7.5 cm – is the same as that of the floats from the dwellings with Early Sărnate Ware. However, these floats exhibit a greater width range, 1.3–5.3 cm (excluding the three exceptionally large ones), than those of the dwellings with Early Sărnate Ware. The mean width – 3.6 cm – also exceeds that of the floats from the dwellings with Early Sărnate Ware. Narrowest (1.3–4.1 cm) are generally the floats of Shape 4: with straight sides and rounded ends. The thickness varies from 0.6 to 2.3 cm, with a mean figure of 1.4 cm – the same as the mean thickness of the floats from the dwellings with Early Sărnate Ware.
Fig. 67. Length and width of unperforated pine bark floats from dwellings with Late Särnate Ware.

As described in Section 6.1.1.1, some of the unperforated floats from dwellings of this group have preserved birch bark binding and/or the remains of twine or a bast band in the groove.

Vankina has also included among the floats certain unusually-shaped wooden boards from Dwelling K. One of these is approximately oval in plan: rounded at one end and with two oblique straight edges at the other end, converging at a wide angle (length: 12.9 cm, width: 8.4 cm, thickness: 2.1 cm).\(^\text{90}\) Since it has no groove, notching or perforation, its interpretation as a float seems most uncertain.

Of the nine larger pine bark floats with a perforation at one end (Fig. 50), eight come from the dwellings with Late Särnate Ware, while the ninth was found in the area between Dwellings K and M\(_D\), and might be thought to derive from K, a dwelling with Late Särnate Ware. They have been described in Section 6.1.1.2.

Eight out of a group of nine heterogeneous ‘floats’ made of bark or wood and having an elongated central perforation come from this group of dwellings (Fig. 51: 6–12). As described in Section 6.1.1.3, the wooden examples and perhaps some of the pine bark pieces as well may in fact not be floats at all: they could instead have been attached to long poles used for driving fish or punting boats.

The four small oval, circular or rhombic pine bark floats with a circular or square central perforation and notched ends, described in Section 6.1.1.4 (Fig. 51:

\(^\text{90}\) A 11416: 104.
1–4), which all come from this group of dwellings, were evidently attached to the net in some special way.

Finally, at least 15 birch bark rolls were found in the dwellings of this group.

### 6.4.2 Sinkers

The 102 pebble sinkers from the dwellings with Late Särnate Ware and finds units are on average slightly larger and heavier than those of the dwellings with Early Särnate Ware. They have a maximum dimension of 4.0–10.3 cm and weigh 15–165 g (mean weight: 46.6 g).

Forty-six of these pebble sinkers still have birch bark wrapping, tied at both ends with bast (Fig. 71: 12–13). Because of the good state of preservation, compared with the sinkers of this kind from the dwellings with Early Särnate Ware, they provide the clearest evidence regarding the mode of attachment (see Section 6.1.2.1).

![Fig. 68. Histogram of weights of small, unworked pebble sinkers from dwellings with Late Särnate Ware.](image)

Fig. 68 shows a histogram of weights of small pebble sinkers (up to 100 g) in the dwellings of this group. As with the pebble sinkers from the dwellings with Early Särnate Ware, the frequency distribution of sinker weight provides no clear indication of sub-groups. Most common are sinkers weighing 21–40 g. Only four pebbles exceed 100 g (113, 139, 156 and 165 g).
Found in Dwelling A_{DR} (Late Särnate Ware), at the southern end of the dwelling under a patch of sand and charcoal, was a cluster of 24 pebble sinkers, some still preserving remains of birch bark wrapping (Vankina 1970a, 21, Figs. 13, 16, XVIII: 2). Sixteen of these were collected, and these weigh 18–40 g. Generally somewhat heavier are the six pebble sinkers associated with the net, also found in Dwelling A_{DR} (Fig. 71: 12–17): these weigh 34–56 g (mean weight: 41.5 cm).

Dwelling T produced a group of three sinkers in birch bark wrapping that had been strung together (Vankina 1970a, XVII: 5).

Unworked large sinkers include a large stone tied with bast, weighing 2808 g, found in Dwelling A_{DR}, and an elongated, flat pebble with a natural notch near one end, weighing 556 g, from Dwelling K.

The great majority of the end-notched pebble sinkers come from this group of dwellings, which has produced a total of 78. Sixty-two intact sinkers were weighed (Fig. 69). There were two particularly heavy pieces, weighing 795 g and 1127 g, while the rest fall within the range of 33–375 g (mean weight, excluding the two heaviest: 167.3 g). At least three weight groups can tentatively be distinguished. Most common are sinkers in the range of 126–250 g. In addition, a group of lighter sinkers may be distinguished (26–50 g) and a group of heavier ones (301–375 g).

---

91 A 11418: 141.
93 A 11418: 125, 68.
Fig. 69. Histogram of weights of end-notched pebble sinkers from dwellings with Late Särnate Ware.

In several cases, sinkers of this kind have been found in twos and threes. Thus, two sinkers of almost identical weight were found within the same metre square in Dwelling N (127, 128 g).\textsuperscript{94} A single metre square in Dwelling O likewise produced two sinkers (137, 157 g),\textsuperscript{95} while another square nearby produced two heavier ones (291, 375 g).\textsuperscript{96} Two metre squares of Dwelling Y each yielded two such sinkers, while another square produced three.\textsuperscript{97}

Like the end-notched sinkers, the side-notched sinkers come mostly from the dwellings with Late Särnate Ware (15 pieces). A cluster of three heavy side-notched sinkers (337, 631, 1194 g) was discovered in Dwelling K.\textsuperscript{98} There is a similar find from Dwelling A\textsubscript{D}: two side-notched sinkers and one sinker notched at one end. These are all heavy sinkers (738, 1127, 1282 g).\textsuperscript{99} Such groups of finds seem to indicate that these heavy sinkers, too, were not used singly, but rather in groups (of three?).

The side-notched sinkers from the dwellings with Late Särnate Ware have a total weight range of 212–1282 g, with a mean of 566.5 g. Although three

\textsuperscript{94} A 1\textsuperscript{11}419: 49, 50.
\textsuperscript{95} A 1\textsuperscript{11}420: 45, 46.
\textsuperscript{96} A 1\textsuperscript{11}420: 42, 43
\textsuperscript{97} A 1\textsuperscript{11}428: 4, 5, 8–10, 16, 17.
\textsuperscript{98} A 1\textsuperscript{11}416: 120–122.
\textsuperscript{99} A 1\textsuperscript{11}415: 67–69.
different weight groups appear to be distinguishable (Fig. 70), the sample is too small for a proper assessment.

Fig. 70. Histogram of weights of side-notched pebble sinkers from the dwellings with Late Sårnate Ware.

6.4.3 The net from Dwelling A\textsubscript{DR} and finds of floats in association with sinkers

From Dwelling A\textsubscript{DR}, there is a cluster of finds that provides a picture of one particular net. On the eastern side of the hearth, within an area of about 1 m\textsuperscript{2}, a number of floats and sinkers were found, along with the remains of the mesh of a net\textsuperscript{100}. This set of remains consists of the following items:

- ten small oval and subrectangular unperforated floats, three of them with preserved birch bark binding (at least eight with a longitudinal groove and one with notches at the ends) (Fig. 71: 1–10),
- one small, oval net float having an oval perforation in the centre and a longitudinal groove with preserved remains of twine for attachment (Fig. 71: 11),
- six unworked pebble sinkers weighing 34–56 g, two of them still in their birch bark wrapping (Fig. 71: 12–17),
- fragments of the mesh of the net and string fragments.

\textsuperscript{100} A 11418: 120.
Thus, the net had at least ten unperforated floats wound in birch bark and attached to the headrope by means of a short bast band or twine. The single perforated float evidently served some special function, which remains unclear. The footrope was weighted down with at least six pebble sinkers wrapped in birch bark. The characteristics of the twine of the mesh and string fragments have already been described in Section 6.1.4.

In several other cases, small, unworked pebble sinkers have been found in the same square metres as small unperforated bark floats (another two cases in Dwelling A_{DR}; two cases in Dwelling A_{DA}; and single cases in Dwellings F and
N), suggesting a functional association between these particular kinds of floats and sinkers.

6.4.4 End-sticks for nets

As already described in Section 6.1.3, the corpus of net fishing gear from the dwellings with Late Särnate Ware includes two wooden rods with spherical knobs at both ends, from Dwelling K (Fig. 54), interpreted as end-sticks, which could have been used on seines or on set nets.

6.4.5 Screens for fishing structures

As described in Section 6.1.5, four bundles of laths were found in the dwellings with Late Särnate Ware, which most probably can be interpreted not as fish-traps, but as rolled-up screens for fishing structures.

6.4.6 Lateral arms of eel clamps

Also described above (Section 6.1.6), are the four distinctively shaped objects identifiable as lateral arms of eel clamps, from Dwellings A_73K, G, K and N of this group (Fig. 62).

6.4.7 Fishing methods

The dwellings with Late Särnate Ware have produced a much greater diversity of fishing gear, compared with the dwellings with Early Särnate Ware. In some measure, this may be because we have a much larger sample of material from the dwellings of this group, but it may also indicate that a greater diversity of fishing methods were practiced during this phase of occupation, compared with the earlier phase.

In particular, as can be seen from the above sections, this group of dwellings has produced a much wider range of float forms, compared with the dwellings with Early Särnate Ware, which suggests that a wider variety of fishing nets were in use.

As regards the kinds of net fishing equipment used, it has to be said that most of the net components are non-diagnostic, in that they can be used on a variety of different kinds of nets. Most clearly indicative of a specific kind of net are the
relatively heavy end-notched sinkers. These were only suitable for use on some kind of stationary net or set net: a net placed across the path of the fish so as to entangle them (e.g. Fig. 54: 1). These were almost certainly 'gill nets', which consist of a simple wall of mesh, where the fish tend to be caught behind the gills.

The sinkers of set nets must be sufficiently heavy to hold the lower edge of the net on the bed of the fishing ground. However, as attested by Latvian ethnographic material, in many cases fairly light sinkers, such as wrapped pebbles, were used on stationary nets as well (Ligers 1942, 68; Cimermanis 1973, 135). Stationary nets in the collections of the Ethnographic Open-Air Museum of Latvia have a variety of sinkers (commonly pebbles sewn into cloth bags), which weigh less than 100 g. Thus, it is quite possible that the wrapped pebble sinkers from Sārnate were also used on gill nets. If greater weight was required, then this could be achieved simply by attaching such pebble sinkers to the footrope at more frequent intervals.

A need for heavier sinkers would have arisen when fishing in conditions with a strong current, i.e. in rivers or in the sea. This explains why the heaviest stone sinkers (c. 150–350 g) in the collections of the Ethnographic Open-Air Museum of Latvia and Ventspils Seaside Open-Air Museum are to be found on nets that were used for marine fishing. Likewise, large stone sinkers were used, for example, on stationary nets for salmon fishing on the River Kemi in Finland (Vilkuna 1975, Fig. 115). Thus, the relatively heavy end-notched sinkers from the dwellings with Late Sārnate Ware would appear to constitute evidence of marine or river fishing.

Unfortunately, no group of floats and end-notched sinkers has been found that might indicate a functional association between the end-notched sinkers and particular forms of floats.

In shallow waters, the headrope of a gill net should float on the surface and the footrope should be lie on the bottom, and the width of the net should exceed the depth of water, so that the net wall hangs loosely, increasing the likelihood of meshing the fish (Borne 1886, 161). A gill net is a much more selective kind of fishing gear than a seine, since the mesh size determines the size of fish caught in a gill net: in trying to swim through the mesh of netting which is a little smaller than the largest circumference of their body, the fish get stuck, usually caught behind the gills and unable to go forward nor backward (Brandt 1984, 355–356). For example, based on the mesh size, the Mesolithic net from Antrea Korpilahti has been interpreted as a gill net for bream or salmon (Pälsi 1920, 17–18; Sirelius 1934, 127).
It is important to note that gill nets can serve as passive or active fishing gear. In the former case, the net is set across the presumed route used by the fish and left there (generally setting in the evening and hauling the following morning). For active fishing, the net is set to surround a location where fish are likely to be (such as a clump of reeds or rushes) and, by beating the water surface with a paddle or with the kind of fish-driving implement discussed above, the fish are driven towards the net.

As discussed in Section 6.1.3, the end-sticks for nets are not so clearly interpretable. Like the end-notched sinkers, they could have been components of set nets for nearshore marine fishing. Or they might have been used on seine nets with towing lines known as ‘warps’. A seine generally consists of a net bag with two net walls, or ‘wings’, attached to it, one on each side (Fig. 54: 2). An end-stick, which stands vertically in the water (being weighted down at one end), is attached at the outer end of each wing. Tied to each end-stick is a towing line or ‘warp’ (Brandt 1984, 283–284). A seine is used to encircle an area of water where fish are thought to be present. Widely spread out to begin with, it is gradually drawn together by hauling on the lines, until finally the fish are forced into the bag. The seine may be hauled out on the shore, so that the fish are trapped between the seine and the shore, or else an area of open water may be surrounded from all sides. The seine is set by one boat or two, and then hauled from the boat(s) or from the shore, hauling both warps simultaneously. First the warps are hauled, then the wings and finally the bag with the catch (Ligers 1942, 95–97, Figs. 113–119; Seligo 1926, 63, 95–96; Vankina 1970a, 133; Brandt 1984, 284, 287).

Particularly suitable for seine nets, being less likely to become entangled in the mesh, are floats with rounded surfaces (Eglītis 1956, 343) – such as the oval floats provided for the net found in Dwelling A DA. Birch bark rolls could also have been used on seines.

The large floats perforated at one end could also have been used on seines. With one end of the float weighted down by the net, the free end rises above the water and becomes visible. Accordingly, such floats may be attached on seines at regular intervals between the ordinary floats, providing visible markers in order to coordinate the hauling of the two wings (Manninen 1931, 180).

Ethnographic data from Latvia and neighbouring countries indicate that small pebble sinkers in birch bark wrapping, of the kind found at Sārnate, were once widely used on seines. Manninen (1931, 205) has even observed that in Estonia, sinkers in birch bark wrapping occur only on seine nets, but not on stationary
nests. In Finland too, wrapped pebble sinkers (though differently wrapped and attached) were used on seines with a fine mesh (Sirelius 1934, 107). Wrapped sinkers securely fastened to the footrope at both ends have the advantage, compared with sinkers attached to the footrope by a band or string tied round the middle, that they are less likely to become entangled in the mesh or in vegetation, something that is particularly important for seining gear. Larger sinkers could also be attached to the end-sticks of the seine, to compensate for their buoyancy.

The pine and birch bark floats and wrapped pebble sinkers could also have been used on smaller-scale seining gear operated by wading fishermen, such as double-stick nets or pole seines (Brandt 1984, 285–286). It should be noted that the Särnate seine end-sticks are too short to have been used for such gear: if the stick is to be held when wading, it needs to be longer. Possible examples of longer end-sticks, up to 1.3 m long, and thus suitable for wading gear, have been found at Vis in northern Russia (Burov 1966, 162). Floats and sinkers of this kind could also have been used on ‘spiral nets’, towed (often by a wading fisherman) in a complicated spiral track in order to trap the fish in chambers created by the net wall (Manninen 1931, 145–151, 167–169; Sirelius 1934, 108–110).

The presence of bundles of laths, interpreted by the author as screens for fishing structures, points to the use of this kind of stationary gear during this phase of occupation as well. Such structures were presumably most important in summer, when aquatic vegetation would have impeded active fishing methods in shallow water-bodies such as the former Lake Särnate. The eel clamps, on the other hand, indicate that eel spearing was practiced, and this would seem to have been mainly a winter-time activity.

6.5 Fishing gear from the ungrouped dwellings
(Dwellings 6DR, 12DR, B, C, H, J, L, S, Zₐ, Unit K/M and Trench 1)

6.5.1 Floats

The dwellings that could not be included in any of the pottery groups have produced a total of 18 unperforated pine bark floats. Two of these dwellings, Zₐ un L, yielded comparatively large floats, all subrectangular with rounded corners and notched at the ends, some quite roughly worked (Fig. 72: 1, 2). The floats from Dwelling S correspond in terms of shapes and sizes to the floats of the
dwellings with Late Sārnate Ware. Overall, the unperforated bark floats from the ungrouped dwellings show a considerable variation in length and width (Fig. 73).


In addition, from Unit K/Mp there is a large pine bark float perforated at one end (Fig. 50, 5), while Dwelling L has yielded a very unusual float, approximately hexagonal or rhombic, with a large rhombic perforation in the centre (Fig. 51: 5). The dwellings of this group have also produced two birch bark rolls.
6.5.2 Sinkers

There are 36 unworked pebble sinkers from dwellings of this group, none of them with preserved bark wrapping. In fact, the great majority of these come from a cluster of pebbles (originally about 40 in number, 31 of which were collected) found in Dwelling 12 Dir.\(^1\)\(^{101}\) evidently either representing the remains of a single net or else a stock of prepared material (Vankina 1970a, 85). The pebbles of this cluster are light compared to those from the dwellings with Early and Late Särnate Ware, weighing only 14–36 g (mean weight: 22.8 g).

There are also 26 end-notched pebbles from the ungrouped dwellings, 13 of them from Dwelling Z\(_{a}\) and eight from Dwelling L. Three side-notched pebbles were also found. Another eight end-notched and one side-notched sinker were collected as stray finds from the site.

---

\(^{101}\) A 11580: 17.
6.5.3 Screens for fishing structures

The bundles of laths interpreted by the author as screens for fishing structures, described in Section 6.1.5, include a relatively well-preserved example found in the area between Dwellings K and M₁₉, and a similar find from Dwelling S.

6.5.4 Fishing methods

The finds from the ungrouped dwellings indicate the use of nets, including stationary nets with relatively heavy end-notched sinkers, and fishing structures consisting of lath screens. Of course, the dwellings considered in this section are not regarded as representing a group sharing cultural traditions, so there is no basis for using the evidence to reconstruct a fishing ‘toolkit’.

6.6 The development of fishing methods

The net fishing gear from Särnate does provide some idea of the course of development of fishing gear in this area, although the uncertainty regarding the chronological relationship between the phases when the site was occupied by the makers of Comb Ware and the makers of Early Särnate Ware, and the differences in preservation conditions in the dwellings of the different groups, are both factors that cloud the picture.

Since no organic material was preserved in the dwellings with Comb Ware, the only evidence of fishing gear is in the form of unworked and end-notched pebble sinkers. The former may have been used on a variety of net fishing gear, while the latter, only represented by four examples, cannot be regarded with certainty as belonging to the material from these dwellings. We may note the relatively common occurrence of unworked stones in the dwellings of this group: perhaps some of these were in fact sinkers for fishing gear.

The only floats from the dwellings with Early Särnate Ware are small, rectangular pine bark examples notched at the ends and birch bark rolls, while the sinkers found here are mostly small (wrapped) pebbles. These small floats and sinkers are not diagnostic in that they could have been used on a variety of gear: seines, double-stick nets, spiral nets or gill nets. However, the restricted range of float and sinker forms suggests that only a limited range of net fishing gear was used.
The dwellings with Late Sārnate Ware display a much greater diversity of net fishing components, including a particularly wide variety of forms and sizes of pine bark floats. Although the floats are not diagnostic of particular kinds of fishing gear, the greater diversity, compared with the floats from the dwellings with Early Sārnate Ware, can in itself be taken as evidence that a wider range of fishing gear was in use.

On the other hand, some elements of the fishing ‘toolkit’ remained virtually unchanged. The unperforated floats from the dwellings with Early and Late Sārnate Ware and the ungrouped dwellings are fairly similar in size, and would all have been comparable also in terms of the buoyancy they provided. Such a pattern suggests that the fishing gear used throughout this period involved only one main functional class of unperforated float of a certain approximate size and buoyancy and that these basic functional requirements did not change appreciably over time.

Likewise, the continued use of pebble sinkers of similar weight suggests that the functional role of such sinkers in the fishing gear used by the occupants of both groups of dwellings were similar.

The overall impression is that although there are elements of continuity, the net fishing gear used during the Late Sārnate Ware phase of occupation was more diverse than that employed by the previous residents at the site. This might indicate that net fishing was growing in importance relative to other fish-catching methods.

The wider use of comparatively heavy end-notched or side-notched sinkers in the latter part of the Neolithic in at least two locations along the Baltic coast – Sārnate in Latvia and Šventoji in Lithuania – may reflect changes in fishing practices at the regional level. Such sinkers would have been more suited for gill nets used in rivers or in the sea, so their spread might be connected with the placing of gill nets across rivers, or else with the development of coastal marine fishing.

The presence of finds interpreted as the remains of lath screens for fishing structures in the dwellings with Early Sārnate Ware and in those with Late Sārnate Ware suggests that fishing structures in the form of barriers or enclosures remained in use throughout these two periods. The fact that arms from eel clamps were found only in the dwellings with Late Sārnate Ware could be significant, but could also be a chance pattern, considering the small number of such finds.

Bearing in mind the large proportion of seal bones among the faunal remains, the possibility should be considered that nets were also used at Sārnate for seal
hunting. In historical times, seals were caught in various kinds of stationary nets with a large mesh size, placed next to rocks in the sea, in marine straits or rivers. It is known that in Estonia and Finland, seal nets, although anchored, were not provided with sinkers: they were instead fitted with long, narrow floats, which became entangled in the mesh when the seal struggled in the net, thus binding the animal even more tightly (Manninen 1931, 79–80; Sirelius 1934, 91–92). Seal nets used in Sweden were anchored with heavy stone sinkers (Broadbent 1979, 128). A Late Neolithic complex of net finds at Tuorsniemi near Pori in western Finland, and likewise the lines of heavy stone sinkers (generally 600–800 g) in a former marine inlet near Lundfors in northern Sweden have been interpreted as evidence of seal-netting (Kauhanen 1974, 37; Forstén & Alhonen 1975, 153; Broadbent 1979, 128, 188, Figs. 57, 80).

Among the net floats and sinkers from Särnate, there are no forms indicative of seal nets in particular, but it is not impossible that the largest floats and likewise the heaviest sinkers served this purpose. Among the seal bones from Särnate, a large proportion belong to ringed seal (*Phoca hispida*), a species that migrates into rivers and lakes (Lõugas 2002, 51), where its path could conceivably have been blocked with nets.

Nets were also used in the region in the recent past for catching waterfowl and beavers, so it is possible that some of the net components at Särnate relate to nets used for these purposes.

Finally, it should be noted that, although the net fishing gear from Särnate includes various materials, technical approaches and forms that are familiar from ethnographic material, it would not be correct to describe this fishing gear as analogous to the gear used in this region in recent times. Precise analogies have not been found in later archaeological or ethnographic material from Latvia for such common artefact forms from Särnate as the unperforated pine bark floats or end-notched sinkers. Thus, for example, the floats found in the early medieval villages of Riga represent entirely different forms (see Caune 1992, 147–150). Although there are features in common with later fishing equipment, nevertheless the characteristics of the fishing gear from Särnate evidently reflect both the traditions specific to the Neolithic of this region, and adaptations to the particular conditions in the fishing grounds exploited from the site.
7 Hearths

The location of many of the dwellings at Sārnate was betrayed by sandy patches in the peat soil – which proved in the course of excavation to be hearths. In fact, these hearth remains turned out to be of an unusual kind: although only sand and charcoal were seen near the ground surface, excavation revealed that many of the hearths included structural layers of wood and bark, in some cases preserved very well in the anaerobic environment. In the further course of excavation at Sārnate, attention focussed on these features. While the stratigraphy in the dwellings was generally fairly simple, the complicated, multi-layered hearth structures demanded careful excavation and recording.

Šturms (1940, 44–47) published the first description of one of the well-preserved hearths, in Dwelling F. Vankina (1970a, 19–85, 127–129, 131) describes each hearth separately in her treatment of the dwellings, as well as giving a very brief summary of the characteristics of the hearths in her discussion of the house remains. The Sārnate hearths have also been discussed in the general context of Neolithic archaeology by Zagorskis (Latvijas PSR arheoloģija 1974, 30) and Loze (1978, 9; 2001b, 87–88).

However, the documented evidence of hearth remains at Sārnate has never been subject to detailed examination. The intention behind the present study is to bring together all the data obtainable from the original excavation reports concerning these features: textual descriptions, plans, sections and photographs (Šturms 1938–40; Vankina 1950; 1969; 1970b–f; 1971), in order to better understand the general patterns of hearth construction and assess the functional role of these structures.

It is calculated that in the excavations by Šturms and Vankina, a total of 46 hearths were uncovered, 30 of which had at least some preserved remains of organic structural layers (Appendix 7, Table 20). The hearths have been grouped according to the groups of dwellings identified on the basis of the pottery, first seeking to discover the general patterns of hearth construction and use within each cultural group and undertaking a comparison between groups.

As can be seen from Table 20, the data on the hearth remains is very patchy, something that reflects differences in the state of preservation of the features, as

---

102 Considered as hearths in this study are only those features whose function is indicated by evidence of burning or by diagnostic structural evidence. By contrast, in the excavation records, the sand layers of the dwellings are often described as hearths even in cases where the hearth actually represents only one part of the sand layer, or in cases where there is no recorded evidence of burning.
well as inconsistency in the standard of documentation. The stratigraphy of the hearth layers generally began at the ground surface or just below it, and in many cases the original hearth sequence had evidently been truncated. Near the surface, the organic layers had dried out and decayed, and in the cultivated parts of the site they had also been disturbed by ploughing. The dimensions given for the layers of wood and bark are approximations, since in many cases the layers were only partially preserved. The original dimensions of the sand layers of the hearths were particularly hard to gauge: the outlines had in many cases become blurred, the sand having spread across a wider area during the time of occupation or through later disturbance.

Only a minority of hearths were clearly associated with house remains, providing confirmation that they were indoor features. In the majority of cases, since building remains were absent or scanty, it is impossible to categorise the hearths as indoor or outdoor features. At the same time, in view of the size and substantial construction of the hearths themselves, a large proportion (if not all of them) can evidently be regarded primarily as indoor heating facilities.

The orientation of the hearth structures and their alignment in relation to the building remains are not discussed in this chapter: this theme, which relates to spatial structure at the site level, is covered in Chapter 8.

### 7.1 The hearths of the dwellings with Comb Ware (3, 5, 6ZA, 8 and 15DR)

In Dwellings 3, 5, and 6ZA, charcoal or ash was observed in the central part of the extensive dwelling sand layer, indicating the location of a hearth (Fig. 74; Vankina 1970a, Figs. 136, 140, 141). Pottery classed as Comb Ware is also associated with certain more limited layers of sand that have evidence of burning (Dwellings 8 and 15DR): in these cases, the sand layer is apparently restricted to the location of the hearth, rather than extending over a larger part of the dwelling. Charcoal or ash are also known to have been present in Dwelling 4, but in this case there is no clear indication of the position of the hearth. There is no recorded evidence of hearths in Dwellings 1, 7, 10, 12ZA, although the absence of such evidence may simply be due to non-preservation or omissions in the documentation.

On this low-lying, wet site, the layer of sand evidently provided a more pleasant, drier living floor than the peaty soil. As a foundation for the hearth, the sand layer would have been of particular importance for insulating the fire from
the peat and thus giving some protection from damp. On the other hand, in periods of dry weather when the ground-water level would have fallen (and especially for indoor hearths, where the peat receives no moisture directly from precipitation), the insulation provided by the sand layer may instead have served a fire safety role, namely to offset the danger of igniting the underlying peat (Apals 1996, 21). Apart from the significance of the sand layer as a barrier to moisture or heat, it would also have functioned as a heat reservoir, releasing the heat gradually to the indoor space for some time after the fire had died down, i.e. having a heat-storage role analogous to that of stones in the stone-lined hearths that are often found on sites of various periods. Although there is no actual evidence of structural arrangements of stone in the hearths at Särnate, it may be noted that while stones are generally very rare in the hearths of the other groups, described below, the hearths of the Comb Ware dwellings did have greater numbers of stones associated with them.

![Fig. 74. Schematic plans of Dwellings 3 and 5, showing the extent of the dwelling sand layer and the spread of charcoal and ash at its centre.](image)

It is important to note that, since the conditions in this part of the site were not such as to permit the preservation of organic remains, it is impossible to tell whether the structure of these hearths also included layers of wood and bark, such
as were found in the dwellings with Early and Late Šárnate Ware, described in the following sections.

The dimensions of the Comb Ware hearths are very hard to gauge: if the spread of charcoal and ash within the extensive dwelling sand layers is any guide, then we have hearths of very diverse extent: 1.2×1.0 m in Dwelling 6ZA, 4.0×1.4 m in Dwelling 5 and an area as great as 6×2 m in Dwelling 3. If the more limited sand layer 15DR represents the hearth itself, then in this case we obtain an extent of 2.4×2.0 m.

7.2 The hearths of the dwellings with Early Šárnate Ware (D, E, IZ, M0, M2A, M2R, P2, RZ, R1-3 and W)

Twelve hearths were excavated in the dwellings that produced pottery classed as Early Šárnate Ware. Several of the dwellings in this group had preserved structural remains in the form of posts and stakes, and in all cases the structural remains were associated with at least one hearth, with the exception of Dwelling IZ. In the case of this dwelling, the absence of hearth remains might be explained in terms of incomplete excavation of the house: on the south-western side, the structural remains seem to continue beyond the limits of the trench (Fig. 85). As regards Dwelling 2, which had no organic preservation, charcoal and ash are mentioned as present in the sand layer, but the location of the hearth is not determinable.

Four of the hearths consisted simply of a sand layer with an admixture of charcoal. In these cases, as with the Comb Ware hearths, it is impossible to say whether the original hearth structure also included layers of wood and bark. There might also have been simple sand hearths, without wood or bark layers, but equally plausible is the idea that the organic layers had simply decayed completely.

The remaining eight hearths had at least some remains of structural layers of organic materials – sheets of bark and wooden poles or laths. In the hearths with organic preservation, the base of the hearth is recorded as lying at a depth of 0.4–0.6 m from the ground surface. In most cases it is unclear whether there was a pit at the bottom of the hearth: the presence of a pit is confirmed in two cases, and only in one case is it clear that there was no pit. One of the positive cases, the hearth of Dwelling M0, had been built over two separate depressions: a larger, deeper pit in the south-eastern part, and a smaller, shallower one in the north-
eastern part. Five adjacent stakes had been driven into the peat along the western edge of the larger pit, but their significance remains unclear.

![Fig. 75. Plans of the hearth of Dwelling E, showing the topmost bark layer (left) and the overlying sand layer delimited by poles (right) (Vankina 1970a, Fig. 23).](image)

In the lower parts of the hearth stratigraphies, various sequences of layers can be identified as constituting the hearth foundation. The hearths of dwellings M₁ and M₂ had branches at the base, covered by a layer of birch bark. The foundation of the hearth of Dwelling E consisted of three parallel poles, covered by a spread of laths, which in turn was overlain by a sheet of bark, the grain of the bark oriented perpendicularly to the poles. The hearths of Dwelling M₂A and W both had a single large log at the very bottom, with a layer of sand covering it. (In the hearth of Dwelling W, a layer of bark was found overlying this sand layer.) The hearths of Dwellings D and R₂ had no wooden foundation structure: in these cases, a bed of sand had been laid down directly on the peat and was overlain by bark. (Since these hearths had preserved organic remains in the overlying layers, wooden foundation structures would also have been preserved, had they been present originally.)

Thus, in all these cases, there was a basal structure providing better drainage under the hearth (poles/branches/sand), overlain by a layer of bark (measuring from 1.8×0.8 m up to 2.4×1.4 m), the latter serving as a dense, damp-proof layer, insulating the overlying hearth layers from soil moisture. Above the bark, a bed of sand was laid down (with an area of between 1.4×0.9 m and 4.0×2.6 m; 0.04–0.2
m in thickness), on which the fire was lit. Difficult to interpret in practical terms is the basal structure of the hearths of Dwellings M ZA and W, where sand covered a single large log.

The recorded stratigraphy shows that at least five of these hearths had been renewed with the addition of new layers. The hearths of Dwellings M ZR and W had a new bark layer and sand layer added on top of the preceding sand layer. (Several episodes of this kind are indicated by the stratigraphy of the hearth of Dwelling W.) The hearths of Dwellings E and M D had a complete set of new layers added: a spread of poles, a layer of bark and a layer of sand (Fig. 75). The sequence of layers in the hearth of Dwelling D ended with a spread of poles, which seems to represent the initial layer of another set of hearth layers – presumably, the overlying layers had been destroyed.

Apart from the wooden structures described above, there is also evidence that, in certain cases at least, the bed of sand had been delimited by logs or poles placed along the sides and end, forming a rectangular hearth area. Remains of such a structure, with poles along three sides of the sand layer, were present in the topmost sand layer of the hearth of Dwelling E (Fig. 75).

Constituting a distinctive kind of structural layer are the spreads of long wooden laths, presumably of pine wood, found in two hearths of this group (Fig. 76). In the hearth of Dwelling E, such a spread of laths (measuring 1.1×0.9 m) seems to have formed part of the hearth foundation, while in the hearth of Dwelling M D a similar layer (1.2×1.2 m) seems instead to have constituted the lowermost layer in a set of layers laid down in the course of hearth renewal. As described in Section 6.3.3, the utilisation of laths in the hearth structure is almost certainly an instance of the secondary use of worn-out fishing gear.

The hearths of Dwellings M ZR and M D shared another characteristic feature: they both included layers of birch bark. Birch bark is not recorded in any of the other hearths. Evidently, the bark of other, less readily identifiable tree species was generally used. Vankina (1970a, 135) mentions that long sheets of lime bark were found in several dwellings, but does not actually state that the bark of the hearth layers was lime.
7.3 The hearths of the dwellings with Late Sārnate Ware
(AZAD, AZAZ, ADAA, ADAR, F1–3, G, K, N, O1–3, P, T, U, X, Y and Zb)

In this group of dwellings, all the house remains indicated by posts or stakes also had associated hearths. Out of 19 hearths altogether, all but three had at least some evidence of organic structural layers. Depths of 0.4–0.95 m are recorded for the base of hearths with organic preservation (Appendix 7, Table 20).

At least seven hearths had been constructed over a pit, and another two had been constructed on level ground (Fig. 81), but in most cases it is not clear whether there was a pit. Similarly to the hearth of Dwelling M0 in the previous group, the pit under the hearth of Dwelling K had stakes along the edges.103

103 The case of Dwelling N is somewhat equivocal: there was a circular pit at the eastern end of the hearth, filled with charcoal and ash, its base lined with bark, but it is not clear whether this should be regarded as the basal pit of the hearth, or as a separate structure. In the pit was a fragmented pottery vessel, interpreted as possibly having collapsed in the course of cooking.
Fig. 77. The raft of longitudinal logs at the base of the main hearth of Dwelling F (F1). In the foreground is a spread of short transverse timbers underlying the logs, perhaps serving to provide additional support on one side (Šturms 1938–40, Fig. 28).

Fig. 78. The main hearth of Dwelling F (F1): the spread of transverse logs of the initial hearth sequence (Šturms 1938–40, Fig. 26).
Various hearth foundation sequences were encountered, generally beginning with a basal raft of logs or poles. In the hearths of Dwellings A_{DA} and X, and Hearth F_1, this foundation raft consisted of parallel poles or logs oriented in the direction of the long axis of the hearth. (On the north side of Hearth F_1, the raft of longitudinal logs was underlain by a spread of short, transversely oriented timbers. See Fig. 77). In the hearth of Dwelling A_{DA} and Hearth F_1, these longitudinal timbers were overlain by a regular spread of poles oriented transversely to the long axis of the hearth (Fig. 78), while in the hearth of Dwelling X the foundation raft was covered by an irregular layer of bark and branches.

![Fig. 79. Basal timbers and stakes of the hearth of Dwelling T (Vankina 1970a, Fig. 101).](image)

The hearths of Dwellings A_{ZAD}, N and T had an irregular basal structure: in these cases, the timbers (as well as stumps and roots) constituting the basal raft showed no particular orientation (Fig. 79). In the hearths of Dwellings A_{ZAD} and T, this layer was overlain by a layer of bark, while in the hearth of Dwelling N, the overlying stratigraphy was unclear. The hearth of Dwelling Y had at its base a tree trunk 15 cm in diameter with roots still attached, on top of which pieces of bark had been placed irregularly.

Regardless of the mode of construction employed in particular cases, the purpose of this basal raft of relatively long timbers was evidently to spread the weight of the hearth structure, so as to prevent it sinking into the peat. The first
bark layer on top of the basal timber raft (Fig. 80) was generally followed by a layer of sand, on which, evidently the fire would have been lit.

Somewhat different is the foundation of the hearth of Dwelling K: in this case, the hearth pit had been lined with bark, overlain by a thick bed of sand.

Preserved directly under the structures of several hearths were the lower parts of vertical or sloping stakes (Figs. 79, 81). Šturms suggests that the basal timbers of the structure were built on stakes to prevent it sinking into the peat (Šturms 1940, 46).

Preserved in several hearths of this group, as in some of the hearths of the dwellings with Early Sārnate Ware, were sets of layers representing hearth renewal phases (Figs. 79, 81). In many cases, there was a simple set of new layers: the previous sand layer had been covered by a layer of bark and then a new bed of sand. Nine such sets of bark and sand layers have been identified altogether (A,D,B, A,D,A, F, G and Y). Also observed were complete sets of renewal layers, consisting of a new spread of poles, a new bark layer and a new bed of sand. A total of eight such sets of timber, bark and sand layers were identified, represented in the hearths of Dwellings K, N, T, X and Y.

Fig. 80. The main hearth of Dwelling F (F1): the bark layer of the initial hearth sequence, with logs delimiting the hearth (Šturms 1938–40, Fig. 24).
Greater numbers of hearth renewal phases were observable in the hearths of this group, as compared with the hearths of the dwellings with Early Särnate Ware. Thus, two hearths had been renewed at least once, three had been renewed twice, and three had been renewed three times. It should be emphasised that the observed number of hearth renewal phases indicates only the minimum number of episodes of hearth renewal. In the first place, since the uppermost sand layers of the hearths were visible already at the ground surface, it is quite possible that there had once been more layers on top – layers destroyed by desiccation and ploughing. Since the dwellings of this group had the most favourable conditions for organic preservation, it is quite logical that the hearths of this group should have had greater numbers of preserved wood and bark layers. Secondly, almost invisible archaeologically are possible episodes of hearth renewal where, in advance of laying down a new set of hearth layers, part of the previous sequence was removed or destroyed. For these two reasons, it seems that the observed numbers of hearth renewal phases cannot serve as any guide for comparing different hearths in terms of the true number of renewal episodes (and thus comparing the duration of use of the hearths).

Rafts of longitudinally or irregularly oriented timbers were observed only in the hearth foundations: the spreads of timbers overlying the foundation rafts, and likewise the spreads of timbers belonging to the hearth renewal sequences, all consisted of parallel poles laid transversely in relation to the long axis of the hearth. These poles generally did not exceed a diameter of about 10 cm. They were 1.1–2.0 m long, sometimes placed close together, but most commonly arranged in the manner of ‘ribs’, separated by intervals of up to about 0.3 m.

The hearth sequences in this group of dwellings included a large number of well-preserved bark layers, of which the more completely preserved examples were rectangular or almost square in outline. As in the hearths of the previous group, these bark layers covered a fairly large area: in nine hearths where the approximate original dimensions of the bark layers could be determined, the largest of these layers measured between 1.2×1.0 m and 3.4×1.6 m. Generally, the sheets of bark were aligned with the direction of the grain parallel to the long axis of the hearth. Sometimes, transversely oriented bark sheets were observed, and occasionally there were bark layers with no consistent orientation. Also noted were sheets of bark that served as ‘patches’ to repair an earlier layer.

The most extensive sand layers in the hearths of this group, oval or irregular in outline, measured between 1.8×1.8 m and 4.6×2.6 m. The records indicate that they varied greatly in thickness: from 3 cm up to about 25 cm. In fact, in most
cases there is no information about the thickness of the sand layers, but it seems that all of the sand layers in the middle part of the hearth sequences, i.e. those belonging to sets of hearth renewal layers, were relatively thin. Thicker sand layers seem to have been found only in the uppermost parts of the hearths – where the original organic layers may have been destroyed, leaving behind what now presents itself as a continuous thickness of sand – and in certain cases (Dwelling K) at the base of the hearth.

In Hearth F, at least one of the sand layers was delimited on all four sides with logs (Fig. 80, with sand layer removed). This feature is similar to the above-described example from Dwelling E of the previous group.

Fig. 81. Cross-sections of the hearths of Dwellings X, Y and K (Vankina 1970a, Figs. 107, 116, 48).
7.4 The hearths of the ungrouped dwellings (6_{DR}, 12_{DR}, 14, C, H, J, L, P_c, S, V and Z_a)

There were ten hearths in the dwellings that were not classifiable on the basis of pottery into any of the main groups, six of them having preserved organic layers. One of these, the partially excavated hearth of Dwelling C, appears to show the features observable in the hearths of the Late Särnate Ware dwellings: a basal raft of longitudinal logs, followed by a spread of transverse poles and a bark layer.

The other hearths of this group do not display features clearly linking them to any of the main groups. In four cases, the stratigraphy was not entirely clear. The presence or absence of a hearth pit could not be determined for any of the hearths. Only the hearth of Dwelling V is recorded as having a pit at its centre, filled with fish and mammal bones, but it is not clear whether this should be regarded as part of the hearth structure.

There is no record of hearth remains in the sand layer of ungrouped Dwellings 6_{DR}, 12_{V} and 15_{ZA}. From Dwellings 9, 11 and 13 there are charcoal samples, but no recorded evidence of the location of the hearth itself.

7.5 Comparison of the hearths of the different dwelling groups

As implied in the above accounts, the apparent differences between the hearths belonging to the different groups of dwellings are largely explicable in terms of differences in preservation conditions. Organic materials, and thus also hearth layers of wood and bark, were best preserved in several of the dwellings with Late Särnate Ware. The hearths in the Early Särnate Ware dwellings would seem to have been very similar in terms of the general structure and sequences of layers, but in this group none of the hearths were so well preserved.

