PRIEDAINE: A NEOLITHIC SITE AT THE HEAD OF THE GULF OF RIGA

VALDIS BĒRZIŅŠ, AIJA CERIŅA, MĀRCIS KALNIŅŠ, LEMBI LÕUGAS, HARALD LÜBKE, JOHN MEADOWS

Abstract

The Neolithic site of Priedaine in Jūrmala was excavated on a small scale in 2007–2008, yielding an assemblage of Comb Ceramics, along with unique wooden implements and fragments of pine-lath fishing structures. The environment and subsistence resources are indicated by plant macrofossil remains and a small faunal collection. Located by a palaeolake and also very close to the sea, the site, dated to c. 3700–3500 cal BC, would have been oriented towards aquatic resource exploitation. However, it had a wider range of functions, as indicated by the evidence of flint and amber processing.

Key words: Neolithic, pottery, fishing gear, plant macro-remains, faunal remains, lake, coastal settlement.

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Discovery and excavation

In 1975, the Jūrmala Town Museum received from Regīna Ērgle (Fig. 4), a resident of the Priedaine district, three objects found in a nearby forest: a stone battle-axe (Fig. 10. 1), a sherd of Comb Ware, and a flint flake. The axe had been brought home by her young sons, who had found it suspended on the branch of a young pine. Presumably, it had been discovered on the site and left there by some other local resident while digging peat for the garden. The potsherd and flint flake were subsequently uncovered by Ērgle in a small peat pit next to the pine tree. The discoveries were reported to the State Museum of History (the present National History Museum of Latvia), and a small test excavation was carried out in the wet ground next to the dune belt by the archaeologist Juris Urtāns, but without results (excavations were hampered by the high groundwater level), so the initial finds did not attract further archaeological attention.

In 2004, Inese Helviga and Voldemārs Rains of Jūrmala Town Museum reviewed all the information about archaeological finds within the town limits, and in the framework of this, visited the Priedaine find spot in the company of Ērgle and the archaeologist Valdis Bērziņš

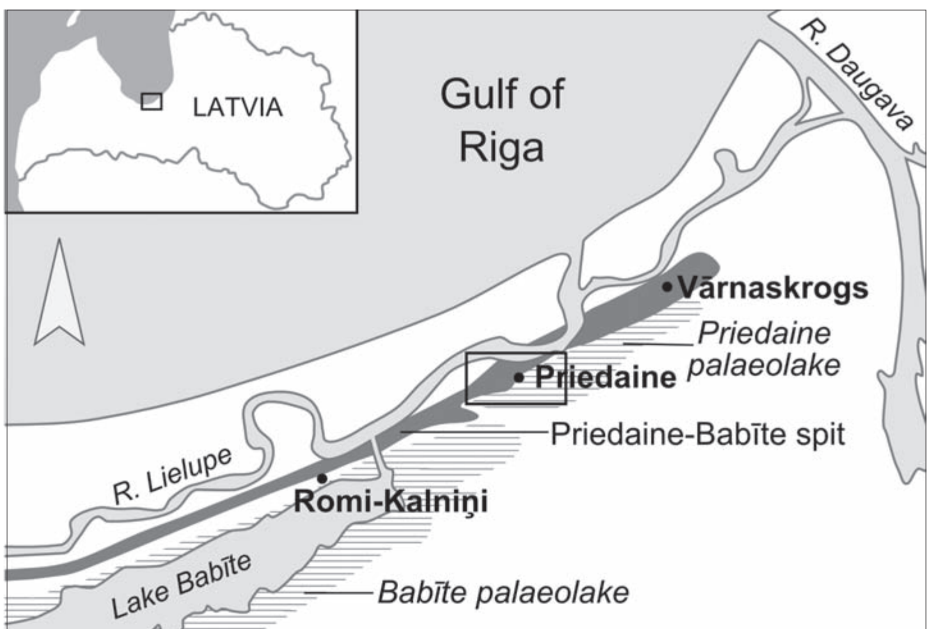

Fig. 1. The southeast shore of the Gulf of Riga, showing palaeogeographic features and Neolithic sites. Data from: Pārskats par ģeoloģiskiem un paleovides pētījumiem Priedaines akmens laikmeta apmetnes rajonā 2008.

from the Institute of Latvian History. Ērgle was able to pinpoint the find location (the particular pine tree still stands), in addition to which flint flakes were found on the surface of the ground and in a small exposure created by peat digging. The site is at the southern edge of a dune belt, at the boundary with a flat area of alder swamp.

At the initiative of Jūrmala Town Museum, in September 2007 the Institute of Latvian History carried out a trial excavation on the Priedaine site. Twelve test pits with a total area of 21 square metres were excavated on the dune slopes facing a wetland area and at the edge of the wetland (Fig. 5).

In some of the test pits on the dune slopes (Nos 4, 5 and 7), a Neolithic occupation layer was revealed in the sandy soil, with potsherds, flint tools and debitage, as well as some amber and non-knapped stone, whereas in test pit 12, at the foot of the dune, pottery, as well as the tip of a wooden stake and pine-wood lath fragments, were recovered from a layer of sandy fen peat. Small numbers of finds also came from test pits 1, 2, 6 and 10.

Excavations continued in 2008, this time focussing on the wetland area at the foot of the dunes (Fig. 5). The previous year's test pit 12 was extended to form a small area (2 by 3 metres). This was excavated in five-centimetre spits, pumping away the groundwater and wet-sieving all the excavated earth through a five-millimetre mesh. The conditions for excavations were very difficult, because of the rapid water inflow and the

Fig. 2. The Priedaine site viewed from the west.

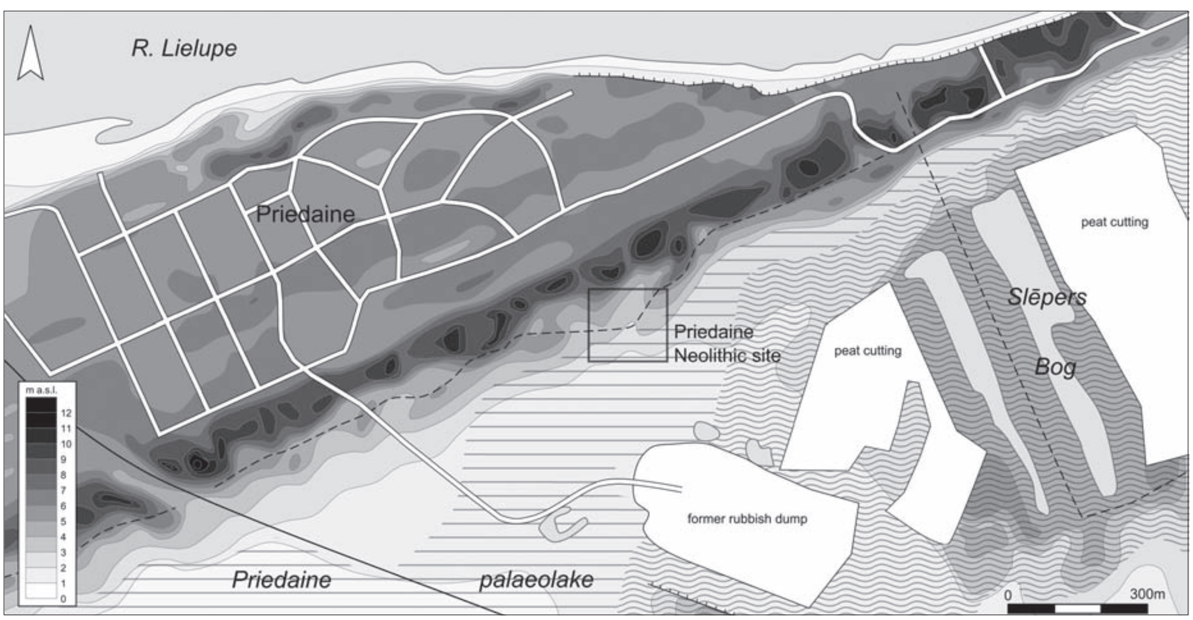

Fig. 3. A location plan of the Priedaine site.

Fig. 4. Regīna Ērgle, the discoverer of the site.

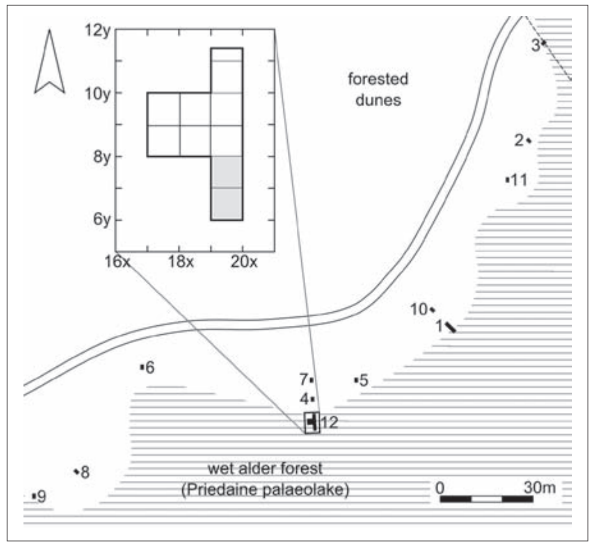

Fig. 5. The layout of archaeological trenches at the Priedaine site, with an enlarged plan of area 12.

very soft ground. The excavations reached a maximum depth of 0.9 metres; even though archaeological finds were still being recovered at this depth, the work was discontinued because water was flowing in too rapidly. The excavated area was re-filled, marking the depth of excavation with a layer of fern fronds.

All the archaeological finds from the Priedaine site are kept at Jūrmala Town Museum. Reports on the two excavation seasons have been submitted to the State Inspection for Heritage Protection.

Palaeogeographical setting

In connection with the archaeological research at Priedaine, a team of researchers from the Faculty of Geography and Earth Sciences of the University of Latvia undertook a study of the area's Quaternary geology and palaeoenvironment. This work was led by Guntis Eberhards, with pollen analysis by Laimdota Kalniņa and Liena Apsīte, and plant macrofossil analysis by Aija Ceriņa (Pārskats par ģeoloģiskiem un paleovides pētījumiem Priedaines akmens laikmeta apmetnes rajonā 2008; Kalniņa et al. 2009; Ceriņa et al. 2010).

It was established that the long belt of dunes, oriented SSW–ENE, covers a former spit formed at the beginning of the Littorina Sea stage, which initially separated the extensive Babīte-Spilve Lagoon from the open waters of the Gulf of Riga (Fig. 1). The archaeological site lies in a zone of low dune hills and ridges stretching along the southern margin of the main dune belt (Fig. 3). The site itself relates to the time of a later transgressional event of the Littorina Sea, known as Lit_b. During this period of relatively high sea level, the plain of the former lagoon behind the dunes was occupied by smaller water bodies, the Babīte and Priedaine lagoonal lakes. The Priedaine habitation site was located on the steep northern shore of the latter (Fig. 1). This freshwater lake, up to four metres deep, gradually became overgrown, and nowadays forms a flat area of wet alder forest. The lake was not directly connected with the sea: the connection was via a watercourse that entered the River Daugava. The geological study also indicates that there was no direct connection between the Priedaine and Babīte palaeolakes at this time.

Stratigraphy

In the dryland part of the site, on the upper parts of the dune slope (test-pits 4, 5, 7 and 10), the Neolithic artefacts came from the uppermost part of the dune sand deposit covering the former spit. The archaeological material derives from the humic and podsol soil horizons; in test-pits 5 and 7, which yielded the most artefactual material, a distinct occupation layer 20 to 30 centimetres thick was recognisable below the humic horizon, predominantly grey in colour, but inhomogeneous, with signs of podsolisation. In the test-pits on the lower slope (Nos 1, 2 and 6) the sand had a thin covering of strongly humified peat or peaty sand.

No archaeological features were identified, and in view of the steepness of the slope and the presence of layers of re-deposited sand with Neolithic material stratified

Table 1. Description of layers in excavation area 12 (see section drawings, Fig. 6)

Layer no.	Texture/ Description	Colour	Inclusions	Interpretation and notes	Archaeological material*
1	strongly humified peat	dark brown	modern rubbish (abundant)	surface layer of fen deposit/modern-day rubbish layer. Apparently fills a pit at least 0.45 m deep in the SW part of the area. Layer 2 was difficult to separate from layer 4 at the time of excavation, and they were properly differentiated only in the sections.	1 unworked piece of amber
2	peaty sand (only in NW part of area)	greyish yellow	large fragments of unworked wood; wood charcoal	colluvial (eroded from the adjacent dune slope by wind/wave action and/or human activity) and limnic material	fragmentary pine wood artefact, wooden laths; 2 unworked pieces of amber; 3 flint flakes; 82 potsherds; hazelnut and water chestnut shells
3	grass peat, sandy, weakly humified	dark red-brown	none	fen deposit	none
4	grass peat, sandy, weakly humified	medium greenish grey-brown	large fragments of unworked wood incl. partial tree stump; wood charcoal	fen deposit with indications of occupation layer	3 wooden artefacts, wooden laths; 17 flints; 3 stone artefacts; 302 potsherds; hazelnut and water chestnut shells; tooth and calcined bone
5	fine sand with organic matter	light grey	wood charcoal	beach formation of colluvial/limnic material	4 wooden artefacts, wooden laths; 10 pieces of amber; 4 stone artefacts; 42 flints; 870 potsherds; hazelnut and water chestnut shells; teeth, bones and fish scales
6	gyttja	dark grey-brown	wood charcoal	littoral limnic deposit	none
7	coarse detritus gyttja	medium grey-brown	wood charcoal	limnic and fen deposit with indications of occupation layer	1 fragmentary wooden artefact; 4 stone artefacts; 14 flints; 136 potsherds; hazelnut and water chestnut shells
8	fine sand with organic matter	light grey	wood charcoal	beach formation of colluvial/limnic material	wooden laths; 1 potsherd

*A proportion of the archaeological finds could not be safely assigned to a particular layer because the layer boundaries were unclear.

between organic deposits at the base of the slope (see below), it may be presumed that the archaeological layers on the upper and middle slopes were affected by erosion already during the time of occupation.

Much more complex stratigraphy was observed in excavation area 12, located at what is nowadays the foot of the slope. Here, the dune sands are overlaid by a sequence of layers with differing amounts of sand and organic matter, which slope away steeply to the south, into the former lake basin (Fig. 6, Table 1). Layers 3, 4, 6 and 7 consist mainly of organic matter deposited in the overgrowing lake, whereas the intervening layers 2, 5 and 8 consist mainly of sand from the steep dune slope that has been eroded and shifted downslope as a result of human trampling and/or wave and wind action during the time of the Neolithic occupation. The layers consisting primarily of sand, and likewise those consisting solely or predominantly of organic matter, were rich in archaeological material, including preserved organic objects; also recovered were waterlogged and charred plant macrofossils along with poorly preserved faunal remains. With regard to the organic-rich layers, this material can essentially be regarded as refuse discarded in the shore zone of the lake. On the other hand, the finds recovered from the sandy layers are likely to represent a mix of material: material eroded and moved downslope along with the sand, as well as material dumped in the lake during occupation. Hence, at least part of the inorganic archaeological material in the sand layers can probably be regarded as re-deposited, with the possibility of inverted stratigraphy. On the other hand, it may be presumed that the preserved organic objects (wood, plant macrofossils, bone) are those that were deposited in the water or close to the waterline at the time of habitation, since such material would have been rapidly degraded in the well-aerated, acid conditions of the dune slope.

Apart from the tip of a single wooden stake in a vertical position, and another found lying horizontally nearby, no structural remains were revealed in area 12. It is concluded that the habitation area would have been further upslope (i.e. in the area of test-pits 4, 5 and 7), whereas the wetland part of the site corresponds to the littoral zone of the lake at the time of habitation, where refuse accumulated.

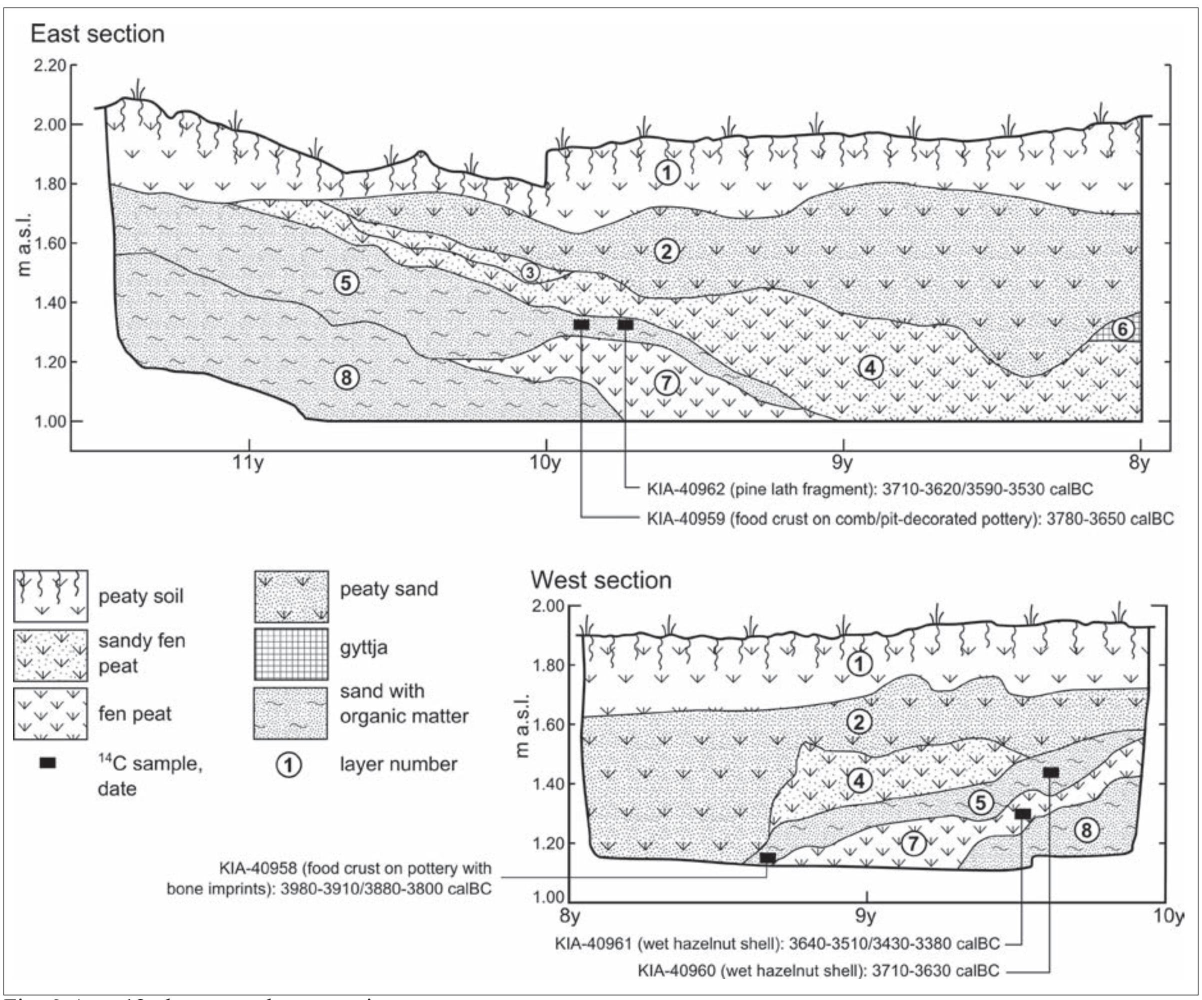

Fig. 6. Area 12, the east and west sections.

Radiocarbon dates and elemental/isotopic analysis of food crusts

Five radiocarbon samples were selected from material recovered in the waterlogged layers in area 12 (food residue on two potsherds, two hazelnut shells preserved in wet condition, and a pine-wood lath fragment typical of the remains from fishing structures), with the aim of dating the deposition of these artefact-rich layers, which should correspond to the time of occupation in this part of the site, and establishing the age of pottery vessels with specific kinds of ornamentation.

The food crust samples were scraped off the sherds in the laboratory, manually cleaned under a microscope, and then treated with a sequence of solvents to remove potential oily or waxy organic contaminants. The charcoal, wood and hazelnut shells were manually cleaned under the microscope before chemical pre-treatment. All samples were then extracted following a conventional acid-alkali-acid protocol, to remove mineral carbonates and secondary organic compounds. The insoluble 'alkali residues' were combusted to CO_2, which was reduced to graphite and pressed into a target for Accelerator Mass Spectrometry (AMS) measurement of the $^{13}C/^{12}C$ and $^{14}C/^{12}C$ ratios, following Nadeau et al. (1998). The results (Table 2) have been converted to conventional radiocarbon ages and calibrated using OxCal v4.2.3 (Bronk Ramsey 2009) and the IntCal13 (Reimer et al. 2013) calibration data, with date ranges rounded outwards to ten years. Fig. 7 shows the calibration of these results.

Aliquots of the food-crust alkali residues were sent to the AMS ^{14}C Dating Centre, Institute for Physics and Astronomy, Aarhus University, for Elemental Analysis-Isotope Ratio Mass Spectrometry (EA-IRMS), to measure C, N and S concentrations, and $^{13}C/^{12}C$ and $^{15}N/^{14}N$ ratios ($\delta^{13}C$ and $\delta^{15}N$) (Table 3).