As already explained, since organic remains were not preserved at all in the dwellings with Comb Ware, the original structure of these hearths cannot be determined. It is quite possible that the hearths of this group also had layers of wood and bark, which have decayed completely. Some of the hearths of the other two groups of dwellings were likewise devoid of organic remains, and in those cases where the conditions in the respective dwelling did not favour the preservation of organic matter, it remains an open question whether these were simple sand hearths, or hearths with layers of wood and bark. It may be noted that none of the dwellings with well-preserved organic remains had a hearth consisting
of a sand layer only, so it is possible that simple sand hearths were not actually used on the site at all.

If we discount the differences explicable in terms of preservation conditions, certain characteristics remain that are specific to the hearths of particular groups of dwellings. Thus, stones associated with hearths are common in the Comb Ware dwellings, but are generally rare or absent in the two Särnate Ware groups. It seems that the Comb Ware residents were making more use of stones, presumably utilising the heat-retention possibilities of rock. It could also be that the stones were used to support cooking pots over the fire or to line the perimeter of the hearth.

Although the two groups with preserved organic hearth layers show the same general patterns in the sequences of upper hearth layers, i.e., bark-sand or pole-bark-sand, certain constructional features may be identified that are apparently specific to one or other group. Thus, layers of wooden laths and birch bark seem to be restricted to the Early Särnate Ware group, while basal rafts of longitudinally oriented logs are recorded only in some of the Late Särnate Ware hearths.

As described above, for several of the Comb Ware and ungrouped dwellings we have no indication of the location of the hearth, and for some dwellings in this group charcoal or other evidence of burning is not mentioned in the documentation. On the other hand, there are no dwellings with house remains in the form of posts and stakes, but without a hearth: the only possible exception is Dwelling IZ, and, as already suggested, this case can be explained in terms of incomplete excavation of the house.

7.6 The hearths in use

The cooking experiments undertaken in collaboration with Baiba Dumpe, utilising replicas of pots from Särnate and a hearth reconstructed after the general features of the well-preserved hearths in the dwellings with Late Särnate Ware, revealed the effectiveness of cooking methods where the pointed base of the pot is supported in the bed of sand of the hearth and the fire stoked up around it (Section 5.7.9.3). The experiments also revealed the importance of the bed of sand as a heat reservoir: it not only kept the contents of the vessels warm for a long time after the fire has died out, but – more importantly – would no doubt have had an important role in heating the indoor space.
In many cases at Sārnate, it was observed that the bark and wood layers were charred at the centre of the hearth – evidently the spot where the main fire had been lit. The presence of a number of charcoal concentrations in one layer of the hearth of Dwelling ADR seems to suggest that several small fires might have been lit at the same time – perhaps several cooking fires (Fig. 82). Certainly, a hearth of this size offers the possibility of having several fires going simultaneously (compare with Fig. 46).

The impressive dimensions of the Sārnate hearths and the effort and care applied in constructing them suggest that heating the house would actually have been their main function, and this would seem to imply that the Sārnate dwellings were occupied during the winter. It is possible that the layer of sand served not only as the location of the fire, i.e. as the hearth proper, but partly also as a living space: the sand layers of at least some of the hearths seem large enough to permit the residents of the house to sit or sleep at the periphery, particularly in cold weather, even when there was a fire going at the centre of the hearth.

Fig. 82. Plan of the hearth of Dwelling ADR, showing several charcoal concentrations. (Vankina 1970a, Fig. 9).
The evidence of hearth renewal in the better-preserved hearths suggests that they remained in use for a long time, presumably for many years. Various circumstances may have prompted renewal of the hearths: decay or charring of the wood and bark, sinking of the hearth structure into the peat under its own weight (Šturms 1940, 45), and possibly also the increase in thickness of the occupation layer around the hearth, which may have necessitated raising the level of the hearth structure.

7.7 Parallels in the region

Possible parallels for the Sārnate hearths with layers of wood and bark have been identified at the sites of Osa and Piestiņa in the Lubāns Lowlands. At the Osa site, discovered at the top of the cultural layer was a round hearth measuring 0.8 m in diameter, formed of sand, bark and stones. In the hearth was a crushed Early Neolithic pottery vessel (Latvijas PSR arheoloģija 1974, 30). On the Piestiņa site, the base of a possible hearth site (no charcoal or charred wood was actually found) consisted of a small area of sand, which had been covered in a spread of sticks and bark, on top of which there were small burnt stones and an extensive concentration of Piestiņa Ware sherds (Zagorskis 1965a, 11–12; Zagorskis 1965b, 36).

The rarity of such features on early prehistoric sites might in fact partly be accounted for by non-preservation. Thus, it is entirely possible that layers of wood and bark, for drainage and damp proofing, were actually quite common in hearth structures on sites with a high groundwater level. However, such hearth structures have been preserved only where anaerobic conditions have continued to exist up to the present day.

7.8 Wood charcoal analysis

The environmental samples preserved from Vankina’s excavation include nine wood charcoal samples from the hearths. In order to examine patterns of wood use at the site, sub-samples of this material were taxonomically determined on the basis of microscopic wood anatomy, and the original diameter of the wood was estimated (Appendix 9, Table 22).

A total of 152 charcoal fragments were identified in these samples, representing seven different wood taxa:
- *Alnus*, i.e. black alder (*Alnus glutinosa* Gaertn.) or grey alder (*Alnus incana* DC.);
- *Betula*, i.e. silver birch (*Betula pendula* Roth.) or downy birch (*Betula pubescens* Erh.);
- *Fraxinus*, i.e. *Fraxinus excelsior* L., ash;
- *Pinus silvestris* L., Scots pine;
- Pomoideae, i.e. rowan (*Sorbus aucuparia* L.), hawthorn (*Crataegus* sp.), wild apple (*Malus silvestris* Mill.) or wild pear (*Pyrus communis* L.);
- *Populus / Salix*, i.e. aspen (*Populus tremula* L.) or willow (*Salix* sp.); and

Alder (*Alnus*) is by far the most common taxon, occurring in all nine samples and constituting the great majority of identified fragments. Considering the site setting – on the boggy shore of a lake – it may be safely assumed that this is black alder. The division, based on curvature of the growth ring boundary, into five ‘diameter classes’, which gives some indication of the original diameter of the timber, suggests that the charred alder consisted mostly of timber originally at least 5 cm thick, i.e. poles or logs.

Birch, pine and lime were also present in two or more samples, the remaining taxa occurring only in one sample each. The lime charcoal, like the alder, represents large-diameter material. In contrast, the pine charcoal comes from small-diameter material, less than 3 cm in diameter. The diameter evidence for the remaining taxa is insufficient to offer any interpretation.

Various factors complicate the interpretation of this evidence, quite apart from the small numbers of identified fragments per sample. Since these samples all derive from dwellings that could not be assigned unequivocally to any of the groups distinguished on the basis of the pottery assemblages, they can only give a general picture of fuelwood use, and cannot provide information about the pattern of fuelwood use for any one particular phase of occupation.

Another problem, but one that also raises some interesting possibilities, is that we cannot be sure all the charcoal actually derives from the wood used as fuel, rather than from the structural material of the hearths. Since we know from the hearths with organic preservation that a large proportion of the hearths on the site, if not all of them, had layers of bark and wood as part of the structure, and we know that these layers tended to become charred in the central part of the hearth, it is entirely possible that at least some of the charcoal in the samples derives from the hearth structure, rather than from the fuelwood. The frequent
occurrence of bark fragments among the charcoal suggests that this is in fact the case.

Considering the taxonomic and size evidence, it seems that the fragments of charcoal from small-diameter pine can safely be regarded as deriving from the fuel, i.e. kindling or brushwood. Among the other taxa, perhaps the large-diameter alder, birch and lime can be thought to represent fuelwood billets. The charcoal from medium-sized timber or timber of indeterminable size could derive from the fuel, or from spreads of rods belonging to the hearth structure, or a mix of both.

In conclusion, it seems we can say that twigs and small branches of pine were used for kindling, with alder and birch, and perhaps also lime, providing logs for the fire. This does make sense in that alder and birch at any rate are good fuel woods. Considering the site location, it would indeed be very surprising if black alder were not one of the main fuelwood species.

Aside from the interpretive difficulties, the frequent occurrence of charred bark in the samples suggests that these hearths may also have had layers of bark, layers that have decayed completely, and may very well have been similar in construction to the hearths of the dwellings with Early and Late Särnate Ware that had well-preserved structures of bark and wood.

In fact, the issues discussed here are relevant at a wider scale: it is possible that hearths with layers of wood and bark were built at other early prehistoric sites as well, particularly at sites in low-lying, wet locations. In conditions with little or no organic preservation, the frequent occurrence of charred bark fragments might be the only indication that such structures were once present. At the same time, when interpreting wood charcoal evidence from hearths at sites of this kind, it is important to bear in mind that some of the charcoal could derive from the hearth structure itself, rather than the fuel.
8 House remains and spatial structure

Covered in this chapter are the structural remains, apart from the hearths, discovered in the dwellings at Sārnate. Utilising this evidence, as well as the data on the alignment of the hearths and the records of the distribution of tools, raw materials and processing debris within the dwellings, site-level and dwelling-level spatial structure is examined. As with the study on hearths, the main sources for this chapter are the original excavation reports.

In keeping with the structure of the preceding chapters, each group of dwellings is considered in turn, closing with a comparison between the groups and a brief examination of comparative evidence from other sites in the East Baltic. Comprehensive spatial analysis has been undertaken on a set of seven dwellings with Late Sārnate Ware that provide the best data for such a study. Briefly treatment only is given to the evidence regarding spatial structure obtained from the remaining dwellings, since this is much scantier.

8.1 House remains and spatial structure in the dwellings with Comb Ware

8.1.1 House remains

The remains of the dwellings with Comb Ware took the form of artefact concentrations associated with sandy layers in the peat very near the ground surface that sometimes formed low mounds. In five cases, the location of the hearth could be distinguished within the sand layer (Section 7.1). As described in earlier chapters, the upper part of the peat had dried out, and so virtually no organic remains were preserved in these dwellings.

The sand layers, which were oval, circular or irregular in plan, varied considerably in extent and thickness. Thus, Dwelling 3 had an oval spread of sand covering an area as large as 12×6 m, with a maximum thickness of 30–35 cm, while the approximately oval sand layer of Dwelling 5 covered an area of 9×6 m, with a maximum thickness of 20–25 cm (Fig. 74; Vankina 1970a, Figs. 136, 140). The sand layers of the other dwellings were less extensive: 7×4 m (Dwelling 4), 5×5 m (Dwelling 6ZA) and 4×3 m (Dwelling 8). The sand layers of Dwellings 7, 10 and 12ZA were incompletely excavated. Most of the dwellings had thin sand
layers, and in some cases there was only a poorly-delimited area where the peat showed an admixture of sand.

Vankina (1970a, 126) interprets these remains as indicating “light circular or oval structures with a conical or cupola roof”. She considers that these dwellings, located on a slight rise (about 0.2–0.6 m above the other dwellings, according to a topographic plan of the site), were on firmer ground, obviating the necessity for the supporting posts of the superstructure to be driven deep into the peat, for which reason there are no preserved remains of posts. In fact, the tip of a single post was found, in Dwelling 7. This situation presents a marked contrast with the dwellings with Early and Late Sārnate Ware, many of which had posts driven through the peat into the underlying strata (see Section 8.3.1).

However, Vankina’s interpretation of the Comb Ware dwellings as light structures without deep posts should perhaps not be accepted without reservation. Since the occupation layer in the Comb Ware dwellings was generally very thin, the depth of excavation was also shallow, only reaching about 45–70 cm (Vankina 1970a, Figs. 136, 140, 141). It is recorded that after the occupation layer of Dwelling 3 had been removed, the peat underneath was excavated as well, to check for any stakes that might be preserved, but no such remains were found. Even so, it may be that the depth of excavation was simply insufficient to reach the constantly waterlogged peat level where wood preservation was possible, and that deep supporting posts had actually been provided for these dwellings, too, perhaps preserved only at a deeper level. Hence, the possibility remains that the apparent difference in the structure of the Comb Ware and Sārnate dwellings simply reflects a difference in preservation conditions.

Perhaps a more significant difference is the relatively frequent occurrence of stones in the sand layers of several of the dwellings with Comb Ware. Many scattered stones are seen in the photographs and plans of Dwellings 3, 5 and 6LA (Fig. 83; Vankina 1970a, Figs. 136, 140, 141). This contrasts with the situation in the dwellings with Early and Late Sārnate Ware, in which stones are generally rare or absent altogether.

Apart from the hearths, two large grindstones next to the hearth of Dwelling 3, one on the north-western, the other on the south-eastern side (Vankina 1970a, Fig. 136), might also be considered structural features of the dwelling.
8.1.2 Spatial structure at the site level

As already indicated in Section 3.3.5, all the dwellings of this group lie in the NNE part of the site, and virtually all of them form a row oriented NE–SW, presumably in line with the former shoreline. Moreover, most of the dwellings belonging to this row also seem to be aligned in this direction. The pattern is most clearly indicated by Dwellings 3 and 5. The oval sandy areas of these dwellings are also aligned approximately NE–SW, as are the elongated charcoal and ash layers representing the hearths (Figs. 74, 84). While the alignment of the hearth areas of the remaining dwellings of this group is unclear, the oval sand layers of several of the others are similarly aligned: NE–SW (Dwellings 4 and 12ZA) or ENE–WSW (Dwellings 8 and 10). It seems that these houses would have constituted a row of elongated structures aligned end-to-end, although it is impossible to say how many of them were occupied simultaneously.
Fig. 84. Plan of the site, showing the dwellings with Comb Ware and indicating the orientation of the long axes of the hearths.
8.1.3 Spatial structure at the dwelling level

The grindstones next to the longer sides of the hearth in Dwelling 3 presumably reflect the location of bone, wood or amber processing activities. No such evidence has been recorded for the other dwellings, so it is unclear whether this reflects a general pattern of use of dwelling space. There is little other recorded evidence of patterning in the distribution of artefacts in these dwellings that might indicate activity areas.

8.2 House remains and spatial structure in the dwellings with Early Särnate Ware

8.2.1 House remains

Timbers were preserved in all but one of the dwellings of this group, providing evidence that the houses had been supported on posts and stakes. Organic preservation was not equally good in all cases. Some of the dwellings (D, ID, MD and RZ) had a number of preserved posts and stakes, giving at least some idea of the extent and layout of the house, others (E, P and W) had very few, and in Dwelling 2 no timbers at all were preserved. In the author’s view, the presence or absence of post remains can most probably be put down to differences in preservation conditions, rather than to differences in house structure. As with the Comb Ware dwellings, in those dwellings with Early Särnate Ware that had no organic preservation, the occupation layer was thin, and the depth of excavation was accordingly shallow. Thus, Dwelling 2 was excavated to a depth of 0.6 m, at which level there was no more evidence of human activity. As described in Section 8.1.1, this leaves open the possibility that deep posts might have gone undetected, if only their lowermost parts were preserved.

The structural evidence from each dwelling of this group is considered in turn. Thus, although Dwelling 2 had no organic preservation, the extensive sand layer seems to give some idea of the limits of the dwelling, indicating a structure of at least 8×4 m (Vankina 1970a, Fig. 133).

In Dwelling ID, the layout of posts and lines of lighter and darker peat appear to indicate a rectangular or square structure about 3 m wide and at least 4 m long – it appears that the building might have continued beyond the south-western limit of the excavated area (Fig. 85).
The remains of Dwelling M_D included a large number of posts. These were associated with fallen timbers, some of which appeared to be the above-ground parts of the posts. The excavators dug down to reach the tips of the more substantial posts. The tip of one of these, with a diameter of 10 cm, lay at a depth of 0.7 cm in the peat, while another, 12 cm in diameter, had been driven right through the peat layer, to a depth of 2.5 m. This post had several thinner stakes next to it, one of which also reached the base of the peat layer. The remains do not seem to provide a clear picture of the extent or orientation of the dwelling. However, judging from the spread of posts, it must have measured at least 7×4 m.

In Dwelling R_Z, pairs of posts formed a square around the hearth. Judging from this arrangement, the house would appear to have been 5 m wide, but the length is indeterminable.

Dwellings I_D and M_D yielded evidence of the above-ground parts of houses as well. Dwelling I_D had a jumble of fallen timbers, pine and birch bark, laths and branches. Among these remains, there was also part of a structure of interwoven laths. Vankina concludes that “the walls and roof were made from interwoven laths and branches, and covered with moss, grass or bark” (Vankina 1950, 6). Likewise, among the posts of Dwelling M_D there were branches and laths, interpreted by Vankina as possibly deriving from the house wall.

It appears from the excavation reports that mainly birch timber was used for the structural supports of the dwellings in this group, although it should be borne in mind that because of its distinctive bark, birch is very easily identifiable and for this reason may be over-represented in the documentation. Birch posts are mentioned in the records of Dwellings D, I_Z, I_D, P_A, M_D and R_Z/R_D. In some cases, the diameter of the timber is given: the birch posts and stakes generally seem to have been 7–12 cm in diameter. Timbers of other woods are also mentioned: a 12 cm diameter ash stake in Dwelling P_A; and 4 cm and 7 cm diameter coniferous wood stakes in Dwelling R_Z. The wood was identified in the course of excavation on the basis of macroscopic features (probably using the characteristics of the bark), so the determinations cannot be regarded as completely reliable.

Vankina (1970a, 129) writes that this dwelling, which – in view of the absence of a hearth – she considers to have been occupied only in summer, was evidently built of light materials. She likens it to the temporary shelters built in Latvia in the recent past for the haymaking season. However, the present author has not found evidence to indicate that this house was a lighter structure than the rest, and, as noted in Section 7.2, the absence of a hearth might be explained in terms of incomplete excavation of this dwelling.
The only other recorded features in the dwellings of this group are two small pits at the north and south margins of the sand layer of Dwelling 2 (Vankina 1970a, Fig. 133).

Another characteristic that sets apart Dwelling 2 from the rest is the abundance of stones in the dwelling, which seem to form linear concentrations (Vankina 1970a, Figs. 132, 133). The stones might be thought to have been utilised in the very intensive amber-working activity that took place here. In all the other dwellings of this group, stones (with the exception of pebble sinkers) were rare or absent.

Layers of nutshells are mentioned in the excavation records of some of the dwellings with organic preservation, namely Dwellings ID, MD, MZA and MZR. In the case of MD, they are specified as being both hazelnut and water chestnut shells. A mallet for cracking nuts was found in Dwelling D, although the records do not mention nutshells in this dwelling. Neither is there any mention of nutshells in Dwellings E, IZ, P, RZ, RO or W, even though all of these did have at least some organic preservation. It appears that nut processing was practiced in some of the dwellings, but not in others.

8.2.2 Spatial structure at the site level

As described in Section 3.3.5, several dwellings of this group in the SSW part of the site form a row running approximately NNE–SSW (Fig. 19) – presumably in parallel with the shoreline of that time.

The dwellings with Early Šārnate Ware show considerable variation in the alignment of the hearth or the house, with no clearly discernible pattern. Thus, the sand layer that seems to roughly indicate the extent of Dwelling 2 is oriented approximately E–W; the hearth of Dwelling E has an ENE–WSW long axis; the building remains of Dwelling RZ show an ESE–WNW orientation; and the remains of house ID seem to form a rectangle oriented NE–SW.

8.2.3 Spatial structure at the dwelling level

There is insufficient data from the dwellings of this group to permit the kind of comprehensive analysis of the internal spatial structure of the dwellings undertaken on the dwellings of Late Šārnate Ware (see Section 8.3.3). Among the dwellings with Early Šārnate Ware, Dwelling ID had a considerable number of preserved organic objects whose find locations are known (Fig. 85). Objects were
found both inside the limits of the house (indicated by the posts and the lines of brown, undecomposed peat) and outside it, immediately to the north-east. There does not seem to be any clearly interpretable patterning of artefacts. As already mentioned, no hearth was discovered, but it seems that the house continued further to the south-west, beyond the limits of the excavated area.

Fig. 85. Schematic plan of Dwelling 10. For key to symbols, see Figs. 99–101, 103.

8.3 House remains and spatial structure in the dwellings with Late Sárnate Ware

8.3.1 House remains

This group of dwellings has furnished the largest body of structural evidence. Thus, Dwellings O, T and Y had sufficient numbers of preserved posts to give at least a partial picture of the house layout. Dwellings A, F, G, K and N also had large numbers of posts, but in these cases the layout is not readily discernable. Little remained of the structures of Dwellings X, P, U and Z, probably because organic preservation was poor in these cases.
Some of the supporting timbers had been driven deep into the peat. In those cases where the excavators dug deep enough to reach the tips of the posts, they discovered that some had been driven more than 2 m into the peat, reaching the underlying layers. In other cases, too, the section drawings show deep posts (Vankina 1970a, Figs. 67, 116). However, these should not be regarded as piles, since piles support the base of a structure, but it is clear that in this case we are dealing simply with post-built houses whose posts had been driven quite deep into the ground, reaching the more stable layer underneath the peat and thus increasing the structural stability of the frame. Although the Sārnate houses have sometimes been listed among pile dwellings (e.g. Dolukhanov & Miklyayev 1986, 81), this is quite misleading: there were no remains of house platforms, which most certainly would have been at least partly preserved, had they been present, given the excellent preservation of organics in several of the dwellings.

In examining the dwelling plans, we see that clusters of adjacent or closely spaced posts are characteristic (Vankina 1970a, Figs. 16, 67, 119, 148). This seems to provide evidence either of the replacement of structural supports, or of the provision of multiple supporting posts to reinforce the structure. Most notably, the wall-lines of Dwelling T seem to have groups of supporting posts (Fig. 87). Certainly, in the wet conditions at Sārnate, posts would have been subject to rapid decay at ground level, necessitating frequent replacement.

In some dwellings, the preserved basal parts of the posts tend to lean in one particular direction, evidently indicating the direction of collapse of the building: thus, Dwelling Y evidently fell to the north-west (Fig. 86; Vankina 1970a, Fig. 119), while Dwelling N seems to have fallen to the west (Vankina 1970a, Fig. 67).

Only houses O, T and Y have a clearly identifiable floor plan. Houses O and Y were interpreted as approximately square single-room structures (Vankina 1970a, 126): O measured about 4 m in width and at least 4 m in length, and had walls aligned NE–SW and SE–NW, while Y apparently measured some 5×5 m and had walls aligned ESE–WNW and NNE–SSW (Fig. 87). However, both of these structures lay close to the limit of the excavation area, and in both cases it is quite possible that the house structure continued beyond the south-eastern limit of the trench. In the case of Dwelling T, the dwelling seems to have been excavated completely. The rows of stakes and the limits of the sand layer indicate an elongated house measuring 4.5×8.5–9 m, oriented ESE–WNW, with a central row of stakes apparently marking the ridge-line (Fig. 87).
Fig. 86. Dwelling Y in the course of excavation, view from the east (Vankina 1970f, Fig. 61).

Fig. 87. Schematic plans of Dwellings T and Y, showing the distribution of posts and stakes, the extent of the dwelling sand layer and the extent of the best-preserved bark layer (the hatching indicates the direction of the grain of the bark). Suggested lines of the walls are given: for Dwelling T, the reconstruction is after Vankina, while for Dwelling Y the reconstruction is the author’s own.
Vankina also attempted to discern the wall-lines of houses K and N (1970a, 127, 129), however in these cases her interpretations appear open to doubt. In both cases, the dwelling plans (Vankina 1970a, Figs. 48, 67) show large numbers of posts, but no unequivocal pattern emerges – quite possibly, the house plan was altered during the time of use, leaving a palimpsest of remains from different building phases.

The jumble of remains in Dwelling K included material evidently deriving from the frame of the house: several timbers up to 15 cm in diameter and 1–2 m long, worked at one or both ends. There were also two poles forked at one end, which had presumably served as supports (Vankina 1970a, Fig. 48). From the materials found in the occupation layer, Vankina concludes that the walls of this house might have been formed of wattling of branches and grass, and that it would have been roofed with bark (Vankina 1950, 7).

The remains of Dwelling AZ1 provide an indication of the structure of the house walls. Found here was a spread of timbers with worked ends, apparently bound together with bark, which "was reminiscent of wattling, a wattle fence or wall that had fallen over" (Vankina 1971, 10). Underlying this spread of timbers was a 3-m-long tree trunk with the roots still attached, and next to it a wooden ‘idol’ – a shaped log, 1.68 m in length, with a roughly carved face at the top (Vankina 1970a, Fig. XXXVII). These structures are interpreted by Vankina as having collapsed all at the same time. Because of the presence of the ‘idol’, Vankina interpreted these as the remains of a shrine (1970a, 103), an interpretation that has found general acceptance, so that the ‘Sārnate Shrine’ is well known in Latvian archaeology. Similar wooden posts with a roughly carved human head at the top have been found at Šventoji 2 (Rimantienė 2005, Figs. 46, 202, 203) and at Malmuta in the Lake Lubāns area (Loze 1970). As regards the shrine hypothesis, it should be added that the rest of the remains associated with this structure are of the same character as those found in the domestic contexts of the other dwellings: a hearth, a layer of water chestnut shells, and scattered net sinkers and floats.

There was no evidence of flooring material in any of the dwellings, only a somewhat firmer stratum “consisting of peat mixed with nutshells, leaves, branches and twigs” (Vankina 1970a, 126).

As in the Early Sārnate Ware dwellings, in this group too, birch is the most frequently mentioned wood used for structural timbers, but, once again, it may be over-represented in the records because it is so easily identifiable. Birch timbers of up to 12 cm diameter are mentioned as present in at least eight dwellings.
However, a range of other wood taxa were used for structural timber as well. Thus, ash poles of up to 12 cm diameter were present in at least two dwellings; aspen is likewise recorded in at least two dwellings, 7 cm and c. 10 cm in diameter; spruce is mentioned in two dwellings, 8–12 cm in diameter, and pine is recorded in one case. Alder was apparently also used. Vankina (1970a, 126) notes the relative paucity of coniferous timber.

Generally, only sparsely scattered stones were found in the dwellings of this group, and some of these might have been unworked sinkers for fishing gear. Greater numbers of stones appear on the plans of Dwellings O (Vankina 1970a, Fig. 78), X (Vankina 1970a, Fig. 106) and Y (Vankina 1970a, Fig. 116). Although there were some clusters of stones, in no case is there any evidence of arrangements of stones forming hearth structures or other features.

Three pits were recorded altogether in this group of dwellings: two in Dwelling K and one in Dwelling O. The larger pit in Dwelling K, 2 m east of the hearth (within the limits of the house?) and measuring about 1.6×1.3 m, with a depth of 0.45 m, had been lined with moss and sand. At the bottom, above the sand, charcoal was observed. The pit was filled with shelled nuts, and also contained a wooden object interpreted as a phallus representation. A smaller pit was found west of the hearth (Vankina 1970a, Figs. 48, XXXVII).

A pit at the limit of the excavation area of Dwelling O, about 6 m metres west of the house, was about 1 m in diameter and 25 cm deep, with a fill of dark peat containing small bird bones, animal rib fragments and fish bones (Vankina 1970a, 78).

Larger or smaller quantities of hazelnut or water chestnut shells were recorded in practically all the dwellings of this group.

### 8.3.2 Spatial structure at the site level

In contrast to the dwellings of the previous group, where only one hearth seemed to have a clearly identifiable ‘long axis’, in the group of dwellings with Late Särnate Ware, the alignment of the axis of the hearth could be determined for as many as 11 hearths. The alignment of the long axis of the hearth was established from the orientation of the better-preserved bark layers and the sand layers belonging to the original structure or the hearth renewal phases. Significantly, eight of these 11 hearths were aligned approximately in the same direction: Hearth F₁ and the hearths of Dwellings A₁DA, G, K, N, T, Y, and probably also the hearth of Dwelling X, were all aligned ESE–WNW or SE–NW.
As already noted in Section 3.3.5, the dwellings of this group clearly form a row in the SSW part of the site, a row that seems to continue in the NNE part as well. Considering the alignment of the hearths in relation to the distribution of the dwellings of this group (Fig. 88), we see that the eight hearths aligned ESE–WNW or SE–NW were in fact approximately perpendicular to the direction of the row of Late Särnate Ware dwellings.

The hearths of three other dwellings show a different alignment. The hearths of Dwellings ADR and Pb are oriented NNE–SSW, i.e. parallel to the row of dwellings, while Zb is oriented ENE–WSW – somewhat obliquely in comparison with the orientation of its nearest neighbour in this group, the hearth of Dwelling Y. It should be mentioned that the alignment of the hearths of Pb and Zb could be estimated only from the orientation of the sand layers, whereas the alignment of the other hearths is somewhat more secure, having been assessed from the orientation of the timber and bark layers.

The fact that most of the hearths are similarly aligned seems to indicate that the houses themselves would have been aligned on the same axis. As described above, in the majority of cases the pattern of structural remains, in the form of posts and stakes, is not interpretable unequivocally, and only a few house remains have a clearly discernable alignment. Most distinct is the outline of Dwelling T: the rows of stakes and the limits of the sand layer indicate an elongated house, oriented ESE–WNW, i.e. parallel to the long axis of the hearth. The hearth itself lay closer to the WNW end, in line with a row of stakes that seems to mark the position of the roof ridge. Dwelling Y, apparently square, had walls corresponding in direction to the orientation of the hearth: ESE–WNW and NNE–SSW (Fig. 88).

Judging from these examples, it seems that the alignment of the hearth can indeed serve as a proxy indication of the alignment of the long axis of the house, and in this way we can obtain a clearer picture of the general layout of the settlement during this phase of occupation. It is concluded that the houses, ranged in a row along the former lakeshore, were for the most part oriented perpendicularly to the shoreline. The house entrance might be thought to have been at the ESE end, facing the lake. This interpretation also serves as the starting point for an investigation of the general pattern of use of space in the dwellings of this group, described in the following sections.

Problematic in this regard is Dwelling K: Vankina’s suggested house plan, with the ridge-line of the house running NE–SW and the entrance at the south-western end (Vankina 1970a, Fig. 48), is at odds with the alignment of the hearth (ESE–WNW, similar to most of the rest in this group). The present author is
tempted to regard Vankina’s interpretation as erroneous (the arrangement of the posts seems open to various interpretations), but the impression she obtained of the house layout at the time of excavation cannot be dismissed out of hand. This remains an equivocal case.
Fig. 88. Plan of the site, showing the dwellings with Late Särnate Ware and indicating the orientation of the long axis of their hearths (compare with Fig. 84).
8.3.3 Spatial structure at the dwelling level

The discovery that the hearths of several dwellings from this occupation phase were aligned in approximately the same direction, and the inference that the houses as such would have been aligned in this direction as well, opens up a new avenue for spatial analysis, providing a good starting point for investigating whether these dwellings share any common patterning with respect to the distribution of tools, waste from the processing of different materials, and structural features. In other words, we may examine whether the dwellings provide evidence of a common spatial pattern of activities.

We are very fortunate in having several dwellings to compare, since the numbers of objects recovered from any one dwelling on its own are too small to give a clear picture of spatial patterning. Moreover, patterning observable in one dwelling may reflect patterns of cultural activity and depositional conditions specific to that particular dwelling, whereas we are primarily interested in identifying more general activity patterns characteristic of this particular phase of occupation.

This is in fact a second attempt to discover common spatial distribution patterns among the Sārnate dwellings. In an earlier paper (Bērziņš 1997), a study was made of five dwellings from different occupation phases that seemed to have relatively clear wall-lines, inferable from the arrangement of posts, thus revealing the approximate extent of the house. However, further study suggests that the wall-lines of the houses, as reconstructed by Vankina and the present author, are not a very secure guide to the true shape and extent of the dwellings. As with so many other sites, so too in the case of Sārnate, the distribution of posts is open to a variety of alternative interpretations. It seems that the hearth, providing a common central point and axis, gives a much better starting point for identifying spatial patterning common to several dwellings.

This approach is guided by an assumption frequently made in dwelling-level spatial analysis, namely that the hearth can be regarded as a meaningful point around which activities would have been structured (e.g. Stapert & Street 1997).

Secondly, the earlier study considered dwellings from different phases, but it seems that we may improve our chances of distinguishing patterns in the use of dwelling space if we restrict our analysis to comparison among dwellings belonging to the same phase.

The spatial analysis described below will thus include those dwellings of the Late Sārnate Ware phase that have hearths aligned ESE–WNW or SE–NW. As
described above, this alignment is shared by hearths in eight dwellings of this phase, only three hearths showing an entirely different alignment. The remains of another eight hearths in dwellings of this phase did not permit the clear identification of hearth alignment. Dwelling K is also excluded, even though its hearth is oriented in the same direction as most of the others: as already discussed, the evidence regarding the layout of this house is contradictory. The alignment of the hearths of the remaining seven dwellings, used in the analysis, is given in Table 6.

Table 6. Alignment of hearths of the dwellings included in the spatial analysis.

<table>
<thead>
<tr>
<th>Hearth</th>
<th>Hearth alignment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&lt;sub&gt;DA&lt;/sub&gt;</td>
<td>110° / 290°</td>
<td></td>
</tr>
<tr>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>115° / 295°</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>105° / 285°</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>95–105° / 275–285°</td>
<td>For analytical purposes, the hearth alignment is taken to be 100°/280°.</td>
</tr>
<tr>
<td>T</td>
<td>115° / 295°</td>
<td>Hearth alignment corresponds to the alignment of the walls of the house, the long axis of the hearth corresponding to the long axis of the building.</td>
</tr>
<tr>
<td>X</td>
<td>120–150° / 300–330°</td>
<td>For analytical purposes, hearth alignment is taken to be 135°/315°.</td>
</tr>
<tr>
<td>Y</td>
<td>120–125° / 300–305°</td>
<td>Hearth alignment corresponds to the alignment of the walls of the square room. For analytical purposes, the hearth alignment is taken as 122.5°/302.5°.</td>
</tr>
</tbody>
</table>

Arithmetic mean alignment 115° / 295°

8.3.3.1 Analytical methods

On the plan of each dwelling, the ‘centre of the hearth’ was established. This served as a reference point for superimposing the dwelling plans. In those cases where there was a central area of intensive burning in the hearth, as indicated by charred bark or hearth timbers, this was taken as the central point, while in other cases the geometric centre of the best-preserved layer was used. Thus, the ‘centre of the hearth’ is only an approximate central point. It should be recognised that some hearths, particularly those of Dwellings A<sub>DA</sub> and N, seem to have shifted by more than a metre during their use-life (Vankina 1970a, Fig. 67), and in these cases the point taken as the ‘centre of the hearth’ (and the subsequent analysis of dwelling plans based on this) is subject to considerable error.
A general template or layout for the composite dwelling plans was drawn up (Fig. 89). North is at the top (in contrast to the site plans). A central dot marks the assumed centre of the hearth, and passing through it is a line running at an azimuth of 115°/295°, corresponding to the mean long axis of the hearths (see Table 6). Drawn around the hearth is a rectangle corresponding to mean size of largest hearth bark layer in these dwellings (2.3×1.5 m), also aligned on the 115°/295° axis. For easier visual comparison of the plans, a circle of 5 m radius has been drawn around the centre of the hearth (not intended to mark a wall-line or boundary!).

Next, the positions of objects and features in each separate dwelling were marked as point symbols or areas on a plan of that particular dwelling. The plan of object and feature positions in each dwelling was then superimposed so that the centre of the hearth of that particular dwelling lay over the dot marking the centre of the hearth in the layout template, and was rotated to match the mean 115°/295° alignment. Thus, Dwelling A_D, with its hearth aligned 110°/290°, was rotated 5° clockwise, and so forth.

Fig. 89. Layout scheme for analysis of composite dwelling plans.

By positioning the object distributions of all the separate dwellings on a single plan, with the centres of the all hearths at the same point, and rotating them into
the same alignment, a ‘composite plan’ was obtained, showing the general distribution of objects in all seven dwellings, in relation to the position and alignment of the hearth.

Included in the analysis were those objects whose 1-m grid square position had been recorded in the finds list or whose position was shown on the excavation plans. Complications arise in the case of closely adjacent dwellings: the spreads of objects overlap, so that it is unclear which objects are associated with which dwelling. This is a problem with Dwelling F: it has neighbouring Dwellings K and M, and likewise with Dwelling AD, in relation to its neighbours AD and AZ. The solution adopted, admittedly somewhat unsatisfactory, was to consider the artefacts as belonging to the dwelling to whose hearth they lie nearest (i.e. establishing a boundary line equidistant from the centres of the hearths of neighbouring dwellings). With Dwelling F there is a further complication: there are two features interpreted as smaller hearths south-west of the main hearth in this dwelling. Accordingly, the objects found closer to these hearths than to the main hearth of Dwelling F are excluded from the analysis, which, unfortunately, leaves the main hearth of this dwelling (F1) with a rather asymmetric distribution of objects.

Considered in the analysis are two kinds of features of the dwelling structure itself: sand layers, restricted in most cases to the hearth, but sometimes extending over a larger part of the dwelling, and posts.

The objects and features relating to particular activities were divided into functional groups. Thus, nut processing evidence includes nut-cracking mallets and layers of water chestnut and hazelnut shells.

Cooking equipment includes spoons, ladles and stirrers, as well as fairly complete remains of pots found in a crushed state.

Various kinds of outdoor gear (i.e. equipment that would have been stored or maintained, but not actually used, in or near the dwelling) includes wooden paddles, spear shafts, bows, mattocks and the arms of eel clamps, as well as slate arrowheads and conical (flat-headed) wooden arrowheads. Considered separately are the numerous components of net fishing gear: the pine bark floats, and the notched and wrapped pebble sinkers.

Woodworking equipment includes stone chisels, as well as bobbin-shaped wooden sleeves and hooked objects that evidently served as handles for the axes. Vankina (1970a, 95) interpreted the wooden hooks as tools for retrieving nets from the water, but Rimantienė’s interpretation of similar pieces from Šventoji as axe handles seems much more credible (Rimantienė 2005, 90, Fig. 41). Grinding
equipment – whetstones and grindstones – were also mapped. Flint flakes have been mapped because of their value as indicators of knapping areas, but flint tools are omitted entirely. Analysis of the flint inventory falls outside the scope of this work, and no use-wear analysis has been undertaken, so the function of the tools is too uncertain for them to be considered in this study. This also applies to the flint points, which might include not only arrowheads, but borers as well. Neither can we distinguish unfinished/discarded pieces (indicative of knapping) from finished tools (relating to other activities).

Amber finds have been separated into unworked/semi-manufactured pieces, flakes and finished ornaments, with the idea that only the former two classes actually reflect amber-working activities, the finished material perhaps exhibiting a different spatial pattern.

The pottery bowls, interpreted as fat-burning lamps, are mapped as a separate class.

It should be made clear that by no means all of the artefacts could be included in the analysis: a large proportion have no grid-square provenience in the finds lists and are not identifiable on the excavation plans, either. Thus, we have positions for 10 out of 12 nut mallets from these seven dwellings, 14 out of 24 paddles, six out of 11 lamps, etc. Most disappointingly, Vankina discontinued the grid-square recording of flint flakes and amber, so that our picture of the distribution of this material is largely restricted to the dwellings excavated by Šturms (A_{DA}, F and G). We may regard the omissions due to unrecorded find locations as essentially random, so that they should not bias the results. There was no consistent recording of potsherd distribution, either, so that, with the exception of some largely complete pots and bowls, which had been drawn on the plans, pottery is excluded from the analysis.

If we assume that the missing data indeed constitutes a random sample, then a variety of point-based or grid-based distributional analyses might have been applied to this data (for an overview, see Blankholm 1991). However, considering the nature of the data, statistical analysis seems unwarranted in this case: since the actual numbers of objects are small, and since there is a combination of point features and areal features, which is statistically very awkward to deal with, simple visual inspection of the plans seemed more likely to yield interpretable conclusions.
8.3.3.2 Results and interpretation

Turning to the structural remains first, we may examine the combined distribution of posts in these seven dwellings. A plan showing the superimposed distributions of all the posts in all seven dwellings (Fig. 90) gives the impression of a dense ‘cloud’ of posts on all sides of the hearth, extending about 2.5 m in all directions from the centre of the hearth, except for the east or ESE, where the dense distribution of posts extends further outwards. Outside this cloud of posts, there are more sparsely distributed posts, particularly on the north-western side.

In the knowledge that the structurally important points of the buildings were often marked by clusters of posts (Section 8.3.1), the study of post distributions was then refined to include only groups of at least three posts, where each post must lie no further than 0.5 m from its nearest neighbour. The hypothesis is that in this way we might isolate the structurally important points of the building, where additional support was provided, while removing from the distribution posts that were structurally less important, which might be regarded as ‘noise’ obscuring the pattern.

Comparing the resulting distribution pattern (Fig. 91) with that of all the posts, we see that the cloud of outlying posts has disappeared almost entirely. The distribution of the clustered posts seems to provide a clearer picture, giving the impression of an elongated building aligned ESE–WNW, with the hearth closer to the WNW end.

Since the hearth serves as the central ‘anchor point’ in our analysis, the sand layers associated mainly with the hearth also occupy a central position (Fig. 92), in some cases extending some way to the WNW and ESE of the hearth, and in other cases laterally to the SSW. Some smaller, outlying sandy areas in several dwellings might be interpreted as dumps of sand from the cleaning of hearths.

We may conclude from these structural remains that all or most of the seven houses studied here were probably rectangular structures aligned ESE–WNW, the hearth being located closer to the WNW end. An average width of about 4.5 m might be postulated, with a length of up to 9 m (Fig. 93). It seems possible to distinguish a main structure at the WNW end, approximately square and with the hearth at its centre, and an unheated ‘ante-chamber’ or ancillary structure at the ESE end. The hearth seems to have been aligned along the central axis of the building – presumably on the ridge-line. The superimposed spreads of sand seem to help define the area of the main structure. It should be stressed that this is a
very generalised, approximate model of the house plan: there may in fact have been considerable variation in shape and layout.

Fig. 90. Superimposed distributions of posts in Dwellings A1A, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.