The %C data (Table 3) are typical of food-crust alkali extracts, while %N is relatively high in both samples, compared to values expected in food crusts derived mainly from cooking plant foods (Yoshida et al. 2013). Thus, foods of animal origin may have contributed a significant amount of carbon in both cases, and the $\delta^{15}N$ values (reflecting protein-rich ingredients) are therefore relevant to the sources of carbon in the food crusts. The higher value, for KIA-40958, could indicate a significant contribution from high-trophic-level fish or marine mammal, whereas animal ingredients in KIA-40959 could be from terrestrial herbivores or low-trophic-level fish. It is therefore possible that both food-crust radiocarbon ages are subject to marine or freshwater reservoir effects, and that the calibrated date ranges reported here are valid only as *termini post quos* for the dates of the pots. Both %S values

Table 2. Radiocarbon results for the Priedaine site, calibrated using OxCal v4.2.3 (Bronk Ramsey 2009) and the IntCal13 (Reimer et al. 2013) calibration data

Findspot	**Laboratory number**	**Material dated**	**AMS $\delta^{13}C$(‰)**	**Corrected pMC**	**Conventional ^{14}C age BP**	**Calibrated date (95% probability)**
Area 12, square 17.0x/8.5y, spit 115–110, layer 2/5 (hand-collected sample)	KIA-40958	food crust on pottery with beaver metapodial imprints, no. 2008/47 (Fig. 8. 3)	-28.08 ± 0.31	52.90 ± 0.19	5115 ± 30	3980–3910 cal BC (44.8% probability) or 3880–3800 cal BC (50.6% probability)
Area 12, square 19.5x/9.5y, spit 135–130, layer 5 (hand-collected sample)	KIA-40959	food crust on pottery with comb/pit decoration, no. 2008/237 (Fig.8.4)	-26.26 ± 0.29	54.12 ± 0.20	4930 ± 30	3780–3650 cal BC (95.4%)
Area 12, square 17.5x/9.5y, spit 145–140, layer 5 (sieved sample)	KIA-40960	hazelnut shell	-22.49 ± 0.53	54.45 ± 0.19	4885 ± 30	3710–3630 cal BC (95.4%)
Area 12, square 17.5x/9.5y, spit 130–125, layer 7 (hand-collected sample)	KIA-40961	hazelnut shell	-24.53 ± 0.27	55.27 ± 0.22	4765 ± 30	3640–3510 cal BC (88.7% probability) or 3430–3380 cal BC (6.7% probability)
Area 12, square 19.5x/9.5y, spit 135–130, layer 5 (hand-collected sample)	KIA-40962	pine wood lath fragment	-23.89 ± 0.37	54.66 ± 0.26	4850 ± 40	3710–3620 cal BC (73.7% probability) or 3590–3530 cal BC (21.7% probability)

Table 3. EA-IRMS on dated extracts from food-crust samples; each result is the average of two measurements

Laboratory number	%C	%N	%S	Atomic C.N	δ^{13}C (‰)	δ^{15}N (‰)
KIA-40958	60.0	7.7	2.0	9.0	-27.2	12.7
KIA-40959	54.5	10.3	1.6	6.2	-26.2	6.2

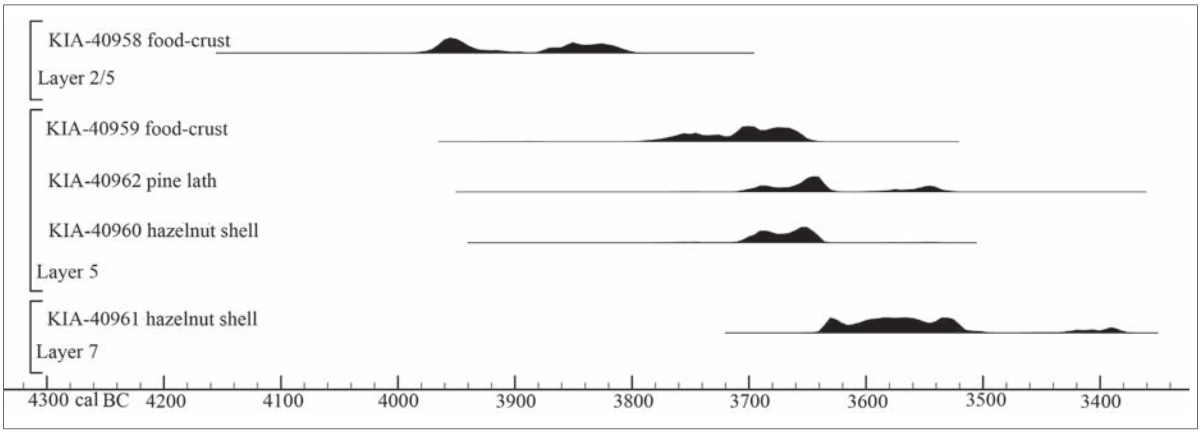

Fig. 7. Calibration of radiocarbon results.

are surprisingly high, which may reflect contamination from the burial environment, but sulphur is also typically more abundant in aquatic species. In the absence of local reference data, EA-IRMS results on slightly later food crusts from Šventoji in northern Lithuania (Heron et al. 2015) may also be used to suggest that KIA-40958 in particular may have been dominated by aquatic ingredients and that the Priedaine food-crust radiocarbon ages may therefore be misleadingly old.

If we disregard the two food-crust datings, considering that they could be misleadingly old, and rely on the three datings of plant remains, then we may conclude that the occupation at least on this part of the site, when the find-rich layers 5 and 7 in area 12 were deposited, occurred during the interval c. 3700–3500 cal BC.

Pottery

The pottery collection from Priedaine consists of 1,855 sherds in total, almost all of this material recovered from area 12 (1806 sherds), and in fact 78% of the sherds from this area are small fragments extracted by wet-sieving. Very small amounts of pottery come from test-pits 4, 5 and 7. On the basis of the characteristics described below, almost all of the pottery from Priedaine may be assigned to the broad tradition of Comb Ceramics.

No major differences were identified between the pottery from the different trenches or the different layers in area 12, with respect to the prevalence of particular temper classes (mineral temper/pores/mineral temper in combination with pores), surface texture (smooth/striated) or decoration element. Hence, all the pottery from the site has been analysed as a single assemblage.

In terms of fabric composition, the Priedaine assemblage is heterogeneous: 51% of the sherds were recorded as having rock temper; 40% are porous, i.e., tempered with organic matter, which has burnt out, and/or with shell, which has been leached in the acid conditions; a further 9% have a combination of mineral temper and pores from shell/organics. Characteristic platy forms of shell fragments, as well as fibrous forms of plant matter, are observable in the voids of the porous fabric.

In the east Baltic region, the shell temper in pottery generally consists of the crushed shells of large freshwater mussels (Kriiska 1996, 374, 377; Bērziņš 2008, 178). At Priedaine, however, one sherd of mineral and shell-tempered pottery with comb and pit decoration shows a clear imprint of the distinctive shell form of the cockle, *Cerastoderma* sp. (Fig. 8.8). These brackish-water/marine molluscs are commonly represented in the Littorina Sea fauna (Tavast 2000; Damušytė 2011). Some similar examples are known in the approximately contemporaneous ceramics of Finland (Mökkönen 2008, 124, Fig. 7). While cockles have been, and still are, widely consumed in Western Europe, those inhabiting the eastern part of the Baltic Sea basin are much smaller, and presumably had no significance as a food source. On the other hand, the incorporation of cockle shell into the pottery fabric provides direct confirmation that at least part of the pottery was being made in the coastal area.

Since no vessel bases have been found, there is no evidence regarding lower-body form. The cross-sectional shapes of three rims (Fig. 8.1, 3, 4) indicate an unrestricted vessel form: the vessel wall did not curve inwards at the mouth. In three cases the vessel rim diameter could be estimated: all three are fairly large vessels, measuring 30 to 45 centimetres, 40 to 45 centimetres, and >45 centimetres at the mouth. With regard to exterior surface finish, smooth-walled vessels overwhelmingly predominated: out of 384 sherds with preserved outer surfaces, 97% are recorded as smooth, and only 3% as striated.

Direct rims (rather than everted forms) only are represented, all with flat lips (Fig. 8.1, 3, 4). Out of seven vessels distinguishable on the basis of rims, in five cases the flat lip was oriented perpendicular to the line of the vessel wall (two without thickening, subtype Ic1; three thickened on the outside, subtype Ic2). Two of the vessels from area 12 had an oblique (inward-facing) flat lip, the rim thickened on the inside and outside (subtype Id4). (For a classification scheme of rim forms, see Bērziņš 2008, Fig. 11.)

If we consider only the pottery collected by hand in the course of excavations, then the proportion of decorated sherds comes to 34% (decoration was generally unidentifiable on the small fragments recovered by wet-sieving). The exterior decoration elements include elongated impressions, represented by wound cord (present on 16% of decorated sherds; Fig. 8. 2, 9), comb (5%; Fig. 8.4), rods (4%; Fig. 8.5, 6), as well as shorter impressions, taking the form of deep round pits (34%), boat-shaped impressions (3%), shallow round pits (3%), and rarer forms, quadrangular and wedge-shaped pits, ovals (Fig. 8.7) and beaver metapodial imprints (Fig. 8.3). The flat lips are decorated with obliquely arranged comb, wound-cord and rod impressions, as well as pits.

The identifiable decorative designs on the vessel exteriors consist primarily of horizontal rows of obliquely oriented elongated impressions, and horizontal rows of pits. Some of the larger sherds reveal the sequence of rows: in one case, there are alternating double rows of slanting wound cord, and deep, round pits (Fig. 8.9). Another vessel has a row of slanting comb impressions, a row of wedge-shaped pits, and another row of slanting comb impressions (Fig. 8.4). Similarly, there is an example with a row of deep pits followed by a row of slanting rod impressions (Fig. 8.6). A further vessel has horizontal rows of slanting ovals alternating with rows of deep pyramidal pits (Fig. 8.7). A zig-zag design of wound-cord impressions also appears (Fig. 8.2). Rather different from the rest is a complex, unreconstructable design of slanting double rows of beaver metapodial imprints (Fig. 8.3; see vessel description below).

Fisher's exact test revealed a few statistically significant associations between temper type, surface finish and exterior decoration element. Given the small size of the assemblage and the possibility of autocorrelation, these statistics should, however, be treated with caution. When considering all decorated sherds with an identifiable decoration element, a statistically highly significant positive association ($p = 0.002$) was revealed linking the presence of mineral temper in fabric (including sherds with mineral temper+pores) with decoration of rod impressions. A weak positive association was discovered between the presence of mineral temper and comb decoration ($p = 0.071$).