Next, looking at the cooking utensils (Fig. 94), we see a markedly asymmetric distribution around the hearth. Most of the spoons and ladles derive from the area adjacent to the ESE end of the hearth, defining what might be called a ‘kitchen area’. The distribution patterns of three pots and three objects interpreted as stirrers do not add significantly to the picture. Thus, two out of three largely complete pots come from the hearth itself (we already know they were being used as cooking vessels), while the three stirrers were found NNE and SSW of the centre of the hearth, outside the ‘kitchen area’ defined by the spoons/ladles. It is hard to say whether the distribution pattern of the stirrers has any significance.

Judging from the spread of nutshell layers (Fig. 95), the most intensive nutshelling work also seems to have taken place at the ESE end of the hearth – in the same area where the majority of spoons were found. The mallets are not as closely associated with the nutshell layers as might have been expected. Some
were found next to the hearth, while others were as much as 5 m from the centre of the hearth, presumably discarded outside the house itself.

Thus, the extent of the nutshell layers and the distribution of spoons/ladles seem to define an area immediately surrounding the ESE end of the hearth where food processing activities were most intensively conducted. The nutshells and spoons/ladles in this area may be interpreted as ‘primary refuse’ – waste and discarded tools left at the location of use (Schiffer 1987, 58). On the other hand, the nut mallets and stirrers occurring outside of the ‘cooking area’ might be viewed as ‘de facto refuse’ or ‘secondary refuse’: since these are somewhat larger objects, they may have been stored away from the zone of intensive activity and dumped elsewhere at the end of their use life.

Fig. 91. Superimposed distributions of groups of three or more posts separated by no more than 0.5 m in Dwellings A, F, G, N, T and Y, in relation to the centre and long axis of the hearth. (There are no such groups in Dwelling X.)

The distribution of oval pottery bowls regarded as lamps (Fig. 96) corresponds approximately to the distribution of the spoons and ladles, and with the area of the most intensive deposition of nutshells, suggesting a functional relationship between these classes of remains. It also seems likely that the gradually
accumulation of a midden-like layer of nutshell provided favourable conditions for the burial, as primary refuse, of small artefacts such as spoons, ladles, nut mallets and oval bowls.

Unlike the cooking utensils, flint flakes (only recorded for Dwellings ADA, F and G) were found on all sides of the hearth (Fig. 97). Aside from two outlying clusters of flakes, to the north and WSW (Dwelling G), which could represent either knapping locations or waste dumps, most of the flint debitage is concentrated in the area that can be regarded as indoor space, suggesting that this is primary refuse from indoor knapping or utilisation of the flakes as tools.

The three grindstones (Dwellings ADA, F and G) were all on the SSW side of the hearth, which seems to reflect the intensive working of materials (presumably bone and stone, possibly amber as well) in this part of the house. The axe and chisel components (stone blades, sleeves and handles) seem to be associated with the flint and grinding equipment.

Unworked amber and semi-manufactured ornaments seem to concentrate near the hearth on its north-eastern side (Fig. 98), but this asymmetry results from a
concentration of amber finds in this part of Dwelling A DA. If we disregard the material from this dwelling, then we have a sparse distribution all around the hearth, with some outlying groups, so that there is no clear indication of some particular area used for working or storage of amber. The distribution pattern of the finished amber seems to correspond to that of the unworked and semi-manufactured pieces.

Fig. 93. Reconstructed general layout of Dwellings A DA, F, G, N, T, X and Y, with superimposed distributions of sand layers and groups of three or more posts, in relation to the centre and long axis of the hearth.

The equipment used in various outdoor activities away from the site – bows, slate and blunt-tipped wooden arrowheads, spears, mattocks, lateral arms of eel clamps and paddles (Fig. 99) – evidently represents either ‘de facto refuse’, i.e. material left in its storage locations when the dwelling was abandoned, or secondary refuse, i.e. material dumped away from its location of use during the life of the dwelling. The general spread of outdoor gear is asymmetrical, continuing much further ESE than WNW, thus conforming to the suggested ESE extent of the house. However, unlike the cooking utensils, the outdoor equipment is not restricted to the ESE part: items were also found next to the WNW end of the
hearth. Also, the distribution of outdoor gear clearly shows an empty area at the ESE end of the hearth, corresponding to the suggested ‘cooking area’. To the NNE and SSW of the hearth, the distribution of these objects might be taken as suggesting storage along the lateral walls of the house, while objects found further out, beyond the suggested limits of the building, would seem to reflect outdoor dumping. A degree of asymmetry is introduced by the presence of a relatively large number of objects to the north-east of the hearth in Dwellings A\textsubscript{DA} and N.

Fig. 94. Superimposed distributions of cooking utensils in Dwellings A\textsubscript{DA}, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.

The notched sinkers (Fig. 100) are scattered in a relatively wide radius around the hearth. There is a dense concentration just to the S of the ESE end of the hearth (particularly in Dwelling Y).

The wrapped pebble sinkers (Fig. 101) appear to cluster somewhat more closely around the hearth than the notched sinkers, and mostly around the ESE
end. As with the notched sinkers, there are particularly dense concentrations (Dwellings A_{DA} and T) in this area.

Strikingly asymmetrical is the distribution of pine bark floats (Fig. 102): they were found mostly at the WNW end of the hearth, on its NNE side and across a wide area to the E of the hearth, with very few floats on the SSW side (a pattern is somewhat similar to that of the outdoor equipment). Pine bark floats are conspicuously absent south of the ESE end of the hearth, where Dwelling T had a dense concentration of wrapped pebble sinkers and where Dwelling Y had large group of notched sinkers. The general observation may be made that the distribution of pine bark floats is perhaps in slightly better accord with that of the notched sinkers than the wrapped pebble sinkers. This may reflect a closer functional association between pine bark floats and notched sinkers, whereas a proportion of the nets weighted with wrapped pebble sinkers would presumably have had birch bark rolls as floats instead (not mapped).

Fig. 95. Superimposed distributions of nutshell layers and nut-cracking mallets in Dwellings A_{DA}, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.
8.3.3.3 Conclusions

The above-described analysis of structural remains and artefact distributions permits the following conclusions regarding general pattern of house layout and activity locations in the seven Late Sārnate Ware dwellings with hearths aligned WNW–ESE or NW–SE:

1. all or most of these houses were rectangular structures, aligned ESE–WNW or SE–NW, parallel to the long axis of the hearth, which is thought to have been situated closer to the westernmost end of the building and was presumably aligned along the ridge-line. In addition to the main room at the westernmost end of the building, heated by the hearth, there may have been a separate, unheated space at the easternmost end; most of the houses seem to have been approximately 4.5 m wide and up to 9 m long;

2. apart from the hearth itself, activities related to cooking mostly took place in the area immediately beyond the easternmost of the hearth, which was also the usual place for nut-shelling;
3. certain other activities, including flint-knapping, were apparently conducted in a variety of locations within the indoor space;

4. hunting and fishing gear and other outdoor equipment was stored along the walls of the house (inside or outside);

5. neither the structural remains, nor the patterns of artefact distribution provide any clear evidence as to the position of the house entrance(s);

6. certain other trends are observable in the artefact distributions that are not readily explicable at present: for example, the relatively higher frequency of objects on the northern side of the house, compared with the southern side, and, more specifically, the concentrations of stone sinkers to the south of the easternmost end of the hearth.

Fig. 97. Superimposed distributions of finds connected with processing of materials in Dwellings A0A, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.
It seems that the clearest and most interesting pattern to emerge from this study is the concentration around the easternmost end of the hearth of tools and refuse connected with a set of activities that mainly relate to food processing. In other words, we seem to have evidence of a ‘kitchen area’ at this end of the hearth. We might further infer that this was the ‘women’s part’ of the house, and that the range of activities represented by the material from this part of the house reflects the spectrum of tasks allotted to women within this community. If we assume that the house entrance was indeed at this end of the house, facing the lake (seemingly the most logical arrangement), we might, in view of the findings of Ränk (1951) and Paulson (1952), based on ethnographic data from a range of societies in Eurasia and North America, go on to suggest that this spatial pattern reflects a patriarchal social structure, where the male head of the household occupied the highest-status position, furthest from the entrance, while the woman occupied the
lower-status area closest to the entrance. (For a discussion of household spatial organisation as a source for reconstructing social structure, see Grøn 1991.)

In the present state of research, such ideas should probably not be regarded as much more than speculation. Whether we are willing to go along with inferences about social structure based on spatial patterning depends, in part, on how much credence we give to ‘cross-cultural rules’ of the kind advanced by Ränk and Paulson. Do the general models apply in this particular case? Quite apart from this, our understanding of the spatial structure of the Särnate dwellings is far from complete: thus, we have very little evidence regarding the use of the space at the westernmost end of the hearth; we cannot clearly identify the main storage location(s) of the fishing and hunting gear; and it is by no means certain that the entrance was in fact at the easternmost end of the dwelling.

Fig. 99. Superimposed distributions of various equipment used in outdoor activities in Dwellings A_38, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.
Fig. 100. Superimposed distributions of notched sinkers in Dwellings A, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.

Fig. 101. Superimposed distributions of wrapped pebble sinkers in Dwellings A, F, G, N, T, X and Y, in relation to the centre and long axis of the hearth.
8.4 House remains and spatial structure in the ungrouped dwellings

8.4.1 House remains

Very limited structural evidence, insufficient for interpreting house form, was obtained from the ungrouped dwellings. Some stakes and sometimes also horizontal timbers were found in Dwellings C, H, J, L and S. In Dwelling Z₃, two apparent rows of stakes were found (in groups of two or three), seemingly marking the lines of walls. Vankina suggests that these remains indicate a rectangular structure with the hearth in the middle, but the shape of the house does not seem clearly determinable from the plan of the excavation area. Some of the posts and timbers in Dwellings L, S and Z₃ were identified as birch (5–12 cm in diameter).
Stones were rare or apparently absent altogether in these dwellings. Nutshells formed a layer up to 40 cm thick all around the hearth of Dwelling L, and the presence of nutshells is also mentioned in Dwellings S and Zα.

8.4.2 Spatial analysis at the site level

Although, of course, the dwellings of this group are not considered to represent one particular occupation phase, the alignment of the hearths and dwelling sand layers may be noted. Thus, the hearths of Dwellings C, H and S, and the sand layers of Dwellings 9 and 13, are aligned similarly to the prevailing alignment among the dwellings with Late Särnate Ware: ESW–WNW or SE–NW. The hearth of Dwelling Zα, aligned E–W, may also be grouped with these, while the hearth of Dwelling J is oriented N–S. The sand layers of Dwellings 12DR and 15ZA are oriented NE–SW, like those of the dwellings with Comb Ware.

In view of the lack of structural evidence, there is no basis for spatial analysis at the dwelling level.

8.5 Comparison of house remains and spatial structure between groups

As indicated in Section 8.1.1, it is possible that the observed differences between the structural remains of the dwellings with Comb Ware and the dwellings with Early and Late Särnate Ware are largely attributable to differences in the preservation conditions. Although the former group may have had lighter structures than the latter, the evidence does not seem conclusive. Perhaps the clearest difference is seen in the greater abundance of scattered stones in the dwellings with Comb Ware, compared to the other groups.

It would be wrong to say that the dwellings with Comb Ware are distinguished from the dwellings of the two Särnate Ware groups by their more extensive sand layer, covering the whole of the living space, rather than just the hearth. An extensive sand layer is indeed a conspicuous feature of some of the dwellings with Comb Ware (3, 5 and 6ZA), but we may note that sand layers covering much of the indoor space were also observed in one of the dwellings with Early Särnate Ware (Dwelling 2) and in some of the dwellings with Late Särnate Ware (O, T and Y). It might also be suggested that the salience of extensive sand floors in the Comb Ware dwellings is in part explicable in terms of the different state of preservation. Thus, in drier conditions, peat wastage has the
effect of concentrating the sand relative to the peat, so that at the time of excavation a distinct sandy layer is seen, even if there was originally only a minor admixture of sand in the peat.

The dimensions of the houses of the different groups are likewise difficult to compare because of the differences in preservation. If the extent of the sand layer can be used as a guide, then the largest houses are represented in the dwellings with Comb Ware: Dwelling 3 would seem to have measured approximately 12×6 m, while Dwelling 5 apparently covered an area of 9×6 m. By comparison, the most extensive sand layer in the Early Särnate Ware dwellings, that of Dwelling 2, measures 8×4 m, and similar dimensions are indicated by the spread of posts of Dwelling M0: at least 7×4 m. These Early Särnate Ware dwellings correspond approximately in size and shape to Late Särnate Ware Dwelling T, which measured 8.5×4.5 m. As described in Section 8.3.3.2, it is thought that several other dwellings of this group were rectangular structures of approximately this same size and shape. The remains of Dwellings O and Y would appear to indicate smaller, square structures, but it seems that in these cases the full extent of the house may not have been excavated. In conclusion, we may say that the houses during different phases of occupation were generally comparable in size, with at least one apparently larger structure in the Comb Ware group (Dwelling 3).

In the dwellings with Early Särnate Ware and likewise in those with Late Särnate Ware, birch stakes and posts of up to 12 cm diameter constitute the most frequently recorded form of structural timber, although, as already mentioned, birch may be considerably over-represented in the records because of its distinctive bark. From the dwellings of both groups, there is evidence that the houses had wattle walls.

As regards hearth and dwelling orientation, we see different patterns in the Comb Ware and Late Särnate Ware groups. In both groups there were elongated hearths whose long axis was evidently aligned with the long axis of the house. However, in the Comb Ware group (at least in the case of the two hearths that produced such evidence), the orientation is approximately NE–SW, which suggests houses placed in a row end-to-end with their long axes parallel to the former shoreline, while in the Late Särnate Ware group we have eight cases of ESE–WNW or SE–NW orientation, indicating dwellings also in a row following the former shoreline, but in this case aligned with their long axes perpendicular to the shoreline. The alignment evidence for the Early Särnate Ware group is insufficient to permit any conclusions.
Comparative material from the East Baltic region

A number of Neolithic sites in Lithuania and Latvia have yielded structural evidence of houses. For the most part, these were above-ground structures, the contours of which are indicated by postholes or preserved lower parts of posts and stakes. Considered below are those remains that have yielded evidence indicating the approximate size and shape of the buildings.

The houses on Narva and Nemunas Culture sites of the Early and Middle Neolithic in Lithuania (Katra 2, Šaltaliūnė, Šventoji 23 and Žemaitiškė 3B) were 3.8–6 m long and 3.4–5 m wide (Grinkevičiūtė 2005, Table 3). The remains from Šventoji 23, although poorly preserved, suggest similar dwellings to those of Sārnate: rectangular with widely spaced posts and apparently with a line of posts along the middle supporting the ridgepole (Rimantienė 2005, 85–86, Figs. 40, 319). Unlike at Sārnate, the posts of the houses at Šventoji 23, where there was only a relatively thin layer of peat, extended downwards only to a shallow depth (Rimantienė 2005, Fig. 316).

At the Early/Late Neolithic site of Iča in the Lubāns Lowlands of eastern Latvia, two wall-lines of a rectangular structure were identifiable, indicated by rows of stake-holes spaced 25–30 cm apart, with preserved tips of stakes. Based on the length of the wall-lines – 6 m and 3.5 m – it is concluded that the house had an area exceeding 25 m². (Loze 1978, 11).

Remains of houses associated with Comb Ware Culture material have been found at the sites of Zvidze and Kvāpāni in the Lubāns Lowlands. A house at Zvidze appears to have been similar in size and construction to the Sārnate houses: 10×4 m in area, with a frame of posts about 15 cm in diameter. The ridgepole is thought to have been supported by posts along the central axis of the house, grouped in twos and threes, and separated by intervals of about 2 m (Loze 1978, 11, Figs. 3, 4). Structural remains at the Kvāpāni sites apparently indicate smaller houses, 12–16 m² in area (Loze 2001b, 80). The walls of a rectangular house at Kvāpāni II are marked by densely spaced postholes, and it appears to have been a much more substantial structure than those at Sārnate (Loze 1978, 10).

From the Late Neolithic in Lithuania, there is evidence of houses similar in size to those of the Early and Middle Neolithic, but considerably longer dwellings – 12–15 m in length – also appear at this time on Narva, Corded Ware and Rzucewo Culture sites (Nida, Šarnele, Šventoji 6 and Žemaitiškė 3).
Based on the configuration of stone hearths at the Comb Ware site of Valma, arranged in pairs separated by a distance of 4–5 m, Jaanits et al. 1982, 67–68 (cited in Kriiska 2002, 239) consider that at least two buildings 7–8 m long stood here, with their gables facing a lake. A third building with only one large central hearth was located some distance away from the others.

In conclusion, the structural remains from the dwellings with Early and Late Sārnate Ware at Sārnate seem to conform to a regional tradition of above-ground, post-built structures. However, by no means all of the Neolithic houses in the region were above-ground structures. Thus, several house-pits have been discovered in Estonia and Lithuania (Gurina 1967, 22–30; Kriiska 2002, 237; Grinkevičiutė 2005, 41–44, Table 3, Fig. 2).

As already explained, the houses at Sārnate cannot be regarded as pile dwellings in the accepted sense of the term. Evidence of true pile dwellings – structures built on platforms supported by piles – has been found in lake deposits at Žemaitiškė 2 in eastern Lithuania (Girininkas & Brazaitis 2001, 8–10; 2002, 12–16), and at Usvyaty 4, Naumovo and Serteya 2 in the Western Dvina basin, Belarus (Miklāev 1971; Dolukhanov & Miklyayev 1986) or in peat, as at Modlona in the Vologda Region of north-western Russia (Ošibkina 1978, 111–118). Lines of posts preserved on a boggy, sloping riverbank at the Late Neolithic site of Abora I in the Lubsāns Lowlands are also thought to have supported platforms (Loze 1978, 13–14, Figs. 9, 10; 1979, 59–60). Šventoji 6 likewise had a large number of posts, driven in deep into the underlying sand (Rimantienė 2005, 87, Fig. 354), and it has been suggested that these remains also derive from pile dwellings, since there were no hearths or pits. Although they were on the shore of the lagoon, the dwellings may have been raised above ground level to avoid flooding (Grinkevičiutė 2005, 46).
9 Landscape and resources

9.1 Introduction

In this last major chapter of the work, we will look at the environmental setting and economic basis of the Neolithic occupation at Sārnate. The chapter begins with a brief examination of the palaeogeographical evidence, which is sufficient to give at least an approximate idea of the site environment at the time of habitation (Section 9.2).

The longest section of this chapter, Section 9.3, is structured in accordance with a site-centred division of the past landscape into landscape/resource areas: the site itself and the immediate environs; the local lake and river system; the River Užava; the beach and dunes; the sea; forest and meadowland; cultivated land and pasture; distant resource areas. The landscape of each of these areas, its location relative to the site and accessibility are examined, followed by a consideration of the food and non-food resources that were definitely or probably obtained from that particular area. By structuring the discussion in this way, emphasis has been placed on the locational connections between different resource extraction activities – connections that would not have been so obvious, had the treatment been structured in a more traditional way (hunting / fishing / gathering / non-food resources).

In Section 9.4, we switch from a spatial to a temporal frame, examining resource use season by season, and considering interannual variation.

In the discussion of resource-use activities, a wide range of evidence has been considered. The detailed analysis of the fishing gear presented in Chapter 6 has furnished much new evidence on the subject of fishing activities. As regards the pattern of use of other kinds of resources, we must rely on the artefactual and palaeoeconomic evidence collected by Šturms (1940) and Vankina (1970a). Since the publication of Vankina’s monograph, the faunal remains from Sārnate have been subject to further investigation: Sloka (1984) has presented a detailed analysis of the fish, and in the frame of the present study, palaeozoologist Lembi Lõugas has re-examined the faunal collection (Appendix 10). A wide range of comparative ethnographic, biological and geological data, as well as artefactual and palaeoenvironmental evidence from other archaeological sites, has been brought together in order to reconstruct as closely as possible the patterns of resource use.
No mathematical modelling has been undertaken. Optimal foraging theory might be seen as providing a theoretical structure for such an analysis, but this would require comprehensive and accurate data (see Kelly 1995, 77, 80). Our data is inadequate to such a task: we lack sufficiently detailed information about the palaeolandscape, and we lack accurate data on search and harvesting costs for resources in the specific environmental setting and using the specific technology. (In fact, for many resources we do not know the actual technology used.) We might wish to construct an economic model as a heuristic device and then test its predictions against the palaeoeconomic evidence from the site, but we would inevitably find that this evidence is itself too meagre for any meaningful comparison. For example, because of poor bone preservation and incomplete recovery (it seems that sieving was never practiced at Särnate), the faunal collection is too scanty for an assessment of the diversity of animal species used for food or their relative importance.

Quite apart from the inadequacy of the data in this particular case for mathematically modelling the use of food and non-food resources, we might well question the usefulness of such a model, even if it could be constructed. From the present-day research perspective, it would be simplistic indeed to view past human relationships with the landscape, and with the plants and animals that provided food, only in terms of maximising energy intake per unit time. In the author’s view, rather than providing hard-and-fast ‘rules’ for reconstructing or interpreting human activities, the tenets of optimal foraging theory can be useful in a heuristic mode. They can suggest how people in the past may have acted, or are likely to have acted, in a given set of circumstances, and this is how they are applied here.

Building on the evidence presented in the landscape/resource study, Sections 9.5 and 9.6 consider the site economy from a variety of perspectives, highlighting factors – mobility patterns, storage and various social aspects of resource use – that have come to the fore in recent discussion on the economy and lifeways of past food-procuring communities in Europe and the transition to food production.

Finally, in Section 9.7, various long-term trends are examined. It should be noted that most of the palaeoeconomic data and the majority of organic artefacts that are so informative about resource extraction techniques derive from the latest phase of occupation, namely from the dwellings with Late Särnate Ware. We have much less data of this kind from the dwellings with Early Särnate Ware, while the dwellings with Comb Ware have produced no organic artefacts and virtually nothing in the way of palaeoeconomic data. Hence, it is the latest phase of
occupation for which we have the clearest picture of the site economy, and our data is insufficient for comparing the different phases in economic/environmental terms.

9.2 Palaeogeography

Sārnate Bog, on whose western margin the Sārnate site is located, lies very close to the present-day coast, in the flat terrain of the Coastal Lowlands of western Kurzeme (Fig. 103). The bog, oriented NNE–SSW, measuring a total of 9 km in length, consists of two separate tracts of raised bog, separated by an area of fen and transitional mire. In the area between the two raised bogs, an elevation of the underlying glacial deposits creates a watershed between two drainage basins. Thus, at the present day, the northern tract is drained northwards by two tributaries of the River Užava, while the southern tract, and Lakes Semba and Pāžu, are drained to the south-west by the River Sārnate (and by the River Pāžu, which flows along the south-eastern margin of the southern tract).

The surface deposits in much of the surrounding territory are sands laid down during earlier stages of development of the Baltic Sea Basin: the Baltic Ice Lake and Litorina Sea (Fig. 103: lgIIIblt, mIVlt). These areas are unsuitable for agriculture, so they are largely forested even at the present day. Cultivation is restricted mainly to finer-grained glacial and glaciolacustrine deposits to the west of the central and northern part of the bog (Fig. 103: gIII, lgIII). Further west, a dune belt stretches along the present-day coast (Fig. 103: vIV). The River Užava, the largest watercourse traversing this part of the Coastal Lowlands, passes close to the northern tract of the bog, and the wet meadows of the river valley lie immediately adjacent to the bog.

It should be added that land drainage projects have transformed the margins of Sārnate Bog and the broad valley of the River Užava. Practically all the river and stream channels have been straightened, an extensive network of ditches has been created, and polders have been established in the Užava Valley.

Geological studies provide a general picture of the development of Sārnate Bog. Peat formation began in the area of the present bog already in the Preboreal, after which it was inundated by the waters of the Ancylus Lake. There is gyttja and freshwater lime from this transgression, overlain by sedge peat (Murniece et al. 1999, 53–56).

The initial Litorina Sea transgression followed in the early part of the Atlantic, inundating much of the Coastal Lowlands. Different views have been
expressed by geologists as to the maximum level at Sārnate of the first Litorina transgression (Lit.). Thus, Grinbergs (1957, 35) considers that the level of this marine transgression is marked by a shoreline at 8–9 m above present sea level, while Mūrniece et al. (1999, 54) consider that the level of the sea at this time would have reached only 5–6 m above present sea level. In Fig. 103, the extent of Litorina Sea deposits is shown in accordance with the latter interpretation. Whatever the case, the whole of the present-day Sārnate Bog and the surrounding plain, including the present valley of the lower course of the River Užava, must have been submerged, forming an extensive lagoon.

The lagoon was isolated from the sea by longshore drift, the salinity of the water decreased, the water level fell and the former lagoon rapidly divided into separate lakes (Mūrniece et al. 1999, 54). There are thought to have been several lakes in the vicinity of the Sārnate site at the time when it was occupied, although we have no precise information about the extent of these water-bodies at the time of occupation. The site was evidently located by the north-western shore of one of these lakes. This lake occupied a hollow in the late glacial topography on the north-western side of the southern tract of the present-day Sārnate bog, a hollow that had partly already been filled with mineral matter and gyttja during the Ancylus Lake transgression, and subsequently by fen peat (Nomals 1942, Maps 2, 6; Mūrniece et al. 1999, 54–56, Fig. 7). The lake would evidently have been shallow and eutrophic, with extensive reedbeds and peat deposition on the lakebed. It gradually became overgrown, leaving only the small present-day Lake Pāžu, while transitional and raised bog developed over most of the former lakebed.

During the second Litorina Sea transgression (Lit.), thought to have occurred at about 4000 BP (Veinbergs 1979, 155), i.e. approximately 2500 cal BC, it seems that the site itself would not have been flooded by seawater, but the rise in sea level would probably have brought about a corresponding rise in the level of water-bodies in the coastal plain, and this would presumably have made the site too wet for continued occupation. The two tracts of raised bog developed during the Subatlantic (Mūrniece et al. 1999, 56).
Fig. 103. Geological map of Särnate Bog and the surrounding area (based on Murniece et al. 1999, Fig. 6). The square marks the area shown in Fig. 4; the star marks the position of the Särnate site.
9.3 Landscape / resource areas

9.3.1 The house, the site and the immediate environs

While there is no clear evidence regarding the vegetation at the site itself before and during the earlier phases of occupation, there are indications from some of the dwellings with Late Särnate Ware that trees, in some cases identified as alders, were growing at the site immediately before and even during this period of occupation. Thus, beneath the hearth layers of Dwelling ADR was a thick layer of decayed roots and stumps, and in the nutshell layer of this same dwelling (partly covered by nutshells) there were several fallen alders with roots attached. In Dwelling AZA, a 3-m-long tree was found together with the remains of a fence-like structure (a house wall?): apparently the tree and the structure had fallen together. In Dwelling U, the sand layer covered a fallen alder some 35 cm in diameter (Vankina 1970a, 9, 10; 1971, 10, 14), while the hearth of Dwelling N had at its base a partly uprooted tree stump (Vankina 1970d, 6).

In the course of fuelwood and timber cutting, people must have markedly altered the lakeshore environment in the immediate vicinity. This would have involved the replacement of climax vegetation by scrub and pioneer tree species. Indeed, the fairly young birches and aspens cut for house timbers may be thought to derive from forest in the early stages of regeneration.

As described in Chapter 8, during all three major phases the settlement seems to have been laid out as a row of houses along the waterline. This is a settlement plan familiar from many coastal, riverbank and lakeshore settlements, giving each household equal access to the waterfront. However, there does seem to be a difference between phases in terms of house orientation: at least some of the houses with Comb Ware seem to be oriented end-to-end, with their long axes parallel to the shoreline, while most of the houses with Late Särnate Ware seem to have been arranged side-to-side, their long axes perpendicular to the waterfront. (There is insufficient house orientation evidence for the dwellings with Early Särnate Ware.) The finds of boat remains next to Dwelling K (Vankina 1970a, 37–39) suggest that – at least during the latest phase of occupation – the row of houses was situated very close to the water. It should be emphasised that, although we can form an idea of the overall settlement layout, we do not know which of the dwellings were exactly contemporaneous.

That the people chose to settle in such a low-lying, boggy location would seem to indicate that they attached great importance to living as close as possible
to the lake itself, which represented an essential resource location and transport route. The south-eastwards shift of the row of dwellings between one phase and the next suggests that the lakeshore was retreating and that the people were following it. The final abandonment of the site could have occurred because of a significant rise in the lake-level (perhaps connected with the second Litorina Sea transgression), or because of an increase in the frequency and intensity of spring flooding as a consequence of climate change.

The substantial nature of the hearth structures in the dwellings with Early and Late Sārnate Ware, whose main function would probably have been to heat the house, is indicative of habitation in winter, and the evidence of repeated renewal of these structures points to long-term occupation. In other words, we are dealing with a permanent or semi-permanent village, consisting of the homes of separate household groups. For the Comb Ware phase, there is much less structural evidence, but, as described in Section 8.1.1, this is largely explicable in terms of non-preservation, and the author does not regard the evidence as sufficient to support Vankina’s (1970a, 126) view of these as less substantial dwellings. Consequently, there does not seem to be a firm basis for the conclusion drawn by Zvelebil (1981, 140) that this was a less permanent type of settlement.

As discussed in Section 8.3.3, the remains of the dwellings with Late Sārnate Ware provide evidence of a common pattern of internal spatial structure, a pattern that relates to the overall orientation of the house. We can guess that house orientation and layout, and the pattern of use of domestic space, would have had social and cosmological significance.

People may also have been buried on the settlement site, as suggested by the finds of human bones from Dwelling ADR (two vertebrae and a hip bone). However, there is no contextual information for these finds. Separate human bones have likewise been found on the Šventoji 4 and 23 settlement sites (Rimantienė 2005, 121).

### 9.3.2 The local lake and river system

The site location itself, and the arrangement of the dwellings along the lakeshore, suggest that the residents were highly dependent on the resources of the adjacent lake, and of other nearby lakes and watercourses.

The lakes at Sārnate would have been shallow, with a wide fringe of aquatic vegetation. They would have been eutrophic, i.e. rich in nutrients, and consequently would have had lush aquatic vegetation, supporting a large fish
population. On the other hand, in lakes of this kind, the fish suffer from oxygen deficiency, especially in winter under the ice, restricting the range of species to those that can withstand such conditions.

The nearby rivers and streams would have been slow-flowing, meandering watercourses, probably also partly overgrown. It may be significant that the Sārnate site lies within the basin of the River Sārnate, but very near the watershed with the basin of the Užava. In this situation the inhabitants would not only have had access to the sea via the adjacent lake and the river(s) draining south-westwards, but presumably would also have been able to reach quite easily the tributaries of the River Užava, and thence the Užava itself.

The remains of watercraft include the prow of a logboat, a 2.3-m-long section of one side of the boat, and the prow of a second boat (or maybe the stern of the same one), all found next to Dwelling K (Bērziņš 2000b, 29–30). Thirty-six whole and fragmentary paddles were recovered at Sārnate, all of them with long, narrow blades (Vankina 1970a, Fig. IX, Fig. X). From the dwellings with Early Sārnate Ware there are three paddles whose blade ends in a narrow tongue, which could have been used not only for paddling, but also for poling or for pushing through reeds and rushes. The leaf shape of the blade is considered to have been suitable for shallow, weed-choked water, since less weed is caught up on paddles with this blade form than on paddles with pronounced shoulders (Rimantienė 1979, 38; Burov 1996, 9).

Because of the low height above sea level and the proximity to the coast, the water level in the lakes and watercourses of this area must have been significantly influenced not only by the amount of precipitation in the catchment area, but also by fluctuations in sea level due to wind forcing, i.e. storm surges. A combination of heavy rainfall or snowmelt and a storm surge on the eastern shore of the Baltic could have led to severe flooding. On the other hand, the fact itself that people were living at such a low-lying site, and were building substantial structures there, suggests that spring flooding was not such a serious problem in the low-lying areas of the Coastal Lowlands as it is today. It may be that either the winters were milder, or else precipitation was lower, so that little snow accumulated during the winter, and spring flooding was not such a problem.

9.3.2.1 Freshwater fish

Although fish from the nearby lakes, rivers and streams was clearly an important food resource for the residents of Sārnate, only three fish species have been
identified in the bone refuse, all of them large predators: pike, pikeperch and wels. Of the three, only pike is represented by a large number of bones. However, as ichthyologist Jānis Sloka, who determined the fish remains, has suggested (1984, 76), the people living here would no doubt also have caught the smaller fish on which these carnivores feed. Bones of smaller fish were evidently not preserved because of the unfavourable soil conditions, or were not recovered because sieving was not used in the excavation.

The nearby Mesolithic site at Vendzavas, situated at the margin of River Užava valley, which would have been a shallow lake at the time of occupation, has produced the remains of at least seven fish species: pike, tench, bream, perch, roach, ide and crucian carp (Lõugas 2002, 49). Preservation of bone was somewhat better at Vendzavas, and wet sieving was employed. Because of this combination of factors, we have a much better picture of the fish fauna.

The fish fauna of the lakes near Sārnate would no doubt have been similar to that represented at Vendzavas, and to that of the present-day shallow, eutrophic lakes along the Latvian coast. Tench (*Tinca tinca* L.) and crucian carp (*Carassius carassius* L.), both of them renowned for their ability to withstand the winter oxygen-deficiency resulting from eutrophication, are particularly characteristic of such water-bodies (Sloka 1956, 12). Pike would have been the main predator. Perch (*Perca fluviatilis* L.), bream (*Abramis brama* L.), roach (*Rutilus rutilus* L.) and eel (*Anguilla anguilla* L.) are also commonly listed in the fish records for Latvia's coastal lakes (Lūmane 1995, 223; Placēna 1995, 51; Tidriķis 1995, 68; Eipurs 1998a, 120; 1998b, 224). The fish fauna of the slow-flowing watercourses of the surrounding area would have been similar to that of the lakes.

That pike would commonly have been caught in the waters around Sārnate comes as no surprise, but the presence of pikeperch and wels in the bone samples requires some comment.

Researchers have distinguished two biological forms of pikeperch (*Stizostedion lucioperca* L.): one lives in the coastal waters of the Baltic, entering the lower courses of rivers and coastal lakes to spawn, while the other inhabits inland waters (Birzaks *et al.* 1997, 140). Bones of pikeperch have been found at the site of Naakamäe on the Estonian island of Saaremaa, as well as Šventoji and inland Neolithic sites (Lougas 1997, 34; Daugnora 2000, Table 11), which means that both of the above-mentioned forms must have been present in this period. As regards its freshwater habitats, it is viewed more as an inhabitant of rivers than lakes, so finds of pikeperch in bone refuse at other sites have been considered as evidence of river fishing (Sloka 1975, 70; 1985a, 73).
The wels (Silurus glanis L.) also seems somewhat out of place at Sārnate, since it is regarded primarily as a deepwater fish, an inhabitant of major rivers (Sloka 1986: 130). Its presence at Sārnate could indicate that the people used fishing grounds beyond the immediate environs of the site – perhaps the River Užava (see Section 9.3.3). Wherever it took place, fishing for wels is likely to have been a summer activity, since this is the time when the fish is most active, feeds most intensively, and moves to shallow water in order to spawn (Sloka 1979, 67; 1986, 130).

From the presence of eel clamp components, we may infer that eel was the subject of a specialised fishing effort. Indeed, eel fishing was particularly important at some of Latvia’s coastal lakes in the recent past. For example, Lake Liepāja on Latvia’s south-west coast is still renowned for its eels, and eel fishing has traditionally been important at other coastal lakes as well (Anonymous 1892). Judging from the ethnographic data, the people at Sārnate, in addition to spearing eels wintering in the mud of lakebeds, are likely to have maintained barriers and traps from the spring through to the autumn, especially at lake inlets and outlets, in order to catch eels making local migrations between lake and river, and those migrating downstream to reach the sea for the spawn (Benecke 1881, 386–388; Anonymous 1892, 6–9).

Next, we may consider the range of fishing methods for which we have actual evidence, and other methods that are likely to have been practiced in the waters around Sārnate. In summer, when the growth of aquatic vegetation would have hampered the use of moving fishing gear such as seines, most of the catch would evidently have come from some kind of stationary gear. This would probably have included set nets, which would almost certainly have been nets with a single mesh, i.e. gill nets. Modern-day gill nets are made so as to be largely invisible to the fish, but in the past, when this was difficult or impossible to achieve, set nets tended to be used in active fishing, i.e. driving the fish into them. Such a technique is particularly effective against fish spawning in shallow water: the net may be placed behind or surrounding a stand of aquatic vegetation where the fish are likely to be, and the fish then driven towards it (Manninen 1931, 193; Sirelius 1934, 127).

Gill nets might have been used in winter too, when it would have been difficult to construct permanent barriers. In this case, holes would have had to be made in the ice, and poles used to extend the net beneath the ice. For driving the fish into the net, additional holes could be made at a distance from the net (Ligers 1942, 80–81, 85–87, Figs. 87, 91–106). In winter, gill nets may also be extended
across river inlets and outlets that serve as fish migration pathways to running water, where they seek to escape the anoxic conditions in the lake under ice cover (Anonymous 1892, 4, 6–7).

Seine nets may well have been used in the lakes, although the presence of end-sticks in the material from Dwelling K should not be regarded as proof of this (see Section 6.1.3). Seining could conceivably have been one of the most important and productive fishing methods in the nearby lakes, but the use of seines is greatly hampered by aquatic vegetation, which means that the technique, if it was used, would have been restricted mainly to the spring, before vegetation growth, and the autumn, after the vegetation has died back (Seligo 1926, 92–93). In historical times, professional fishermen also made extensive use of winter seining under the ice, but this might be regarded as too complicated a technique to have been used in prehistory. Seining (unlike gill-netting) is a rather non-selective technique, in that all fish too big to pass through the mesh of the net will be caught, unless they succeed in jumping over the seine or slipping under it. This means that a range of different species and fish sizes would have been represented in seining catches.

The lath screens from Särnate were evidently used to build more permanent barriers for catching fish in shallow waters. These structures, which would have been supported by stakes, could have consisted entirely of lath screens, constructed in the manner of *katicas* and similar devices (c.f. Section 6.1.5), which channel the fish into catching chambers from which they cannot find their way out. Alternatively, such screens may have formed only the barrier itself, with fish-traps as the catching devices.

Such barriers could have been used at various times of the year to catch a range of fish species. In spring, they can be erected at the spawning grounds or across the paths that the fish use to reach these grounds (Cimermanis 1962, 175). In summer, fish fences would have been erected in or between clumps of aquatic vegetation in the spawning grounds (Anonymous 1892, 10; Ligers 1942, 34).

Bone spearheads that could have been used for spearing fish are absent at Särnate, but evidence from other sites shows that they did remain in use during the Neolithic, although the range of forms is reduced, compared with the Mesolithic (Zagorska 2000a, 13, 17, Fig. 4). Fish-spearing actually includes a whole group of techniques, each of them specific to particular seasonal conditions. First, we may mention the spearing of fish by day at their spawning grounds – especially pike, which spawns in spring in very shallow water. Bream and tench could also have been speared in this manner, and perhaps pikeperch and
wels too (Sirelius 1934, 97; Cimermanis 1963, 90; Sloka 1986, 130). That pike were being speared in the Stone Age is proven by three cases in Estonia and Sweden, where pike bones have been found on former lakebeds together with bone fish spears (Clark 1948, 58). It is likely that many of the large pike whose bones have been found at Sārnate and other Neolithic sites were caught in this way. It is generally only during the spawn that pike can be approached close enough for spearing. Although this method could provide a rich catch, it did require great skill and endurance: the fisherman had to wade through the cold water of flooded meadows, stabbing with the weapon, or throwing it, wherever telltale movement of the water betrayed the presence of spawning pike (Sabaneev 1911, 318, 472; Ligers 1942, 24; Cimermanis 1962, 169).

A second method was spearing by night, with a light source, which served both to illuminate the water, and to attract and momentarily daze the fish. This method was possible later in the spring, once the floods had subsided and the water was sufficiently clear once again, but before vegetation had grown up (Ligers 1942, 29). However, it was most commonly an autumn activity, practiced after the aquatic vegetation had died back. This method of spearing was usually conducted from a boat. A variety of large fish were speared in this way: tench, pike, vimba bream, bream, burbot and wels. (Sabaneev 1911, 102, 110, 477; Sirelius 1934, Fig. 174; Ligers 1942, 25–32; Cimermanis 1962, 169).

Thirdly, fish may be speared through holes in the ice: mainly burbot during their winter migration (Manninen 1931, 120–121).

Finally, eel spearing can be distinguished as a separate method. As described in Section 6.1.6, eels were speared at Sārnate and other Neolithic sites along the Baltic coast using a special weapon, the ‘eel clamp’, which would have been employed most intensively during the winter, when the eels lie concealed in the mud of the lakebed.

Angling would have been primarily a method for catching large carnivorous fish, such as pike, perch, wels and burbot (Cimermanis 1973, 121; Lõugas 1996, 105; Sloka 1979, 69). Large numbers of single-piece bone fish-hooks, as well as bone points and bone or slat e shanks of composite fish-hooks, and some bone gorges and sinkers, have been recovered at archaeological sites, and particularly as stray finds at Lake Lubāns and Lake Lielais Ludzas in eastern Latvia. Several kinds of fish-hooks can be dated to the Neolithic. They show a range of forms and sizes, and would have been suited for catching particular species of fish (Zagorska 1977; 1994). The absence of fish-hooks at Sārnate may be explained in terms of non-preservation. Somewhat surprising, however, is the almost total
absence of fish-hooks at Šventoji, where bone preservation was better (Rimantienė 2005, 78).

During the spawn, large fish may also have been shot with the bow. This is recorded as a method of catching pike among the Khanty and Mansi of Siberia (Sirelius 1934, 97). Zagorska (1991, 47, 49) considers that the Mesolithic and Neolithic needle-shaped bone points found in large numbers on lakebeds in eastern Latvia would have been particularly suitable as arrowheads for shooting fish (an alternative interpretation being that they were used on arrows shot at waterfowl).

Another method frequently mentioned by ethnographers is the stunning of fish (mainly pike, burbot and perch) in early winter before snowfall, under the first thin cover of ice. It appears that this may have been an important method of catching fish in these specific conditions, when fishing by other methods was problematic (Manninen 1931, 107; Ligers 1942, 9–12).