Further, the ten sherds with exterior striation all have porous fabric without mineral temper, statistically a very significant association ($p = 0.006$). This fits the general pattern of Middle Neolithic[1] pottery in western Latvia, where porous (organic- and/or shell-tempered) fabrics and surface striation both represent characteristics associated with the Sārnate Ware ceramic tradition; thus, it seems that a small component of pottery corresponding to this tradition is represented at Priedaine.

The presence of burnt residue, frequent on the better-preserved pottery from area 12, indicates that an important vessel function was cooking on a hearth (cf. the use-alteration evidence on the Sārnate pottery, described in Bērziņš 2008, 195-211).

Although the pottery from area 12 probably includes a component of material eroded from the cultural layer and redeposited at the waterfront, a major part of the assemblage evidently derives from vessels discarded at the waterfront or in the shallows of the lake at this location. This is indicated by the presence of large sherds in unabraded condition. Providing an example of vessel discard at this location is a dense spread of ornamented sherds from a single pot (Fig. 8.3), restricted to an area of 0.5 square metres along the west section of area 12 in the height interval 110–135 centimetres a.s.l. (layers 4 and 5). In addition to deep pits, this vessel displays a distinctive form of impression made with the distal articular surface of a beaver metapodial. The bone utilised for this purpose has been identified through comparison with photographs of impressions

[1] This corresponds to the Early Neolithic in the recently adopted chronological scheme for the Stone Age of Estonia (Kriiska 2009).

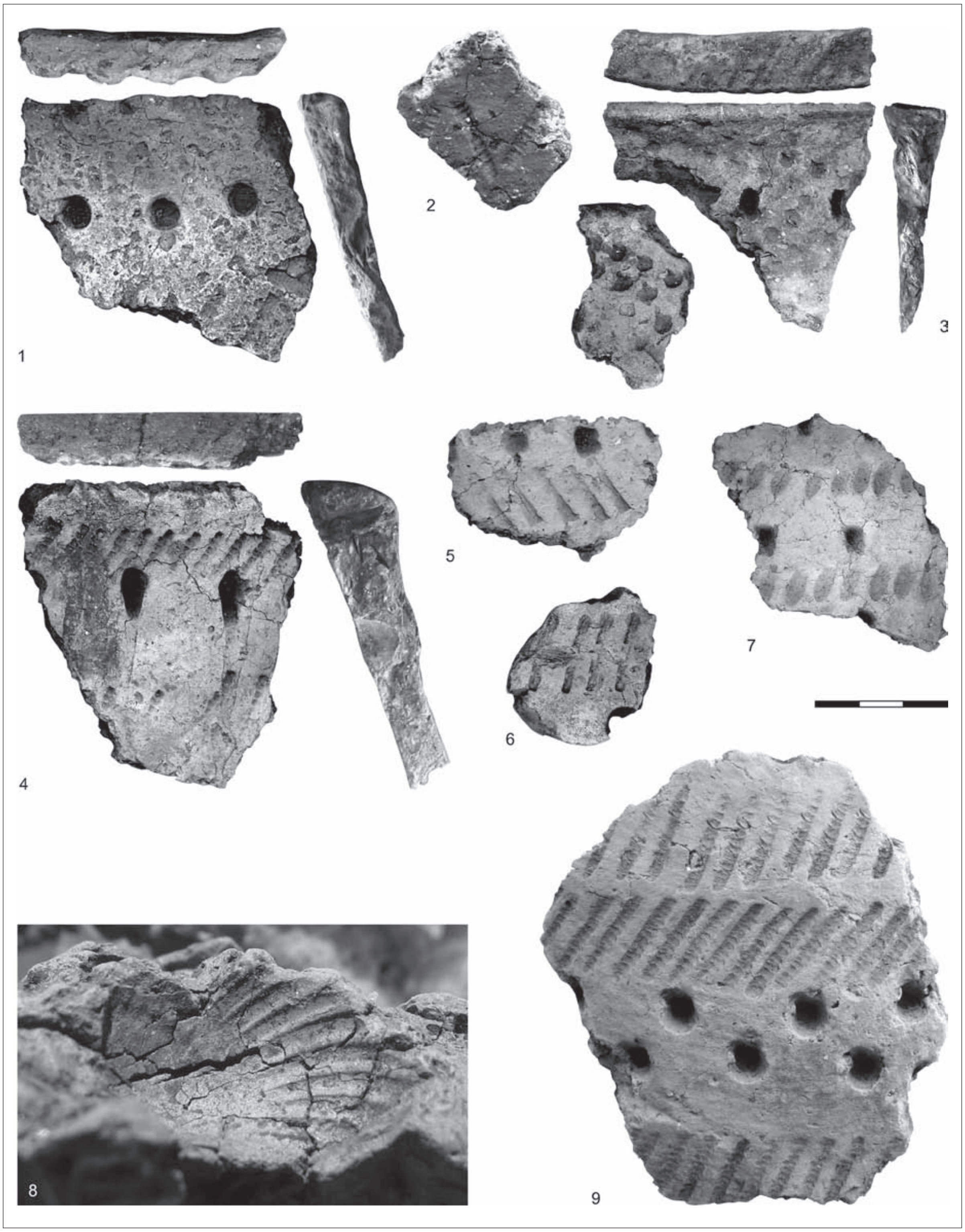

Fig. 8. Pottery: 1 No 2008/226; 2 No 2008/19; 3 No 2008/47, /49 (^{14}C dating KIA-40958); 4 No 2008/237 (^{14}C dating KIA-40959); 5 No 2008/247; 6 No 2008/68; 7 No 2008/77; 8 *Cerastoderma* shell imprint; 9 No 2007/35.

obtained in experiments by Kostyleva and Kalinina (2002, Fig. 1.19).

The Priedaine ceramic assemblage closely parallels the much larger but poorly preserved assemblages from the dwellings with pottery classed as Comb Ware at the Sārnate site in west Latvia (Bērziņš 2008, 125-137), especially considering the heterogeneous fabric composition and the prevalence of wound-cord decoration over real comb impressions. Hence, on the strength of the Priedaine datings, the dwellings at Sārnate with Comb Ceramics may likewise be thought to date from the period c. 3700–3500 cal BC, although we do not yet have sufficient evidence to indicate the duration of this phase. The weak statistical association between mineral temper and comb impressions identified at Priedaine seems to be reflecting, in inverse expression, the same phenomenon as the association observed in the Comb Ware assemblage at Sārnate between wound-cord decoration and shell temper (Bērziņš 2008, 130).

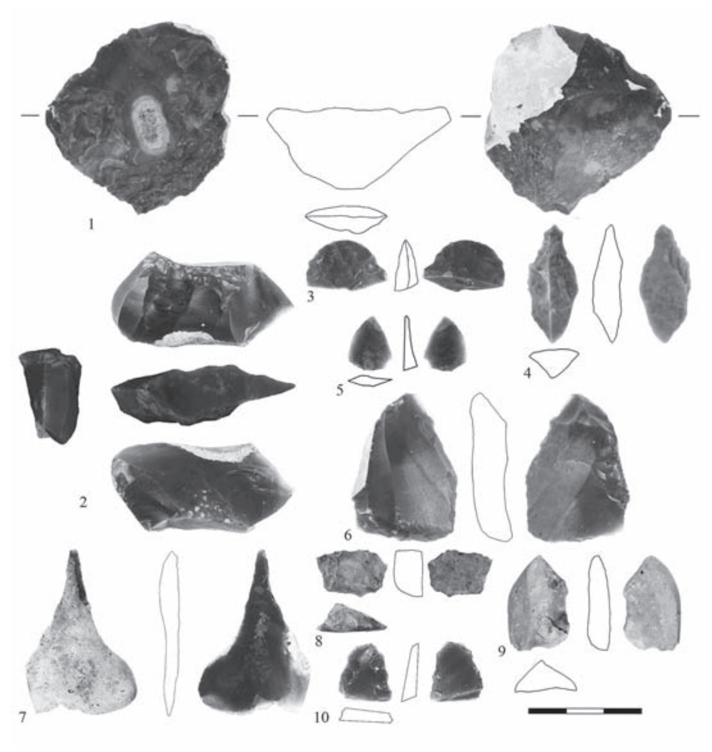

Fig. 9. Flint cores and tools: 1, 2 cores (Nos 2008/5; 2007/20); 3 bifacial tool fragment (No 2008/10); 4 borer/burin (No 2008/3); 5 arrowhead (No 2008/25); 6, 9 scrapers (Nos 2008/345; 2008/13); 7 borer (No 2008/14); 8 fragment of a scraper (No 2007/32); 10 fragment of a tool (No 2007/22).

Flint

The flint assemblage consists of 266 pieces: in addition to debitage, 249 flakes and one piece of angular shatter, there are five tools, five tool fragments, one tool preform, four cores, and one core fragment. Almost all of the flint is excellent-quality, imported dark brown and dark grey material. However, the site inhabitants were using, or trying to use, local poor-quality flint as well. A core of local flint was found in test-pit 2, and three flakes and a scraper in area 12 (scraper from the profile, flakes in layers 5 and 7).

Cores

The above-mentioned core of local flint is a pebble used as multidirectional flake core, from which four flakes had been detached. The other three cores are unidirectional platform cores of imported flint. A core fragment from layer 4 in area 12 is likewise of very high-quality imported flint, but it was not possible to determine the exact type of core; apparently, this could be part of a multidirectional irregular core. The largest complete core (Fig. 9.1), found in layer 4 of area 12, is conical, the flakes having been produced along a front corresponding to three quarters of its circumference. Although it is still quite big (platform maximum linear dimension: 51 millimetres, weight 43.8 grams), and its front still contains approximately 20% cortex, it was thrown away, because its interior structure is very granular and patchy. The smallest core of imported flint (area 12, layer 5) is a sub-conical flake platform core, but the last flake was detached parallel to the platform, because the platform edge had already been destroyed. The core was discarded because it had become too small (platform maximum linear dimension: 20 millimetres; weight 3.7 grams) and exhausted. A third unidirectional platform core (test pit 7, Fig. 9.2) was mainly used for blade production, but large flakes have also been detached. It was discarded because no further blade production was possible: the platform edge had been destroyed through unsuccessful attempts to detach blades using a soft hammer, and the small size of the core precluded the creation of a new platform.

Tools

One fragment of a large bifacial tool was recovered (Fig. 9.3), most probably from a knife or a spearhead. All the other tools have been made from flakes simply by retouching the edges. There are three complete scrapers, and two parts of broken scrapers, one borer, one complete arrowhead, two undeterminable tool fragments, an implement that could have been used as a combined scraper and cutting tool, as well as a borer, possibly with a burin bit at the other end.

The majority of the tools and tool fragments (8) were found in area 12. The arrowhead, the borer/burin (Fig. 9.4), and probably also the largest scraper and one fragment of a scraper, were all found in layer 4 of this area. All these tools are made from high-quality imported flint. The arrowhead (Fig. 9.5) has a rounded triangular form, and is made from an interior flake, retouching the edge on the dorsal side. The complete scraper (Fig. 9.6), with a maximum dimension of 39 millimetres and a weight of 10.5 grams, has a vertical front and one lateral working edge; the scraper front fragment comes from a vertical-front end scraper with a convex working edge (Fig. 9.8). One more front fragment from a vertical-front end scraper was found in test pit 5.

Layer 5 of area 12 yielded a borer and part of a large bifacial tool. The borer (Fig. 9.7) was made from a primary flake, retouching the dorsal and ventral face in the narrowest part. Like the tools from layer 4, these were made from imported flint. One more small scraper (Fig. 9.9) (maximum dimensions: 25 millimetres, weight. 3.4 grams), with a vertical front and one lateral working edge made from local flint (the only identified tool from the site made of local flint), were also found in area 12.

The only acute-edge scraper, with a 15-millimetre-long convex edge, is from test-pit 7. It was made by retouching the ventral face of a secondary flake. From the same layer, there is a fragmented tool of indeterminate form (Fig. 9.10), which likewise has ventral retouch only.

Debitage

The debitage (Table 6) consists of rather fine material: the maximum dimension of the largest piece is 42.7 millimetres; 97.6% of the fragments are no bigger than 30 millimetres, and 76.4 % do not exceed 20 millimetres (Table 4). This may be explained in terms of the parsimonious use of high-quality imported flint, indicating that such flint represented rather exclusive material on the site. (However, it should also be noted that the assemblage includes many small fragments that were recovered by sieving.)

Taking into account the fact that the flint assemblage includes a multidirectional core, platform cores and fragments of bifacial tools, all the debitage that could be recognised as complete or almost complete proximal flakes was grouped using the triple cortex typology (Adrevsky 1998, 111). In terms of this typology, the bifacial thinning flake and retouching flake groups are commonly represented. Accordingly, all the complete or almost complete proximal flakes and blades with striking platforms were grouped into seven different types (Table 5). According to this typology, almost half of the flakes (complete flakes and flakes with no distal end) are from the last stages of tool producing: bifacial thinning and retouching. Very interesting in this particular respect are flakes from test pit 5, because all the thinning flakes and at least three of the retouching flakes that were found together are from the same structure and colour; therefore, they were most probably detached from one bifacial. As the largest of the thinning flakes has a maximum dimension of 2.5 centimetres (weight. 0.75 grams), and the flake negatives on the distal end of the dorsal side follow the same direction as the flakes, in all likelihood the item being produced was a bifacial spearhead or knife, forms typical of the Middle Neolithic (Loze 2015, 57). A comparatively large number of bifacial thinning flakes were also present in test pit 7, which produced the largest number of complete or almost complete proximal flakes of all the excavated areas.

Of the total 250 pieces of debitage from the site, 18.5% had dorsal cortex (Table 5). Among complete and almost complete proximal flakes and blades, the proportion with dorsal cortex is very similar, approximately 17% (Table 5, groups 1–4). The majority of flakes and all the blades at Priedaine were produced in the interior core reduction stage (Table 5, group 5), in the second and third biface thinning stages (Whittaker 1999, 200) (Table 5, group 6), and in the tool or bifacial retouching stage (Table 5, group 7).

For 107 pieces of proximal debitage, it was possible to determine the platform type (Table 7); 42 proximal flakes had broken platforms. The debitage from the site shows six different platform types altogether (Table 7), the most common being the plain form. Sixty-seven proximal flakes and all three blades have this kind of platform, accounting for more than half of the proximal debitage in all the areas and layers where flakes and blades were found. Only in two cases has trimming been used to prepare the butt of flakes with a plain platform; generally, abrasion only was used. The second most common kind of butt preparation is with two facets, a feature generally associated with bifacial thinning flakes (Odell 2004, 121). Fifteen proximal flakes with this type of platform have been found. Ten flakes with a two-facet butt, constituting two thirds of the total, were found in test pit 7, and at least seven of these are bifacial thinning flakes. All three proximal flakes with a three-facet platform also come from this test pit. There are five flakes with a rounded platform from two different test pits, 7 and 12, but only test pit

Table 4. Maximum size of all debitage found in the site

Maximum dimension (mm)	Surface	Test-pit 4	Test-pit 5	Test-pit 6	Test-pit 7	Test-pit 10	Area 12, layers											Total
							1	2	2/4	2/5	3/4	4	4/5	5	5/7	7	?	
0–10	1		4		22	2						2		6	5	1	1	44
10–20	1	1	19	1	58	5	1	3				6	1	30	10	10	1	147
20–30			7		19					2	2	7		9	3	3	1	53
30–40	1								1					1	1			4
40–42.7	2																	2
Total	5	1	30	1	99	7	1	3	1	2	2	15	1	46	19	14	3	250

Table 5. Types of complete and broken distal end flakes and blades

Type	Sur-face	Test-pit 4	Test-pit 5	Test-pit 6	Test-pit 7	Test-pit 10	Area 12, layers											Total
							1	2	2/4	2/5	3/4	4	4/5	5	5/7	7	?	
1. Primary stage (100 % cortex)												1						1
2. Secondary stage with >50% cortex						1	1					2		4				8
3. Secondary stage with 50% – 10% cortex					7							1		2				10
4. Secondary stage with < 10% cortex			2									1						3
5. Interior stage	1	2	2		13	1					1	4		9	6	3	1	43
6. Bifacial thinning flakes			7	1	18	1								1	2	5		35
7. Retouching flakes	1		5		12	2						1		4	4			29
Total	2	2	16	1	50	5	1	0	0	0	1	10	0	20	12	8	1	129

Table 6. Condition of all debitage found in the site

	Debitage	Sur-face	Test-pit 4	Test-pit 5	Test-pit 6	Test-pit 7	Test-pit 10	Area 12, layers											Total
								1	2	2/4	2/5	3/4	4	4/5	5	5/7	7	?	
Proximal flake	Complete flake	1	2	14		30	4					1	6		17	11	7		93
	Broken distal end	1		2	1	19	1						3		3	1	1	1	33
	Proximal part			2		2									3		1	1	9
Flake shatter	Medial part			2		13			2				1		2	1			21
	Distal part					13								1	6	3			23
	Broken proximal part			4		3	1		1	1	1		1		5		1	1	19
	Flakes right side							1											1
	Flakes left side			1									1			1			3
	Broken more than one part	1		2								1	1		4				9
	Only striking plat-form			1													3		4
	Indeterminable flake part			2		17					1		1		6	2	1	1	31
	Blade					2							1						3
	Angular shatter						1												1
	Total	**3**	**2**	**30**	**1**	**99**	**7**	**1**	**3**	**1**	**2**	**2**	**15**	**1**	**46**	**19**	**14**	**4**	**250**

Table 7. All proximal debitage platform types

Maximum dimension (mm)	Surface	Test-pit 4	Test-pit 5	Test-pit 6	Test-pit 7	Test-pit 10	Area 12, layers											Total
							1	2	2/4	2/5	3/4	4	4/5	5	5/7	7	?	
0–10	1		4		22	2						2		6	5	1	1	44
Convex					3													3
Two facets					10							1		1	1	2		15
Tree facets					2											1		3
Plain			10	1	22	3					1	6		12	8	5	2	70
Rounded					2						1	2				1		6
Cortex		2	1		1	1						1		3	1			10
Broken	1		2		16	1	1	1				3		9	3	5		42
Total	**1**	**2**	**13**	**1**	**56**	**5**	**1**	**1**	**0**	**0**	**2**	**13**	**0**	**25**	**13**	**14**	**2**	**149**

Fig. 10. Artefacts made from stone and amber: 1 stone battle-axe, discovered 1975; 2 miniature stone chisel (No 2007/8); 3–4 amber pendants (Nos 2007/6, /16).

7 had proximal flakes with a convex platform, three in number. According to these data, the most complex preparation before flake removal was undertaken on that part of the site where test pit 7 was located.

The debitage terminations provide further interesting evidence of the knapping skills of the settlement inhabitants. Out of 145 flakes, parts of flakes and blades with a distal end, 32 (21.6%) have hinged terminations (including all three blades), but only three flakes (2%) show an overshot or plunged termination, and two (1.4%) have a step termination. It seems that some kind of termination mistake was made with each fourth flake at all stages of knapping.

Overall, the site displays the same flint knapping technology and pebble reduction as is seen in the whole of the surrounding region. Multidirectional flake cores represent the most typical kind of core for flake detachment from pebbles of local flint in the Neolithic. For example, a large number of such cores have been found in dwellings 2 and 3 at Sārnate. Neolithic blade cores have not been studied in Latvia so far, but according to Loze (2006, 51), blade technology was more extensively used at Comb Ware sites. Freehand core technique was used to produce unidirectional flake and blade platform cores, and irregular multidirectional flake cores.

All the tool forms, and particularly the bifacial tool, are most typical of the Middle Neolithic, but such forms were used in the Late Neolithic as well (Loze 2001a, 100ff.). The main difference from other Middle Neolithic sites is seen in the type of imported flint. Thus, no colourful flint, very common at other Neolithic sites in the region, has been found at Priedaine; only highest-quality dark brown and dark grey flint.

Non-knapped stone

The battle-axe that was presumably found at the site in 1975 (Fig. 10.1), representing a simplified (late) form of this artefact, remains the only object from Priedaine attesting to Late Neolithic activity.

Found in test pit 5 was a miniature stone chisel (Fig. 10.2), measuring 2.9×1.7×0.7 centimetres. Small ground-stone tools of this kind occur at Middle as well as Late Neolithic sites (e.g. Loze 1979, Pls. XIII–XV, 1988, Pls. XXXII, LXIV). Test pit 7 yielded a small whetstone of sandstone; and from test pits 2 and 5 there are two unworked pebbles, which, considering their size and form, most probably served as net sinkers.

Amber

Test pits 5 and 7 have yielded a very small assemblage of amber: two irregular-shaped amber pendants (Fig. 10.3, 4), as well as four split pieces of amber and two unworked lumps. Area 12 produced further evidence of the collection and working of amber on the site, in the form of eight unworked lumps and five flakes.