The stable isotope studies undertaken on the Zvejnieki material indicate the importance of freshwater fish in the diet of the Mesolithic and Neolithic people inhabiting an inland lake basin such as that of Lake Burtnieks. Although there is evidence that from the Middle Neolithic the contribution of mammals or birds to the diet increased at Zvejnieki (compared to almost total dependence on fish in earlier periods), fish remained an important component of the diet (Lõugas et al. 2003). Probably, the inhabitants of settlements at the coastal lakes of the East Baltic also subsisted largely on fish. Freshwater fish can be regarded as a stable resource in that they would have been present in this location all year round. However, it must be emphasised that in order to exploit this resource throughout the year, the fishermen would have had to vary their methods and the kinds of gear they used in order to match seasonal changes in fish behaviour and conditions at the fishing locations. Each of the fish-catching methods described above can be very productive, but each is practicable and efficient only at certain times of the year, under the right conditions. This in itself would account in large measure for the diversity of fishing gear remains recovered at Sārnate and other sites.

It might be suggested that fish are likely have contributed less to the diet during winter: quite apart from the technical difficulties of ice fishing, many fish species become inactive during this season, making them almost impossible to catch. However, several lines of evidence suggest that people were applying the special techniques of ice fishing, which may have been no less productive than fishing in other seasons. As we have seen, the eel clamp is an implement that
seems to have been used mainly in winter. Also, a large number of finds of bone implements interpreted as ice-picks have been recovered from former lakebeds in Estonia and Latvia (Lõugas 1996, 107; Vankina 1999, 259–261), a good indication that people were making holes in the ice for fishing. The bones of burbot, present in the faunal remains at certain Mesolithic and Neolithic sites (Sloka 1985b, 111–112; Daugnora 2000, Table 11), constitute an important seasonal indicator: since the burbot’s spawning migration takes place in midwinter, it would have been a special target of fishing activities during this season (Benecke 1881, 90, 395, 405, 409; Sabaneev 1911, 118; Manninen 1931, 120–121, 129–134; Cimermanis 1962, 176). Physical anthropologists, too, have obtained evidence suggesting that people were active on the winter ice: three cases of fractured lumbar vertebrae were recorded on the male skeletons from the Mesolithic/Neolithic cemetery of Zvejnieki. These rather unusual fractures are thought have resulted from falls on the ice during fishing (Jankauskas & Palubeckaitė 2006, 156).

9.3.2.2 Waterfowl

Sārnate lies on the important bird migration route along the west coast of Kurzeme, and in the Neolithic, as today, the nearby lakes and the sea would no doubt have been teeming with migratory birds in spring and autumn. Consequently, during these seasons in particular, and in the moulting season at midsummer, the hunting of migratory waterbirds could certainly have yielded great returns.

There is also some direct evidence of fowling. In Dwelling O there was a pit full of bird bones, and a large number of bird bones were found in Dwelling V (Vankina 1970a, 18, 126). However, most of this material remains undetermined. The few bones that have been identified include duck, not identified to species (Vankina 1970a, 18).

From Dwellings A, D, G and T there are three blunt wooden arrowheads (Vankina 1970a, 96, Fig. XXII: 5–7), which would have been used against birds and/or small fur-bearing mammals. Mass catches of waterfowl could also have taken place: they may have been caught in nets or driven into nets, especially during or after the migration, when they are exhausted, or even caught by hand or clubbed, which is possible during the moulting season, when the birds are almost incapable of flight (Storå 1968).
Although the evidence from Sârnate is meagre, bird remains from Neolithic coastal sites of the East Baltic with better bone preservation indicate that waterfowl were indeed a very important resource. A classic example is the site of Narva Riigiküla III, by a former estuary in north-eastern Estonia, where ducks in particular were hunted on a mass scale (Gurina 1967, 155, 157–158). Many different waterbirds were hunted in the lagoonal lake at Šventoji: as many as 17 species are represented in the material from the sites here (data from Daugnora & Girininkas 2004). Some of the Neolithic coastal sites in Finland (Jettböle I, Vepsänkangas) have likewise produced rich collections of waterfowl remains (Mannermaa 2003, 20, Appendix 3).

In late spring and early summer, eggs of waterbirds (as well as forest birds) could also have been gathered on a large scale (Nunez 1991, 44).

There are also several bird representations carved in wood from the dwellings with Late Sârnate Ware. These are mainly found on spoon handles. The objects include: a spoon with a handle in the shape of a goose’s head; a spoon handle resembling a duck’s head; a carving of the head of a waterbird, probably also from a spoon handle; a broken-off part of some object carved into the head and long neck of a waterbird – apparently a swan; and the torso of a bird figurine, which constituted part of some utensil. (Vankina 1970a, 103, Fig. XXXVIII: 3; Fig. XXXIX: 3, 5, 6).

9.3.2.3 Beaver

There is also evidence that the people at Sârnate were hunting a mammalian inhabitant of watercourses, namely the European beaver (Castor fiber L.). The bone refuse from three dwellings includes beaver teeth (Appendix 10, Tables 23, 25, Figs. 104, 105).

The sluggish rivers and streams, and eutrophic lakes, of the Coastal Lowland area would evidently have provided many locations for beaver habitation. Beaver families are easy to locate because of the conspicuous evidence of their gnawing and building activities. On the other hand, they are mainly nocturnal, and are well protected in the water or in the lodge, so they are difficult to hunt. Even today, beaver hunting requires specialised, labour-intensive techniques (Medības Latvijas PSR 1984, 89). Active hunting techniques could have included driving the beavers out of the lodge and into nets placed in the river (Sirelius 1934, 44). Passive methods were also practiced in the recent past: beavers were caught in
traps or nets (Henriksson 1978, 49), or in fences or ‘weirs’ under the ice (Sirelius 1934, 83–84).

Beavers would apparently have been easiest to hunt in autumn, when they are particularly active building dams and amassing winter stores (Zvelebil 1981, 189), although special techniques could have been used in winter hunting, as mentioned above. Beaver was no doubt important for its fur, which is in best condition between late autumn and early spring (Medības Latvijas PSR 1984, 89).

Bone remains from other Neolithic sites confirm that otters (*Lutra lutra* L.) were also being hunted in the East Baltic region (Daugnora & Girininkas 2004, Table 9, Table 22).

### 9.3.2.4 Water chestnut

As described in Chapter 8, the shells of water-chestnuts (*Trapa natans* L.) were found in many of the dwellings with Early and Late Sārnate Ware. In several cases, the shells formed thick layers, and it is evident that the nuts were being collected in large quantities. Water chestnut shells and charred whole nuts have been found at other Mesolithic and Neolithic sites in the East Baltic, and likewise in southern Sweden, southern Finland and north-western Russia (for an overview, see Zvelebil 1994, Table 1), but nowhere in such great quantities as at Sārnate.

The water chestnut is an annual aquatic plant that produces spiny nuts concealed under its floating leaves. Under natural conditions, the nuts become detached from the plant in autumn and fall to the bed of the water-body, where they germinate in spring. In order to successfully reproduce, the water chestnut requires a sufficiently high water temperature in spring for germination, and also sufficient warmth in summer for flowering. During the Atlantic and Subboreal, this thermophilous plant had a distribution extending as far north as southern Finland, but has since retreated southwards, and nowadays its northernmost occurrences in Europe are in Lakes Klaucāni, Pokrata and Priekulāni in eastern Latvia. Various reasons have been suggested for its retreat: the direct or indirect influence of climatic change, as well as human activity. (Apinis 1935; 1940, 78–79; Žvagiņa, Enģele, Kalniņa & Mešķis 2005).

The abundant finds of water chestnut shells at Sārnate, together with nut-cracking mallets that still have the spines of the nuts embedded in them (Apinis 1940, 19), demonstrate that the water chestnut was one of the major resources obtained from the surrounding water-bodies. The nuts, which consist mainly of starch, can be eaten raw, roasted or boiled, or they can be pounded into fragments
to be consumed in a broth, or even ground into flour for baking bread or pies, or for making soup (Apinis 1940, 18; Vasil’ev 1960, 72–77). At Sārnate, after being shelled in raw condition, the nuts could have been prepared in various of the above-mentioned ways, and finds of burned unshelled nuts confirm that some were being roasted in ashes (Vankina 1970a, 134). As with hazelnuts, the importance of water chestnuts as a food resource would have been due in large measure to their storability in an unprocessed state (Rowley-Conwy & Zvelebil 1989, 55). Large quantities of nuts, harvested in late summer or early autumn, could have constituted a ready stock of food for the winter.

Exploitation of the water chestnut could have involved simply collecting the ripe nuts, but this can lead to local extermination of the plant through over-exploitation (Vasil’ev 1960, 84). At the present day in parts of Asia, the water chestnut is under cultivation: part of the harvest is kept for seed and sewn in lakes, ponds or paddy-fields (Vasil’ev 1960, 80–81; Mazumdar 1985). It has been suggested that in prehistory the water chestnut may have been cultivated and deliberately spread in Europe as well (Apinis 1940, 18, 74 and works cited therein). A variety of management practices could have been used. At the simplest level, people could certainly have aided the spread of the plant by tossing ripe nuts in autumn into lakes with suitable conditions where the plant had not yet become established (Vuorela 1999, 340). They could also have promoted successful regeneration of the plant by avoiding over-exploitation: intentionally leaving a proportion of the nuts unharvested.

Under natural conditions, the water chestnut competes for light and nutrients with other aquatic plants, such as water crowfoot and waterlilies. At the present day at its relict sites in eastern Latvia, this competition restricts the water chestnut to conditions that are particularly favourable for it: relatively deep water (1 m or more) with neutral or slightly acid reaction (Apinis 1940, 21–22, 78). This suggests another management practice that could have been employed: people may have weeded out less useful plants in order to promote the growth of water chestnut, thus maintaining it even at those sites where under natural conditions it would tend to be ousted by its competitors.

It is even possible that the water chestnut was being sown in a systematic manner in the spring, but in order to keep the nuts in a viable condition, they must be prevented from drying out. To this end, they may be stored underwater or in a wet substrate, for example on the bed of the water-body or in a closed pit (Vasil’ev 1960, 83). The Sārnate excavation records do not provide any clear evidence of such a practice. A 25-cm-thick layer of unshelled nuts near the base
of the hearth of Dwelling N (Vankina 1970a, 47) could be such a stock of seed material, but it could just as well be a stock of nuts intended for processing.

It is hard to say whether the water chestnut constituted a reliable resource in the Late Atlantic / Early Subboreal. Even if it was favoured by human management, germination and flowering would have taken place only if spring and summer temperatures were warm enough. In the northern part of the plant’s range, the nut yield may have varied considerably from year to year, depending on the spring and summer temperatures.

9.3.2.5 Molluscs

The use of crushed mollusc shells, probably those of freshwater mussels, for pottery temper (see Section 5.7.2) suggests that the molluscs may in the first place have been collected for food. Judging from the pottery, where the shell temper has virtually always been dissolved, the acid conditions on the site could also have dissolved mollusc shells in the food refuse. Apart from this, the utilisation of mollusc shells as pottery temper may account at least in part for the general rarity of shell accumulations in the region. The only true shell midden in the East Baltic has been discovered at Rūņukalns in northern Latvia, next to the outflow of the River Salaca from Lake Burtnieks, but smaller accumulations of freshwater mollusc shells (*Unio*) have been found at Narva Riigiküla I (Gurina 1967, 22, 25, 159, Fig. 10, Fig. 12) and at sites in the Polish Lowlands (Bogucki 1982, 50, 80, Fig. 11). Freshwater mussels were also consumed in Latvia in the Bronze Age: large quantities of mussel shells (*Unio pictorum*) were found by the hearths of the hillforts of Ķivutkalns and Vīnakalns on the River Daugava, and were present in the cultural layer of Brikuļi Hillfort in eastern Latvia (Graudonis 1989, 81; Vasks 1994, 61).

At Sārnate, the species of freshwater mussels available nearby and large enough to be collected and eaten may have included *Anodonta cygnaea* and *Anodonta anatina*, which live in standing water-bodies, as well as *Unio pictorum* and *Unio tumidus*, which inhabit both lakes and rivers (Sloka 1994; 1998). Living molluscs, which lie almost entirely buried in the bed of the lake or watercourse, would most easily have been collected in summer low water periods. Alternatively, they can also be collected in winter under the ice, if visibility is good (Birgitta Johansson, pers. comm.). They can be regarded as a stable, predictable resource, but one that may have been locally depleted if collecting was intensive. Although molluscs are not particularly nutritious, they may have
served as a supplement to the diet, and as an important protein source in times when hunting and fishing did not give sufficient returns (see Waselkov 1987; Erlandson 1988).

9.3.3 The River Užava

As today, so too in the Neolithic, the basin of the River Sārnate would have been small and restricted to the plain of the Coastal Lowlands. As we have seen above, the lakes and streams of this basin would have offered a variety of food resources, and the Sārnate itself provided a connection to the sea, but it did not give access to inland areas. However, as noted above, the site was located near a watershed, on the other side of which began the drainage basin of the River Užava. Streams from the area of the present-day northern tract of the bog join the River Užava itself, and in the past these would presumably have provided a travel connection with the Užava. Apart from this, at the closest point, the River Užava is only 5 km from the Sārnate site, as the crow flies, so it may easily have been reached overland too.

In Neolithic times, the River Užava would have been an important feature of this coastal landscape. It must have served as a communications route, linking the coast with inland areas, and thus facilitating the exploitation of the resources of the latter, and presumably also contact with people living there.

Apart from this, salmon, trout and lamprey migrate up this river at the present day (Īpaši aizsargājamās dabas teritorijas dabas parka “Užavas lejtece” dabas aizsardzības plāns. Undated, Table 6; Birzaks et al. 1997, 147), and in the Neolithic, too, the Užava must have been economically important for its migratory fish.

A number of stray finds of Mesolithic and Neolithic bone and antler implements have been recovered from the bed of the Užava, almost all of them deriving from one particular stretch of the river by the village of Sise (Fig. 103). At this same location, sherds of Comb Ware, Corded Ware and porous pottery, as well as flint and stone artefacts, have been found on the riverbed and on its banks (Murniece et al. 1999, 51–52; Bērziņš 2004, 13). In other words, this must have been a particularly favourable location, occupied at various times during Stone Age.

The long-continued human occupation at Sise must have been connected with the fishing opportunities that this location offered. Fishing structures would almost certainly have been set up on the Užava to catch migrating salmon during
the summer and autumn (Cimermanis 1963, 97–101), and perhaps also lamprey in
the autumn and winter (Manninen 1931, 226; Cimermanis 1964). The spawning
grounds would have been further upstream: trips could have been made to these
locations in late autumn, in order to spear the fish during the spawn itself
(Cimermanis 1963, 90; Vilkuna 1984, 452).

Bones of salmonid fishes have been found at Mesolithic and Neolithic sites in
the East Baltic, but only in very small numbers (Lõugas 1997, 26; Daugnora
2000, Tables 3, 5, 10, 11). Consequently, salmonids have not received much
attention from prehistorians as a past food source. However, the rarity of finds
may be put down to poor preservation, a consequence of the high fat content of
the salmonid skeleton. During the migration season, they must have been
exploited as a major resource. The same is probably true of lamprey, which is
likely to remain archaeologically invisible, because it has no bony skeleton.

It is impossible to say whether the people living at Sārnate were able to utilise
the seasonal fish resources of the River Užava and use the river as a transport
corridor, but, in view of its proximity, it is hard to imagine that they would not
have made use of it – unless other human groups prevented them from doing so.

9.3.4 The beach and dunes

The seacoast would have been reached by walking a few kilometres directly
westwards, or by travelling down the River Sārnate to its mouth. In Neolithic
times, as today, the coastline was fairly straight, with long beaches of sand and
shingle.

The beach was the source of a highly-prized material that evidently had
considerable economic and social importance: amber. It was a material that only
became widely available in the East Baltic at around the end of the Early
Neolithic and the beginning of the Middle Neolithic, when, during a
transgressional phase of the Litorina Sea in the southern Baltic, amber-rich strata
of the Sambian Peninsula were intensively eroded and the amber carried
northwards by the current (Blüjienė 2007, 65, and sources cited therein).

Nowadays only small amounts of amber are washed this far north along the
coast, but during the Litorina Sea stage, amber was evidently much more common
along the western coast of Kurzeme and even in the Gulf of Riga, and occurred in
the form of lumps big enough to be used for making ornaments. This situation can
partly be explained in terms of the intensive erosion of amber-bearing strata in the
southern Baltic at this time and the prevalence of strong northward currents.
However, the greater salinity of the Litorina Sea, compared with the present day Baltic, must also have contributed to the intensive longshore transport of amber. Greater salinity means increased water density, and even a small increase in salinity is enough to significantly improve the buoyancy of amber, so that it tends to be transported further (Faber, Fransen & Ploug cited in Bliujienė 2007, 73).

Given the importance of amber, people would presumably have made trips to the beach for the express purpose of collecting it, trips that would have been undertaken immediately after spring and autumn storms in the Baltic, when amber is cast up on the shore. Being much less dense than stone, amber is generally not to be found in the beach shingle, but in the seaweed washed up by storms. More serious amber-gathering, as practiced in historical times by the Sudovians of the south-eastern Baltic coast, involved wading into the sea and collecting it with long-handled scoop nets (Bliujienė 2007, 75 and sources cited therein). Since amber was clearly of some value in the Neolithic, it is conceivable that the coast-dwellers of this time also went to the trouble of wading out to sea in order to collect it, and might have had special tools for the purpose.

The dune belt and beach would also have been the major source of sand for the hearths and dwelling floors, and the source of pebbles, selected for shape and rock type appropriate to specific uses: small elongated pebbles for sinkers to be wrapped in birch bark, and larger flat quartzite pebbles for end-notched and side-notched sinkers, as well as quartzite and sandstone blocks for grindstones and whetstones.

Pebbles are washed into the sea along certain stretches of the Kurzeme peninsula and further south, where the sea erodes glacial till, and are carried northwards, rolled and sorted by longshore drift. At the present day, harbour structures block the northwards movement of the shingle, restricting its availability, but in the past it could have been carried without hindrance along almost the whole of the west coast of Kurzeme. (Jānis Lapinsksis, pers. comm.).

Pebbles of poor quality flint (‘chert’ in the geological terminology), eroded from glacial till, were probably also present in the beach shingle, so that the beach would have been one of the main sources of raw material for knapping, albeit of much inferior quality to the flint and chert obtainable from more distant areas by exchange. The locally obtainable material, generally white, light grey or tan in colour, constitutes a high proportion of the knapped stone at Sārnate, as at other Neolithic (and Mesolithic) sites along the west coast of Kurzeme.
Finally, it may be noted that the beach, free from hindrance and offering easy orientation, is also likely to have provided a north-south travel route along the coast.

9.3.5 The sea

9.3.5.1 Conditions in the Baltic Sea

The west coast of Kurzeme has quite a straight coastline, largely exposed to the prevailing south-westerly winds, from which there is little shelter even in the coastal waters. The situation in this regard would probably have been similar during the Litorina Sea stage. The pattern of formation of sandbars and spits along the coast shows that in that period, as today, sediment was predominantly being carried northwards along the coast.

However, winter conditions on the sea may have differed significantly from those of the present day. The importance of harp and ringed seal as game species at Sārmate (and at Šventoji, even further south) would seem to indicate that ice cover was more extensive on the Baltic Sea during Late Atlantic and Early Subboreal winters that it is today. This applies particularly to the ringed seal, which was apparently breeding along this coast (see Section 9.3.5.3). It has been hypothesised that during the Subboreal, with a more continental climate than that of the present, i.e. warmer summers, but colder winters, the boundary of the pack ice in the Baltic lay further south (Lepiksaar 1964, 263), or that ice cover was more extensive during the Litorina Sea stage because of the strong influx of salt water through the deep and broad Danish sounds (Forstén & Alhonen 1975, 152).

9.3.5.2 Sea travel

Logboats, if they are to serve as seagoing craft, generally have to be modified in some way to improve their transverse stability: either by expansion through controlled heating or by adding stabilisers along the sides or additional timbers to increase the freeboard and beam (Bērziņš 2003b, 31). There is some evidence that logboats used in the Baltic region in the Neolithic did indeed have attachments along the sides (Rimantienė 2005, 79, 81). Even in recent times, modified logboats were used in coastal waters of the Baltic: Bielenstein (1918, 619) writes
that logboats enlarged by attaching one or more planks along the sides (and fitted with a sail) were being used as fishing vessels in the Gulf of Riga.

Of course, seafaring requires not just seaworthy craft, but also good knowledge of the sea and special navigational skills. If the Neolithic inhabitants of this coast were taking their boats out to sea on this exposed coast, they were presumably making fishing trips (and perhaps sealing trips?) fairly close to shore, and coastal voyages from one headland to the next, or from one river mouth to the next. The coastal waters may have been a convenient route for north-south travel along the Kurzeme shore, and perhaps across to the island of Saaremaa in the north. (Bērziņš 2000b, 38–40).

Jaanits (1985) has brought together archaeological evidence of early contacts across the Baltic between Sweden and Estonia towards the end of the Neolithic: similar ornaments on pottery, common spear types and analogies in burial practices. He suggests that the first accidental contacts across the Baltic may have occurred when Neolithic seal hunters were carried on drifting ice or driven by storm winds to the opposite coast. Artefactual evidence shows that closer trans-Baltic contact developed during the time of the Boat-Axe Culture of the Late Neolithic, but it is not clear whether this took the form of planned trading trips.

Sārnate lies directly opposite the island of Gotland, but the distance separating the two shores is 150 km. Assuming that both coasts were visible from a distance of 10–20 km out to sea, this still leaves over 100 km to travel out of sight of land (Bērziņš 2000b, 40). It might be assumed that voyages across such an expanse of open water were not made, at least not intentionally, but if it is true that the winter ice was more extensive on the Litorina Sea, seal hunters might indeed have made their way across in winter.

9.3.5.3 Seals

Seals are prominent in the refuse fauna of many Neolithic sites on the Baltic coast, and at Sārnate they constitute the best-represented group of mammals in the faunal remains from the Late Sārnate Ware phase – the only phase that produced a sufficient number of bone remains to permit meaningful interpretation. At least two seal species are present: harp seal (*Phoca groenlandica* Erxlm.) and ringed seal (*Phoca hispida* Schreb.). There is also one bone tentatively identified as grey seal (*Halichoerus grypus* Fabr.). (Appendix 10, Tables 23, 25, Figs. 104, 105).

The harp seal is absent from the Baltic at the present day, but is one of the main seal species represented at Neolithic and Bronze Age sites (Lõugas 1997,
354

Storå & Ericson 2001, 2), a phenomenon that has given rise to extensive debate among palaeozoologists. According to one hypothesis (Lepiksaar 1986, 62; Lõugas 1998, 68), the harp seal – an Arctic species that stays at the ice-edge all year round – did not form a breeding population in the Baltic Sea. Instead, harp seals are regarded as having made autumn/winter feeding migrations into the Baltic, particularly during the Subboreal, when winter ice cover is thought to have been more extensive than today, leaving the Baltic Sea before their early spring breeding season.

The alternative hypothesis – that harp seals did breed in the Baltic – has received new support from the evidence that there are very young harp seals, including newborns, in the refuse fauna of sites in Eastern Middle Sweden, Gotland and Åland (Storå & Ericson 2001, 12, 15–16). It seems the hunters of this time were able to reach the breeding grounds, which are suggested as having been located south of Åland, between mainland Sweden and Gotland (Storå & Ericson 2001, 16). On the other hand, bones from such young harp seals are absent from the coastal sites in Estonia and from Västerbjerger on the east coast of Gotland: evidently, the seal hunters of the East Baltic could not easily reach the breeding grounds (Storå 2001, 46; Storå & Ericson 2001, 12).

Forstén & Alhonen (1975, 153, 154) suggest that the peak season for harp and grey seal hunting was in the spring off the fast ice, which would explain the rarity of these species in the bone refuse of mainland Finnish sites: they are thought not to have occurred this far north during the peak sealing season. It is suggested that they followed the receding ice northwards, inhabiting the Gulf of Bothnia only in the summer and autumn. On the other hand, Storå (2001, 28) considers that after the breeding season harp seals migrated from the areas around Gotland to various other parts of the Baltic – the Åland Islands, the Estonian and Polish coast, and probably the Gulf of Bothnia as well. Based on the osteological data, he argues that considerable numbers of harp seals would have been hunted or captured in open waters during the summer half of the year, and probably during the entire ice-free period (Storå 2001, 46; Storå 2002b).

Harp seal bones are recorded at Neolithic sites all along the East Baltic coast: at Narva Riigiküla I and III and Kudruküla by the shore of the Gulf of Finland; at Kõpu XI, Loona and Naakamäe on the Estonian islands; at Kaseküla on the west coast of the Estonian mainland; at Siliņupe at the southern end of the Gulf of Riga; by the open-sea coast of Kurzeme at Sārmate; at several of the Šventoji sites by the Lithuanian coast; and at Rzucewo in present-day Poland (Lõugas 1997, 39; Daugnora 2000, Table 15; Lasota-Moskalewska 1997).
It would be of great interest to ascertain whether harp seal hunting along the east coast of the Baltic took place in the winter or early spring from the ice, or whether they were being hunted in the open water during the ice-free period. Since the latter method would definitely have required seagoing craft, this question is highly relevant to the history of seafaring and marine resource exploitation in general. However, if seals were present in the Baltic all year round, this is not an easy question to answer. Presumably, the migration of harp seals to this coast was connected with the shorewards migration of marine or anadromous fish species, but these fish migrations occur at various times of the year, from spring to late autumn.

As regards the actual method used to hunt harp seals, there is a find of a skeleton of this species together with a bone harpoon head on the former seabed at Närpiö in Finland, which proves that harpooning was one of the hunting techniques used against this species in the Baltic. The find has also been regarded as evidence of the season of hunting: a seal in sleek, fat condition may float, but in spring the animals are emaciated, their fat reserves exhausted after breeding, and the carcase will sink, as had evidently occurred in this case (Forstén & Alhonen 1975, 151). It has also been suggested that nets were used to catch harp seals in the Baltic, as they have been in modern times in the animal’s present area of distribution (Storå 2002a, 397).

The harp seal bones from Särnate represent body parts of relatively low meat value: bones of the head, as well as limb bones. This suggests that, instead of discarding the head and flippers of these rather large seals, the hunters were transporting whole carcases back to the site. Such a pattern could indicate that seal meat was intensively utilised, or it may have to do with the pattern of hunting forays: if seal culls were not particularly large, and/or if hunting took place on the open water, then there may not have been an acute need to reduce transport costs by discarding low-utility body parts.

The ringed seal continues to inhabit the Baltic at the present day, and was hunted until very recently, so it’s past ecology and economic role are somewhat easier to assess. It is smaller than the harp seal, and its behaviour differs in important respects from that of the harp seal, and from its present-day relative in the Baltic – the grey seal. It is more solitary than these two species, and tends to remain close to the shore. It does not avoid narrow bays and may travel far upriver in search of food. Moreover, unlike the other species, it can make breathing holes in the fast ice, permitting it to stay near the coast even in winter.
The pups are born on the fast ice in specially constructed lairs. (Forstén & Alhonen 1975, 146–147, 152).

Ringed seal bones, though generally less abundant than those of harp seal, have likewise been recorded at Neolithic sites all along the East Baltic coast (Lõugas 1997, 37; Daugnora 2000, Table 15). As already mentioned, since we know that ringed seal was common enough to be hunted along the west coast of Kurzeme and further south, we may infer that ice conditions in this period were more favourable for them along this coast than they are at the present day. Since the ringed seal breeds near the edge of the fast ice, optimal conditions for hunting this species in the winter apparently exist where there is stable ice cover, but where the fast ice does not extend too far out, so that the breeding sites can easily be reached by the hunters (Gustavsson 1997, 115). It may be that such optimal winter conditions tended to occur along this stretch of the Baltic coast during the Late Atlantic and Early Subboreal (c.f. Siiriäinen 1981, 25).

Refuse faunas from Neolithic sites along the central and northern Baltic Sea include bones of very young seals, indicating that ringed seals were hunted on the ice in the early spring, during the breeding season (Storå 2001, 31, 46; Storå 2002a, 395, 397; 2002b). Presumably, the seasonal pattern was similar along the west coast of Kurzeme. At any rate, this stretch of the Baltic coast does not provide an attractive habitat for seals during the ice-free period of the year: the straight, mostly sandy shore with no islets is distinctly lacking in suitable haul-out locations for seals (Pilâts 1989, 180). As far as we may judge, the situation in this regard would not have been very different in the Subboreal.

Because of its solitary nature, the kinds of mass hunting techniques used against other species generally cannot be applied in hunting the ringed seal (Sirelius 1934, 90). A method of ringed seal hunting frequently mentioned in ethnographic accounts involves harpooning the seals at their breathing holes. Most of the breathing holes are plugged, leaving open only one or a few holes, where the hunters then await the seals and harpoon them when they come up for air (Manninen 1931, 88; Sirelius 1934, 91; Clark 1946, 32). The same technique is likely to have been used in antiquity (Clark 1946, 35; Forstén & Alhonen 1975, 154). That harpooning was used against this species is indicated by finds of harpoon heads in association with ringed seal bones in Litorina Sea layers at Norrköping in Eastern Middle Sweden and at Oulu on the Gulf of Bothnia (Clark 1946, 24). The Särmät site has produced two fragmentary bone harpoon heads, from Dwellings T and R2 (Vankina 1970a, XXVI: 1, 2), and harpoons have likewise been recovered at other East Baltic coastal sites of this period.
Apart from the harpooning of adult seals at breathing holes, seal pups could have been killed in the lairs, or even used as live bait to lure their mothers (Sirelius 1934, 91).

According to Broadbent (1979, 187), netting is a more rewarding means of exploitation of this particular species, compared with techniques such as those described above. He lists a number of characteristics of the ringed seal which make netting appropriate: the small body size of this species, its shyness of man and its relatively solitary behaviour, as well as its close connection with the coast.

In the recent past, seal nets were set in the open water on dark autumn nights, and in winter under the ice (Manninen 1931, 80; Kalits 1959, 483). Ringed seal netting need not have been restricted to the sea: it is known that ringed seals also swim upriver to feed on migratory fish such as salmon (Piläts 1998, 12), and seal netting has been practiced in the rivers, for example by the Saami on the Tana River in late autumn after the salmon run (Fellman 1906 cited in Broadbent 1979).

The Late Neolithic find from Tuurnsiemi, on the Finnish side of the Gulf of Bothnia, consisting of a vast number of large pine bark net floats, together with remains of bast mesh, possible sinker-stones, and some seal and fish bones (Luho 1954), has been interpreted as seal netting gear (Forstén & Alhonen 1975, 153). The same interpretation has been offered for the complexes of long nets indicated by the linear distributions of stone sinker finds at Lundfors, on the Swedish side of the gulf (Broadbent 1979, 188). As noted in Chapter 6, none of the net components from Särnate (or elsewhere along the East Baltic coast) can be definitely identified as deriving from seal nets. If seal nets were used along this coast, they would have been provided with pine bark floats and anchored with large stones – such as the large sinkers tied round with bast.

Ethnographic accounts portray sealing as a hazardous activity that required very good knowledge of the sea and ice, and one whose returns were highly unpredictable (Manninen 1931, 88; Sirelius 1934, 92–94; Kalits 1959, 485). Considering the differences in behaviour of these two species, it seems that the harp seal, being highly migratory and less shore-bound than the ringed seal, would have been especially unpredictable as a resource. At the same time, in favourable conditions, whole herds of harp seals may have been culled, providing a return much larger than that obtainable from hunting the smaller and more solitary ringed seal.

In addition to their role as a source of meat, the seals would have been important for blubber and skins. The blubber is melted to produce train oil, which
has a wide variety of uses: as fuel for lighting, as fat for cooking, as a preservative for meat and plant foods, as a medicine, as a softening agent for skin and leather, etc. The skins can be used for making dress and shoes, as well as straps and ropes, tents, bags, etc. (Clark 1946, 37; De Laguna 1972, 398; Gustavsson 1997, 112–114).

In the Neolithic, train oil was evidently being used as fuel in the pottery lamps, and both the oil and skins, like amber, would no doubt have been important for exchange with inland groups. Seal bones have been found on inland sites, as have the teeth, which were used as pendants (Zagorska 2000b, 282; Lõugas 2006).

9.3.5.4 Marine fish

There is no actual proof that the residents at Sārnate fished in the sea: no bones of marine fish have been identified. Marine fish remains (cod, flounder, turbot, brill, plaice and saithe) have been found at several other Neolithic sites along the East Baltic shore (Lõugas 1997, 33; Daugnora 2000, Table 11). The absence of such remains at Sārnate could easily be explained in terms of non-preservation. Apart from this, as described in Chapter 6, end-notched pebble sinkers, of the kind recovered mainly from the dwellings with Late Sārnate Ware, would have been unnecessarily heavy for nets used in a lake. Nets with relatively heavy sinkers of this kind must have been set in waters where there was a strong current, i.e. in the rivers or the sea. If we consider that river fishing could have made use of other kinds of barrier (weirs, etc.), the presence of such sinkers may be viewed as circumstantial evidence of marine fishing with set nets (stationary nets).

It seems that fishing in the sea could have been practiced from early spring right up to the autumn. The catches may have included not only true marine fishes, but also anadromous species entering the coastal waters on their way to the mouths of the rivers. Thus, in the recent past, salmon fishing began on the west coast of Kurzeme in spring, as soon as the ice had been blown safely away from the shore (Šulcs undated, 96). Off the Finnish coast, salmon nets were even placed in the first cracks that appeared in the sea ice in early spring. Later, nets were placed extending out from the shore (Vilkuna 1984, 448–449).

Marine fishes such as cod, flounder and turbot migrate into coastal waters in the spring or summer in order to feed, returning to deeper parts of the Baltic in the autumn (Plikšs & Aleksejevs 1998, 162; Šics & Plikšs 1997, 101; Ustups 1997, 105). Fishing in coastal waters may have produced catches largely consisting of
immature individuals, which live particularly close inshore during the summer. This seems to have been the case at Šventoji, where the cod and plaice bones were mainly from small individuals (Daugnora 2000, 87).

In traditional inshore fishing along this coast, nets were set in a horseshoe shape, one end anchored closer to the shore, the other further out. The fishermen sometimes drove the fish into the nets, using the kind of fish-driving sticks described in Section 6.1.1.3. (Bielenstein 1918, 654; Šulcs 1961, 160–161). Large fish, such as cod and salmon, were also caught with hook and line (Benecke 1881, 401, 406; Manninen 1931, 125, 129).

As described above, there is evidence that in the Neolithic logboats were being adapted for marine conditions, thus opening the way for the exploitation of marine resources. At the same time, it may be noted that not all inshore fishing methods actually required boats. Thus, ethnographic accounts relate that flounder and turbot came close enough to the shore in summer to be speared by wading fishermen (Šulcs undated, 18–20; Manninen 1931, 107).

9.3.6 Forest and meadowland

Much of the Coastal Lowland area surrounding the site consists of flat, nutrient-poor and poorly-drained terrain: the sandy plain left after the retreat of the Baltic Ice Lake and Litorina Sea (Fig. 103: IgIIIbI, mIVlt). These areas nowadays support pine, spruce and birch forest, and in the study period (Late Atlantic/Early Subboreal) as well, they presumably constituted large, unbroken tracts of mainly coniferous forest.

However, in the environs of the Sārnte site, the surface geology of the Coastal Lowlands is much more varied, and in terms of vegetation cover this would have been more of a mosaic landscape. A short distance west and northwest of the site we find patches of finer-grained surface deposits, richer in nutrients: glacial and glaciolacustrine loams and clays, which, since they occur on higher ground, are relatively well drained (Fig. 103: gIII, IgIII). Today much of this area is farmland, and before land clearance it would have been important for its stands of broadleaved forest.

In the low-lying parts of the former Litorina Sea lagoon, as the water level fell in the relict lakes and they became overgrown, new areas of relatively fertile, but very wet land would have been created, favouring the development of wet deciduous forest (black alder, ash, birch). The floodplain areas of the river and lake system would no doubt also have had meadowland, which could exist and
develop because of seasonal flooding, as well as the activities of beavers (Lepiksaar 1986, 61) and perhaps also the impact of grazing animals (Section 9.3.6.1). Both kinds of habitat – wet deciduous forest and floodplain meadow – would evidently have been present in the immediate vicinity of the site.

9.3.6.1 Terrestrial mammals

In addition to meat and fat, the various mammal species would have provided a range of useful non-food products, most importantly hides for clothing and other uses, bone and antler for toolmaking, and sinew for tying and binding. Sārnate has produced only a small collection of remains from terrestrial mammals (Appendix 10, Tables 23, 25, Figs. 104, 105). On the other hand, hunting weapons are well represented at Sārnate (Vankina 1970a, Table 1, Table 3).

Ten bows are represented among the wooden objects from the dwellings with Early and Late Sārnate Ware, although only three of them are more or less complete (Vankina 1970a, 87–88, Fig. I: 6–11). As noted by Vankina (1970a, 87) one of these, from Dwelling M1, is actually very small for a real bow, measuring only 56 cm in length. Most of the flint and slate points (Vankina 1970a, 88–91, Figs. III–VI) are evidently arrowheads. In addition, as already noted in Section 9.3.2.2, there are three conical wooden objects that may be regarded as blunt wooden arrowheads and could have been used to hunt small fur-bearing animals (Sirelius 1934, 30).

Six whole or fragmentary wooden objects regarded as spears were found in dwellings with Early and Late Sārnate Ware (Vankina 1970a, 86, Fig. I: 1–5), and the flint inventory of Dwelling 2 (Early Sārnate Ware) and Dwellings 5 and 8 (Comb Ware) included 11 flint points large enough to be classed as spearheads (Vankina 1970a, 90–91, Fig. VI: 7, 8, Fig. VII: 1–7, 9, 13).

Cross-cultural studies of traditional hunting activities, as practiced today or in the recent past, reveal that the bow and the thrusting spear can largely be regarded as complementary weapons: the bow is a versatile weapon that makes possible a variety of hunting techniques and can be used against a very wide range of species, large and small. Hunting with spears, on the other hand, tends to be restricted to a few resource species, generally large-bodied animals, and the spear is generally a dispatching weapon of great force, which can be applied effectively once the prey has been placed in a disadvantaged position (Shott 1993; Churchill 1993).
From Dwelling G there is also a wooden object with a groove and a perforation at one end, which the workmen of Šturms’ excavation identified as a sling (Šturms 1940, 54, Fig. 12: 3; Vankina 1970a, Fig. II: 1). A fragment of a similar object was found in Dwelling A_{DA} (Vankina 1970a, Fig. II: 2).

Trapping also needs to be considered, even though no traps were identified in the artefactual remains from Sârnate. Trapping was an important method of catching wild animals among recent food procuring groups inhabiting the boreal and northern deciduous forest. It seems that one of the main reasons for this is the dispersed distribution of many animal species in these forested areas, resulting from the generally low productivity of such environments and the small package size of plant foods. In such conditions, setting traps tends to be advantageous, compared to search-and-pursuit tactics, since it increases the hunter’s encounter rate with the prey (Holliday 1998). Ethnographic sources indicate that in the boreal zone of Europe trapping was indeed very important in the recent past: a wide variety of traps were used, and a range of different animals and birds were caught by this means. Most of the traditional devices were constructed using materials and technology that would have been available in the Neolithic, so it appears more than likely that trapping would have been a major sphere of activity at this time in the northern deciduous and boreal forest areas.

Because traps are generally made of wood and other organics, trapping tends to be an archaeologically invisible activity. Even in cases where wooden objects are preserved, trapping gear has not been identified, evidently because many components of such gear would have been fashioned out in the hunting grounds and would have been discarded there when no longer needed. Also, archaeologists are generally unfamiliar with the forms of trap components, so such pieces are likely to end up in the category of ‘objects of indeterminate function’. Apart from this, certain kinds of traps (e.g. pitfalls) do not involve any humanly-modified portable objects at all.

It should be noted that both of the main weapon forms present at Sârnate – bows and spears – could have been used not only for active hunting, but also in a passive manner, namely as self-triggering devices, i.e. equivalent to traps. The very small bow from Dwelling M_{D} might have been made specifically for this purpose (or maybe it is a bow drill?).

Communal hunting, usually taking the form of drives, is favoured in quite the opposite situation to trapping, namely in conditions of prey aggregation (Driver 1990, 19), which occurs at particular times of the year among the herbivores of the boreal and temperate forest: generally during the rut and in certain kinds of
feeding conditions (as described below for the individual species). Communal hunting is evidently also efficient where the prey animal is particularly large, giving very high returns. This applies to such activities as driving bears from their winter dens.

Travel to the hunting grounds and the transport of the carcase is also an essential factor to consider. From Särnate there is a fragmentary object interpreted as part of a ski (Vankina 1970a, 91, Fig. I: 12). Skis were certainly being used in parts of north-eastern Europe by this time (Berg 1950; Vilkuna 1997), and would have greatly extended the possibilities of winter hunting. In winter, sleds would have been used to transport meat back to the settlement. A sled runner has been found at Osa in eastern Latvia (Zagorskis 1965c, 26).

Because of the nature of the seasonal cycle in the temperate and boreal zone, hunting and trapping nowadays tends to be largely an autumn and winter activity, and probably would have been so in the past as well. This relates in part to the physiology of the prey. The fat content of the meat is important in terms of nutritional quality and also in terms of palatability, and the mammals generally accumulate fat during the summer, so that by the autumn their fat reserves are highest. It is also in autumn that their new winter coat is in prime condition. (Driver 1990, 14, 18–19).

Although the condition of the animals gradually deteriorates during the winter, this season offers particularly advantageous conditions for hunters. With the first snowfall, tracking becomes much easier (Manninen 1931, 29; Henriksson 1978, 32), and thick or crusted snow in late winter and early spring provides the best conditions for pursuit hunting. Some herbivores tend to congregate in herds in times of winter food shortage, while hibernating animals such as bears become vulnerable to attack at their dens. In addition, meat storage is, of course, much less of a problem in winter than it is in summer (Sirelius 1934, 23, 63).

The bone refuse from Särnate includes a number of terrestrial mammal species. Because of poor preservation, the refuse fauna cannot be seen as representing the true range of hunted animals, and with such small numbers of bones, there is very little basis for assessing the relative economic importance of particular species.

Bones of wild boar (*Sus scrofa* L.) were found in several of the dwellings with Late Särnate Ware, and a boar’s tooth pendant was recovered in Dwelling ZA. The presence of bones representing body parts of relatively low meat utility (leg bones from Dwellings ADR and O; a cranium from Dwelling AZA) suggests that wild boar carcases were transported to the site in fairly complete condition.
The preferred habitat of the boar is broadleaved or mixed forest, and the animal is very dependent on the autumn crop of acorns and nuts, as well as being sensitive to harsh winter conditions (thick snow cover and frozen ground), which prevent access to food (Paaver 1965, 206). Rather gregarious animals, they are likely to have been hunted in communal drives, particularly in autumn, when they congregate during the rut, and in winter, when they tend to be short of food and form herds of weak and inactive animals (Medības Latvijas PSR 1984, 28–29, 254).

Red deer (Cervus elaphus L.) remains were found in Dwellings O and T. Like the boar, red deer favour broadleaved and mixed forest (Paaver 1965, 243). Although generally gregarious, they tend to be more dispersed in summer, when the feeding conditions are good (Medības Latvijas PSR 1984, 17). Stalking and hunting from a hide are characteristic hunting techniques for stags during the rut in early autumn, when their call may be imitated. In the winter, when red deer form larger herds and when deep snow impedes their movement, they may be hunted in drives. (Paaver 1965, 243; Medības Latvijas PSR 1984, 15, 17, 253).

Roe deer (Capreolus capreolus L.) is represented by one bone from Dwelling O. Roe deer favour areas of mixed and deciduous forest alternating with open vegetation. They do not form large herds, and are likely to have been hunted by stalking or ambush, and by call-imitation to lure the males during the rut in summer (Paaver 1965, 226; Medības Latvijas PSR 1984, 24, 253–254). Human influence on the forest (through the collection of fuelwood and timber for construction) would have stimulated the growth of herbs, bushes and young trees, creating attractive conditions for roe deer (Jonsson 1988, 61).

Several dwellings produced remains of elk (Alces alces L.): two bones (a fragmentary rib and an ulna fashioned into a dagger) and six teeth (at least four of which had been fashioned into pendants). Although the sample is admittedly very small, anatomical part representation seems to be somewhat different from that of the other commonly represented large mammals, namely wild boar and aurochs. In the case of elk the pattern might indicate more selective transport of body parts to the site, taking only those parts that had high meat utility or industrial value. Also, there is an elk-head figurine in amber from Dwelling 3 (Vankina 1970a, Fig. 144, Fig. LV: 2).

Compared with the boar and the two species of deer, elk is much better adapted to life in the boreal forest. Individual hunting and trapping may have been undertaken in summer, especially at elk paths and at the aquatic and wetland feeding locations (Sirelius 1934, 68). Opportunities for stalking are better during
the rut in early autumn, when the animals are fattest and when the males can be located by their calls and are less cautious, so that they may be lured by imitating the calls (Manninen 1931, 33; Medības Latvijas PSR 1984, 252–253; Zvelebil 1981, 186). The hunting of elk by driving could have begun in late autumn, at which time the animals tend to form larger herds (Medības Latvijas PSR 1984, 11, 252). In the winter, deep or crusted snow provides favourable conditions for running down elk by hunters on skis (Manninen 1931, 38; Sirelius 1934, 39; Henriksson 1978, 37). Ethnographic accounts also describe a variety of trapping devices for elk: self-shooting spears and bows, pitfalls, vice-traps and snares, which were often placed on elk paths or at feeding locations, and could be combined with fences (Manninen 1931, 44, 45; Sirelius 1934, 53, 55, 57; Henriksson 1978, 34–36).

In addition to browsers (red and roe deer, elk), the region was also inhabited at this time by two species of grazing animals: aurochs and wild horse.

Aurochs (Bos primigenius Boj.) bones and teeth (including one tooth pendant) were found in five dwellings at Sārnate. The presence of bones from body parts with relatively low meat utility (bones of the legs in Dwelling W, a mandibula in Dwelling T) might be taken as an indication that aurochs carcasses were being transported to the site in relatively complete condition.

Although the aurochs’ preferred habitat would have been natural riverbank meadows and fens, in addition to its main diet of grasses, it also fed on acorns in the autumn and foliage in the winter (Lepiksaar 1986, 59; Van Vuure 2002, 7). There is some disagreement as to whether the aurochs, by its grazing and manuring, prevented afforestation of meadowland, or whether the existence of such open areas was due simply to the water regime of the rivers (Lepiksaar 1986, 59; Van Vuure 2002, 8). Since the aurochs was a gregarious animal (Van Vuure 2002, 6), communal hunting methods are likely to have been used.

Wild horse (Equus caballus L.) is represented by a bone tool from Dwelling Rd. The horse is adapted to a high-silicate diet, and hasty flight from predators in an open landscape, so its occurrence in a mainly wooden environment is surprising, and it has even been suggested that wild horse remains from the Subboreal in the East Baltic can be interpreted as resulting from sporadic invasions from the steppe or forest-steppe zones on occasions of severe drought (Lepiksaar 1986, 57, 63). On the other hand, Paaver (1965, 183–184) regards the wild horse of this period as belonging to the fauna of the temperate forest zone, where it probably inhabited riverbanks and the margins of bogs.
A brown bear (*Ursus arctos* L.) ulna shaped into an awl was found in Dwelling P₀, and a fragmentary amber figurine, apparently depicting a bear, in Dwelling 3 (Vankina 1970a, LV: 1). Bears are generally sedentary and territorial animals that prefer coniferous and mixed forest (Medības Latvijas PSR 1984, 48). During the vegetation season, when they are active, they could have been lured with bait (Sirelius 1934, 49) or caught in various kinds of baited traps (Sirelius 1934, 53–55, 69, 73–74, 77, 78; Henriksson 1978, 37, 38, 39; Mugurēvičs 1999, 229).

In the winter, bears may have been attacked at their dens. Ethnographic accounts tell that a bear den could be located by following the bear’s tracks in early winter, on the first snow. Then, preparations are made for driving the bear from its den, but this was best conducted when the snow was already thick enough to impede the bear’s movements if it had to be pursued after being forced from its den. Spears and stakes were used to impale the bear at the den itself. Nets have also been used in winter bear hunting. (Manninen 1931, 43; Sirelius 1934, 27, 38; Henriksson 1978, 39–40).

Two pendants made of badger (*Meles meles* L.) teeth were found in Dwelling O. The badger, also a sedentary, hibernating animal, would have been hunted or trapped at its den. Hunters may have killed badgers when they emerged from the den, but, since the animal is nocturnal, this was only possible on moonlit nights. Badgers might also have been driven from their den and hunted with dogs, or dug out of the den and killed. Presumably, the most efficient method was to place traps or snares at the entrance to the den or across a path. (Bielenstein 1918, 585; Manninen 1931, 33; Sirelius 1934, 71; Henriksson 1978, 40).

One bone of pine marten (*Martes martes* L.) is recorded as present in the faunal remains from Sārnate by Paaver (1965, Table 28). In the recent past, martens, valued for their pelts, were captured in the hollows of trees where they make their nests, caught in nets or traps, or shot with self-triggering bows (Manninen 1931, 53; Sirelius 1934, 44, 55, 74, 77, 78). A variety of other small mammals would also have been trapped by the people living at Sārnate, primarily for their winter pelts, although the bones have not been preserved in the unfavourable conditions. Species represented at other Neolithic sites in the East Baltic include: fox (*Vulpes vulpes* L.), mountain hare (*Lepus timidus* L.), brown hare (*Lepus europaeus* L.), stoat (*Mustela erminea* L.) and red squirrel (*Sciurus vulgaris* L.) (Daugnora & Girininkas 2004).
9.3.6.2 Forest birds

Apart from duck, the only other identified bird species are jay and black grouse (Vankina 1970a, 18, 132). Bones from the wings of jay (*Garrulus glandarius* L.) have also been found in three Middle Neolithic graves at Zvejnieki. It is thought that the jay wings, with distinctive blue feathers, would have been placed in the graves as a special offering, or as a decoration of the grave or the clothing of the deceased, the colour possibly having some symbolic significance (Mannermaa 2006, 291–292, 296, Table I). The presence of jay at Sārnate, too, suggests that perhaps the jay’s bright plumage was widely prized not just by the people at Zvejnieki, but across a wider region.

The black grouse (*Tetrao tetrix* L.), and probably other gallinaceous birds as well, were probably hunted or trapped, especially in autumn and winter, and in the mating period in early spring (Mannermaa 2003, 22).

9.3.6.3 Plant foods

Shells of hazelnut (*Corylus avellana* L.) were found together with water chestnut shells in many of the dwellings with Early and Late Sārnate Ware (see Chapter 8). Evidently, like water chestnuts, hazelnuts were collected in large quantities.

Hazel would have formed understorey vegetation, particularly in areas with fertile glacial and glaciolacustrine soils, and the development of hazel groves would have been promoted by tree-cutting. Hazels would also have grown in forest-edge locations, such as riverbanks, lakeshores and next to meadows. (Bušs 1981; Mauriņš & Zvirgzds 2006, 176).

Hazelnuts are likely to have been important as a readily storable food source (Rowley-Conwy & Zvelebil 1989, 55). On the other hand, nut production shows marked interannual variation, making this a very unreliable resource.

Although the inhabitants of the site must have collected berries and other plant foods in the forests and meadows (c.f. Broadbent 1979, 172; Nunez 1991, 36–43), systematic sampling was not undertaken at the time of excavation, so there is no information about such foods.

9.3.6.4 Bee products

The East Baltic falls within the present distribution range of the European honeybee (*Apis mellifera* L.), and bees would no doubt have been present during
That honey and beeswax were collected by the people at Sārnate is suggested by two artefacts that seem to have had some practical or at least symbolic connection with this activity, since they are decorated with a very distinct hexagon/honeycomb design. These are: a wooden object resembling a small hoe, from Dwelling N (Vankina 1970a, Fig. XL), and a large sherd from a pottery vessel, from Dwelling F (Vankina 1970a, XLI: 1).

A variety of techniques can be used to locate the hollow trees in the forest where bees have established their hive. After that, it would have been a matter of climbing the tree and extracting the honeycombs, a task generally done in the autumn, when honey stocks are at their peak. (Crane 1983, 21–23; Dumpe 1999, 348, 353)

In its simplest form, ‘honey hunting’ involves killing the bees in the course of plundering the hive, but in many Eurasian forest areas, including the East Baltic, the general practice in the recent past was to maintain the colony alive, simply subduing the bees with smoke while removing the honeycombs. In such a system, the bee tree itself – generally an oak, lime or pine – becomes a valuable asset. (Crane 1983, 78–79, 83; Dumpe 1999, 345–349).

Of course, it is impossible to say whether such management practices were used in the Neolithic.

Both objects from Sārnate with a honeycomb design could conceivably have had a practical role in this activity. The hoe-like object from Dwelling N might conceivably have been a tool for cutting the honeycombs loose from the hollow of the tree, a job done in recent times using a special knife or a wooden spatula (Dumpe 1999, 352). Likewise, the pottery vessel bearing a similar design could have been intended specifically as a receptacle for honey or wax.

Honey and beeswax would have been highly prized products, but obtaining them would have been a complicated and arduous activity, and one whose returns were rather unpredictable. In the first place, there was the problem of locating the hive, and even then there remained the risk that it might be raided by a bear or marten before the honeycombs could be collected. And of course, the honey collector had to face the angry bees, and risked a fall when climbing the tree. (Crane 1983, 78–79; Dumpe 1999, 351).
9.3.6.5 Wood products

The Sārnate excavation has provided various kinds of evidence concerning the pattern of wood use: the excavation records include notes as to the tree species (and diameter) of structural timbers (Chapter 8); taxonomic determination of preserved wooden artefacts by V. E. Vihrov (1960; Appendix 8, Table 21) indicates the woods used for making tools and utensils; wood charcoal identification helps us to identify the important fuelwoods (Section 7.8; Appendix 9, Table 22); and the preserved objects of bark and bast testify to the use of these materials. This section brings together the evidence regarding the use of each particular tree species, with an ecologically-based assessment of the habitats within the surrounding landscape where the species would have grown. The ecological data utilised here is drawn from Bušs (1981), Priedītis (1999) and Maurīņš & Zvirgzds (2006). General accounts of forest development during the Holocene in the area of present-day Latvia, and of human utilisation and impact, are provided by Zunde (1999) and Priedītis (1999). Dumpe (1999) has covered the traditional uses of the main tree species.

The people at Sārnate had a particularly wide range of applications for ash (*Fraxinus excelsior* L.): it was used for structural timber in both groups of dwellings with Sārnate Ware and for making a wide range of tools and utensils found in the dwellings with Late Sārnate Ware. There was evidently no substitute for ash in cases where both springiness and durability were essential: for bows and lateral arms of eel clamps. However, it was used for a wide variety of other objects as well, such as paddles, spears, mallets, spoons and ladles. At the same time, ash may be somewhat overrepresented relative to its actual importance, because objects made of ash wood were better preserved at Sārnate than those made of other woods (Vankina 1970a, 14).

Ash would have formed part of the tree layer of the wet deciduous forest in the vicinity of the site, together with black alder and birch, and would have grown together with other breadleaved species in the drier deciduous forest on the areas of clay and loam to the west. Where ash trees were felled, they would have regenerated vigorously by root shoots.

Alder wood, which is soft and easily worked, was used extensively in the dwellings with Early and Late Sārnate Ware for house posts, for tools (four nut-cracking mallets, a bow, a hoe, a paddle and a perforated disc) and evidently also as fuelwood. As Vihrov (1960, 30) has remarked, the use of such a soft wood as alder for a bow and a paddle is somewhat surprising. Although the two native
alder species, black alder (*Alnus glutinosa* Gaertn.) and grey alder (*Alnus incana* DC.) are anatomically indistinguishable, in this case, given the site location, we are evidently dealing mostly with the latter.

Because of its resistance to rotting, alder is a logical choice for posts, especially in such wet locations. At the present day, because of its relative high density, it is an important fuelwood, with a high calorific value.

Being very tolerant of flooding, alder would have been main tree species of the lakeshore belt and the floodplain areas of the streams and rivers, and in such locations it would have successfully regenerated from stump shoots after cutting.

Bird cherry (*Prunus padus* L.), which generally occurs in the understorey of forest on rich soils and particularly in wet locations, has been recorded in one case: it had been used to make an object of indeterminate function.

Birch timber was commonly used for house posts in both groups of dwellings with Sārnate Ware, which is very surprising, given that birch is known for its poor resistance to damp. Evidently, in this case other considerations were more important: presumably, young birches of a suitable size for structural timbers were growing close by. Equally surprising is the lack of evidence for its use in making tool handles and other artefacts. Being fairly hard and durable, it was widely used in the recent past for such purposes (Dumpe 1999, 312). That it was used for fuel at Sārnate is no surprise at all, given that it is traditionally regarded as the best fuelwood in the region today. Birch bark had many uses: for floats and for the wrappings of pebble sinkers, for waterproofing layers in two of the hearths in dwellings with Early Sārnate Ware, and perhaps also as roofing material (Dwelling 10). It no doubt had many other applications.

The two native species of birch, namely silver birch (*Betula pendula* Roth.) and downy birch (*Betula pubescens* Erh.), are indistinguishable under the microscope. Given the site location, it seems that much of this timber would have been downy birch, which grows in wetlands. Both species are ecologically tolerant pioneers: they will quickly colonise forest cuttings and abandoned open land in a great variety of soil conditions, but in mature forest they will eventually give way to other tree species.

The lime tree (*Tilia cordata* Mill.) must have been valued primarily for its bark. It is recorded that long sheets of lime bark were found in several dwellings, and this may have been the main material for the bark layers of the hearths. The inner bark of lime provides long bast fibres: it is likely that the strips of bast and the bast thread used on fishing gear would have been lime, although it has not been positively identified. Lime wood has been used to make a boat-shaped
container, and it was apparently burned as fuel at Särnate, although it is not considered a good fuelwood. The main distribution of lime in the site environs would probably have been in the deciduous forest growing on the clay and loam to the west of the site. Young lime trees in this area may have been intensively exploited for bast.

Maple \((Acer platanoides\) L.) was utilised mainly for carving spoons, ladles and containers. Hard and durable, it was sometimes used instead of ash for making paddles. Like the lime, it is quite demanding with regard to soil conditions, and was presumably growing mainly on the clay and loam.

There is only one record of the use of oak \((Quercus robur\) L.): for a mallet. Clearly, a particularly hard and heavy material had been sought in this case. Since oak wood tends to preserve relatively well in waterlogged conditions, the paucity of oak really does indicate that it was rarely used for tools, structures or fuel. This could be because it was too difficult to work (Rimantienë 1979, 10), or because it was not available near the site.

The only recorded use of European white elm \((Ulmus laevis\) Pall.) or wych elm \((Ulmus glabra\) Huds.), which are not distinguishable by microscopic anatomy, is for the making of an object interpreted as a ski, from Dwelling K (Vankina 1970a, Fig. I: 12). Both species, particularly the white elm, can also be numbered among demanding species that require fertile soils with good drainage conditions. It seems that the hard and resilient elm would indeed have been suitable material for skis.

Interestingly, two of the nut-cracking mallets from the dwellings with Late Särnate Ware were made of hazel, which is not recorded as used for any other purpose. Since hazel wood is hard, it provided suitable material for mallets. The ecology of hazel has already been considered in Section 9.3.6.3.

Pine \((Pinus sylvestris\) L.) had various specific uses. Not surprisingly, pine twigs were used as kindling for fires. The long thin splints used for fishing gear were presumably made from sections of pine trunk, but it seems that pine was not commonly used for structural timbers. Net floats were made from the bark. In the environs of Särnate, pine would have been growing mainly on the nutrient-poor sands of the exposed former seabed.

The remains of some spruce \((Picea abies\) Karsten) posts were found in the dwellings with Early Särnate Ware. There is no other record of its use, although sheets of spruce bark could have been used as waterproofing layers in the hearths. Spruce is likely to have formed mixed coniferous forest together with pine on the sands of the former Baltic Ice Lake.
One of the spears is made of rowan (*Sorbus aucuparia* L.). Rowan trees would have been found in the understorey of various kinds of forest in the area, chiefly on the drier soils.

Aspen (*Populus tremula* L.) was used for structural timbers in dwellings with Late Sārnate Ware. It was also used to make a logboat – a traditional use of aspen trunks in the region (Bielenstein 1918, 619). The relatively soft wood of the aspen was also utilised for nut-cracking mallets. Like the birches, aspen is a pioneer species, which quickly colonises abandoned open land, cuttings, etc., but is more demanding than the birches with regard to soil conditions, so in the Sārnate area it would have been favoured mainly by disturbance to deciduous forest on the clay and loam.

When trees were cut in the deciduous forest, the result would have been vigorous regeneration by means of stump or root shoots. Disturbance to the tree layer would also have promoted the development of hazel groves and the production of nuts. Where conifers were felled on the sandy soils, the resulting gaps in the forest would have been colonised by birch. Likewise, areas subject to intensive human disturbance, such as the immediate environs of the site and possibly also small fields for cereal cultivation (see Section 9.3.7), would have become overgrown soon after abandonment with pioneer trees – birch, aspen and perhaps also grey alder. All of these effects would seem to have been beneficial for human utilisation of the forest: compared to mature trees, stump and root shoots of various diameters (i.e. coppice wood) would have been easier to cut for fuelwood and wooden artefacts; young trees of the pioneer species would have provided suitably-sized straight structural timbers; and the development of hazel groves was obviously beneficial. The rich regrowth of foliage in forest subject to human disturbance would also have provided attractive feeding grounds for browsing animals, and thus also hunting locations for the people.

**9.3.7 Cultivated land and pasture**

It may be significant that the Sārnate site is not only situated at an advantageous location for exploiting wild food resources, but also lies near areas of loam and clay (Fig. 103) that are under cultivation at the present day and could also have been the focus of Neolithic farming. There are some indications that, during the later phases of occupation at least, the people may also have been practicing agriculture at Sārnate, and may have been keeping domestic stock.
In the first place, five whole or fragmentary wooden hoes have been found in dwellings with Late Sārnate Ware: three in Dwelling A_{DA}, and single examples in Dwellings A_{ZA} and S (Vankina 1970a, Fig. XIX). \footnote{The small decorated example from Dwelling N (Vankina 1970a, Fig. XL) may have had a special function (see Section 9.3.6.4.)} Šturms (1940, 56) regarded these as evidence of agriculture, as did Vankina (1970a, 95, 134), although she notes that they could have been used to dig up wild roots.

There is now also pollen evidence that crops were grown near Sārnate Bog in the Neolithic. A pollen sequence from a core taken immediately south-east of the southern part of the site in 1997 included pollen of barley and oats: these were present in the part of the sequence dated to the early Subboreal (SB1) (Laimdota Kalniņa, pers. comm., 12.07.07). The cereal pollen could derive from cultivation during the time of occupation of the dwellings with Late Sārnate Ware, or it be connected with slightly later agricultural activities, perhaps relating to the artefactual evidence of the Corded Ware/Rzucewo Culture in this area.

The only clear evidence of domesticated animals is a hip bone of sheep or goat, found near the hearth of Dwelling S. Of course, one such find certainly is not enough to indicate that stockkeeping was practiced locally. Apart from this, in re-examining the animal bones, Lembi Lõugas noted that two pig metapodia fragments from Dwelling A_{DR} seem too small for adult wild boar, and could instead derive from domesticated or semi-domesticated pig. The same is true of a pig skull from Dwelling A_{ZA}. (Appendix 10, Table 23).

In sum, the evidence regarding early food production at Sārnate is rather inconclusive. Contemplating the meagre evidence, Vankina (1970a, 134) concludes that this was not an important part of the economy at Sārnate. Nevertheless, we should reckon with the possibility that food production may have been a significant element of the economy at the west coast of Kurzeme already in the Middle Neolithic. There is evidence from both coastal and inland areas of the East Baltic region that agriculture and animal husbandry were being practiced at this time. From this period there is pollen and/or macrofossil evidence of wheat, barley, oats and hemp, as well some artefactual evidence of plant cultivation, and there are bones of domestic cattle, pig and sheep/goat, although everywhere much less numerous than those of wild animals (Vasks et al. 1999, 296; Maldre 1999; Antanaitis-Jacobs & Girininkas 2002, 13–14; Kriiska 2003, 15; Rimantienė 2005, Figs. 62: 2, Figs. 289–291; Fig. 292: 11).
The possible evidence of semi-domesticated pig at Sârnate is particularly interesting, if we consider that pig bones possibly deriving from semi-domesticated or domesticated animals have also been found at Loona on the island of Saaremaa (Paaver 1965, 201; Maldre 1999; Lõugas et al. 2007, 27–28) – a site with pottery very similar to that of Sârnate Dwellings L, S and V (see Section 5.5.12).

9.3.8 Distant resource areas and resources obtainable by exchange

As noted in Section 9.3.6, there were small areas of glacial till and meltwater deposits near the Sârnate site, which would have had stands of broadleaved forest. However, much larger areas with this kind of surface geology and vegetation would have existed in the inland areas behind the Coastal Lowlands. One could reach this very different landscape – the West Kurzeme Uplands – by travelling ten kilometres south-east of Sârnate. This hilly area, dissected by streams and dotted with small lakes, could potentially have been the setting for longer resource-collecting trips, especially for hunting forays (see Section 9.5.4).

So far, virtually no evidence of Early or Middle Neolithic activity has been obtained in this area, but because only very small parts of the uplands have been subject to systematic survey, it is hard to say as yet whether this area really was the uninhabited forest it appears to have been. The limited navigability of the rivers in the uplands (in contrast to those of the lowlands) has been emphasised as a factor contributing to the marginalisation of this area (Bērziņš 2000b, 45).

Finally, treatment of the resources used by the people at Sârnate would be incomplete without at least a mention of certain kinds of materials obtainable mainly or exclusively by exchange, although the Neolithic long-distance exchange network is a major topic in its own right, falling outside the scope of this study.

The flinty material obtainable locally in the form of pebbles is of relatively poor quality for knapping. Also occurring in small amounts in the dwellings with Early and Late Sârnate Ware, and in larger quantities in some of the dwellings with Comb Ware, is superior knapping material: flint or chert evidently deriving from Cretaceous deposits in present-day southern Lithuania or Belarus, and/or from Carboniferous strata in central and north-western Russia (Kinnunen et al. 1985, Fig. 1). The question of the origin(s) of this material, and the mode of exchange and utilisation, would merit a special study.
Aside from this, there are some polished stone chisels, gouges and a stone point, fashioned from a variety of raw materials (Vankina 1970a, 90, 98–99). At least some of these objects are made of non-local materials – such as a grey slate arrowhead (Vankina 1970a, Fig. III: 18), presumably brought from present-day Finland or Karelia.

9.4 The annual resource cycle

9.4.1 Introduction

Rowley-Conwy & Zvelebil (1989, 40) distinguish three scales of resource fluctuation relevant to higher-latitude hunter-gatherers:

1. seasonal, the variations within one year;
2. interannual, the variations between years; and
3. long-term, variation extending over a generation or more.

In this section, we shall address the first two scales of variation: seasonal and interannual (long-term variation is considered in Section 9.7). Addressing seasonal variation essentially means re-organising into a temporal framework the seasonality information that has already been presented in the above sections on specific resource areas. Bringing together the artefactual and palaeoeconomic evidence from the Särnate excavations, along with the biological and ethnographic data, we can try to assess what resource-getting activities definitely were undertaken, are likely to have been undertaken or could possibly have been undertaken in particular seasons of the year. Concomitant with this, we can attempt to assess the relative importance of the different landscape/resource areas in particular seasons. Building up this kind of spatio-temporal picture of the annual cycle is an important step towards understanding the economic basis of the groups that used the Särnate site.

Interannual resource variation is considered in the final part of this section. Year-to-year fluctuations can be regarded as having been largely unpredictable, so this is a topic closely connected with that of risk and uncertainty.
9.4.2 Spring

It may be supposed that, starting from early spring, the local water-bodies would have been a focus of attention for the people at Sārnate. Soon after the ice in the lakes melted, pike would spawn, followed in succession by the spawning seasons of various other fishes (perch, roach and bream). If seining was indeed practiced, the springtime, before aquatic vegetation had grown up, would have been one of the most favourable times for it. Also in this season, barriers and traps may have been set up at river inlets and outlets to catch migrating eels, an activity that could have continued until autumn. In this season, the water-bodies would presumably also have been a focus of fowling activities, since the arrival of migratory waterfowl provided an opportunity for mass hunting.

In the forest, spring is the most favourable season for hunting gallinaceous birds such as capercaillie and grouse, which are particularly oblivious to danger during their mating rituals. At the end of spring and in early summer, bird eggs can be collected, both in the forest and at the aquatic nesting sites of waterfowl.

Certain important non-food resources would also have become available in the spring. Thus, it is only in spring that bark can be easily detached from tree trunks, so birch bark, and likewise lime bark for bast, would have been collected at this time of the year, and this is presumably the time when hearth structures were provided with a new layer of bark. At the seacoast, amber could have been gathered in the wake of spring storms.

If the people at Sārnate did fish in the sea, then the season may have begun with salmon fishing, perhaps even while there was still ice present. Also in spring, marine species such as flounder, turbot and cod would have appeared in coastal waters.

The adoption of agriculture would have meant that spring fishing and hunting activities, which provided the immediate returns to sustain the community during this season, had to be undertaken in parallel with the tilling of field plots, as part of the delayed-return economy of farming.

9.4.3 Summer

The spawning season for freshwater fish continues into summer (tench, crucian carp, pikeperch and wels), although, as the vegetation season progressed, aquatic vegetation would have increasingly impeded active fishing methods in the shallow water-bodies, forcing a shift to reliance on stationary gear, such as fish
fences and set nets. The wels represented by bone remains at Särnate are likely to have been caught in summer, when they are active and move into shallow water for the spawn.

At around midsummer, the moulting season for waterfowl, when they temporarily become almost flightless, would have created another good opportunity for mass hunting. Fishing in the sea could also have been an important summer activity.

This would also have been the time to catch salmon migrating up the River Užava, although, as described above, there is no actual evidence that the people at Särnate were making use of this resource.

Roe deer are likely to have been hunted during their rutting season in summer, especially by stalking and call-imitation, but otherwise summer was presumably not an important season for hunting mammals.

In late summer, various plant foods – wild and possibly cultivated as well – were ripe for harvesting: hazelnuts in the forest, water chestnuts in the lakes, and, for those groups practicing agriculture, cereal crops in the fields. With honey stocks at their maximum, late summer would also have been the best time for taking the honeycombs from bee trees.

### 9.4.4 Autumn

The gathering of waterfowl for their southwards migration in late summer and autumn provided another opportunity for mass hunting on the lakes. Aquatic vegetation died back, and this would have brought a change in the pattern of fishing activities in lakes: seining would have become practicable once again, as would night-time fish-spearing with a light. The first thin cover of ice provided the conditions for stunning fish.

The question of the possible utilisation of migratory fish in the River Užava arises also in connection with autumn activities. Thus, autumn marks the beginning of the lamprey migration, and in late autumn salmon could have been speared at their spawning grounds in the river’s upper reaches. The beaver, too, since it is particularly active in the autumn and its coat is in good condition, is likely to have been hunted along the rivers at this time of the year.

Autumn was undoubtedly a very important season for hunting and gathering in the forest. Early autumn brings the rutting season of wild boar, red deer and elk. Less wary during this time, these animals are likely to have been hunted by stalking. Later in the season, when elk tend to form herds, they may be hunted by
driving. Trapping for furs would probably have begun at this time, since fur-bearing animals now had new winter coats. Gallinaceous birds, too, were probably trapped during autumn and winter. And of course, autumn was the season for berry collecting.

Although the opportunities for marine fishing would have come to a close in the autumn, because of the migration of fish species away from the shore and the onset of stormy autumn weather, the conditions in this season may actually have prompted trips out to the beach – for the purpose of gathering amber washed up in storms.

9.4.5 Winter

The eel clamps would have been used in the winter to spear eels through holes in the ice, and other kinds of ice fishing, too, may have been conducted. In contrast to spring and summer, when fishing activities would have been concentrated at the spawning and feeding locations (shallow water, aquatic vegetation), winter fishing would largely have focussed on river inlets and outlets, where fish seek to escape the oxygen-deficient conditions of stagnant waters under the ice, and possibly also the deeper parts of lakes, from which wintering fish might have been driven into nets.

On the River Užava, fishing structures for migrating lamprey could have been maintained through the winter. Special methods may also have been used to hunt beaver under the ice.

Winter conditions are advantageous for hunters: in deciduous forest, visibility is much better than in summer, and animals can much more easily be located by their footprints in the snow. Moreover, the winter aggregation of large mammals such as wild boar and red deer would have created favourable conditions for hunting drives, and the animals’ difficulty of movement, particularly on the deep and crusted snow of late winter, made it possible to run them down. For the same reason, elk could have been run down by hunters on skis, and bears were less likely to escape when their dens were attacked. Presumably, the aurochs and wild horse were likewise vulnerable in deep or crusted snow. Winter would also have been the main season for trapping and hunting fur-bearing animals.

Late winter and early spring would also have been the time for a completely different kind of hunt: trips out onto the sea ice to kill breeding ringed seals and their pups.
9.4.6 Lacunae in the seasonality evidence

Not all of the food resources of which we have evidence from Sârnate are covered in the above description. In some cases, we have too little information to assess the likely or possible season of exploitation. In particular, the season of harp seal hunting remains uncertain (see Section 9.3.5.3).

It is not clear whether the reconstruction of the seasonal resource cycle for Sârnate should include utilisation of the anadromous fish resources of the nearby River Užava. As described in Section 9.3.3, it is highly probable that there were economically important runs of salmonids and lamprey in the Užava, and that these constituted the main economic basis for the settlement at Sise, 5 km east of Sârnate, but we simply do not know whether the people living at Sârnate had access to these resources.

Likewise, because the evidence is somewhat inconclusive, it is not clear whether the yearly cycle included agricultural and stockkeeping tasks.

9.4.7 Interannual variation and risk

Interannual resource variation is closely connected with the theme of risk, which may be defined as unpredictable variation in some economic or ecological variable, over time and/or space (Kelly 1995, 100). Our treatment of resource use would not be complete without at least an approximate assessment of the element of risk associated with the utilisation of various resources.

The resources described above may be approximately grouped according to their reliability. Among the more reliable resources we may include freshwater fish, whose population size, behaviour and location exhibit a high fairly degree of predictability. The runs of anadromous fishes in the River Užava would also have been predictable events, the coastwards migration of marine fish during the warmer half of the year perhaps somewhat less so. The migratory behaviour of waterfowl would likewise have been fairly predictable.

The hunting of large mammals is an activity involving much greater risk of failure. Considerable time and energy may be invested in locating and killing animals, activities that, as described in Sections 9.3.6.1 and 9.4.1, are highly dependent on weather conditions. This applies not only to terrestrial mammals, but also to seals: interannual variation in ice conditions would have had a major effect on seal behaviour and on the hunters’ ability to reach them out at sea.
A rather different kind of problem is presented by those plant foods whose yield can fluctuate dramatically from year to year, such as hazelnuts. In the northern part of its range, the water chestnut, too, may have been an unreliable resource, since the occurrence of cold weather in spring or summer could prevent successful germination or nut production.

One non-food resource, namely amber, might also be classed among the less predictable resources: amber is washed up on the seashore mainly during storms, so its availability would have been highly dependent upon the weather. Since amber was evidently being processed into ornaments on a fairly large scale (Bērziņš 2003c), amber-workers may well have experienced a shortage of suitable raw material during prolonged intervals of calm weather. In such conditions, in order to replenish their stocks, people might have resorted to the more laborious task of digging up amber from coastal deposits.

Apart from risk in the sense usually considered, namely the possibility that resource extraction activities can bring significantly smaller returns than anticipated, some of these activities would also have involved somewhat different kind of risks, namely the possible loss of life and limb, and the loss of valuable equipment. Such occurrences, quite apart from their psychological and social aspects, naturally could bring economic consequences for the individual and the community. Positively dangerous activities would have included: sealing, where ice conditions can prove treacherous; marine fishing, where a sudden change in the weather can bring disaster; the hunting of particularly dangerous animals, such as bear, wild boar and aurochs; and tree-climbing for honey. Certain kinds of fishing techniques also required elaborate gear, whose manufacture would have represented a considerable investment of labour and material, and in some situations there would have been a real risk of losing this valuable gear. This applies particularly to the possible loss of nets in storms at sea, and the destruction of fishing installations on rivers because of unexpected ice movement during winter thaws.

**9.4.8 Summary and comparison**

At the risk of over-simplifying, it may be suggested that the main subsistence effort in spring and early summer would have been concentrated on locally available freshwater fish, possibly also marine fish, as well as waterfowl. Late summer and autumn was important as the time of collection of plant fruits and nuts in both the forest and lakes, and possibly also fishing for migratory fish in
rivers. Hunting would have been particularly important in autumn and winter: both hunting for terrestrial mammals in the forest and seal hunting out on the sea ice. In parallel with this, there is likely to have been a continuation of freshwater (and possibly migratory) fishing activities. Simplifying even further, we obtain a basic annual cycle of changing emphasis in the food quest from spring to winter: freshwater (maybe also marine) fish, then plant foods (maybe also migratory fish), then mammals.

At this level of generalisation, we can certainly detect an overall similarity with annual cycles of food resource use among recent groups in the boreal and temperate forest zone that relied largely or entirely on wild foods (e.g. Wanatebe 1973, 50–52; Winterhalder 1981b, Fig. 4.5; Rowley-Conwy 1983, Table 10.1; Halinen 2005, 96–100), and with the annual cycles for past groups of this kind in neighbouring regions of Northern Europe, as reconstructed on the basis of archaeological evidence and ethnographic analogy (Broadbent 1979, 194–195; Hulthén & Welinder 1981, 142–144; Zvelebil 1981, Fig. 5.5; Matiskainen 1989, 58).

That there should be a common overall pattern should come as no surprise, since throughout the areas concerned the pronounced seasonal variation in insolation exerts a common influence on the basic patterns of plant and animal life cycles, and consequently also on human use of these resources. At the same time, it is clear that there is an important human dimension: human skills, knowledge, technology, priorities and preferences are significant in shaping the annual pattern of resource acquisition. And for some resources, the human factor is more important than for others.

Thus, for some resources, namely migratory fish and birds, the seasonality of use is biologically restricted to a very high degree, simply because they are absent from the region for much of the year. Other resources only obtain characteristics making them attractive for human consumption at certain times of the year (e.g. fruit and nuts ripen at the end of the vegetation season; herbivores accrue maximum fat reserves and grow new winter coats in the autumn).

In this regard, non-migratory freshwater fish differ from the above-mentioned resources: they constitute a major food source that is potentially available and in good condition throughout the year, but requires different extraction methods, and different levels of energy and time input, skill or technology to make use of them at different times of the year. As already emphasised in Section 9.3.2.1, fish will only be caught in a particular season if the catching methods are appropriate to the environmental characteristics and fish behaviour in that season. Hence, the
seasonality of fish as a food source would have depended in large measure on the fisherman’s knowledge of the behaviour of the various fish species, and on the application of diverse gear and techniques to match the changing conditions at the fishing grounds. Vilkuna (1984) has demonstrated how, in the recent past, an anadromous fish resource was exploited during the whole of the migration season by employing a succession of fishing techniques to match changes in water conditions and fish behaviour. The same is apparent from Wanatebe’s (1973) description of Ainu salmon fishing. However, the same principle applies to fishing for non-migratory species: since they are potentially available all year round, they constitute a resource whose seasonality of extraction is ‘technologically determined’ to an even greater degree.

Because of this, predictive models that simply take into account the likely presence of freshwater fish in an area of prehistoric settlement are of limited value in themselves for assessing the seasonality of fishing activities. Direct evidence concerning fishing gear is very important. In this regard the diversity of fishing gear represented at Särnate may be seen as reflecting a versatile repertoire of fishing methods, one that permitted exploitation of this food source at various times of the year, as described in Section 9.3.2.1.107

9.5 The pattern of resource use

9.5.1 Evidence for sedentism

Although some degree of residential mobility is taken to be the general rule among human groups subsisting on wild resources, there are various examples of recent hunter-gatherers, mostly in high-latitude coastal areas, who were sedentary or semi-sedentary in the sense that they had villages ‘occupied by at least some of the people all of the time’ (Rowley-Conwy 1983, 112). Such a pattern has also been postulated for certain prehistoric food-procuring groups with a similar pattern of resource use (e.g. Broadbent 1979; Rowley-Conwy 1983). In most cases, it is problematic to demonstrate from archaeological evidence that a particular site really was occupied all year round. However, as noted by Zvelebil (1981, 140), Särnate has furnished good empirical evidence for year-round human presence.

107 In a similar vein, Daugnora & Girininkas (2004, 66) write that the diversification of fishing technologies during Mesolithic and Early Neolithic would have permitted year-round fishing.
Naturally, most of this evidence comes from the dwellings with good preservation conditions, and relates to the phases of occupation by the makers of Early and Late Särnate Ware. The lakeside location of the site is almost sufficient proof in itself that it was occupied in spring and early summer, since lacustrine resources (fish and waterfowl) would certainly have been a major focus of subsistence activities in this part of the year. The accumulations of water chestnut and hazelnut shells in several of the dwellings of these two phases confirm that people were using the site in late summer and autumn as well. At the same time, the character of the hearth structures excavated in the dwellings of these two phases indicates that these were heating facilities, not simply cooking hearths (see Section 7.6), and this is a clear pointer to winter occupation. Between them, these seasonal indicators thus cover the whole annual cycle.

The fairly substantial character of the house structures and the presence of fragile and bulky equipment (large pottery vessels, lath fish screens, nets with heavy sinkers) may be regarded as further indications that the people did not undertake frequent residential moves. However, in the author’s view, these characteristics do not in themselves constitute firm evidence of sedentism. Thus, durable housing could conceivably be constructed with the intention of repeated utilisation on a seasonal basis, while the possibilities of water transport would have greatly alleviated the problem of shifting cumbersome gear.

The use of pottery in particular, especially if the vessels are large and frail, has been taken as indicative of sedentism (e.g. Siiriäinen 1981, 18; Pesonen 1996, 111–112; Nunez & Okkonen 1999, 106–107). It should be pointed out that this issue is closely related to that of pottery function. Thus, the large Comb Ceramic vessels have been interpreted as storage containers (Edgren 1982; Nuñez 1990, 38), and the practice of large-scale storage, especially in such fragile containers (rendering the stores virtually impossible to move) certainly does not seem compatible with an economy characterised by residential moves, unless the stores were being left behind for use on return. On the other hand, as we have seen, the pots of both Early and Late Särnate Ware functioned primarily as cooking vessels, and could have been transported by boat for use at another site without too much trouble.

Because of the poorer conditions of preservation, the dwellings with Comb Ware naturally provide much less evidence regarding seasonality of occupation. There is virtually no palaeoeconomic data. However, considering the site location, we may assume that people were present in spring and summer for fishing and fowling. Whether they stayed here during autumn and winter remains an open
question. As discussed in Section 8.5, the house and hearth structures of the dwellings with Comb Ware were not necessarily less substantial than those built during the Early and Late Särnate Ware phases. In conclusion, while the dwellings with Early and Late Särnate Ware can be regarded as permanent homes, we do not have sufficient evidence to assert the same for the dwellings with Comb Ware, although it is entirely possible.

9.5.2 The context of sedentism

In terms of Binford’s (1980) ‘forager-collector’ continuum of hunter-gatherer settlement systems, where ‘foragers’ move the consumers to the resources (residential mobility) while ‘collectors’ move the resources to the consumers (logistical mobility), in the light of the evidence considered above, the community at Särnate, at least during the Early and Late Särnate Ware phases, can be viewed as lying at the extreme ‘collector’ or ‘logistical mobility’ end of the spectrum.