Wooden artefacts

Several fragmentary wooden tools were recovered in area 12, including some very unusual objects of indeterminate function. One of these (Fig. 11.2) is a carefully worked rod of pine wood, D-shaped in cross-section, with regularly spaced oblique grooves cut in the rounded side along the middle part of its length (so that, viewed from this side, it is reminiscent of a screw thread), while the other side is almost flat, showing very shallow perpendicular grooves or imprints, which may derive from wear. Found broken into several sections, it has a total reconstructed length of at least 82 centimetres, measuring 2×2 centimetres in cross-section in the thickest part. The rod tapers towards one end, and here the grooves become progressively shallower, although

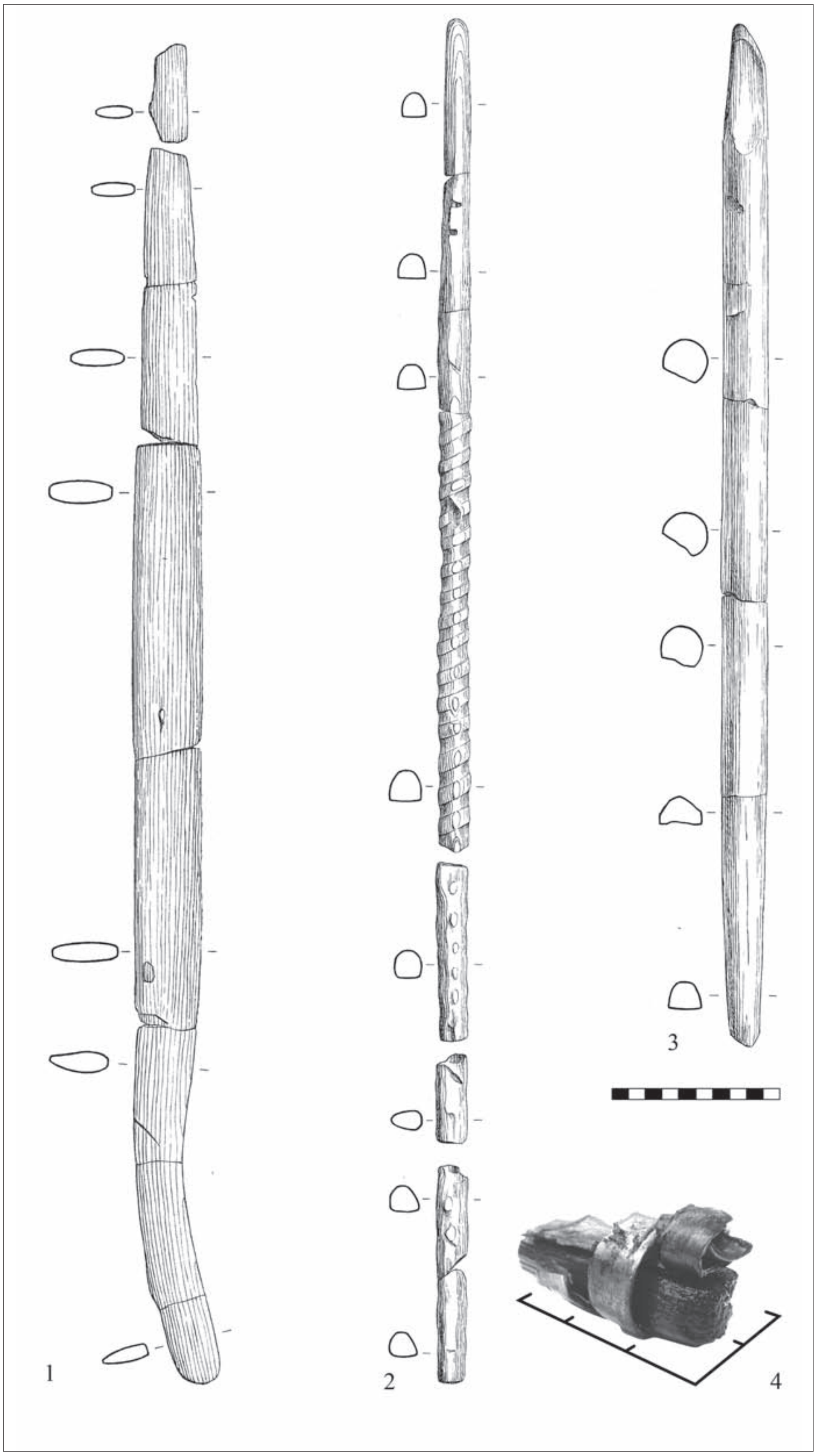

Fig. 11. Wooden objects: 1 object with a curved blade (No 2008/269); 2 object with oblique grooving (No 2008/260); 3 tool handle (?) (No 2008/270); 4 lath fragment with birch bark binding (No 2008/266) (drawings by Anda Bērziņa).

the cross-sectional shape does not change; neither is the grooving present at the other end. No ethnographic or archaeological parallels have been identified for this strange object, and its purpose remains unclear. It could have formed part of the frame of a fish-trap or fishing structure of laths (see below), with perpendicular-oriented laths or rods bound to the flat side at each of the oblique grooves. The regularly spaced grooving also suggests a connection with netting: it could be imagined as forming part of a net frame, or as a gauge for net-making. In any case, this seems to have been an object of some importance, given the care invested in carving the grooves.

A second enigmatic object (Fig. 11.1), made of ash, is somewhat reminiscent of a very narrow paddle, but evidently served a different purpose. The flat, fragmentarily preserved wooden implement, at least 80 centimetres long, is oval in cross-section along most of its length, widest and thickest in the middle, and provided with a somewhat narrower, curving short knife-like blade at one end, terminating in a rounded, very worn tip. One face of the blade has split away. The opposite end shows more decay, with dark discolouration that could indicate hafting. The function of this piece likewise remains enigmatic. The flat cross-section suggests that, as in the case of a paddle, it was intended to move through the water with minimal resistance, while the wear at the tip of the blade may be from abrasion against the bed of the body of water. When searching for ethnographic parallels, we may consider the variety of odd-shaped wooden implements utilised in fishing with nets under the ice (e.g. Benecke 1881, Fig. 154). At the level of conjecture, such a blade could potentially also have been useful for cutting the submerged stems of aquatic plants.

Area 12 yielded fragments of another four carefully shaped wooden implements, most of them made of ash. These include a rod-like object at least 60 centimetres long, circular in cross-section (part split away on one side), with a worn chisel-like end; the end of a tool handle, semi-circular in section (Fig. 11.3); and a small fragment of a paddle or other flat object. There are also two short pieces of a maple tool handle with a semi-circular cross-section. Finds of split and cut pieces of wood indicate that woodworking took place on the site.

Also found in area 12 were pine-wood lath fragments, 232 in total, varying in length from 1.6 centimetres to 71 centimetres, including two short pieces bound with narrow strips of birch bark (Fig. 11.4). These fragmentary remains evidently relate to fishing structures with screens and/or traps made of wooden laths, a tradition widely represented in ethnographic and archaeological material from northern Eurasia (Sirelius 1906; Koivisto 2012; Koivisto, Nurminen 2015). The fragments from Priedaine can generally be regarded as pieces discarded during the splitting of pine trunks to provide material for lath fishing structures, and during the construction/repair of the screens or traps themselves. The mean radial dimension of the laths (i.e. in the direction from the pith to the bark) was 0.8 centimetres, and the mean tangential dimension 1.4 centimetres, which indicates the size of material that was being sought when splitting the wood. The two pieces with birch-bark binding and a small number of other fragments were D-shaped in cross-section, having been whittled into this form after splitting. There are no clear examples of pointed or rounded lath tips.

The lath-screen tradition is represented in the material from Sārnate and probably also other Neolithic sites of the east Baltic (Bērziņš 2008, 241ff.). At Sārnate, bast is the material used for the bindings; bast and bulrush bindings of screens are known from sites in Russia. On the other hand, at Purkajasuo and other fourth/third millennium BC sites in Finland, birch bark has been used for this purpose, hence Koivisto (2015, 62) considers it a 'Finnish adaptation'. Fish-traps made of laths are also known in the region from the Neolithic and later times (Loze 2001b, 36ff., Fig. 5; Rimantienė 2005, 71, Fig. 177; Koivisto 2011, Fig. 3). It is impossible to determine from the highly fragmented remains recovered at Priedaine the kind of fishing structure being made here.

The pointed tips of two stakes were found in the northern part of area 12: one of these, discovered in a vertical position, is made of coniferous wood, with a diameter of 5.6 centimetres; the other, found lying horizontally, is made of alder/aspen, and has a cross-section of 4×1.9 centimetres.

The small set of wooden implements from Priedaine displays forms that do not appear in the extensive collections of organic objects from the east Baltic wetland sites associated with organic-/shell-tempered ceramics (Šventoji, Sārnate, Zvidze, etc). This is tantalising evidence that the intrusive Comb Ceramic tradition represented at Priedaine was accompanied not only by a different flint tradition and highly distinctive burial practices, but also by a culturally specific toolkit of wooden fishing gear and other equipment. We may expect that future excavations at waterlogged Comb Ceramic sites will shed further light on this question.

Plant macroremains

All of the sediment excavated in area 12 was wet-sieved through a five millimetre mesh. A total of 252 samples were processed, each deriving from a 5×50×50-centimetre excavated spit. After the excavation, the material recovered on the sieve was re-washed and sorted, extracting the waterlogged plant remains. The rest of the sample was dried and the archaeological material extracted, along with charred botanical remains (charred wood, hazelnuts). This was supplemented with plant remains hand-collected in the course of the excavations.

In addition to wood charcoal and partially charred wood fragments, the samples from the on-site sieving programme contained other kinds of plant macroremains, mainly waterlogged (Table 8). Most frequent among these were hazelnuts (*Corylus avellana*), mainly represented by shell fragments; also commonly recovered were water chestnut pericarp (spine) fragments (*Trapa natans*). Other remains were present in small quantities: three juvenile acorns and one acorn fragment (cupula) of pedunculate oak (*Quercus robur*), four cone scales of spruce (*Picea abies*) with two nuts, three Scots pine (*Pinus sylvestris*) cones, and four seeds of bearberry (*Arctostaphylos uva-ursi*) in a united round stone. Only four of the hazelnut shell fragments were charred.

The volume of sieved sediment from each layer was obtained, permitting the calculation of the quantity of each kind of remains per litre. It can be seen that both hazelnut and water chestnut occur much more frequently in layer 5, a layer of fine, organic-rich sand, as well as in the sediment that could not be clearly assigned to layer 5 or 7 ('layer 5/7' in Table 8). Evidently, these are food remains deposited at the waterfront during a period of intensive human activity, when sand was being eroded from the dune slope and deposited in the shallow water.