The nature of settlement systems is closely tied up with the character and distribution of food resources across the landscape. Where several different resource spaces lie close together, they may be exploited simultaneously or alternately from the same base, and in the case of exceptionally productive environments non-agrarian sedentism may develop (Nunez 1991, 48). Certain authors (Rowley-Conwy 1983; Renouf 1984, 22) have stressed the significance, for the development of such a pattern, of locations where several species of migratory animals appear at different times of the year. This we will consider further in the next section.

According to Kelly (1995, 152), a sedentary pattern is likely where resources are locally abundant in an overall situation of regional scarcity. The lakeshore habitation at Särnate might be seen as fitting these conditions. The lakes in immediate environs of the site clearly represented a locus of very high productivity relative to the general level in the Coastal Lowlands. The lakes were evidently eutrophic in character, with high primary productivity and the capacity to support dense fish populations.

Such locations would certainly have represented magnets for settlement during the period from spring through to late summer/early autumn, the period that includes the spawning times of the majority of freshwater fish species, the favourable times for mass hunting of migratory waterfowl, and the harvesting time for aquatic plant resources such as water chestnut. In the case of Särnate, the nearby presence of areas with relatively fertile clays and loams augmented the
resource potential of this location, especially during the vegetation season: the broadleaved forest here would have provided a variety of wood products, as well as an important food source – hazelnuts. The soil conditions here also made possible the development of agriculture.

However, the evidence for year-round habitation indicates that the Sārnate site, and probably other similar locations, retained their attractiveness as settlement locations in other times of the year as well. The simplest explanation for this would seem to be that fishing was important in autumn and winter as well. As we have seen, this depends in large measure on fishing skill and technology. That fishing really was a significant activity in these seasons, too, is suggested by the finds of eel clamps in several dwellings with Late Sārnate Ware: they constitute evidence of what can be regarded primarily as a winter fishing technique. Other fishing methods that would have been appropriate to autumn and winter conditions have been considered in Section 9.3.2.1.

Apart from this, the lakes would have been important nodes in the network of communications by water, and this situation of good connectivity would have made the lakeshore site at Sārnate a suitable focal point for trips out to the seacoast and to inland areas (c.f. Broadbent 1979, 191–194), thus making it an attractive settlement location even in times of the year when the local aquatic resources may have been less important relative to resources obtained from more distant areas. As described in Section 9.3.2, the Sārnate site is also significant in that it lies within the basin of the River Sārnate, but close to the watershed with the basin of the River Užava. It seems that, via the tributaries of the Užava, it would thus have been well connected to the River Užava itself – a larger waterway that, in its turn, gave access to the uplands of the interior of western Kurzeme, and was possibly also significant for its migratory fish resources.

Many of the factors discussed above probably apply at a more general level, and are important for understanding the Neolithic settlement pattern in the Coastal Lowland belt of the East Baltic. A very large proportion of the known settlement sites in this belt are associated with the lagoons and lagoonal lakes that characterised this coast. Thus, along the coast of the Baltic proper, we have the extensively researched settlement concentration connected with the former lagoonal lake of Šventoji (Rimantienė 2005, Fig. 15), and just north of there, on the Latvian side of the border, in the area of Lake Pape and Nida Bog, there are finds of Neolithic material that likewise relate to settlement by a lagoonal lake (Murniece et al. 1999, 62). Further north is Sārnate, and then along the west and south coast of the Gulf of Riga the sites of Ģipka B, Siliņupe and Romi-Kalņiņi,
all of them located on the former sandy spits of the Litorina Sea stage, facing the lagoons or lagoonal lakes that had formed behind these spits (Eberhards 1998; 2000, 218–219; 2003, Fig. 93). None of these sites have produced such clear evidence of year-round occupation as Sārnate, but the economic and locational factors at work would have been similar, and on this basis it seems more than likely that some or all of them were likewise permanently occupied. For example, Loze (2006, 173) has concluded from her excavation results that Ģipka B was a permanent habitation. Along the coast of Estonia, several Neolithic settlements were likewise situated at lagoons and relict lakes, and here too, considering the availability of a wide range of food resources within a small area, a degree of settlement permanence has been postulated (Lõugas 1999, 189; Kriiska 1999, 177; 2000). There seems to have been a similar pattern along some other stretches of the Baltic coast. Thus, the Late Mesolithic settlement and subsistence pattern in southernmost Sweden has been interpreted along similar lines: base camps (combined with cemeteries) at lagoons or estuaries, with seasonal use of the interior (Larsson 1997).

It has been suggested – and this seems entirely plausible – that permanent settlements existed at favourable locations in the East Baltic already in the Mesolithic, and in this connection researchers have highlighted the role of lacustrine resources, particularly freshwater fish. Loze (1995, 19) regards the Mesolithic occupations at Sūļagals and Zvidze in the Lake Lubāns area as permanently occupied sites, stressing the importance of the food resources of the adjacent rivers or lakes. In fact, she has suggested that fishing may have provided the basis for permanent settlement at Lake Lubāns already from the Final Palaeolithic (Loze 2001a, 45). Zagorska (2000a) interprets Middle Mesolithic sites in the East Baltic (Zvejnieki II, Kunda-Lammasmägi) as permanent, year-round settlements. Emphasising that fishing could be practiced almost throughout the year, she argues that, in the East Baltic region, fishing was important for keeping people at one particular settlement location.

As for the Coastal Lowland belt of western Latvia, the development of resource-use and settlement patterns during the Late Mesolithic and Neolithic

---

108 This interpretation of Kunda-Lammasmägi as a year-round permanent site is not universally accepted. Lūgas, who analysed the faunal remains, does not see this evidence as pointing unequivocally to year-round occupation: in her view, the site seems to have been inhabited from autumn to spring, with insufficient evidence of summer or midwinter hunting (1996, 290). Daugnora & Girininkas (2004, 41) see Kunda-Lammasmägi as a base camp for the exploitation of local food sources during part of the year, with the establishment of seasonal camps in summer in order to fulfil particular functions.
should evidently be considered in relation to the major environmental changes that resulted from the combined influence of land uplift and intensive longshore drift during the period after the initial Litorina Sea transgression. These processes resulted in the development of lagoons, and their subsequent isolation and transformation into freshwater lakes. The occupation at Sārnate relates to a late stage in this environmental sequence. Of course, it would be interesting to trace the changes in the settlement and resource-use pattern that occurred in the preceding periods: at the time of the initial Litorina transgression and during the earlier stages of regression and lagoon formation, corresponding in archaeological terms to the Late Mesolithic and Early Neolithic. However, this is a major subject of enquiry in its own right, beyond the scope of the present study.

### 9.5.3 The question of resource specialisation

As mentioned above, some researchers have suggested that among groups dependent on wild foods, a sedentary mode of life was made possible by a special focus on migratory resources, and marine resources in particular. There is indeed evidence that various migratory animals were important to the economy of the people at Sārnate. Thus, we can judge by the high proportion of seals in the faunal refuse from the dwellings with Late Sārnate Ware that seal hunting did make a major economic contribution, and we may reasonably suppose from the site location that hunting of migratory fowl probably did too (and perhaps also catches of marine and anadromous fish). However, specialised exploitation of migratory or marine resources would not seem to have been the main economic basis for habitation at Sārnate. Instead, the site location itself, the artefactual evidence and the discussion of the seasonal cycle all indicate that the stable backbone of a sedentary mode of food acquisition was provided by the rich plant and animal resources of the eutrophic coastal lake(s), and especially by the year-round potential of freshwater fish.

The degree of reliance on marine resources would have been affected not only by the richness of lacustrine resource concentrations in the coastal belt, but evidently also by the natural characteristics of the coast itself and the potential for exploiting the sea’s resources. In contrast to the more highly indented coasts and archipelagos of the northern Baltic, which provide many suitable haul-out sites for seals, as well as narrow bays where they can be netted, the straight, sandy west coast of Kurzeme would seem to have offered much poorer conditions for catching seals during the ice-free period of the year. Sealing along this coast is
likely to have been even more of an ice-dependent winter activity than it was in other parts of the Baltic, and hence more sensitive to the risk of unfavourable ice conditions (see Section 9.3.5). For marine fishing, too, this is a difficult and dangerous coast, because there is little shelter from the prevailing winds. Overall, it would seem that along this stretch of the Baltic coast, the natural conditions were relatively unfavourable for the development of an economy specialising in marine resources.

It has been suggested that the people at Sänrate practiced specialised exploitation of water chestnut (Zvelebil & Rowley-Conwy 1986, 87). Of course, it is difficult to assess the importance of this food resource relative to others. Because of the preservation conditions at Sänrate, the evidence of water chestnut (and hazelnut) exploitation is very conspicuous to the archaeologist. Just as with the shelling of molluscs, water chestnut processing leaves profuse amounts of debris, the sheer volume of which may give a misleading impression of the actual importance of the resource. All the same, water chestnut could have made a large dietary contribution, and might have been subject to intensive exploitation practices, even to the extent of intentional management or cultivation (see Section 9.3.2.4).

Although the collection of faunal remains from Sänrate is a very small one, the wide range of land mammal species appears to indicate that terrestrial hunting was generalised rather than specialised. This makes sense in terms of the diet-breadth model of optimal foraging theory: if search cost is high relative to pursuit cost – as it generally is for mammals in a forested environment – then, in order to maximise energy return compared with energy expenditure, hunters should not be particularly selective in their choice of foray (Winterhalder 1981a, 25). Search costs could have been particularly high if the animal population was seriously depleted in the environs of a sedentary settlement, promoting increasingly generalised hunting.

The food quest during the phases characterised by Early and Late Sänrate Ware included a wide range of resources. This is true not only at the level of the site or occupation phase, but also at the level of the individual household unit. The dwellings with good organic preservation provide evidence that the occupants were engaged in a wide range of food-getting activities (Table 7). In ecological terms, we would say that each household group was exploiting a wide niche. The subsistence economies of the individual households can be seen as generalised, rather than specialised. At the same time, it is very difficult from archaeological evidence to assess the relative dietary contribution of various plant
and animal resources, and in this regard there may have been major differences between households and occupation phases.

If we apply the diet-breadth model from optimal foraging, we may interpret the utilisation of a diverse range of food resources as a response to a shortage of those resources that are most highly-ranked in energy terms (those that give the greatest energy return in relation to energy expenditure). Alternatively, diversification of the resource base may be viewed as ensuring greater subsistence reliability (Hayden 1981). Whichever of these interpretations comes closer to the truth, the adoption of agriculture and animal husbandry (if indeed they were practiced by the people at Särnate) constituted even further diversification. This issue is discussed in Section 9.7.5.
Table 7. Evidence of the use of different resource groups from dwellings with good organic preservation.

<table>
<thead>
<tr>
<th>Dwelling group</th>
<th>Dwelling</th>
<th>Fishing</th>
<th>Terrestrial hunting, trapping &amp; fowling</th>
<th>Marine mammal hunting</th>
<th>Plant food gathering</th>
<th>Agriculture &amp; animal husbandry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Sărnate Ware</td>
<td>I2/I3</td>
<td>Unperforated pine bark floats; birch bark rolls; unworked stone sinkers</td>
<td>Spear, bows</td>
<td>Nutshells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Sărnate Ware</td>
<td>M20/M21/M2</td>
<td>Unperforated pine bark floats; unworked, end-notched, side-notched stone sinkers</td>
<td>Bows, flint points</td>
<td>Hazelnut, water chestnut shells Nut-cracking mallets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Sărnate Ware</td>
<td>A0A</td>
<td>Unperforated pine bark floats; pine bark floats with an elongated central perforation; birch bark rolls; unworked, end-notched, side-notched stone sinkers</td>
<td>Spear, blunt wooden arrowhead, slate point</td>
<td>Water chestnut shells Nut-cracking mallets Hoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Sărnate Ware</td>
<td>A0R</td>
<td>Unperforated pine bark floats; pine bark float with an elongated central perforation; unworked, end-notched stone sinkers; bundle of laths (screen for fish fence?); arm of eel clamp</td>
<td>Wild boar remains Flint points</td>
<td>Nutshells Nut-cracking mallet</td>
<td>Remains of semi-domesticated (?) pig</td>
<td></td>
</tr>
<tr>
<td>Late Sărnate Ware</td>
<td>A2A</td>
<td>Unperforated pine bark floats; pine bark floats perforated at one end; birch bark roll; unworked, end-notched stone sinkers</td>
<td>Wild boar, elk bones</td>
<td>Water chestnut shells Nut-cracking mallet</td>
<td>Remains of semi-domesticated (?) pig Hoe</td>
<td></td>
</tr>
<tr>
<td>Late Sărnate Ware</td>
<td>F</td>
<td>Unperforated pine bark floats; pine bark float perforated at one end; unworked, end-notched, side-notched stone sinkers</td>
<td>Blunt wooden arrowheads</td>
<td>Water chestnut shells Nut-cracking mallets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Sărnate Ware</td>
<td>G</td>
<td>Unperforated pine bark floats; birch bark roll; unworked, end-notched, side-notched stone sinkers; wooden arrowhead bundle of laths (screen for fish fence?); arm of eel clamp</td>
<td>Flint points; blunt</td>
<td>Nut-cracking mallets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling group</td>
<td>Dwelling</td>
<td>Fishing</td>
<td>Terrestrial hunting, trapping &amp; fowling</td>
<td>Marine mammal hunting</td>
<td>Plant food gathering</td>
<td>Agriculture &amp; animal husbandry</td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
<td>---------</td>
<td>----------------------------------------</td>
<td>----------------------</td>
<td>---------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td>K</td>
<td>Unperforated pine bark floats; pine bark float perforated at one end, with an elongated central perforation; birch bark rolls; unworked, end-notched, side-notched stone sinkers; bundles of laths (screws for fish fence?); arm of eel clamp</td>
<td>Spears, bow</td>
<td>Nutshells</td>
<td>Nut-cracking mallets</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td>N</td>
<td>Unperforated pine bark floats; pine bark float with an elongated central perforation, with central perforation and notched ends; unworked, end-notched, side-notched stone sinkers; arm of eel clamp</td>
<td>Wild boar, elk remains</td>
<td>Hazelnut, water chestnut shells</td>
<td>Hoe</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td>O</td>
<td>Pike, pikeperch bone</td>
<td>Aurochs, badger, wild boar, elk, red deer, ?roe deer, beaver remains, bird remains</td>
<td>Harp seal remains</td>
<td>Hazelnut, water chestnut shells</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td>T</td>
<td>Wels bone</td>
<td>Elk, aurochs, red deer remains</td>
<td>Harp seal remains</td>
<td>Water chestnut shells</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td>Y</td>
<td>Unperforated pine bark floats; unworked, end-notched, side-notched stone sinkers</td>
<td>Elk? remains</td>
<td>Seal remains</td>
<td>Nut shells</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td></td>
<td></td>
<td>Flint point; blunt wooden arrowhead</td>
<td>Harpoon</td>
<td>Nut-cracking mallet</td>
<td></td>
</tr>
<tr>
<td>Late Särnate Ware</td>
<td></td>
<td></td>
<td>End-notched stone sinkers</td>
<td>Bow</td>
<td>Nut-cracking mallet</td>
<td></td>
</tr>
</tbody>
</table>


9.5.4 Logistical forays

If the consumers stayed put, as at Sārnate, then all food and non-food resources had to be brought to them: this is the extreme example of a ‘logistical mobility’ system. In such a system, nearby resources could be exploited by making one-day trips from the permanent settlement, but in order to make use of resources located further away, field camps had to be established (Binford 1980, 10).

Further, in accordance with optimal foraging theory, resources with a high return rate in relation to energy expenditure may be procured at a longer distance from the base than those giving a low return rate. Since large game provides high return rates once it is sighted, hunting in particular (rather than gathering) should be characterised by long-distance logistical forays (Kelly 1995, 131). Taking into account this theoretical postulate, as well as the situation of the site in its environment and the assessment of resource seasonality in Section 9.4, we can postulate that at least two important kinds of long-distance expeditions are likely to have been undertaken:

- autumn/winter hunting trips into more distant parts of the Coastal Lowlands and the adjacent areas of the West Kurzeme Uplands; and
- winter/early spring sealing trips along the coast and far out on the sea ice.

The proposed seasonal pattern of logistical movements out to the sea and to inland areas resembles the pattern suggested, for example, for the Mesolithic and the Pitted Ware Culture of eastern Sweden (Welinder 1976, 28; Hulthén & Welinder 1981, 144), even if the landscape is rather different.

Fish resources obtainable at a distance from the site might also have been sufficiently attractive to warrant logistical expeditions. Thus, fishermen may have camped seasonally at the coast in summer to catch marine fish, and/or by the River Užava in late summer or autumn to catch anadramous fish.

Are there Neolithic sites in the coastal areas of the East Baltic that can be regarded as field camps? Seal hunting camps could have been set up on the sea ice, as was the practice among seal hunters in the Baltic in the recent past, in which case all trace of them is lost. The seal hunters also camped on remote islands. The oldest traces of occupation on the islands of the Estonian archipelago, dating from the Late Mesolithic and Early Neolithic (Kõpu, Ruhnu and Võhma), have been interpreted as temporary camps primarily for sealing (Moora & Lõugas 1995, 479; Kriiska & Saluäär 2000, 26; Kriiska 2000; 2003, 12).
Rowley-Conwy & Zvelebil (1989, 53) consider that a number of Middle and Late Neolithic sites – Naakamäe, Loona, Šventoji and Siliņupe – should be placed in the category of ‘highly specialised extraction camps’, citing the high proportion of recovered seal bones in relation to other animal bones. However, none of these really fit the bill. The seal-rich faunal collections from these sites seem to reflect no more than the relative importance of marine-mammal versus terrestrial-mammal hunting. (In fact, all except Naakamäe have a significant proportion of wild terrestrial mammal bones. See Kriiska 2000, Fig. 5; Zagorska 2000b, Fig. 4; Daugnora 2000, 98.) All of these sites have produced fish remains as well (Lougas 1997, Table 2; Zagorska 2000b, 279; Daugnora 2000), and gathering of plant foods could also have been important, simply less visible archaeologically. Naakamäe and Loona are located on Saaremaa, which was already a large island by the time these sites were occupied, and could have provided an important component of terrestrial resources. Kriiska (2000, 161) considers that the Middle and Late Neolithic island sites may have been occupied all year round. Šventoji and Siliņupe belong to the group of sites on the shores of lagoonal lakes, which, as described above, are also likely to have been permanent occupations.

Also worth considering from this perspective are the occupation sites in the Ģipka–Purciems dune belt on the north-east coast of the Kurzeme Peninsula. These dune sites lie on the spit of land that separated a lagoonal lake from the sea. Loze (2006) regards them as seasonal occupations, stressing their function as ritual centres. This applies particularly to the Ģipka A site, which has produced a number of clay figurines, as well as copious amounts of ochre. Apart from this, there is also evidence of amber-working, relating mainly to the preliminary stages of ornament manufacture (Loze 2006, 133–135). It seems logical that one of the reasons for staying out at the seacoast was for the purpose of collecting amber, which was shaped into ornament blanks at the coastal campsite. It is conceivable that these sites were also seasonal bases for seal hunting and/or marine fishing, but this is impossible to establish because bone has not been preserved in the acid soil.

It seems that the paucity of evidence in the Neolithic of the East Baltic for specialised field camps forming part of a logistical mobility pattern may largely be accounted for by the difficulty of discovering and correctly identifying such camps. Coastal dune sites may be buried deep in the sand, or they may have been destroyed as a result of coastal erosion. Short-term hunting camps may leave very meagre archaeological remains, discoverable only through intensive survey. Furthermore, since there may not have been any need for transporting pottery to
the temporarily occupied locations, sherds may be absent on Neolithic seasonal
camps, which might in consequence be mis-dated to the Mesolithic.

9.5.5 Collective resource-use activities

The degree of cooperation involved in resource-use activities is another important
dimension of these activities, one that has direct economic effects, as well as
social repercussions. Many activities can be efficiently conducted individually, or
require only a minimal level of cooperation, such as between two or more
members of a family. However, particularly in hunting and fishing, there are
certain methods that can provide increased returns per individual if a larger group
of people cooperate, pooling their energy, skill and/or material resources.

In certain conditions, hunting is likely to be an individual activity – most
commonly when the hunted animals are also solitary. As described in Section
9.3.6.1, this could apply to stalking or ambushing species such as roe deer, red
deer and elk during the summer or autumn. On the other hand, if the animals are
gregarious, cooperation in hunting can confer a variety of advantages.
Cooperative search procedures are likely to be advantageous if a herd of animals
is present at an unknown location, and joint hunting drives will likewise be
appropriate if the hunted animals are gregarious (c.f. Smith 1981; Driver 1990).
Particularly in late autumn and winter, cooperative hunting drives may have been
undertaken against gregarious animals such as wild boar, red deer and aurochs,
and against elk, which also tends to form winter herds. Another set of group
hunting methods involves surrounding and killing the animals at the den:
ethnographic records indicate the use of such techniques against bears, beavers
and badgers.

As regards seal hunting, the ethnographic literature indicates that cooperation
was mainly motivated by the advantages, in terms of efficiency and safety, to be
gained from following cooperative search procedures under the guidance of an
experienced hunter, and by the need to pool material resources. As Stiriänen
(1981, 32) has pointed out, sealing did not in all cases require large groups. The
behavioural difference between the species is also relevant: being not only larger,
but also much more gregarious, the harp seal was, in terms of energy-return, a
more suitable prey species for cooperative hunting than the ringed seal. On the
other hand, the pooling of manpower is required in ‘breathing hole sealing’, a
hunting method specific to ringed seals, where each hunter waits at one of the
seal’s many breathing holes (Smith 1981, 612).
With certain kinds of fishing methods, cooperation likewise has the potential of greatly increasing efficiency or effectiveness. For example, if four fishermen link together their seine nets to make a seine four times as long as their individual nets, they will be able to use it to surround an area much more than four times greater than they could by seining alone with their individual nets. Similarly, in the case of fishing barriers constructed across a stream or river, a group of several fishermen can expect to maximise the catch per individual if they pool their resources so that they manage to construct a weir that blocks a waterway completely. The ethnographic literature provides numerous examples of fishing structures built and maintained by organised groups of fishermen (e.g. Cimermanis 1964). Set nets can likewise be joined together to form a long net wall in a lake or in the sea, and then the fishermen can jointly drive the fish into the net (e.g. Šulcs 1961, 161). Similar considerations evidently apply to bird netting (Storå 1968) and seal netting (Broadbent 1979, 188–189).

The social aspects of cooperative resource-use activities are considered in Section 9.6.

### 9.5.6 Seasonal food shortages and storage

Is it possible to identify the likely lean periods in the annual cycle? One might naturally think of winter and spring in these latitudes as the likely seasons of food shortage, but the account of the annual resource cycle (Section 9.4) shows that a wide variety of hunting and fishing activities could have provided food in the cold months as well. The occurrence of food shortages might rather be seen as relating more to the reliability of seasonally procured resources (Section 9.4.7). Thus, spring and early summer resource peaks (fish spawning times, arrival and moulting of migratory waterfowl) seem to be highly predictable. The situation in late summer and autumn might have been less secure: the yield of at least two major plant foods that ripen at this time – hazelnut and water chestnut – is likely to have fluctuated considerably because of weather conditions. The returns from hunting of both terrestrial and marine mammals would likewise seem to have been unpredictable, particularly in winter, when snow conditions on land and ice conditions at sea could prove very unfavourable. Consequently, in late winter and early spring there might indeed have been a serious risk of food shortage. This risk may have been reduced by using a diverse range of food resources, and by stocking up on those foods that did have a high yield in that particular year.
So, was food storage an important element of the economy? It certainly could have been, since (at least for the Early and Late Särnate Ware phases) the main impediment to large-scale storage, namely residential mobility, had been eliminated. Considering the general situation – resource diversity coupled with possible seasonal resource failure – it seems that stored foods might have served less as a planned reserve for a predictable lean season, but as a standby in case of need.

Theoretically, large pottery vessels could have served as storage containers. However, as discussed in Chapter 5, this functional interpretation seems more valid for Comb Ware, while the Early and Late Särnate Ware pots, even the large ones, were primarily cooking vessels. If food storage was important in the Early and Late Särnate Ware phases, then perhaps receptacles made of organic materials (baskets or bark containers) might have been used for this purpose.

Archaeologists and anthropologists have given much thought to the relationship between food storage and other aspects of the lives of food-procuring groups (especially mobility patterns and the development of social inequality), but have devoted relatively little attention to the technical aspects of food storage itself. It needs to be emphasised, at the risk of stating the obvious, that food resources differ enormously in terms of the amount of additional processing required to store them, and in terms of the use-life of the stored supplies.

Plant foods such as water chestnut and hazelnut (and grain, if agriculture was being practiced), as well as honey, would have been the simplest to stock up, requiring no additional processing compared to that needed for immediate use. If the late summer/autumn harvest was a good one, then the community could easily lay up a reserve of long-lasting food. Seasonally available non-food resources – animal skins, seal fat, bark, bast and beeswax – would also have been stockpiled for the time of need. Timber may also have been stored for fuel, construction and toolmaking.

On the other hand, fish and meat, even if they were obtainable during particular seasons in amounts far exceeding immediate needs, would have required special processing if they were to be kept for later use. Since storage of highly perishable resources is much easier in cold weather, surplus stocks of fish and meat would have been most useful if obtained in autumn and winter. Cold winter weather would have made possible the simplest storage method: freezing. Other possible processing methods, namely drying, combined drying-smoking and fermentation, all generally require considerable labour. In the absence of salt, at least in the quantities needed for food preservation, drying and smoking
methods would have had to be very thorough if the products were to have an adequate use-life. Fermentation in pottery vessels is also a possibility (see Section 5.7.9.2), as is the method of storing food in seal oil (De Laguna 1972, 398).

Migratory fish have often been mentioned as a potentially important stored resource (Rowley-Conwy & Zvelebil 1989, 51). Migrating salmonids and lamprey are likely to have been obtainable at the River Užava in the latter half of the year. Dried or smoked migratory fish could certainly have been a very important stored resource for communities living along the Užava and other large rivers, but, as seen above, there is no direct evidence of their use at Sárnate.

9.6 Social correlates of the resource-use pattern

Without asserting that the environment determines the character of a human society, we may nevertheless acknowledge that the characteristics of available food and non-food resources and the pattern of their utilisation do play an important role in shaping social structure. This aspect is examined in the present section.

One characteristic widely regarded as central to socio-economic structure is the pattern of land tenure, or more precisely, tenure of resource locations. By upholding a claim to particular food and non-food resources and restricting their use by others, a human group benefits from exclusive use, but this benefit may be weighed against the cost of defending the resources. It has been suggested that the cost/benefit equation favours territorial behaviour where the resources in question are productive, concentrated and predictable. Conversely, shared access, or at least less restrictive behaviour, may be expected in the case of dispersed and unpredictable resources. (Dyson-Hudson & Smith 1978; Winterhalder 1981a).

If we apply this idea to the case in question, we find that the lake itself, with its cluster of productive resources, most of them also predictable (fish, waterfowl, water chestnut, freshwater mussels), is most likely to have been a focus of resource defence. Territorial behaviour might be thought to have extended to important river fishing locations, and perhaps also to stretches of the seacoast with favourable conditions for marine fishing and amber collection. A similar idea has been advanced by Andersen (1995, 61, 62) with reference to the Limfjord area in the Late Mesolithic of Denmark: he likewise highlights the importance of good fishing locations (providing abundant and predictable resources) as one of the essential factors determining settlement location along the coast, and argues that this points in the direction of a high level of territoriality.
With regard to terrestrial resources, territorial behaviour would seem to have focussed on stable and valuable resource locations in the forest, such as hazelnut groves, bee trees and stands of lime that provided bast. When agriculture was adopted, areas of land with soils suitable for cultivation (a resource of limited availability in many parts of the Coastal Lowlands) would probably also have become valuable and subject to restrictions.

In accordance with the theoretical ideas outlined above, we may place sealing at the opposite end of the resource-control spectrum, especially if we accept the idea that, because of the natural conditions along this coast, sealing is likely to have been mainly a winter activity. Ethnographic accounts portray a picture of seal hunters ranging freely on the sea ice, wherever they hoped to find their unpredictable quarry.

The situation is less clear with regard to terrestrial hunting and trapping grounds. We might expect social control to have been strongest over the known living places of territorial animals, such as bears, beavers and badgers, and the favourite feeding locations of the more mobile browsers and grazers.

The resource characteristics likely to favour territoriality are partly the same as those suggested as providing the basis for permanent settlement, so it is no surprise that the resource locations in the environs of the permanent settlement come across as the ones most likely to have been held by a particular group. At a more general level, we may hypothesise that in the Neolithic settlement in the Coastal Lowlands took the form of separate ‘lake communities’, each deriving the basis for its existence from the resources of a particular lake and its environs, and upholding a claim to exclusive use of these resources. Of course, the widely varying size of these water-bodies, and the presence of major rivers flowing across the lowland belt, providing concentrations of migratory fish resources, would have introduced an element of variability into this pattern.

As described in Section 9.5.5, various hunting and fishing activities are likely to have involved cooperation within the community, and this too has important social implications, as noted, for example, by Broadbent (1979, 189) and Siiriäinen (1981, 33). Such cooperative ventures obviously required organisation and leadership. Ethnographic accounts of major sealing and fishing ventures highlight the importance of task-group formation and the role of the task group leader, who had to be a person with considerable experience in that particular activity (e.g. Sirelius 1934, 92; Gustavsson 1997, 111; Cimermanis 1998, 181). Because of the economic importance of fishing and hunting, these task-groups would have been very important socio-economic units, and an individual’s status
within the task group may be thought to have constituted an important element of their overall status within the community.

Territoriality, sedentism and dependence on food storage belong to the cluster of features characteristic of those food-procuring groups that have been viewed as ‘complex’. Other co-occurring features include: large settlement size, high population density, organisation into corporate descent groups (lineages), hierarchical social structure, occupational specialisation, frequent warfare, an ethic of competition, exchange with wealth objects and competitive feasting (Kelly 1995, Table 8-1). Sedentism and the related characteristic of reliance on stored food have widely been seen as factors behind a shift in the direction of complexity, especially through their role in promoting population growth (which obviously has far-reaching consequences for the conditions of subsistence), and in terms of the development of storage from a strategy of saving for lean periods into a strategy of aggrandisement (see Kelly 1995, Chapter 8).

In the circum-Baltic region, the concept of complexity has been applied to the Ertebølle Culture (Rowley-Conwy 1983; Price 1985). Likewise, Zagorska (2000a, 6, 19) sees evidence of increasing social complexity in the Mesolithic and Neolithic of the East Baltic. The concept has also been applied at a more general level to the Late Mesolithic of the circum-Baltic area (Zvelebil 1996, 331). In view of the evidence for semi-sedentary or sedentary occupation at Sārnate, it seems likely that the community would also have exhibited at least some of the other traits generally viewed as characteristic of complex food-procuring groups. However, if agree to define complexity in terms of social organisation, namely control by leaders of non-kin labour and inherited social differentiation (Arnold 1996), then it is important to consider archaeological evidence for such phenomena in the spheres of craft production, exchange relationships and mortuary contexts, i.e. in spheres that lie beyond the scope of the present study.109

109 In a separate study, the author has found evidence that amber-working was largely a specialist activity (Bērziņš 2003c), and no doubt a detailed analysis of the Sārnate amber and flint assemblages could provide much new evidence on this score. Craft specialisation, and exchange in craft products, are likely to have been important aspects of social differentiation within the Neolithic societies of the East Baltic. The ownership of the most important means of transportation, namely watercraft, may also have been socially very important (Bērziņš 2000b, 33).
9.7  Long-term trends

Owing to the differences in preservation conditions, the quality of the data from Sārnate is not equally good for all three major phases of occupation, and this reduces the possibilities for tracing long-term developments in the environment and economy. Nevertheless, it is necessary to at least consider the various factors likely to have been significant and the direction of trends.

9.7.1 Climatic change

In terms of climate history, the total period of occupation at the site (c. 4400–3000 cal BC) corresponds to the Late Atlantic and the Early Subboreal periods. No detailed climatic reconstruction has been undertaken for this region of Latvia. Instead, we must rely on more general assessments and on studies undertaken in neighbouring areas. The climate in the Late Atlantic is regarded as having been warmer and more humid than that of the present day, becoming cooler and drier during the Subboreal (Zunde 1999, 122–124; Segliņš 2001, 130–131). However, if we can judge from a quantitative reconstruction of climatic parameters for the Pärnu region of south-west Estonia, it seems that the study period was not characterised by major climatic change, appearing instead as a time of relative stability (Segliņš 2001, Fig. 59, based on Veski 1998).

It must be admitted that the available palaeoclimatic data is coarse-grained, and the apparent long-term stability may conceal shorter-term climatic variation. Mention should be made of two economic activities that would have been particularly sensitive even to short-term variation in temperature and precipitation:

– variation in winter temperature would have affected ice conditions along the Baltic coast, which was the crucial factor for seal hunting;
– variation in winter temperature and precipitation would have meant variation in the duration and thickness of snow cover, which, in turn, would have markedly influenced terrestrial hunting conditions.

Unfortunately, the faunal data is too meagre for an assessment of differences between the phases of occupation in terms of the pattern of hunting, so we have no evidence regarding changes in the pattern of faunal exploitation that might be connected with climatic change.
Apart from the influence on hunting, because of the low-lying lakeshore position of the Sārnate site, in periods with an appreciable amount of snowfall, spring flooding may well have been a problem for the people living here. Because of the gradual transition to a more continental climate during the Subboreal, permanent occupation could have become impossible at such low-lying sites, so that people were forced to move to locations safe from spring floods.

9.7.2 Sea- and lake-level change, eutrophication

The occupation of the site falls in a period of marine regression due to isostatic uplift between the initial Litorina Sea transgression and the second, lower transgression (see Section 9.2). The main effect of marine regression during the time of occupation is likely to have been indirect: through its impact on the drainage system of the Coastal Lowlands. In this low-lying coastal area, the water level in lakes and rivers is very closely tied to that of the sea, and any sea-level change will tend to produce corresponding changes in the water level of freshwater bodies and watercourses. Thus, during the study period, accompanying the marine regression, there would have been a gradual trend of falling water levels in the coastal lakes.

At the same time, the coastal lakes – shallow and eutrophic from the start – would have been subject to a trend of gradual further eutrophication and overgrowing, a trend that would have been reinforced by the fall in the water level. The overall trend would have been in the direction of terrestrialisation of the coastal lakes. The gradual retreat of the lakeshore next to the settlement site at Sārnate may be reflected in the eastwards shift of the rows of dwellings (see Section 3.3.5).

As the surface area of the coastal lakes was reduced, the total biomass of food resources they supported would have fallen, thus gradually diminishing the attractiveness of this resource concentration and its potential for supporting a human population. At the same time, it is hard to say whether the process of terrestrialisation was proceeding fast enough to significantly alter the conditions for subsistence during the total period of occupation at Sārnate.

The second Litorina Sea transgression, which came at the end of the Neolithic, would evidently have brought about a rise in the lake level, making the

---

110 It seems that the resource potential of the Lake Lubāns area in eastern Latvia was likewise adversely affected by overgrowing of the water-body during the Neolithic (Loze 2001, 46).
site too wet for continued occupation. After this time, the site itself no longer served as a major settlement location. However, the finds of Corded Ware Culture material from the surrounding area show that this area did retain its attractiveness for human settlement at the close of the Neolithic.

9.7.3 Human population size and pressure on resources

In the author’s view, it is impossible to give a meaningful estimate of the size of the community inhabiting Sărne for any one phase of occupation. Vankina (1970a, 131) estimates the population at 150–160, but this is based on the assumption that all the dwellings are contemporaneous – which is evidently not the case. Neither is the palaeoenvironmental data adequate to permit an assessment of the quantity of available food and non-food resources. Hence, there is no possibility of directly assessing the size of the human population in relation to available resources and examining whether population pressure could have led to the over-taxing of resources.

On the other hand, it is possible to suggest which of the local resources are likely to have been particularly sensitive to over-exploitation. In the first place, long-continued settlement at certain particularly advantageous locations in the coastal zone is likely to have resulted in the depletion of relatively less densely distributed resources in the environs of these locations. This would seem to apply above all to the mammal population of the surrounding forests, and especially to territorial species (Zvelebil 1981, 95), such as beaver, bear and badger. Because of this, hunting in the vicinity of the settlement would probably have become inefficient: if the animal population was depleted, the animals would have been too rarely encountered to make hunting worthwhile in the immediate environs of the settlement. Consequently, if hunting of terrestrial mammals was to continue as a viable activity, as it evidently did, since a range of species are represented in the faunal assemblage relating to the last major phase of occupation (dwellings with Late Sărne Ware), this would probably have necessitated fairly long forays into areas more remote from the loci of intensive settlement, i.e. to interfluves in the coastal zone and to inland areas, which seem to have been less densely populated.

Although a eutrophic lake such as that existing at Sărne represents a highly productive habitat, and would therefore have been comparatively resistant to over-exploitation, an intensive fishing effort might have led to the depletion of fish stocks. This could have been compounded by the gradual terrestrialisation of the lake, reducing the extent of this productive recourse space (Section 9.7.2).
That fishing really was intensive is suggested by the wide range of fishing gear. Other lacustrine resources could also have been depleted by intensive exploitation. Water chestnut is likely to have been adversely affected if intensive gathering coincided with a period of unfavourable climatic conditions: low spring and summer temperatures, preventing germination and successful reproduction of this annual plant.

9.7.4 Change in the pattern of resource procurement

It has been suggested that in response to a situation where the yield from the resources used is no longer sufficient (food resources only have been considered, but the idea can be extended to include the non-food value of resources), two different forms of intensification can be proposed (Zvelebil 1989). One is diversification: adding resources that were not previously used because they were of low preference. The second is specialisation: concentrating more time and effort, and evidently also more knowledge and technology, in order to maximise the returns from a relatively narrow range of resources.

Is there evidence of diversification or specialisation over time at Sārnate? Unfortunately, the collection of faunal remains is too meagre for an assessment of changes in resource use between successive occupation phases. On the other hand, the analysis of the fishing gear has provided some indications on this score. As described in Section 6.6, the dwellings with Late Sārnate Ware have produced a much more diverse range of bark floats than the dwellings with Early Sārnate Ware. Likewise, in addition to the wrapped-pebble sinkers common in the dwellings with Early Sārnate Ware, the assemblages from the dwellings with Late Sārnate Ware also include considerable numbers of end-notched pebble sinkers. Judging from these additive changes in technology, fishing methods seem to have diversified in the later phase, compared with the earlier one. Moreover, the presence of the relatively heavy end-notched stone sinkers is interpreted as an indication that the people were fishing not just in the lake, but also in rivers or in the sea (Section 6.6). In terms of the overall pattern of resource use, these changes may indicate a specialisation towards fishing: more technology, and presumably more time and effort, is being invested in this particular sphere. At the same time, in terms of fishing strategy, this might be seen as diversification (Zagorska 2000a, 15), since the fishing effort was being spread across a wider range of fishing locations, evidently utilising a wider range of species. In any case, this is evidence
of economic intensification, which could have been a response to pressure on resources.

**9.7.5 The adoption of food production**

Although the evidence for agriculture and animal husbandry at Sārnate, deriving from dwellings with Late Sārnate Ware and some of the ungrouped dwellings, is rather inconclusive, the idea that food production constituted an element of the subsistence pattern is entirely plausible in the general context of evidence from this period obtained from other sites in the East Baltic (see Section 9.3.7). If cereals really were being grown at Sārnate, and sheep and pigs were being raised, then it is clear that these new activities complemented the utilisation of a wide range of wild food sources. In terms of Zvelebil and Rowley-Conwy’s (1984) model of neolithisation, this would place the economy in the ‘substitution’ phase, when farming strategies were developing, while foraging strategies were retained. The gradually accumulating evidence from the East Baltic does seem to support Zvelebil’s (1996, 329) notion of the substitution phase in this region as an extended one.

Should the appearance of elements of food production within the frame of a food-procuring economy be explained in terms of insufficient returns from the use of wild foods, where the shortfall had to be made up by food production, or were there other reasons for these additive changes to the economy?

Some authors support the first view: Vasks et al. (1997, 45) see signs of economic crisis in the food procurement economy in the Middle and Late Neolithic in Latvia, brought about by climatic deterioration concurrent with immigration of new human groups. In this situation, domestic stock provided a necessary food reserve. For the Lake Lubāns area of eastern Latvia, Loze (2001a, 46) likewise connects the development of food production with resource stress: she argues that areas with rich wild resources, such as Lake Lubāns in eastern Latvia, were bound to be depleted eventually as a result of population pressure, and points out the further adverse effect of a climate-induced reduction in the size of the lake itself.

Alternatively, we might see the addition of food production to the range of food sources as diversification for risk-reduction, in a situation where wild resources were generally adequate, but not very reliable. Thus, for example, if the water chestnut did not produce fruit because the summer had been too cold, or if seal meat could not be obtained in winter because ice conditions were
unfavourable, it was useful to have a grain stock or a herd of domestic animals to fall back on.

Almost the exact opposite is suggested by Kriiska (2003, 22) in his interpretation of Middle Neolithic indications of agriculture in Estonia: he regards the security gained by sedentary broad-based foraging as a basis and ‘guarantee’ that made the beginnings of cultivation possible. In his view, farming was an initially marginal ‘side interest’ among the food procuring communities of the Typical Comb Ware Culture. Rimantienė (1999, 286–287) sees social motives for the adoption of food production. Rejecting the notion that climatic deterioration or wild resource depletion forced a transition to farming, she suggests that ‘it was not a series of disasters that brought this about, but rather the ideal conditions for obtaining food and its resulting abundance, which led to a quest for luxury and prestige. This was a social phenomenon: certain groups appeared within society who demanded novelties.’ Domesticated plants and stock certainly would have provided a range of new foods and materials.\textsuperscript{111}

The adoption of food production is likely to have altered the settlement pattern in the Coastal Lowlands, permitting habitation in locations remote from the important wild resource concentrations (the eutrophic lakes, the major rivers and the seacoast), wherever suitable soils for farming could be found. At the same time, for the coastal belt as such, it would be inappropriate to seek evidence of a wholesale ‘transition to food production’. Rather, the major potential of fish as a food source remained. Both marine and freshwater fisheries were vitally important for the economy of Latvia’s coastal belt during the historical era, and we may suppose that this was also the case in the Bronze and Iron Age as well.

\section*{9.8 The essential characteristics of the resource-use pattern}

The case of Sārnate can probably serve as an illustration of the general characteristics of Middle Neolithic settlement and economy in the coastal belt of Latvia and Lithuania. We know that marine hunting was important at Sārnate and at all of the other sites in the coastal belt where faunal remains are preserved, and

\textsuperscript{111} In contrast to the classic theory that farming was first introduced in the East Baltic in the Late Neolithic by immigrant Corded Ware Culture people, nowadays there seems to be general agreement among researchers in the East Baltic that the initial appearance of food production in this region can be interpreted largely in terms of adoption by the indigenous population during the Middle Neolithic. This process is viewed as having been stimulated by the diffusion of cultural traits from the Funnel Beaker and Globular Amphora Cultures (e.g. Loze 1998; Rimantienė 1999, 287; 2005, 135–136).
the remains of marine fish from Šventoji prove that people were fishing in the sea at this time in some locations at least (and quite possibly at Sărnate, too, as we may conclude from the analysis of the fishing gear). However, the fairly straight, sandy coastline, especially along the western coasts exposed to the prevailing winds, offered conditions that were far from ideal for the emergence of a maritime economy. On the other hand, the eutrophic lagoonal lakes, created during the marine regression, represented rich biomass concentrations that could be intensively exploited. These factors can account for the lacustrine focus of the Neolithic settlement and economy along this part of the Baltic coast.

The basis for sedentary or semi-sedentary lakeshore occupation was probably the year-round resource potential of freshwater fish. It should be emphasised that this potential could be realised only if the people applied a range of seasonally-appropriate fishing techniques, and indeed the wide array of fishing gear represented at Sărnate suggests that they did. Added to this, the coastal lakes provided important seasonal resources, most notably waterfowl and water chestnut. It would seem that the coastal belt had a chain of such ‘lake communities’: human communities for which the lacustrine resources represented the subsistence mainstay, and which are likely to have upheld a claim to exclusive use of these resources.

Apart from this, the lakeshore settlement locations would have been nodes in the water transport network. They would have been starting points for trips out onto the sea ice for hunting marine mammals in winter or early spring, and also for collecting amber and perhaps also marine fishing during the warmer half of the year. Likewise, particularly in autumn and winter, forays would have been made in the opposite direction, into the forests, in order to hunt and trap a range of different mammals.

The attractiveness of the Sărnate area would have been further enhanced by the nearby occurrence of patches of glacial and glaciolacustrine surface deposits, supporting stands of broadleaved forest that provided various wood products and plant foods generally unavailable on the nutrient-poor sandy plains of the coastal belt. Also, the site’s position gave fairly easy access to the River Užava, which was a potential transport corridor to inland areas and would have had economically important runs of anadromous fish, although we have no actual evidence that these were used by the people living at Sărnate.

The inhabitants of Sărnate were utilising a diverse range of food and non-food resources, at least during the Early and Late Sărnate Ware phases, from which almost all of our palaeoeconomic evidence derives. And there is evidence
of further diversification in the later phase, compared with the earlier one: a wider range of fishing gear components are present, and it seems that cereal cultivation had been added to the already extensive repertoire of subsistence activities.

We have little direct evidence for environmental change during the life of the site. Presumably, the lakes were subject to a natural trend of further eutrophication and terrestrialisation, while human activities were altering the character of the surrounding forest. Whether the local resource concentration was being depleted by over-exploitation is hard to say, but the diversification of food-getting activities may have been a response to shortages. In any case, it was probably a rise in the lake level that made the site unsuitable for settlement and forced people to abandon it for good.

In our picture of the economy of this coastal lakeshore community, various dark areas remain, areas that could be illuminated through future excavation at Neolithic sites in the coastal belt. Systematic recovery and identification procedures would provide a better picture of the true range of economically significant plant and animal species. In particular, we could hope to establish more clearly the role of marine fishing, as well as the timing and character of initial food production in this area. Marine mammal hunting also remains somewhat enigmatic: we know it was an important element of the economy, but in order to fit it into the general economic picture, we need to understand better the seasonal pattern of seal hunting along this particular coast.

The pattern of resource exploitation, as reconstructed in this chapter, implies that, in addition to permanently-occupied settlements, there were seasonal hunting camps. So far, however, there is very little evidence of such camps. It seems that occupations of this kind, which have probably left comparatively meagre remains, are likely to be discovered only through intensive and systematic survey work in areas peripheral to the main centres of Neolithic settlement – perhaps at the small lakes in the hills behind the coastal belt.

As has been pointed out already, we have very little evidence regarding the economy of the makers of Comb Ware at Särnate. We can guess that the economic rationale for living here was similar to that which attracted people to the site during the Early and Late Särnate Ware phases, but there may also have been significant differences. Unfortunately, because of the absence of organic remains from the dwellings with Comb Ware, the Särnate site tells us little about the subsistence economy of the makers of this pottery ware living at the Latvian coast.
10 Summary and conclusions

In this study, the material excavated at Sārinate by Eduards Šturms and Lūcija Vankina has been thoroughly re-examined and re-evaluated. The focus has been on the collections of pottery and fishing gear, the palaeoeconomic data and the textual and pictorial records of the excavation. Because archaeological research interests have broadened, and whole sets of new questions and new approaches have emerged and developed, there was ample scope for a fresh look at this classic collection. In the course of the re-analysis, we have delved deeper into various aspects of lakeshore habitation in the coastal belt during the Neolithic of the East Baltic.

In accordance with the theoretical framework set out in the introduction, as a prerequisite for a general analysis of the material, the many separate dwelling assemblages had to be grouped into culturally meaningful larger entities (`cultural grouping`). The dwellings, regarded as individual household units, were arranged into three major groups on the basis of their pottery assemblages: dwellings with Comb Ware, dwellings with Early Sārinate Ware and dwellings with Late Sārinate Ware. This pottery-based grouping of the material provided the framework for the next stage of the study – `cultural analysis` of the pottery and of various other classes of cultural material, namely the fishing equipment, hearths and structural remains.

The pottery assemblages from several dwellings in the NNE part of the site (Dwellings 1, 3, 4, 5, 6ZA, 7, 8, 10, 12ZA & 15DR) have been grouped together as Comb Ware. The vessels were smooth-walled, characteristically having direct rims with inward-slanting flat lips, and comb or wound cord impressions on the rim. Vessel exteriors were highly decorated, characteristically with designs consisting of alternating horizontal bands of pits and elongated stamp impressions. It must be admitted that this is a heterogeneous pottery group, showing considerable variation in temper and decorative elements. Furthermore, the pottery from these dwellings is highly fragmented and weathered, and does not constitute a good basis for Comb Ceramic studies.

Dwelling 3 in this group produced a large collection of amber ornaments, among which the characteristic forms are barrel-shaped and discoidal beads, as well as trapezoidal pendants with a concave base and angular or rounded margins. No wood or other plant materials were preserved in the dwellings of this group, so our picture of materials and technologies is rather impoverished. The only preserved components of fishing gear are some unworked and end-notched pebble
sinkers. The location of houses was indicated by spreads of sand, often with evidence of a central hearth. From such meagre remains, in the author’s opinion, we cannot assess how substantial the structures were. There is virtually no palaeoeconomic data either. Nor can we date these dwellings: there are no suitable samples for radiocarbon dating. However, recently-obtained dates at other sites (Zvejnieki, Piedägi) have pushed back the time of the appearance of Comb Ware in the East Baltic, and there is no longer any basis for the assumption that the Comb Ware dwellings at Sārnut post-date the rest of the material from the site.

With incomparably better preservation conditions, the dwellings of the other two major groups have provided much more information. Thus, a couple of the dwellings with Early Sārnut Ware, and a number of dwellings with Late Sārnut Ware, as well as some of the ungrouped dwellings, had outstanding preservation of organics and pottery, offering a much richer corpus of material remains for analysis and interpretation.

Now dated to about 4365–3780 cal BC is the group of dwellings with Early Sārnut Ware (Dwellings 2, D, E, I2/I1, M2Z/M2Z/R, M0, P2, R2/R1 & W). The pointed- or round-based pots of this ware had been tempered with shell or plant material, and had striated or smooth exteriors. Characteristic are inward-slanting direct rims with flat lips, and tooth stamp or bar decoration on the rim. In the exterior decoration, lozenge and herringbone designs occur, with unmistakable Comb Ware influence in the design motifs, although it is important to note that actual comb or wound cord impressions are virtually absent. Characteristic amber ornaments from the dwellings of this group include: circular button-shaped beads of biconical cross-section, rectangular button-shaped beads, and trapezoidal pendants with a straight base and angular or rounded margins.

Several well-preserved examples of hearths in the dwellings of this group show that these were substantial features: the bed of sand on which the fire was lit had a substructure of timbers and bark. Moreover, the stratigraphy showed that the hearths had been renewed by the addition of new layers. The houses were also quite substantial post-built structures, and at least some of the posts had been driven deep into the peat to reach the layer of clay underneath.

In spite of good preservation, the range of different fishing gear components is not very extensive. Thus, net fishing gear is limited to small, rectangular pine bark floats and floats of rolled birch bark, together with sinkers mostly in the form of small (wrapped) pebbles. From remains found in the hearths, it is concluded that fishing structures of lath screens were also used.
The dwellings and artefact clusters with Late Sārnate Ware (Dwellings A\textsubscript{DA}, A\textsubscript{DR}, A\textsubscript{ZA}, F, G, K, N, O, P\textsubscript{b}, T, U, X, Y & Z\textsubscript{b}; Find Unit F/K; Hearth 3), dated approximately to 3630–2850 cal BC and representing the final major phase of occupation, produced the majority of organic artefacts, the largest number of well-preserved structural features and the main body of palaeoeconomic data. The pointed-based pots, tempered with shell or plant matter, characteristically had everted rims curved on the inside, with pits or knot/plait impressions on the rim. Exterior decoration is very sparse, compared with the other wares. Although the exterior is most commonly striated, vessels with a distinctive and characteristic undulating surface are also frequent. And there is a second vessel form – the oval bowls, interpreted as fat-burning lamps. In the amber assemblages of these dwellings, irregular and rounded pendants prevail.

The dwellings of this group had a large number of well-preserved, approximately rectangular hearth structures, essentially similar to those of the dwellings with Early Sārnate Ware. In many cases there were also remains of post-built houses. The structural evidence was sufficiently extensive to permit a study of spatial structure, with the aim of identifying a common layout pattern. Included in this analysis were seven dwellings with elongated hearths whose long axis was oriented approximately WNW–ESE or NW–SE. All or most of the houses associated with these hearths were rectangular, aligned in the same direction as the long axis of the hearth, which is thought to have been placed closer to the westernmost end of the building, and was probably aligned along the ridge-line. Most of these houses seem to have been about 4.5 m wide, measuring up to 9 m in length. The distribution of artefacts in relation to the structural features was investigated, and the clearest pattern to emerge was the concentration around the easternmost end of the hearth of tools and refuse connected with a set of activities relating mainly to food processing, i.e. a ‘kitchen area’.

The dwellings with Late Sārnate Ware display a much greater diversity of net fishing components, including pine bark floats in a particularly wide variety of forms and sizes, which can be taken as evidence that a more diverse range of fishing gear was in use. In addition to the light pebble sinkers, there are also considerable numbers of heavier end-notched sinkers, interpreted as belonging to nets used for fishing in the sea or in rivers. There are also end-sticks for nets, remains of lath fish-screens and lateral prongs of eel clamps.

We are left with several dwellings (B, C, H, J, L, S, V & Z\textsubscript{a}) and find units (G/I\textsubscript{0} & K/M\textsubscript{0}) that cannot be assigned with confidence to any one of the above...
pottery-based groups, either because they show a mix of characteristics or because they have produced very little material, lacking characteristic features. Among these ungrouped dwellings, L, S and V might in fact be regarded as constituting a separate small group, characterised by everted vessel rims angled on the inside at the transition to the body.

The dwellings belonging to the different groups form rows that are thought to have run parallel to the lake shoreline, approximately in a SSW–NNE direction. However, the Comb Ware and Late Sārnate Ware groups show different patterns of hearth and dwelling orientation. In both groups, there were elongated hearths whose long axis was evidently aligned with the long axis of the house. However, at least some of the dwellings in the Comb Ware group seem to have been placed end-to-end, with their long axes parallel to the former shoreline, while in the Late Sārnate Ware group the prevailing pattern is of dwellings also in a row following the former shoreline, but aligned with their long axes perpendicular to the shore. (The alignment evidence for the Early Sārnate Ware group is insufficient to permit any conclusions.)

While the chronological position of the Comb Ware from Sārnate is not altogether clear, the Early Sārnate Ware–Late Sārnate Ware sequence fits into the general pattern of development of pottery in western Latvia and western Lithuania. In the fishing gear, too, there is evidence of a regional pattern of development: the widespread use of comparatively heavy end-notched stone sinkers in the dwellings with Late Sārnate Ware is paralleled at Šventoji by the wider use of side-notched sinkers. These changes may reflect important developments in fishing practices – perhaps the emergence of marine fishing.

The patterns of sooting and residue deposition on the pottery show that a high proportion of the round pots of Early and Late Sārnate Ware, including many of the largest examples, served as cooking pots. Consideration of the Early and Late Sārnate Ware from a technological point of view indicates that both wares belong to a pottery tradition primarily oriented towards the production of low-fired vessels suitable for a specific mode of cooking on an open fire. Technological features appropriate for cooking pots (shell temper, pointed bases, thin walls, etc.) are very widespread in the Neolithic pottery of the East Baltic (Narva Ware sensu lato), and we can guess that cooking would have been the predominant mode of use of pottery in the region. There remains the question of the functional and technological significance of the interaction, very evident in the East Baltic region, between the tradition of shell/organic-tempered pottery, which was
evidently used mainly for cooking, and the tradition of Typical Comb Ware, which seems to have been used largely for storage.

The cooking experiments have revealed how the hearths with a bed of sand could have complemented the functional characteristics of the cooking pots: it is suggested that food was cooked by standing the pointed base of the pot in the sand of the hearth and building up the fire around it. The substantially-constructed hearths evidently also functioned as heating facilities for the house, the bed of sand serving as a heat reservoir. The evidence of successive episodes of hearth renewal suggests that these facilities remained in use for a long time, presumably for many years.

For the Early and Late Särnate phases, pooling various lines of evidence, we can reconstruct the basic settlement-subsistence pattern. Three main characteristics seem apparent:

1. a major focus on the subsistence resources of the eutrophic lagoonal lakes (indicated by the site location and palaeoeconomic evidence, and by an assessment of the resource potential of the surrounding area);
2. a semi-sedentary or sedentary pattern of life, with a permanent occupation at Särnate (indicated by the seasonal range of subsistence evidence from the site, by the presence of substantial hearths serving as heating facilities, and secondarily by the presence of substantial houses and cumbersome equipment); and
3. utilisation of a diverse spectrum of subsistence resources (indicated by artefactual and palaeoeconomic evidence).

The pattern identified at Särnate, at least in its main lines, can probably be applied at a more general level: it can serve to illustrate a mode of subsistence and settlement common to a number of Neolithic settlements at lagoonal lakes in the littoral belt of the East Baltic. As outlined in the introduction, this kind of picture of the methods by which the members of a human community met their everyday physiological requirements can serve as a frame of reference for future studies on those aspects of the life of the community that relate more to inter-personal relationships (ideology, social structure and exchange).

This study has certainly not exhausted the potential for re-analysis of the Särnate site. Even those classes of material that have been examined in detail could yield further evidence with the application of methods that were beyond the scope of this study. Thus, microscopic examination and physico-chemical characterisation of the pottery and the residues adhering to it could reveal much
more about the ceramics. Information about the sources of clay and temper material would naturally be very welcome, and characterisation of food residues could permit a clearer understanding of how the pottery tradition relates to the subsistence pattern. New information about practices of food processing might also be obtained from a functional study of the household utensils that would have been used together with the cooking vessels, i.e. the wooden spoons, ladles and stirrers.

There is also potential for further study of other kinds of wooden artefacts from Sârnate, such as the hunting weapons and wood-processing equipment. At the same time, the collection of wooden objects could yield new information about woodworking techniques.

Apart from the multivariate statistical analyses of the dwelling assemblages of amber ornaments, undertaken in the frame of ‘cultural grouping’, and a brief consideration of amber gathering in the frame of resource use, amber has remained outside the scope of the study. Although amber-working traditions and the amber exchange network of North-Eastern Europe have been extensively studied by other authors already, there remains plenty of scope for additional research on this theme, and the major amber collection from Sârnate could be made to yield a great deal more evidence. Closely related to amber, as a logical exchange equivalent for it, and as a raw material for amber-working tools, is flint. Technological and provenience studies on the flint collection from Sârnate could thus complement research on the amber.

On the other hand, for some research topics it seems that the limits of the Sârnate data have been reached, which means that further investigation of these topics would require a new excavation at Sârnate, or excavation of other sites from this period. One or more sites with good preservation could be selected for research excavation, which should naturally proceed at an unhurried pace, in order to allow more detailed recording of find provenience and structural remains. In this way, a great deal of additional evidence could be collected regarding the layout and functional division of the dwellings of this time. With systematic recovery of plant and animal remains by sieving or flotation, there would be hope of resolving various fundamental questions that remain unanswered concerning the economy of the coastal belt during the Neolithic. As we have seen, the currently available data provides only vague indications regarding the beginnings of marine fishing along this coast or the initial development of food production.

Because of the excellent preservation conditions, Sârnate is deservedly rated as an outstanding site. However, it is by no means the region’s only Stone Age
site with superb organic preservation. The Lake Lubāns wetlands in eastern Latvia, the meadowlands at Šventoji in western Lithuania and other wetland areas in this region have likewise yielded rich collections of material preserved in anaerobic conditions. In Latvia’s Coastal Lowland belt, and in other parts of the East Baltic region, there still exist many relatively intact areas of bog that have developed through the overgrowing of lakes or paludification of river valleys, so, in the author’s estimation, we have every chance of discovering new sites with excellent organic preservation. Systematic efforts should be made to identify such sites, safeguard them, and tap them as rich sources of information about the past.
Bibliography

Apinis A (1935) Ezerrieksts (Trapa) [The Water Chestnut (Trapa)]. Latvijas Universitātes dabas zinātņu studentu biedrība, Rīga.


Burov G M (1969) O poiskah drevnih derevânych vešej i rybolovnych sooruženij v stariičnych torfânikah ravinných rek [In search of ancient wooden artefacts and fishing equipment in the former bogs of lowland rivers]. Kratkie soobšeniâ o dokladah i polevyh issledovaniâh instituta arheologii 117: 133–134.


Caune A (1992) . pati Rīga ūdenī [...Riga Itself is in the Water]. Zinātne, Rīga.


Edward A L (nd) An Introduction to Linear Regression and Correlation. W H Freeman and Co., San Francisco.


Fedorov V V (1937) Rybolovnye snarâdy neolitičeskoj èpohi iz doliny r. Oki [Fishing equipment of the Neolithic from the valley of the River Oka]. Sovetskaâ Arheologiâ 2: 61.


Grīnbergs E F (1957) Pozdnelednikovâ i poslelednikovâ istoriî poberež'â Latvijskoj SSR [Late Glacial and Postglacial History of the Coast of the Latvian SSR]. Akademiî nauk Latvijskoj SSR, Rīga.


Gurina N N (1967) Iz istorii drevnih plemen zapadnyh oblastej SSSR (po materialam narvskoj ekspedicii) [On the History of Ancient Tribes of the Western Regions of the USSR (based on the material of the Narva expedition)]. Materialy i issledovaniâ po arheologii SSSR 144.


Kalniņš A (1944) Ķīmiskā meža tehnoloģija [Chemical Techniques in Forestry]. Saimniečības literatūras apgāds, Rīga.


Loze I A (1979) Pozdnij neolit i rannââ bronza Lubanskoj ravniny [The Late Neolithic and Early Bronze Age on the Lubâns Plain]. Zinatne, Riga.


426


Paaver K L (1965) Formirovanie teriofauny i izmenčivost’ mlekopitaûših Pribaltiki v golocene [The Development of the Mammal Fauna and the Variability of Mammals in the Baltic Region During the Holocene]. Akademiâ nauk Èstonskoj SSR, Tallin.


Rausenbah V M (1956) Srednee Zaural'ë v èpohu neolita i bronzy [Central Transuralia in the Neolithic and Bronze Age]. Gosudarstvennoe Izdatel'stvo Kul'turno-Prosvetitel'noi Literatury, Moskva.


Sloka J (1985a) Zivis Brikuļu apmetnē vēlājā bronzas laikmetā un dzelzs laikmetā [Fish at the settlement site of Brikuļi in the Late Bronze Age and Iron Age]. Latvijas PSR Zinātņu Akadēmijas Vēstis 1985 (3): 72–75.


Tallgren A M (1922) Zur Archäologie Estis, I. Vom Anfang der Besiedlung bis etwa 500 n. Chr. np, Dorpat.


Vasks A (1994) Brikuļi nocietinātā apmetne. Lubāna zemiene vēlajā bronzas un dzelzs laikmetē (1000. g. pr. Kr. – 1000. g. pēc Kr.) [Brikuļi Fortified Settlement: the Lubāna Lowlands in the Late Bronze and Iron Age (1000 BC – 1000 AD)]. Preses nams, Rīga.


## Appendices

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix 1</td>
<td>Summary tables of pottery data</td>
<td>441</td>
</tr>
<tr>
<td>Appendix 2</td>
<td>Tables of results from correspondence analysis of pottery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>rim subtypes</td>
<td>451</td>
</tr>
<tr>
<td>Appendix 3</td>
<td>Tables of results from correspondence analysis of pottery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>rim decoration elements</td>
<td>452</td>
</tr>
<tr>
<td>Appendix 4</td>
<td>Data on amber ornaments</td>
<td>453</td>
</tr>
<tr>
<td>Appendix 5</td>
<td>Tables of results from correspondence analysis of amber ornament sub-types</td>
<td></td>
</tr>
<tr>
<td>Appendix 6</td>
<td>Data on fishing gear</td>
<td>456</td>
</tr>
<tr>
<td>Appendix 7</td>
<td>Data on the hearths</td>
<td>462</td>
</tr>
<tr>
<td>Appendix 8</td>
<td>Determination of wood taxa used for artefacts</td>
<td>464</td>
</tr>
<tr>
<td>Appendix 9</td>
<td>Analysis of the wood charcoal</td>
<td>467</td>
</tr>
<tr>
<td>Appendix 10</td>
<td>Analysis of the faunal remains</td>
<td>469</td>
</tr>
</tbody>
</table>
Appendix 1 Summary tables of pottery data
Table 8. Summarised data on the round pots (based on rim sherds): fabric, surface finish and rim form.

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>No. of vessels</th>
<th>Fabric</th>
<th>Exterior finish</th>
<th>Interior finish</th>
<th>Rim form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Porous</td>
<td>Min. temper</td>
<td>Pores + min. temper</td>
<td>Smooth</td>
</tr>
<tr>
<td>Comb Ware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>62 22</td>
<td>6</td>
<td>28</td>
<td>48</td>
<td>38 2</td>
</tr>
<tr>
<td>4</td>
<td>1 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6zA</td>
<td>1 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Group total</td>
<td>74 25</td>
<td>6</td>
<td>31</td>
<td>51</td>
<td>42 2</td>
</tr>
<tr>
<td>% in group</td>
<td>34 8</td>
<td>42</td>
<td>69</td>
<td>57</td>
<td>3</td>
</tr>
<tr>
<td>Early Sărmata Ware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>5 5</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>6 6</td>
<td>3</td>
<td>3</td>
<td>1 2</td>
<td>2</td>
</tr>
<tr>
<td>Iz/Bg</td>
<td>7 3</td>
<td>4</td>
<td>3</td>
<td>1 4</td>
<td>1</td>
</tr>
<tr>
<td>Mz/Mz/Mzzz</td>
<td>23 23</td>
<td>4 13</td>
<td>1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Pz</td>
<td>3 3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rz/Rz</td>
<td>3 2</td>
<td>1 2</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>W</td>
<td>6 5</td>
<td>1 3 1</td>
<td>3 1</td>
<td>3 1</td>
<td>3 1</td>
</tr>
<tr>
<td>Group total</td>
<td>69 58</td>
<td>11</td>
<td>29 1</td>
<td>13 27</td>
<td>1 1</td>
</tr>
<tr>
<td>% in group</td>
<td>84 16</td>
<td>25</td>
<td>42 1</td>
<td>19 39</td>
<td>1</td>
</tr>
<tr>
<td>Dwelling/ finds unit</td>
<td>No. of vessels</td>
<td>Fabric</td>
<td>Exterior finish</td>
<td>Interior finish</td>
<td>Rim form</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
<td>--------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Porous</td>
<td>Min. temper</td>
<td>Pores + min. temper</td>
<td>Smooth</td>
</tr>
<tr>
<td>Late Sarmate Ware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A0A</td>
<td>19</td>
<td>17</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>A0H</td>
<td>12</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>A0X</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>F</td>
<td>42</td>
<td>36</td>
<td>6</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>F/K</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>39</td>
<td>36</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>K</td>
<td>16</td>
<td>13</td>
<td>2</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>O</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Pb</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>T</td>
<td>10</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>U</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td>8</td>
<td>2</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Y</td>
<td>16</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Zb</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hearth 3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Group</td>
<td>207</td>
<td>186</td>
<td>16</td>
<td>13</td>
<td>115</td>
</tr>
<tr>
<td>% in group</td>
<td>90</td>
<td>8</td>
<td>6</td>
<td>56</td>
<td>14</td>
</tr>
<tr>
<td>Dwelling/ finds unit</td>
<td>Fabric</td>
<td>Exterior finish</td>
<td>Interior finish</td>
<td>Rim form</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of vessels</td>
<td>Porous</td>
<td>Min. temper</td>
<td>Poros + min. temper</td>
<td>Smooth</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G/Id</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>J</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>K/MD</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>L</td>
<td>18</td>
<td>15</td>
<td>-</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>V</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Za</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Group total</td>
<td>49</td>
<td>40</td>
<td>1</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>% in group</td>
<td>82</td>
<td>2</td>
<td>14</td>
<td>4</td>
<td>65</td>
</tr>
<tr>
<td>Overall total</td>
<td>399</td>
<td>309</td>
<td>7</td>
<td>65</td>
<td>83</td>
</tr>
<tr>
<td>% in group</td>
<td>14</td>
<td>16</td>
<td>14</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>
445

–

7
1
65
88

5

6ZA

Group total

% in group
11
2
4
6
16
3
1
1

2

D

E

IZ/ID

MZA/MZR/MD

Pa

RZ/RD

W

Early Sārnate Ware

1

1

4

–

–

–

2

1

4

1

5

5

4

–

3

1
55

Rim decoration present

3

–

Pits

1

Comb Ware
–

Knots/plaits
–

–

–

6

2

–

–

2

–

–

–

–

–

–

–

Fingernail
–

–

–

–

–

–

–

–

8

6

–

1

–

5

–

Bars
–

–

1

3

1

–

–

–

–

–

–

–

–

–

–

Tooth stamp
1

1

1

6

1

–

1

–

–

–

–

–

–

–

Comb/wound cord
–

1

Exterior decoration present
–

6

1

–

–

–

–

–

–

–

2

6

3

3

15

6

6

4

13

30 73

22 54

–

–

–

22 46

Exterior decoration element

–

Pits
4

2

–

5

1

4

1

9

53

39

–

3

–

36

–

Knots/plaits
–

–

–

–

–

–

–

–

–

–

–

–

–

–

–

Fingernail
–

–

–

1

1

–

–

–

–

–

–

–

–

–

–

Bars
–

–

1

2

–

–

1

–

–

–

–

–

–

–

–

Tooth stamp
4

1

2

6

1

–

2

3

–

–

–

–

–

–

–

Comb/wound cord
–

–

–

–

–

–

–

2

30

22

–

–

–

22

–

Incised lines
–

–

–

–

–

–

–

–

–

–

–

–

–

–

–

Single horizontal row
–

–

–

–

1

–

1

3

4

3

–

1

–

2

–

Multiple horizontal rows
1

1

–

8

2

1

1

1

4

3

–

–

–

3

Exterior design

–

Alternating multiple
horizontal rows
1

–

–

–

–

–

–

1

11

8

–

–

–

8

–

Undulating lines
–

–

–

–

–

–

–

1

–

–

–

–

–

–

–

Zigzag
–

–

–

–

–

–

–

–

1

1

–

–

–

1

–

Lozenge
–

–

–

4

–

–

–

–

1

1

–

–

–

1

–

Herringbone
–

–

–

2

1

–

–

1

–

–

–

–

–

–

–

Complex
2

–

1

–

–

–

–

1

1

1

–

–

–

1

–

Dark throughout
–

1

–

2

1

–

–

–

5

4

–

–

–

4

1

Oxidised throughout
2

–

1

5

1

–

2

10

42

31

1

6

1

22

3

1

2

7

4

3

1

5

38

28

–

–

–

27

1

Oxidised surfaces, dark core

residue

Colour profile Exterior

2

1

–

14

3

1

2

–

8

6

–

–

–

6

–

Present, but no separate layer

Rim decoration element

–

1

–

2

4

1

–

–

1

1

–

–

–

1

–

Separate layer

finds unit

Interior
residue

–

–

2

3

3

–

2

3

16

12

–

–

–

12

–

Present, but no separate layer

Dwelling/

–

–

–

8

1

2

1

–

1

1

–

–

–

1

–

Separate layer

Table 9. Summarised data on the round pots (based on rim sherds): decoration, use alteration and repair features.

–

–

–

3

2

–

–

1

–

–

–

–

–

–

–

Drilled perforation


<table>
<thead>
<tr>
<th>Exterior decoration element</th>
<th>Colours profile</th>
<th>Exterior design</th>
<th>Dwelling/ find unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rim decoration present</td>
<td>Oxidised surfaces, dark core</td>
<td>Oxidised throughout</td>
<td>Oxidised surfaces, dark core</td>
</tr>
<tr>
<td>Exterior decoration present</td>
<td>Oxidised throughout</td>
<td>Oxidised throughout</td>
<td>Oxidised throughout</td>
</tr>
<tr>
<td>Pits</td>
<td>Dent, triangular</td>
<td>Complex</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Knots/plaits</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Fingernail</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Bars</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Tooth stamp</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Comb/wound cord</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Incised lines</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Single horizontal row</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Multiple horizontal rows</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Alternating multiple horizontal rows</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Undulating lines</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Zigzag</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Lozenge</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Herringbone</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Complex</td>
<td>Oblique hatched lines</td>
<td>Oblique hatched lines</td>
<td>Drilled perforation</td>
</tr>
<tr>
<td>Separate layer</td>
<td>Separate layer</td>
<td>Separate layer</td>
<td>Separate layer</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>OX 12</td>
<td>15 1 10 – – – – 9 1 – – – – – 1 1 1 – – – – – – 1 3 15 15 3 2 7 1</td>
<td></td>
<td>1 3 15 15 3 2 7 1</td>
</tr>
<tr>
<td>Dwelling/ finds unit</td>
<td>Rim decoration element</td>
<td>Exterior decoration element</td>
<td>Exterior design</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>Pits</td>
<td>Knots/plaits</td>
</tr>
<tr>
<td>Hearth 3</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>25</td>
<td>81</td>
</tr>
<tr>
<td>% in group</td>
<td>88</td>
<td>12</td>
<td>39</td>
</tr>
<tr>
<td>Other dwellings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>G/B</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>J</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>K/Md</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>L</td>
<td>11</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>S</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Z                  10</td>
<td>1</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>% in group</td>
<td>82</td>
<td>16</td>
<td>47</td>
</tr>
<tr>
<td>Overall total</td>
<td>332</td>
<td>50</td>
<td>114</td>
</tr>
</tbody>
</table>
Table 10. Summarised data on potsherds from Dwellings 1–15_R.

<table>
<thead>
<tr>
<th>Dwelling Accession unit</th>
<th>Fabric</th>
<th>Exterior decoration element</th>
<th>Length of stamp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of sherds</td>
<td>Porous</td>
<td>Mineral tempered</td>
</tr>
<tr>
<td>Comb Ware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>103</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>A 11422: 62</td>
<td>160</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>A 11422: 178</td>
<td>383</td>
<td>174</td>
<td>128</td>
</tr>
<tr>
<td>A 11422: 179</td>
<td>60</td>
<td>36</td>
<td>11</td>
</tr>
<tr>
<td>A 11422: 181</td>
<td>36</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>A 11422: 237</td>
<td>677</td>
<td>385</td>
<td>141</td>
</tr>
<tr>
<td>A 11422: 252</td>
<td>3</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>A 11422: 312</td>
<td>165</td>
<td>155</td>
<td>5</td>
</tr>
<tr>
<td>A 11422: 313</td>
<td>365</td>
<td>221</td>
<td>79</td>
</tr>
<tr>
<td>A 11422: 314</td>
<td>112</td>
<td>63</td>
<td>31</td>
</tr>
<tr>
<td>Topsoil</td>
<td>208</td>
<td>125</td>
<td>44</td>
</tr>
</tbody>
</table>

(A 11422:179, :181, :314)
<table>
<thead>
<tr>
<th>Dwelling Accession unit</th>
<th>Fabric</th>
<th>Exterior decoration element</th>
<th>Comb or wound cord</th>
<th>Length of stamp</th>
<th>No. of sherds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1060</td>
<td>209</td>
<td>221</td>
<td>791</td>
<td>388</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1422</td>
<td>178</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>237</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>984</td>
<td>381</td>
<td>15</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>123</td>
<td>94</td>
<td>365</td>
<td>204</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>52</td>
<td>1</td>
<td>123</td>
<td>94</td>
<td>365</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>1</td>
<td>123</td>
<td>94</td>
<td>365</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>20</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>21</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>15</td>
<td>7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>12</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>2347</td>
<td>1147</td>
<td>528</td>
<td>1697</td>
<td>986</td>
</tr>
<tr>
<td>total</td>
<td>381</td>
<td>21</td>
<td>15</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td>% in group</td>
<td>49</td>
<td>22</td>
<td>72</td>
<td>41</td>
<td>1</td>
</tr>
</tbody>
</table>

449
<table>
<thead>
<tr>
<th>Dwelling Accession unit</th>
<th>Fabric</th>
<th>Exterior decoration element</th>
<th>Length of stamp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of sherd(s)</td>
<td>Porous</td>
<td>Mineral tempered</td>
</tr>
<tr>
<td>Other dwellings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>239</td>
<td>178</td>
<td>8</td>
</tr>
<tr>
<td>6d(1)</td>
<td>37</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Overall</td>
<td>2624</td>
<td>1356</td>
<td>534</td>
</tr>
</tbody>
</table>
### Appendix 2 Tables of results from correspondence analysis of pottery rim subtypes

**Table 11. Eigenvalues and corresponding inertia.**

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values</td>
<td>0.550</td>
<td>0.387</td>
<td>0.214</td>
<td>0.048</td>
<td>0.040</td>
<td>0.037</td>
<td>0.017</td>
<td>0.012</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Inertia %</td>
<td>39.2</td>
<td>27.6</td>
<td>15.2</td>
<td>6.6</td>
<td>3.4</td>
<td>2.8</td>
<td>2.6</td>
<td>1.2</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>39.2</td>
<td>66.8</td>
<td>82.1</td>
<td>88.6</td>
<td>92.1</td>
<td>94.9</td>
<td>97.5</td>
<td>98.8</td>
<td>99.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Table 12. Column and row contributions to inertia (%), for the first four axes.**

<table>
<thead>
<tr>
<th>Column/Row</th>
<th>Axis 1</th>
<th>Axis 2</th>
<th>Axis 3</th>
<th>Axis 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia1</td>
<td>2.1</td>
<td>1.4</td>
<td>26.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Ic1</td>
<td>1.6</td>
<td>3.4</td>
<td>27.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Id1</td>
<td>0.2</td>
<td>0.5</td>
<td>6.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Id2</td>
<td>30.6</td>
<td>0.0</td>
<td>16.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Id3</td>
<td>6.3</td>
<td>1.6</td>
<td>9.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Id4</td>
<td>10.9</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Sa1</td>
<td>0.0</td>
<td>9.8</td>
<td>1.7</td>
<td>8.9</td>
</tr>
<tr>
<td>Sa2</td>
<td>4.4</td>
<td>0.0</td>
<td>3.4</td>
<td>68.2</td>
</tr>
<tr>
<td>Sa3</td>
<td>37.7</td>
<td>13.3</td>
<td>8.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Sb1</td>
<td>2.2</td>
<td>38.9</td>
<td>0.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Sb3</td>
<td>3.4</td>
<td>31.0</td>
<td>0.2</td>
<td>4.2</td>
</tr>
<tr>
<td>2</td>
<td>15.2</td>
<td>0.0</td>
<td>14.5</td>
<td>1.8</td>
</tr>
<tr>
<td>3</td>
<td>27.8</td>
<td>0.6</td>
<td>9.4</td>
<td>4.6</td>
</tr>
<tr>
<td>A13A</td>
<td>8.6</td>
<td>3.6</td>
<td>4.3</td>
<td>0.1</td>
</tr>
<tr>
<td>A23A</td>
<td>3.2</td>
<td>2.7</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>A22A</td>
<td>2.6</td>
<td>1.3</td>
<td>3.9</td>
<td>3.0</td>
</tr>
<tr>
<td>E</td>
<td>4.1</td>
<td>0.1</td>
<td>8.4</td>
<td>0.4</td>
</tr>
<tr>
<td>F</td>
<td>0.0</td>
<td>2.2</td>
<td>15.4</td>
<td>0.0</td>
</tr>
<tr>
<td>G</td>
<td>11.4</td>
<td>0.7</td>
<td>1.4</td>
<td>36.1</td>
</tr>
<tr>
<td>I</td>
<td>1.8</td>
<td>0.1</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>K</td>
<td>3.0</td>
<td>0.0</td>
<td>0.7</td>
<td>18.3</td>
</tr>
<tr>
<td>L</td>
<td>2.1</td>
<td>64.5</td>
<td>0.8</td>
<td>3.1</td>
</tr>
<tr>
<td>M</td>
<td>5.7</td>
<td>0.6</td>
<td>1.1</td>
<td>6.5</td>
</tr>
<tr>
<td>N</td>
<td>1.1</td>
<td>2.0</td>
<td>0.1</td>
<td>3.3</td>
</tr>
<tr>
<td>O</td>
<td>1.7</td>
<td>1.5</td>
<td>3.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Pb</td>
<td>0.1</td>
<td>0.4</td>
<td>4.1</td>
<td>0.7</td>
</tr>
<tr>
<td>S</td>
<td>2.2</td>
<td>10.9</td>
<td>0.3</td>
<td>2.0</td>
</tr>
<tr>
<td>T</td>
<td>1.2</td>
<td>1.2</td>
<td>3.3</td>
<td>10.9</td>
</tr>
<tr>
<td>W</td>
<td>3.0</td>
<td>1.5</td>
<td>5.6</td>
<td>1.5</td>
</tr>
<tr>
<td>X</td>
<td>3.1</td>
<td>2.4</td>
<td>0.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Y</td>
<td>2.0</td>
<td>2.2</td>
<td>5.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Z</td>
<td>0.1</td>
<td>1.5</td>
<td>17.3</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Appendix 3 Tables of results from correspondence analysis of pottery rim decoration elements

Table 13. Eigenvalues and corresponding inertia.

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values</td>
<td>0.785</td>
<td>0.358</td>
<td>0.228</td>
<td>0.027</td>
<td>0.020</td>
</tr>
<tr>
<td>Inertia %</td>
<td>55.4</td>
<td>25.25</td>
<td>16.1</td>
<td>1.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>55.4</td>
<td>80.6</td>
<td>96.7</td>
<td>98.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 14. Column and row contributions to inertia (%).