In parallel, samples were collected for macroremains analysis at the Quaternary Environment Laboratory of the Faculty of Geography and Earth Sciences, University

Table 8. Plant macrofossils from area 12 (sieved, >5 mm). No of fragments; concentration per litre in brackets

		Layer									Total
		2	2/4	4	4/5	5	5/7	6	7	8	
Sieved volume (litres)		818	107	601	25	386	160	31	233	19	**2381**
***Corylus* nut fragm.**	**Water-logged**	21 (0.026)	2 (0.019)	6 (0.010)	–	88 (0.228)	23 (0.143)	–	3 (0.013)	–	**143**
	Charred	–	2 (0.019)	–	–	1 (0.003)	1 (0.006)	–	–	–	**4**
***Trapa* fruit fragm. (waterlogged)**		3 (0.004)	1 (0.009)	2 (0.003)	–	66 (0.171)	39 (0.243)	–	7 (0.030)	–	**118**
***Quercus* juvenile acorn (waterlogged)**		1 (0.001)	–	–	–	1 (0.003)	1 (0.006)	–	–	–	**3**
***Pinus* cone (waterlogged)**		–	–	–	1 (0.040)	2 (0.005)	–	–	–	–	**3**
***Arctostaphylos* stone with seeds (waterlogged)**		–	–	–	–	1 (0.003)	–	–	–	–	**1**
***Picea abies* cone fragm. (waterlogged)**		–	–	–	–	–	–	–	1 (0.004)	–	**1**
Wood charcoal fragments		1272 (1.556)	114 (1.063)	1150 (1.913)	57 (2.280)	966 (2.500)	508 (3.167)	17 (0.544)	231 (0.990)	6 (0.320)	**4321**
Partially charred wood		204 (0.249)	25 (0.233)	119 (0.198)	4 (0.160)	74 (0.191)	51 (0.318)	2 (0.064)	27 (0.116)	1 (0.053)	**507**
Notes		incl. 3 whole hazelnuts				incl. 2 whole hazelnuts	incl. 1 *Quercus* cupula				

of Latvia. Processing and identification were carried out in accordance with standard methodology (Birks 2007). Plant detritus was recovered on a 0.25-millimetre sieve from four samples (each representing one litre of sediment), and examined under a binocular microscope, extracting identifiable plant and aquatic animal remains (Table 9). A reference collection of modern seeds and atlases was used for determination (Bojnansky, Fargašova 2007; Cappers et al. 2006; Katz et al. 1965; Velichkevich, Zastawniak 2006, 2008).

Predominant in the plant detritus are fragments of reed stems and leaves, roots of various plants, wood and charcoal. In total, remains from 67 plant species were found (identified mainly on the basis of seeds); 18 were determined only to a family or genus level. The remains of nine forms of aquatic animal are represented: caddisfly (*Orthotrichia* and *Limnephilus*) larval cases, water flea (*Cladocera ephippia*), etc (Table 9). Regularly occurring in the tree, shrub and dwarf shrubs group (15 taxa) are spruce and pine needles, birch nutlets, and seeds of raspberry and bearberry. Found only in sample 8 (layer 7) were seeds of oak (*Quercus sp.*), small-leaved lime (*Tilia cordata*), raspberry (*Rubus idaeus*), blackberry (*R. caesius*) and *Prunus* sp. Most widely represented is the group of open-habitat plants, with 28 species (including ruderals). Frequently occurring are seeds of several species of *Chenopodium, Atriplex* and *Stellaria*, along with common nettle. Also represented are seeds of Roehricht nettle (*Urtica kioviensis*), not part of the present-day flora of Latvia (Table 9). This nettle species occurs nowadays in southern Belarus, Ukraine and Germany, and has also been found in Holocene sediments (Wolters et al. 2005). The species has previously also been found in Latvia in deposits in the southern part of Lake Lubāns (Ceriņa 2011). The wetland plants group is represented by 24 taxa. Predominant are remains of reeds, nuts of sedges (*Carex*); also occurring regularly are seeds of hemp-agrimony (*Eupatorium cannabinum*); sample 8 contained a significant quantity of seeds of jointed rush (*Juncus articulatus*), a plant of boggy shores. The aquatic plants group consists of 12 taxa. Dominant among the remains of submerged aquatic water plants are seeds of holly-leaved naiad (*Najas marina*); also present are seeds of pondweed (*Potamogeton*) and horned pondweed (*Zannichellia palustris*). Floating-leaf plants include seeds of white water-lily (*Nymphaea alba*). Present in greatest numbers are fragments of the fruits of water chestnut (*Trapa natans*), dominant among which are the spines of the fruits in particular (197 in total).

The sediment, consisting of coarse detritus gyttja with a small admixture of sand (sample 8, from layer 7), as well as sand with an admixture of plant remains (sample 2, from layer 7, samples 1 and 5, from layer 5), contains the remains of autochthonous plants (lacustrine aquatic plants and plants of overgrowing littoral wetlands, occurring in a shallow littoral belt with a fluctuating water level, including swamp conditions), as well as allochthonous herbs of forest and scrubland, together with plants of open places, which have been washed, blown by the wind, or transported through human activity from the dune belt and shore slope, ending up in the deposits (Table 9, Fig. 12). Such assemblages usually occur in the shallow littoral belt of lakes, in coarse detritus gyttja, or else in the reedbed peat of littoral swamp (Lowe, Walker 1997; Gaillard, Birks 2007). The quantitative variation in open-habitat plant remains in the sediment (Fig. 12) is probably related to the increase or reduction in erosion of the deposits of the dune belt under the influence of wind or human activity. Drift deposits could have formed in the littoral zone during storms, as is suggested by the regular occurrence of *Atriplex littoralis, A. hastata* and *A. patula* (Kubiak-Martens 1999). The occurrence of ruderal species as well as charred seeds, conifer needles, reed fragments and the considerable quantity of wood charcoal (Table 9) in these sediments testifies to human activity in the environs. The regular occurrence of bearberry seeds (*Arctostaphylos uva-ursi*) indicates the presence of sunny, open places on the dune belt and in the environs of the habitation.

Hazelnuts and water chestnuts were collected for food, as is indicated by the quantity of recovered fragments. Not present in the sediment were the fine harpoon-like bristles of water chestnuts that project from the tips of the spines; and water chestnut macroremains as such were absent from the samples of palaeolake deposits from core 20, located 20 metres south of the site (Kalniņa et al. 2009). Together, these observations suggest that water chestnut did not grow in the lake close to the site, and was collected elsewhere. Bristles have been recovered in previous studies in Latvia. Thus, in the deposits sampled in core 16 in the former Ģipka lagoonal lake (Eberhards et al. 1999), the number of bristles in some samples even exceeded twofold the number of other remains of water chestnut fruit (data of A. Ceriņa), and in the occupation layer of the Ģipka B Neolithic site, two bristles were found among charred water chestnut fragments (Ceriņa 2006). Water chestnut bristles were regularly recovered in the sediment samples from the Zvidze settlement (Loze et al. 2011).

Seeds of other food plants recovered at Priedaine include: raspberry, blackberry, wild strawberry, and a plant of the genus *Prunus* (dwarf cherry?). Bearberry could potentially also have been used as food or for medicinal purposes (Bårdseth, Sandvik 2010; Vanhanen 2012).

Table 9. Plant macrofossils from area 12 (sieved, >0.25 mm)

		Layer	**5**				**7**			
		Sample no.	1		5		8		2	
		Square	18.0x/9.5y		17.0x/8.5y		18.5x/9.0y		17.5x/9.5y	
		Depth, cm a.s.l.	135–140		120–125		115–110		130–135	
Scientific name	**Common name**	**Material**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**
Trees, shrubs and dwarf shrubs										
Pinus sylvestris	Scots pine	seeds					7		1	
		leaf fr.			1		1	1	2	
Picea abies	Norway spruce	leaf fr.		3	1	1	8	7	1	2
		seeds			3					
Pinaceae		seed fr.	3				2			
Betula sect. *Albae*	Tree birch	fruits	6		28		6		22	
		scales					1		2	
		bark fr.			3					
Alnus glutinosa	Common alder	fruits	1		2				3	
		cones			1					
Alnus incana	Grey alder	fruits							1	
Corylus avellana	Common hazel	fruit fr.							2	
Quercus sp.	Oak	acorn fr., cupulae			8		2			
Rubus idaeus	Raspberry	fruits	4		1		1		7	
Rubus caesius	Dewberry	fruits			1					
Prunus sp.	Plum/dwarf cherry	endocarp fr.			1					
Tilia cordata	Small-leaved lime	seed			1					
Arctostaphylos uva-ursi	Common bearberry	seeds	6		6		11		7	
Vaccinium myrtillus	Bilberry	seeds			1					
Vaccinium vitis idaea	Cowberry	seeds							1	
		Seeds, sum	20	3	58	1	39	8	49	
		Diversity	5	2	14	2	9	2	11	2
Waterlogged to dry open habitats, ruderals										
Festuca arundinacea	Tall fescue	fruits								1
Fallopia convolvulus	Black-bindweed	fruits	2		1					
Fallopia dumetorum	Copse-bindweed	fruits			2					
Polygonum persicaria	Redshank	fruits	4		2	4	5		9	
Polygonum lapathifolium	Pale persicaria	fruits			5		1	2	5	1
Polygonum minus	Small water-pepper	fruits	4		3		30	1	1	
Polygonum mite	Tasteless water-pepper	fruits	2		4					
Rumex crispus	Curled dock	fruits							1	
Urtica dioica	Common nettle	fruits	12		8		19		9	
Urtica kioviensis ?	Roehricht nettle	fruits					1		1	
Chenopodium album	White goosefoot	fruits	13		15		8		23	
Chenopodium glaucum	Oak-leaved goosefoot	fruits			1				1	
Chenopodium polyspermum	Manyseed goosefoot	fruits	1		2					
Moehringia trinervia	Three-nerved sandwort	seeds	2		1				3	
Atriplex patula	Common orache	fruits	3		10	1			1	
Atriplex litoralis	Grass-leaved orache	fruits	1		1				2	