<table>
<thead>
<tr>
<th>Column/row</th>
<th>Axis 1</th>
<th>Axis 2</th>
<th>Axis 3</th>
<th>Axis 4</th>
<th>Axis 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pits</td>
<td>0.1</td>
<td>4.9</td>
<td>74.7</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Knots/plaits</td>
<td>16.5</td>
<td>6.5</td>
<td>20.6</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Fingernail</td>
<td>13.7</td>
<td>0.0</td>
<td>1.0</td>
<td>0.4</td>
<td>81.5</td>
</tr>
<tr>
<td>Bars</td>
<td>1.6</td>
<td>25.3</td>
<td>0.2</td>
<td>69.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Tooth stamp</td>
<td>2.0</td>
<td>62.8</td>
<td>1.8</td>
<td>28.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Comb/wound cord</td>
<td>66.1</td>
<td>0.5</td>
<td>1.7</td>
<td>0.1</td>
<td>17.9</td>
</tr>
<tr>
<td>2</td>
<td>79.2</td>
<td>0.6</td>
<td>1.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>0.7</td>
<td>1.3</td>
<td>16.2</td>
<td>1.1</td>
<td>12.6</td>
</tr>
<tr>
<td>ADA</td>
<td>1.9</td>
<td>2.1</td>
<td>3.8</td>
<td>2.1</td>
<td>0.4</td>
</tr>
<tr>
<td>ADR</td>
<td>2.0</td>
<td>0.0</td>
<td>7.0</td>
<td>29.9</td>
<td>0.0</td>
</tr>
<tr>
<td>F</td>
<td>1.7</td>
<td>0.4</td>
<td>3.1</td>
<td>17.3</td>
<td>4.8</td>
</tr>
<tr>
<td>G</td>
<td>3.1</td>
<td>4.1</td>
<td>2.5</td>
<td>2.6</td>
<td>0.5</td>
</tr>
<tr>
<td>I</td>
<td>0.9</td>
<td>8.8</td>
<td>0.8</td>
<td>15.5</td>
<td>0.2</td>
</tr>
<tr>
<td>K</td>
<td>0.3</td>
<td>3.1</td>
<td>33.4</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>L</td>
<td>1.1</td>
<td>1.4</td>
<td>1.0</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>M</td>
<td>3.8</td>
<td>70.5</td>
<td>1.7</td>
<td>5.1</td>
<td>0.0</td>
</tr>
<tr>
<td>N</td>
<td>0.1</td>
<td>1.3</td>
<td>0.0</td>
<td>1.1</td>
<td>80.6</td>
</tr>
<tr>
<td>S</td>
<td>0.5</td>
<td>2.2</td>
<td>8.6</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>T</td>
<td>0.5</td>
<td>2.2</td>
<td>8.6</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Y</td>
<td>2.4</td>
<td>0.1</td>
<td>8.7</td>
<td>21.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Z</td>
<td>1.7</td>
<td>2.0</td>
<td>3.0</td>
<td>1.8</td>
<td>0.3</td>
</tr>
</tbody>
</table>
## Appendix 4 Data on amber ornaments

### Table 15. Data on amber ornaments.

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Dwellings with Comb Ware

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Dwellings with Early Sârmate Ware

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Dwellings with Late Sârmate Ware

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dwellings with Comb Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dwellings with Early Sârmate Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dwellings with Late Sârmate Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Group total for each category:

Dwellings with Comb Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Group total: 6 8 3 3 4 1 – – – 2 2 3 1 – 8 2

Dwellings with Early Sârmate Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Group total: 12 – 1 54 18 1 3

Dwellings with Late Sârmate Ware:

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discoidal</td>
<td>Bliconvex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat convex</td>
<td>Oval</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
<td>Straight base, rounded margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concave base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convex base, angular margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Droppeled shaped</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rounded</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triangular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Group total: 1 1 – 1 19 9 – – – 3 10 1 28 3

453
<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Tubular beads</th>
<th>Button-shaped beads</th>
<th>Pendants</th>
<th>Discs/ rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circular</td>
<td>Trapezoidal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical</td>
<td>Discoidal</td>
<td>Flat-convex</td>
<td>Oval</td>
</tr>
<tr>
<td>Ungrouped dwellings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6CR</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>12Cv</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>14</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>J</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>L</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Pc</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>V</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Za</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Trench 1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Group total</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Overall</td>
<td>Total</td>
<td>22</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

454
Appendix 5 Tables of results from correspondence analysis of amber ornament sub-types

Table 16. Eigenvalues and corresponding inertia.

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values</td>
<td>0.503</td>
<td>0.466</td>
<td>0.226</td>
<td>0.199</td>
<td>0.114</td>
<td>0.070</td>
<td>0.054</td>
<td>0.015</td>
<td>0.014</td>
<td>0.001</td>
</tr>
<tr>
<td>Inertia %</td>
<td>30.2</td>
<td>28.0</td>
<td>13.6</td>
<td>12.0</td>
<td>6.9</td>
<td>4.2</td>
<td>3.3</td>
<td>0.9</td>
<td>0.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>30.2</td>
<td>58.3</td>
<td>71.8</td>
<td>83.8</td>
<td>90.7</td>
<td>94.9</td>
<td>98.2</td>
<td>99.1</td>
<td>99.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 17. Column and row contributions to inertia (%) for the first four axes.

<table>
<thead>
<tr>
<th>Column/row</th>
<th>Axis 1</th>
<th>Axis 2</th>
<th>Axis 3</th>
<th>Axis 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>ambb-bico</td>
<td>35.0</td>
<td>0.1</td>
<td>19.2</td>
<td>04.7</td>
</tr>
<tr>
<td>ambb-fico</td>
<td>14.8</td>
<td>0.2</td>
<td>1.8</td>
<td>0.2</td>
</tr>
<tr>
<td>ambb-oval</td>
<td>2.0</td>
<td>4.2</td>
<td>0.2</td>
<td>15.3</td>
</tr>
<tr>
<td>ambe-bar</td>
<td>3.9</td>
<td>31.3</td>
<td>28.2</td>
<td>1.1</td>
</tr>
<tr>
<td>ambe-cyl</td>
<td>10.3</td>
<td>4.0</td>
<td>0.2</td>
<td>1.0</td>
</tr>
<tr>
<td>amdisc/amring</td>
<td>2.5</td>
<td>0.5</td>
<td>7.9</td>
<td>3.1</td>
</tr>
<tr>
<td>ampe-drop</td>
<td>4.9</td>
<td>0.1</td>
<td>1.7</td>
<td>2.5</td>
</tr>
<tr>
<td>ampe-ire</td>
<td>15.8</td>
<td>48.1</td>
<td>31.1</td>
<td>0.6</td>
</tr>
<tr>
<td>ampe-round</td>
<td>4.9</td>
<td>0.5</td>
<td>1.5</td>
<td>64.6</td>
</tr>
<tr>
<td>ampe-irca</td>
<td>2.0</td>
<td>5.1</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>ampe-trcr</td>
<td>1.5</td>
<td>6.0</td>
<td>3.0</td>
<td>0.7</td>
</tr>
<tr>
<td>ampe-trsr</td>
<td>2.5</td>
<td>0.1</td>
<td>3.9</td>
<td>4.9</td>
</tr>
<tr>
<td>2</td>
<td>36.5</td>
<td>2.8</td>
<td>19.4</td>
<td>8.5</td>
</tr>
<tr>
<td>3</td>
<td>11.3</td>
<td>45.2</td>
<td>37.8</td>
<td>0.7</td>
</tr>
<tr>
<td>ε2A</td>
<td>5.4</td>
<td>7.5</td>
<td>3.8</td>
<td>0.4</td>
</tr>
<tr>
<td>A(α)</td>
<td>4.9</td>
<td>10.8</td>
<td>3.6</td>
<td>1.3</td>
</tr>
<tr>
<td>A(αr)</td>
<td>4.9</td>
<td>10.8</td>
<td>3.6</td>
<td>1.3</td>
</tr>
<tr>
<td>G</td>
<td>5.4</td>
<td>05.6</td>
<td>07.1</td>
<td>03.6</td>
</tr>
<tr>
<td>M2/M2/M0</td>
<td>4.9</td>
<td>0.4</td>
<td>2.9</td>
<td>0.0</td>
</tr>
<tr>
<td>F</td>
<td>4.9</td>
<td>0.8</td>
<td>0.1</td>
<td>11.7</td>
</tr>
<tr>
<td>O</td>
<td>4.9</td>
<td>0.2</td>
<td>4.4</td>
<td>31.1</td>
</tr>
<tr>
<td>X</td>
<td>4.4</td>
<td>0.3</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>ε2R</td>
<td>3.4</td>
<td>3.0</td>
<td>0.1</td>
<td>31.4</td>
</tr>
<tr>
<td>N</td>
<td>3.4</td>
<td>15.5</td>
<td>8.9</td>
<td>0.8</td>
</tr>
<tr>
<td>A(αr)</td>
<td>3.0</td>
<td>7.8</td>
<td>3.3</td>
<td>1.3</td>
</tr>
<tr>
<td>D</td>
<td>2.5</td>
<td>0.0</td>
<td>2.1</td>
<td>1.6</td>
</tr>
<tr>
<td>I2/I0</td>
<td>2.5</td>
<td>0.1</td>
<td>2.2</td>
<td>1.6</td>
</tr>
<tr>
<td>E</td>
<td>2.5</td>
<td>0.0</td>
<td>3.2</td>
<td>5.5</td>
</tr>
</tbody>
</table>
Appendix 6 Data on fishing gear
Table 18. Summarised data on the fishing gear.

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Floats</th>
<th></th>
<th>Sinkers</th>
<th>Bundles of laths (screens &amp; clamps for fish fences?)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pine bark floats</td>
<td>Stone sinkers, unworked</td>
<td>Notched stone sinkers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Elongated, central perforation</td>
<td>Circular, square central perforation, notched</td>
</tr>
<tr>
<td>Dwelling with Comb Ware</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>69</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dwelling with Early Sārnate Ware</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>I/1/0</td>
<td>4</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>M/M/M</td>
<td>5</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>R/R</td>
<td>3</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>5</td>
<td>28</td>
<td>12</td>
</tr>
</tbody>
</table>
## Floats and Sinkers

<table>
<thead>
<tr>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine bark floats</td>
<td>Stone sinkers, unworked</td>
<td>End-notched</td>
<td>Side-notched</td>
</tr>
<tr>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Perforated at one end</td>
<td>Perforated at one end</td>
</tr>
<tr>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Notched stone sinkers</td>
<td>Notched stone sinkers</td>
<td>Notched stone sinkers</td>
</tr>
<tr>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td>Thereof, with remains of binding</td>
<td></td>
</tr>
<tr>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Dwellings with Late Särnate Ware

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Table

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Data

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwelling/ finds unit</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Notes

- **AC4**: 19 – 1 – – – 1 1 – – – – – – – –
- **AC6**: 15 – 1 – – – 1 1 – – – – – – – –
- **AC9**: 2 4 – – – 1 1 – – – – – – – –
- **F**: 3 1 – – – 1 1 – – – – – – – –
- **F/K**: 2 – – – – 1 1 – – – – – – – –
- **G**: 4 – – – 1 1 – – – – – – – –
- **K**: 8 2 2 – 2 1 1 – – – – – – – –
- **N**: 7 – 1 2 – 1 1 – – 23 2 – – 2 1
- **O**: 1 – – – – – – – 10 – – 1 – – –
- **Pb**: – – – – – – – – 1 – – – – –
- **T**: 10 1 2 2 1 2 2 2 2 – – – – –
- **U**: 1 – – – – – – – 1 – – – – –
- **X**: 5 – – – – 1 1 – – – – – – – –
- **Y**: 2 – – – – 2 2 – – 18 2 – – – –
- **Hearth 3**: – – – – – – – – 1 – – – – –

<table>
<thead>
<tr>
<th>Total</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths (screens)</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Birch bark rolls</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
<td>Circular/perforation</td>
</tr>
<tr>
<td></td>
<td>Pebbles</td>
<td>Thereof, with remains of wrapping</td>
<td>Thereof, with remains of binding</td>
<td>Various notched pieces, indeterminate fragments</td>
</tr>
<tr>
<td></td>
<td>Large stones</td>
<td>Thereof, with remains of binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Birches</td>
<td>Various notched pieces, indeterminate fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Floats  
- Pine bark floats
  - Unperforated
  - Perforated at one end
  - Elongated central perforation
  - Circular perforation, rounded ends
  - Birch bark rolls

Sinkers  
- Stone sinkers, unworked
  - Pebbles
  - Theretof, with remains of wrapping
  - Large stones
  - Theretof, with remains of binding
- Notched stone sinkers
  - End-notched
  - Side-notched
  - Theretof, with remains of binding
  - Various notched pieces, indeterminate fragments

 Bundles of laths (screens for fish fences?)
- Arms of eel clamps

<table>
<thead>
<tr>
<th>Dwelling/finds unit</th>
<th>Floats</th>
<th>Sinkers</th>
<th>Bundles of laths</th>
<th>Arms of eel clamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pine bark floats</td>
<td>Stone sinkers, unworked</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unperforated</td>
<td>Perforated at one end</td>
<td>Elongated central perforation</td>
<td>Circular perforation, rounded ends</td>
</tr>
<tr>
<td>Ungrouped dwellings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6CHR</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12CHR</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>J</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>K/MD</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>5</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Trench 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>18</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stray finds</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overall total</td>
<td>103</td>
<td>9</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 19. Unperforated floats: shape in plan view (see Fig. 49 for key).

<table>
<thead>
<tr>
<th>Dwellings with</th>
<th>Notched</th>
<th>Grooved</th>
<th>No notches or groove</th>
<th>Indeterminate:</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Sārnate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Íý/Ý</td>
<td>– 3</td>
<td>– 3</td>
<td>– 3</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>M₂₀/M₂₁/M₀₂</td>
<td>– 4 1</td>
<td>– 4 1</td>
<td>– 4 1</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>R₂/R₀</td>
<td>– 3</td>
<td>– 3</td>
<td>– 3</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>1 10 1</td>
<td>– 12</td>
<td>– 12</td>
<td>– 1</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwellings with</th>
<th>Notched</th>
<th>Grooved</th>
<th>No notches or groove</th>
<th>Indeterminate:</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Sārnate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A₀ₐ</td>
<td>– 3 3 1</td>
<td>– 7</td>
<td>– 1 3 1 5</td>
<td>–</td>
<td>12</td>
</tr>
<tr>
<td>A₀ₓ</td>
<td>– 3 1</td>
<td>– 4 6 10</td>
<td>– – – – –</td>
<td>–</td>
<td>15</td>
</tr>
<tr>
<td>A₁₂</td>
<td>– 1 2</td>
<td>– 1 3</td>
<td>– – – – –</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>– – – 2</td>
<td>– – – 2</td>
<td>– – – – –</td>
<td>– 1 1</td>
<td>3</td>
</tr>
<tr>
<td>F/K</td>
<td>– 1</td>
<td>– 1</td>
<td>– 1</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>– 1</td>
<td>– 2 3</td>
<td>– – – – –</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>K</td>
<td>– 1 2</td>
<td>– 3</td>
<td>– 1 2 3 2 1 2 1 2</td>
<td>–</td>
<td>8</td>
</tr>
<tr>
<td>N</td>
<td>– 1 1 2</td>
<td>– 5 2 3 5 2 – 1 1 1 – 1</td>
<td>–</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>– – – –</td>
<td>– – – 1</td>
<td>– – – – –</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>T</td>
<td>– 3 1</td>
<td>– 2</td>
<td>– 2 3 – 5 – 2 3 1 – 1</td>
<td>–</td>
<td>10</td>
</tr>
<tr>
<td>U</td>
<td>– – – –</td>
<td>– – – 1</td>
<td>– – – – –</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>X</td>
<td>– 1</td>
<td>– 2 2 4</td>
<td>– – – – –</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>Dwelling/shape</td>
<td>Notched</td>
<td>Grooved</td>
<td>No notches or groove</td>
<td>Indeterminate: notched/grooved</td>
<td>Overall total</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
<td>---------</td>
<td>----------------------</td>
<td>---------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>1 2 4 5 8 9 Other Indet. Total</td>
<td>1 2 4 5 Other Indet. Total</td>
<td>4 7 9 Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>– 1 – – – – – 1</td>
<td>– – 1 – – – 1</td>
<td>– – – – –</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>– 16 3 7 1 1 3 1 32</td>
<td>1 11 6 13 3 1 35</td>
<td>– 1 2 3 2</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Ungrouped dwellings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K/M4</td>
<td>– – – 1 – – – – 1</td>
<td>– – – – – – –</td>
<td>– – – –</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>– 5 – – – – – – 5</td>
<td>– – – – – – –</td>
<td>– – – –</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>– 5 3 1 – – – – 9</td>
<td>– – – – – – –</td>
<td>– – – –</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Z0</td>
<td>– 3 – – – – – – 3</td>
<td>– – – – – – –</td>
<td>– – – –</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>– 13 3 2 – – – – 18</td>
<td>– – – – – – –</td>
<td>– – – –</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Overall total</td>
<td>1 39 7 9 1 1 3 1 62</td>
<td>1 11 6 13 3 1 35</td>
<td>1 1 2 4 2</td>
<td>103</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 7 Data on the hearths

Table 20. Data on the Sārnate hearths

<table>
<thead>
<tr>
<th>Dwelling/ hearth</th>
<th>Preserved hearth renewal phases</th>
<th>Preserved organic layers</th>
<th>Hearth dimensions (m)</th>
<th>Most extensive sand layer</th>
<th>Most extensive bark layer</th>
<th>Depth of hearth base (m)</th>
<th>Orientation of hearth long axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>–</td>
<td>–</td>
<td>~6×2</td>
<td>–</td>
<td>–</td>
<td>0.4</td>
<td>45°/225°</td>
</tr>
<tr>
<td>5</td>
<td>–</td>
<td>–</td>
<td>4.0×1.4</td>
<td>–</td>
<td>0.3</td>
<td>35°/215°</td>
<td></td>
</tr>
<tr>
<td>6ZA</td>
<td>–</td>
<td>–</td>
<td>1.2×1.0</td>
<td>0.3</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>–</td>
<td>–</td>
<td>~4×3</td>
<td>0.15</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>1SBR</td>
<td>–</td>
<td>–</td>
<td>2.4×2.0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hearths of dwellings with Comb Ware

<table>
<thead>
<tr>
<th>Dwelling/ hearth</th>
<th>Preserved hearth renewal phases</th>
<th>Preserved organic layers</th>
<th>Hearth dimensions (m)</th>
<th>Most extensive sand layer</th>
<th>Most extensive bark layer</th>
<th>Depth of hearth base (m)</th>
<th>Orientation of hearth long axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>2?</td>
<td>+</td>
<td>2.4×1.6</td>
<td>–</td>
<td>0.6</td>
<td>60°–80°/240°–260°</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>+</td>
<td>–</td>
<td>1.8×1.4</td>
<td>0.6</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td>IŻ</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>MISBN</td>
<td>?</td>
<td>+</td>
<td>4.0×2.6</td>
<td>2.4×1.4</td>
<td>0.6</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>M2A</td>
<td>–</td>
<td>+</td>
<td>2.4×1.2</td>
<td>–</td>
<td>0.4</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>M2R</td>
<td>1</td>
<td>+</td>
<td>3.4×2.0</td>
<td>–</td>
<td>0.4</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>P 7</td>
<td>–</td>
<td>+</td>
<td>3.6×2.0</td>
<td>0.4</td>
<td>–</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>RZ</td>
<td>–</td>
<td>–</td>
<td>2.2×1.2</td>
<td>–</td>
<td>0.4</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td>RQ1</td>
<td>–</td>
<td>+</td>
<td>1.6×1.2</td>
<td>–</td>
<td>0.4</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td>RQ2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>?</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td>RQ3</td>
<td>–</td>
<td>+</td>
<td>2.2×1.4</td>
<td>1.6×1.2</td>
<td>–</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>Several</td>
<td>+</td>
<td>1.4×0.9</td>
<td>1.8×0.8</td>
<td>–</td>
<td>105°/285°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hearths of dwellings with Early Sārnate Ware

<table>
<thead>
<tr>
<th>Dwelling/ hearth</th>
<th>Preserved hearth renewal phases</th>
<th>Preserved organic layers</th>
<th>Hearth dimensions (m)</th>
<th>Most extensive sand layer</th>
<th>Most extensive bark layer</th>
<th>Depth of hearth base (m)</th>
<th>Orientation of hearth long axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0X</td>
<td>–</td>
<td>+</td>
<td>At least 4×2</td>
<td>2.6×1.2</td>
<td>0.4</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>A0XZ</td>
<td>–</td>
<td>+</td>
<td>3.0×1.6</td>
<td>–</td>
<td>0.4</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>A0R</td>
<td>1</td>
<td>+</td>
<td>4.6×1.8</td>
<td>–</td>
<td>0.65</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>A0RA</td>
<td>2</td>
<td>+</td>
<td>4.4×2.2</td>
<td>?</td>
<td>0.75</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>3</td>
<td>+</td>
<td>1.8×1.5</td>
<td>?</td>
<td>0.75</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>–</td>
<td>+</td>
<td>1.4×1.2</td>
<td>?</td>
<td>?</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>–</td>
<td>+</td>
<td>1.2×1.0</td>
<td>?</td>
<td>?</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>+</td>
<td>4.6×2.6</td>
<td>3.4×1.6</td>
<td>0.75</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>3</td>
<td>+</td>
<td>3.2×2.0</td>
<td>0.75</td>
<td>3.0–105°/275°–285°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>?</td>
<td>+</td>
<td>3.6×3.0</td>
<td>2.0×1.2</td>
<td>0.55</td>
<td>95°–105°/275°–285°</td>
<td></td>
</tr>
<tr>
<td>O1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.45</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>O2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.5</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>O3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>P 1</td>
<td>–</td>
<td>(+)</td>
<td>4.0×1.8</td>
<td>0.4</td>
<td>?</td>
<td>30°/210°</td>
<td></td>
</tr>
<tr>
<td>Dwelling/hearth</td>
<td>Preserved hearth renewal phases</td>
<td>Preserved organic layers</td>
<td>Hearth dimensions (m)</td>
<td>Depth of hearth base (m)</td>
<td>Orientation of hearth long axis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------</td>
<td>-------------------------</td>
<td>-----------------------</td>
<td>------------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>1</td>
<td>+</td>
<td>~3×?</td>
<td>2.4×1.6</td>
<td>0.9</td>
<td>115°/295°</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>−</td>
<td>(†)</td>
<td>1.8×1.8</td>
<td>−</td>
<td>0.5</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>3</td>
<td>+</td>
<td>3.6×2.6</td>
<td>2.2×2.0</td>
<td>0.6</td>
<td>120°–150°/300°–330°</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>2</td>
<td>+</td>
<td>3.6×2.2</td>
<td>1.8×1.2</td>
<td>0.55</td>
<td>120°–125°/300°–305°</td>
<td></td>
</tr>
<tr>
<td>Zb</td>
<td>−</td>
<td>+</td>
<td>2.4×1.4</td>
<td>?</td>
<td>?</td>
<td>70°/250°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearths of ungrouped dwellings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12on</td>
<td>−</td>
<td>−</td>
<td>?</td>
<td>?</td>
<td>0.15</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>−</td>
<td>−</td>
<td>~3×2</td>
<td>−</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>−</td>
<td>+</td>
<td>?</td>
<td>?</td>
<td>0.5</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>+</td>
<td>?</td>
<td>1.9×1.4</td>
<td>0.65</td>
<td>130°/310°</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>−</td>
<td>+</td>
<td>2.6×1.2</td>
<td>2.4×1.0</td>
<td>?</td>
<td>0°/180°</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>−</td>
<td>+</td>
<td>2.2×1.6</td>
<td>1.8×1.0</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Pc</td>
<td>−</td>
<td>−</td>
<td>2.4×1.6</td>
<td>−</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>At least 1</td>
<td>+</td>
<td>4.0×2.0</td>
<td>?</td>
<td>0.65</td>
<td>110°/290°</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>−</td>
<td>−</td>
<td>?</td>
<td>−</td>
<td>0.35</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Zb</td>
<td>1</td>
<td>+</td>
<td>3.6×2.6</td>
<td>2.2×1.4</td>
<td>?</td>
<td>90°/270°</td>
<td></td>
</tr>
</tbody>
</table>

* A possible second hearth is recorded in this dwelling.
Appendix 8 Determination of wood taxa used for artefacts

Taxonomic determination of the wood used for artefacts from Sārnate was undertaken in collaboration with Lūcija Vankina by V. E. Vihrov, who published the results in abbreviated form (Vihrov 1960). Included here is the full list of identifications, based on the records kept in the archive of the Archaeology Department of the National History Museum of Latvia. The author has made some corrections to the functional interpretation of the objects.

Table 21. Taxonomic determination of wood used for artefacts (results of study by V. E. Vihrov).

<table>
<thead>
<tr>
<th>Object</th>
<th>Dwelling / Accession number</th>
<th>Taxon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings with Early Sārnate Ware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bow</td>
<td>I 11416:35</td>
<td>Alder</td>
</tr>
<tr>
<td>Nut-cracking mallet</td>
<td>D 11415:211</td>
<td>Alder</td>
</tr>
<tr>
<td>Dwellings with Late Sārnate Ware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm of eel clamp</td>
<td>N 11419:58</td>
<td>Ash</td>
</tr>
<tr>
<td>Board (function unknown)</td>
<td>G 11415:467</td>
<td>Pear?</td>
</tr>
<tr>
<td>Board (function unknown)</td>
<td>K 11416:99</td>
<td>Alder</td>
</tr>
<tr>
<td>Block (function unknown)</td>
<td>N 11419:75</td>
<td>Pine</td>
</tr>
<tr>
<td>Bow</td>
<td>N 11419:63</td>
<td>Ash</td>
</tr>
<tr>
<td>Bow</td>
<td>O 11420:48</td>
<td>Ash</td>
</tr>
<tr>
<td>Container</td>
<td>F 11421:34</td>
<td>Lime</td>
</tr>
<tr>
<td>Container</td>
<td>F/K 11418:79</td>
<td>Maple</td>
</tr>
<tr>
<td>Hoe</td>
<td>A 11415:168</td>
<td>Alder</td>
</tr>
<tr>
<td>Ladle</td>
<td>A 11415:146</td>
<td>Ash</td>
</tr>
<tr>
<td>Ladle</td>
<td>G 11415:392</td>
<td>Ash</td>
</tr>
</tbody>
</table>
| Logboat                 | F/K 11418:77                | Aspen / Poplar
| Nut-cracking mallet     | A 11418:145                 | Aspen       |
| Nut-cracking mallet     | F 11415:295                 | Ash         |
| Nut-cracking mallet     | F 11415:301                 | Aspen       |
| Nut-cracking mallet     | G 11415:372                 | Alder       |
| Nut-cracking mallet     | G 11415:383                 | Ash         |
| Nut-cracking mallet     | G 11415:391                 | Alder       |
| Nut-cracking mallet     | G 11415:416                 | Alder       |

112 Evidently the former, since poplar is not part of the native flora of this region.
<table>
<thead>
<tr>
<th>Object</th>
<th>Dwelling / Finds unit</th>
<th>Accession number</th>
<th>Taxon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nut-cracking mallet</td>
<td>G</td>
<td>A 11415:468</td>
<td>Ash</td>
</tr>
<tr>
<td>Nut-cracking mallet</td>
<td>K</td>
<td>A 11416:60</td>
<td>Aspen</td>
</tr>
<tr>
<td>Nut-cracking mallet</td>
<td>K</td>
<td>A 11418:58</td>
<td>Hazel</td>
</tr>
<tr>
<td>Nut-cracking mallet</td>
<td>N</td>
<td>A 11419:60</td>
<td>Hazel</td>
</tr>
<tr>
<td>Paddle</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:43</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:44</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:85</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:127</td>
<td>Alder</td>
</tr>
<tr>
<td>Paddle</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:170</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>F</td>
<td>A 11415:340</td>
<td>Maple</td>
</tr>
<tr>
<td>Paddle</td>
<td>F</td>
<td>A 11421:39</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>G</td>
<td>A 11415:415</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>G</td>
<td>A 11415:471</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>K</td>
<td>A 11418:56</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>N</td>
<td>A 11418:118</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>N</td>
<td>A 11419:55</td>
<td>Maple</td>
</tr>
<tr>
<td>Paddle</td>
<td>N</td>
<td>A 11419:64</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>N</td>
<td>A 11419:66</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>O</td>
<td>A 11420:49</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>O</td>
<td>A 11420:50</td>
<td>Ash</td>
</tr>
<tr>
<td>Paddle</td>
<td>T</td>
<td>A 11418:92</td>
<td>Ash</td>
</tr>
<tr>
<td>Perforated disc</td>
<td>K</td>
<td>A 11416:79</td>
<td>Alder</td>
</tr>
<tr>
<td>Ski?</td>
<td>K</td>
<td>A 11417:267</td>
<td>Elm</td>
</tr>
<tr>
<td>Spear</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:110</td>
<td>Ash</td>
</tr>
<tr>
<td>Spear</td>
<td>N</td>
<td>A 11419:54</td>
<td>Rowan</td>
</tr>
<tr>
<td>Spear</td>
<td>N</td>
<td>A 11419:70</td>
<td>Maple</td>
</tr>
<tr>
<td>Spoon</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:129</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:131</td>
<td>Maple</td>
</tr>
<tr>
<td>Spoon</td>
<td>A&lt;sub&gt;OA&lt;/sub&gt;</td>
<td>A 11415:182</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>A&lt;sub&gt;DR&lt;/sub&gt;</td>
<td>A 11418:128</td>
<td>Maple</td>
</tr>
<tr>
<td>Spoon</td>
<td>G</td>
<td>A 11415:400</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>K</td>
<td>A 11416:290</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>K</td>
<td>A 11416:310</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>K</td>
<td>A 11418:71</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>N</td>
<td>A 11419:59</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>N</td>
<td>A 11419:61</td>
<td>Ash</td>
</tr>
<tr>
<td>Spoon</td>
<td>N</td>
<td>A 11419:70</td>
<td>Maple</td>
</tr>
<tr>
<td>Unidentified object, flat with handle</td>
<td>T</td>
<td>A 11419:84</td>
<td>Ash</td>
</tr>
<tr>
<td>Object</td>
<td>Dwelling / Finds unit</td>
<td>Accession number</td>
<td>Taxon</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------</td>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Unidentified object, perforated frag.</td>
<td>K</td>
<td>A 11418:61</td>
<td>Ash</td>
</tr>
<tr>
<td>Unidentified object, fragment</td>
<td>A_04</td>
<td>A 11415:181</td>
<td>Ash</td>
</tr>
<tr>
<td>Unidentified object, handle fragment</td>
<td>F</td>
<td>A 11421:35</td>
<td>Aspen</td>
</tr>
<tr>
<td>Unidentified object, handle fragment</td>
<td>K</td>
<td>A 11418:73</td>
<td>Maple?</td>
</tr>
<tr>
<td>Unidentified object, handle fragment</td>
<td>N</td>
<td>A 11419:69</td>
<td>Ash</td>
</tr>
<tr>
<td>Unidentified object, rod-shaped frag.</td>
<td>A_07</td>
<td>A 11418:139</td>
<td>Bird cherry</td>
</tr>
<tr>
<td>Unidentified object, rod-shaped frag.</td>
<td>F</td>
<td>A 11421:36</td>
<td>Pine</td>
</tr>
<tr>
<td>Unidentified object, rod-shaped frag.</td>
<td>F</td>
<td>A 11421:37</td>
<td>Pine</td>
</tr>
<tr>
<td>Ungrouped dwellings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallet</td>
<td>K/M_2</td>
<td>A 11421:57</td>
<td>Oak</td>
</tr>
</tbody>
</table>
Appendix 9 Analysis of the wood charcoal

The samples preserved from the time of Vankina’s excavation include some wood charcoal samples from the hearths. In order to shed some light on patterns of wood use at the site, sub-samples of this material were taxonomically determined by the author, on the basis of microscopic wood anatomy (Table 22).

The following wood taxa were identified:

- *Alnus*, i.e. black alder (*Alnus glutinosa* Gaertn.) or grey alder (*Alnus incana* DC.);
- *Betula*, i.e. silver birch (*Betula pendula* Roth.) or downy birch (*Betula pubescens* Erh.);
- *Fraxinus*, i.e. *Fraxinus excelsior* L., ash;
- *Pinus silvestris* L., Scots pine;
- Pomoideae, i.e. rowan (*Sorbus aucuparia* L.), hawthorn (*Crataegus* sp.), wild apple (*Malus silvestris* Mill.) or wild pear (*Pyrus communis* L.);
- *Populus* / *Salix*, i.e. aspen (*Populus tremula* L.) or willow (*Salix* sp.); and

For a small number of charcoal fragments where the growth ring boundaries were clearly visible, the curvature of the boundaries was used to classify the charcoal in terms of the original diameter of the wood, in accordance with the method developed by Ludemann and Nelle (2002).

Unfortunately, the samples all derive from dwellings that could not be assigned unequivocally to any of the groups distinguished on the basis of the pottery assemblages, so they cannot be used to assess patterns of wood use specific to any particular phase of occupation.
<table>
<thead>
<tr>
<th>Dwelling</th>
<th>Sample no.</th>
<th>Species / genus / sub-family</th>
<th>Total no. of wood charcoal frags.</th>
<th>No. of bark frags.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Alnus</em></td>
<td><em>Betula</em></td>
<td><em>Fraxinus</em></td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>18</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>15</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>12g/12v/12Dr</td>
<td>4</td>
<td>18</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>17</td>
<td>16</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>10</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>15g/15v/15Dr</td>
<td>21</td>
<td>18</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Rv/Rd</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>&quot;</td>
<td>11</td>
<td>3</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>&quot;</td>
<td>14</td>
<td>16</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dwelling total</td>
<td>24</td>
<td>2</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Total no. of fragments</td>
<td>119</td>
<td>5</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Ubiquity (no. of samples with taxon)</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Wood diameter equivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20 cm</td>
<td>3</td>
<td>–</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2–3 cm</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>3–5 cm</td>
<td>8</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>5–10 cm</td>
<td>10</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>&gt;10 cm</td>
<td>10</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
Appendix 10 Analysis of the faunal remains

Some of the faunal remains were initially identified by N. K. Vereshchagin, after which the whole collection was studied by Kalju Paaver (1965). In 2004, the material was submitted for study to Lembi Lõugas of the Institute of History at Tallinn University, with two main aims: to refine some of the identifications (in particular, to identify the seal bones to species and check the possibility that some of the cattle and pig remains may derive from domestic stock), and to establish which species are represented in which dwellings (something that is not entirely clear from Paaver’s records). The list of mammal remains (Table 23) has been compiled from the results given by Lõugas, adding Paaver’s determinations of bones that were recorded by him as present in the particular samples but were no longer available for study. Some of these had been used for radiocarbon dating.

The fish bones (Table 24) have been studied in detail by Sloka (1984), although evidently not all of the fish remains were available to him, since vertebrae of pike (*Esox lucius* L.) were noted by Lõugas in samples from Dwellings AZA, not listed by Sloka.

The data on mammal and fish remains is summarised in Table 25, which is based on Tables 23 and 24. The mammal data from the dwellings with Late Särnate Ware is graphically presented in Figs. 104 and 105. For the reasons outlined above, the numbers of mammal bones and the species identified differ somewhat from those presented in Paaver (1965).

There is no systematic record of bird bone identification. Vankina (1970a, 18, 132) writes that many bird bones were found in Dwellings O and V, and notes the presence of jay (*Garrulus glandarius* L.), black grouse (*Tetrao tetrix* L.) and duck (*Anas* sp.).
### Table 23. List of mammal remains.

<table>
<thead>
<tr>
<th>Dwelling</th>
<th>Accession no.</th>
<th>Species, body part (human modification)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Dwellings with Early Sārnate Ware</strong></td>
</tr>
<tr>
<td>RD A 11426: 30</td>
<td>Equus caballus, metapodium (bone tool)</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Bos primigenius</strong>: phalanx 1, ulna/radius frag., tubular bone frag., os sesamoide</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Castor fiber</strong>: dens M, dens I frag.</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Phoca sp.</strong>: vertebra thoracalis</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Sus scrofa</strong>: dens M3, femur dist., humerus dist., phalanges (3), dentes P2 (2), patella, tubular bone frag.</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Sus sp.</strong>: metapodia frag. (2) (too small for adult Sus scrofa, maybe domesticated or semi-domesticated)</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Halichoerus grypus?</strong>: scapula</td>
</tr>
<tr>
<td>W</td>
<td>–</td>
<td><strong>Phoca groenlandica</strong>: os temporale sin.</td>
</tr>
<tr>
<td>O A 11420: 28</td>
<td><strong>Phoca hispida</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 23</td>
<td><strong>Bos primigenius</strong>: dens I (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 24</td>
<td><strong>Meles meles</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 25</td>
<td><strong>Meles meles</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 129</td>
<td><strong>Sus scrofa (Sus domesticus?)</strong>: cranium + dentes</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 136</td>
<td><strong>Sus scrofa</strong>: dens P1</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 143</td>
<td><strong>Alces alces</strong>: dens I (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 23</td>
<td><strong>Bos primigenius</strong>: dens I (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 24</td>
<td><strong>Meles meles</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 25</td>
<td><strong>Meles meles</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 28</td>
<td><strong>Phoca hispida</strong>: dens C (pendant)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 38</td>
<td><strong>Sus scrofa</strong>: dens I frag.</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 51</td>
<td><strong>Alces alces</strong>: dens deciduous PM</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 28</td>
<td><strong>Capreolus capreolus?</strong>: femur</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 25</td>
<td><strong>Castor fiber</strong>: dientes I (2)</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 23</td>
<td><strong>Sus scrofa</strong>: dens I, dens M3, astragalus</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 24</td>
<td><strong>Phoca groenlandica</strong>, dientes C (2), humerus sin., ulna sin.</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 51</td>
<td><strong>Phoca sp.</strong>: phalanx, os carpi, vertebra thoracalis</td>
<td></td>
</tr>
<tr>
<td>O A 11420: 23</td>
<td><strong>[Not available for analysis, but recorded by Paaver: Cervus elaphus]: antler]</strong></td>
<td></td>
</tr>
<tr>
<td>P A 11421: 13</td>
<td>[not available for study, but recorded by Paaver: Ursus arctos: ulna] (awl)</td>
<td></td>
</tr>
<tr>
<td>P A 11421: 18a</td>
<td><strong>Phoca sp.: phalanx, frag. (3) (burnt)</strong></td>
<td></td>
</tr>
<tr>
<td>P A 11421: 18b</td>
<td><strong>Bos sp.</strong></td>
<td></td>
</tr>
<tr>
<td>T A 11417: 226</td>
<td><strong>Alces alces</strong>: ulna prox. (dagger)</td>
<td></td>
</tr>
</tbody>
</table>
Dwelling Accession no. Species, body part (human modification)

Phoca sp.: metapodia (9), phalanges (11), vertebra caudalis (1), costae (2), osa tarsalia (2), vertebrae frag., scapula frag.  
[Not available for study, but recorded by K.Paaver: Bos primigenius: mandibula; Cervus elaphus]  

U A 11580: 110  Bos primigenius: dens M2  

Y A 11428: 42  Alces alces?: frag.  
Phoca sp.: phalanx frag., metapodium frag.  

Ungrouped dwellings  
S A 11580: 191  Bos primigenius: scapula frag.  
S A 11580: 192  Alces alces: dentes I (3) (incl. 2 pendants)  
S A 11580: 193  Ovis aries/Capra hircus: os coxae  
V A 11580: 119  Castor fiber: dens I  
Phoca hispida: mandibula dext.  
[Not available for study, but recorded by Paaver: Cervus elaphus: costae, vertebrae cervicales]  
Za A 11580: 73  Alces alces: dens I (pendant)  
Za A 11580: 78  Sus scrofa: dens I (pendant)  
Za A 11580: 80  Phoca hispida: dens C (pendant)  

Table 24. List of fish bones, summarised from Sloka (1984), with accession numbers added.  

<table>
<thead>
<tr>
<th>Dwelling</th>
<th>Accession no.</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dwellings with Comb Ware</td>
</tr>
<tr>
<td>3</td>
<td>–</td>
<td>Lucioperca lucioperca, vertebra (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dwellings with Late Sásmate Ware</td>
</tr>
<tr>
<td>O</td>
<td>A 11420: 38</td>
<td>Esox lucius, dentale (1), quadrum (1), vertebrae (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lucioperca lucioperca, vomer (1)</td>
</tr>
<tr>
<td>T</td>
<td>–</td>
<td>Siluris glanis, vertebra (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungrouped dwellings</td>
</tr>
</tbody>
</table>
| V        | A 11580: 118 | Esox lucius, 170 bones  

*For full list, see Sloka (1984).*
Table 25. Summary table of mammal and fish remains from Sänate: total no. of fragments (ubiquity: no. of dwellings with species present).

<table>
<thead>
<tr>
<th>Species</th>
<th>Dwellings with Comb Ware</th>
<th>Dwellings with Early Sänate Ware</th>
<th>Dwellings with Late Sänate Ware</th>
<th>Ungrouped dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human (Homo sapiens)</td>
<td>–</td>
<td>–</td>
<td>3 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Aurochs (Bos primigenius)</td>
<td>–</td>
<td>4 (1)</td>
<td>3 (3)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Bos sp.</td>
<td>–</td>
<td>–</td>
<td>1 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Badger (Meles meles)</td>
<td>–</td>
<td>–</td>
<td>2 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Brown bear (Ursus arctos)</td>
<td>–</td>
<td>–</td>
<td>1 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Elk (Alces alces)</td>
<td>–</td>
<td>–</td>
<td>4 (4)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>European beaver (Castor fiber)</td>
<td>–</td>
<td>2 (1)</td>
<td>2 (1)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Ovis aries / Capra hircus</td>
<td>–</td>
<td>–</td>
<td></td>
<td>1 (1)</td>
</tr>
<tr>
<td>Red deer (Cervus elaphus)</td>
<td>–</td>
<td>–</td>
<td>2 (2)</td>
<td>–</td>
</tr>
<tr>
<td>Roe deer (Capreolus capreolus)</td>
<td>–</td>
<td>–</td>
<td>1 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Wild boar (Sus scrofa)</td>
<td>–</td>
<td>–</td>
<td>17 (4)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Sus sp.</td>
<td>–</td>
<td>–</td>
<td>5 (2)</td>
<td>–</td>
</tr>
<tr>
<td>Wild horse (Equus caballus)</td>
<td>–</td>
<td>1 (1)</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>Harp seal (Phoca groenlandica)</td>
<td>–</td>
<td>–</td>
<td>12 (3)</td>
<td>–</td>
</tr>
<tr>
<td>Ringed seal (Phoca hispida)</td>
<td>–</td>
<td>–</td>
<td>1 (1)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>?Grey seal (Halichoerus grypus)</td>
<td>–</td>
<td>–</td>
<td>1 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Phoca sp.</td>
<td>–</td>
<td>1 (1)</td>
<td>38 (4)</td>
<td>–</td>
</tr>
<tr>
<td>Pisces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pike (Esox lucius)</td>
<td>–</td>
<td>–</td>
<td>5 (1)</td>
<td>170 (1)</td>
</tr>
<tr>
<td>Pikeperch (Lucioperca lucioperca)</td>
<td>2 (2)</td>
<td>–</td>
<td>1 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Wels (Siluris glanis)</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>
Fig. 104. Graph of faunal remains from dwellings with Late Särnate Ware: total number of fragments.

Fig. 105. Graph of faunal remains from dwellings with Late Särnate Ware: number of dwellings with species present.
72. Schmitz, Gerhard (2006) Sieben Aufsätze um Nietzsche
73. Pazvola, Leila (2006) Maternal sensitive responsiveness, characteristics and relations to child early communicative and linguistic development

Book orders: OULU UNIVERSITY PRESS
P.O. Box 8200, FI-90014
University of Oulu, Finland

Distributed by OULU UNIVERSITY LIBRARY
P.O. Box 7500, FI-90014
University of Oulu, Finland
Valdis Bērziņš

SĀRNATE: LIVING BY A COASTAL LAKE DURING THE EAST BALTIC NEOLITHIC