		Layer	5				7			
		Sample no.	1		5		8		2	
		Square	18.0x/9.5y		17.0x/8.5y		18.5x/9.0y		17.5x/9.5y	
		Depth, cm a.s.l.	135–140		120–125		115–110		130–135	
Scientific name	**Common name**	**Material**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**
Atriplex prostrata	Spear-leaved orache	fruits			7		19		1	
Stellaria media	Common chickweed	seeds			13					
Cerastium holosteoides	Common mouse-ear	seeds			1					
Ranunculus acris	Meadow buttercup	fruits	1							
Veronica arvensis	Wall speedwell	seeds			2					
Brassica campestris	Wild turnip	seeds			1	2				
Viola tricolor	Wild pansy	seeds					1			
Viola hirta	Hairy violet	seeds			1					
Fragaria vesca	Wild strawberry	fruits	3		1		3			
Fragaria viridis	Green strawberry	fruits					1			
Plantago major	Greater plantain	seeds							1	
Taraxacum officinalis	Common dandelion	fruits							1	
		Seeds, Sum	48		81	7	88	3	59	2
		Diversity	12		20	3	10	2	14	3
Wetlands, wet meadows, riverside										
Juncus articulatus	Jointed rush	seeds			11					
Alisma plantago-aquatica	Water-plantain	seeds							1	
Cladium mariscus	Great fen-sedge	seeds			1		1			
Scirpus tabernaemontani	Grey club-rush	fruits					3		4	
Ranunculus repens	Creeping buttercup	fruits	1							
Scirpus sp.	Bulrush	fruits	1							
Eleocharis palustris	Common spike-rush	fruits							1	
Carex spp.	Sedge	fruits	1		13		13		3	
Polygonum hydropiper	Marshpepper	fruits	7							
Caltha palustris	Marsh-marigold	seeds			2		2			
Ranunculus lingua	Greater spearwort	fruits			1				4	
Stellaria palustris	Marsh stitchwort	seeds							3	
Filipendula ulmaria	Meadowsweet	fruits							1	
Menyanthes trifoliata	Bogbean	seeds							1	
Potentilla erecta	Tormentil	fruits							1	
Solanum dulcamara	Bittersweet	seeds					3		2	
Euphorbia palustris	Bog spurge	seeds					1			
Rorippa palustris	Marsh yellow-cress	seeds			4					
Eupatorium cannabinum	Hemp-agrimony	seeds	2		2		4		2	
Lycopus europaeus	Gipsywort	fruits					1		1	
Lysimachia thyrsiflora	Tufted loosestrife	seeds	1		1					
Stachys palustris	Marsh woundwort	fruits	1		1		1			
Phragmites	Common reed	stem fr.	x		x	4	x		x	
Equisetum sp.	Horsetail	stem fr.				1				
		Seeds, sum	14		40	5	29		34	
		Diversity	7		9		9		12	
Aquatics										

		Layer	**5**				**7**			
		Sample no.	1		5		8		2	
		Square	18.0x/9.5y		17.0x/8.5y		18.5x/9.0y		17.5x/9.5y	
		Depth, cm a.s.l.	135–140		120–125		115–110		130–135	
Scientific name	**Common name**	**Material**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**	**Waterlogged**	**Charred**
Typha sp.	Bulrush	fruits			1		2		1	
Potamogeton perfoliatus	Perfoliate pondweed	endocarp			3		3		1	
Potamogeton lucens	Shining pondweed	endocarp					1			
Potamogeton sp.	Pondweed	endocarp	1				1		1	
Najas marina	Holly-leaved naiad	seeds	27		36		60		33	
Zannichellia palustris	Horned pondweed	fruits			2				1	
Scirpus lacustris	Common club-rush	fruits	1		3		5		1	
Nymphaea alba	White water-lily	seeds	5		4		12		13	
Nuphar lutea	Yellow water-lily	seeds			2		1	1		
Ceratophyllum submersum	Soft hornwort	seeds	2				1			
Batrachium sp.	Water-crowfoot	fruits					1		1	
Trapa natans	Floating water-nut	fruit fr.	11		123		12	1	50	
		Seeds, sum	55		178		105	9	112	
		Diversity	6		8		11	2	9	
Ecologically undefined										
Hypnum	Hypnum moss	stems			13					
Gramineae	True grasses	seeds			1	2		1		1
Atriplex sp.	Orache	seeds								1
Caryophyllaceae (Stellaria /Cerastium)	pink family	seeds	7				8		18	
Lamiaceae	Mint family	seeds			1					
Brasicaceae	Cabbage family	seeds			1					
Indeterminate		seed fr.		1			3	1		1
		Seeds, sum	7	1	16	2	9	2	18	3
Other remains										
Charcoal		fragments		>50	>50			>80		>50
Fungi		sclerotia	15		16		16		30	
Amber		flakes	1		2		7		3	
Aquatic animals										
Insecta	Insects	exoskeleton fr.			31				5	
Oribatida	Beetle mites	exoskeletons			11				6	
Orthotrichia	Caddisfly	larval cases			25		3		33	
Limnephilus sp.	Caddisfly	larval cases			6		6		12	
Cladocera	Water flea	ephippia	50		40		20		11	
Daphnia	Water flea	ephippia			2					
Bryozoa	Moss animals	statoblasts							10	
Plumatella-type	Moss animals	statoblasts			11				2	
		Sum	51		122		29		79	

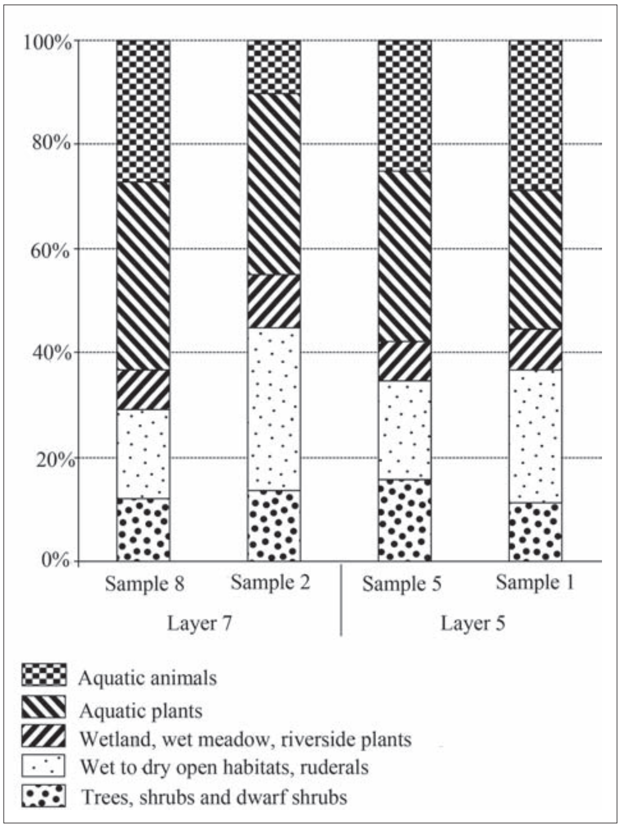

Fig. 12. Plant macro-remains from layers 5 and 7 in area 12. Relative percentages of ecotypes.

Faunal remains

The collected animal bones were quite fragmentary and badly preserved. Regardless of this, about 72 of 96 registered fragments were taxonomically more precisely identified; the remainder have been recorded simply as mammal bone fragments (Table 10).

In addition to the bone fragments, 46 fish scales were found, all of them from cyprinids, the group of freshwater fish including bream, roach, ide, tench, etc. In addition to cyprinid scales, only one fishbone was recovered: a slightly burnt caudal vertebra of cod (*Gadus morhua*). As cod is a marine fish, this find in Priedaine relates to connections with the Baltic Sea and the fishing of marine fish.

Most of the identified skeletal fragments of mammals are from large ungulates, most probably the (European) elk (*Alces alces*). In addition to elk tooth fragments, there is a mandibula together with some teeth of red deer (*Cervus elaphus*). No other species were recorded, since the bone fragments are too small and lack specific characteristics for anatomical and taxonomical analysis. Elk and red deer were common game animals for Neolithic hunter-gatherer (i.e. pre-agricultural) communities in the east Baltic area.

Unfortunately, no bird bones were found, and thus we do not have any information about the avian fauna of that area. Based on our knowledge about the palaeogeographical situation of the site, we can only guess that waterfowl were also intensively exploited.

The palaeoeconomic and cultural context of the Priedaine site

In spite of the very small scale of the excavations, the Priedaine site provides key insights into the life of a Comb Ceramic group in a typical lakeshore setting near the southern shore of the Gulf of Riga. The site location reflects a primary focus on the exploitation of aquatic resources in the former Lake Priedaine: fish and aquatic plants, presumably also waterfowl and freshwater mussels. Also very close to the sea, the site could be used for marine fishing and amber-gathering. Because the faunal assemblage is so impoverished, we cannot say whether or not Priedaine also served as a base for marine mammal hunting, like Siliņupe, a Middle Neolithic site in a similar location further west along the Gulf of Riga coast (see Zagorska 2000). The scanty faunal evidence that we do have indicates the hunting of terrestrial mammals; the water system would have offered good access to the surrounding forest. In addition to food procurement, materials such as flint and amber were also processed here; hence, although small in extent, the Priedaine site was definitely more than just a fishing-hunting station.

The range of fish and plant species represented at Priedaine points to activities spanning the period from spring until at least early autumn, but in view of the diversity of the available resources, Priedaine could potentially have been a year-round settlement. Thus, fishing structures could also have been set under the ice, and late autumn/winter would have been an advantageous season for hunting elk and red deer (Bērziņš 2008, 247, 249, 362ff.).

The closest neighbouring Neolithic sites, although associated with the same dune belt (Fig. 1), and hypothetically with a similar economic basis, do not offer direct parallels in terms of artefactual material. Romi-Kalniņi, seven kilometres to the southwest on the former shore of Lake Babīte, has both Sārnate Ware and Comb Ceramics, but the latter do not show a particularly close correspondence with the Priedaine assemblage. Located five kilometres to the northeast of Priedaine is Vārnaskrogs, with a small lithic assemblage and highly fragmented pottery displaying Late Neolithic traits, thus probably relating to the phase of

Table 10. Vertebrate remains, area 12

Layer	Recovery method	Species or animal group	Description	No. of fragments
2	wet-sieved	Mammalia	bone fragment	1
		Cyprinidae	fish scales	2
2/4	wet-sieved	Cyprinidae	fish scales	2
2/5	hand-collected	large ungulate	long bone	1
4	hand-collected	Elk (*Alces alces*)?	animal tooth fragments	3
		Mammalia	burnt bone	1
4/5	hand-collected	Mammalia; elk (*Alces alces*) tooth	tooth and bone fragments, incl. 1 burnt	5
	wet-sieved	Mammalia	bone fragments	2
		Cyprinidae	fish scale	1
5	hand-collected	Cyprinidae	fish scales	4
		Elk (*Alces alces*)	tooth, fragmented	8
			tooth fragments	5
			teeth	9
		Red deer (*Cervus elaphus*)	mandibula + teeth	
		Mammalia	burnt bone	1
	wet-sieved	Elk (*Alces alces*)	tooth fragments, P2sup.	4
			tooth fragments	16
		large ungulate	tooth fragments	3
		Mammalia	bone fragments	2
			bone fragment, burnt	1
			tooth fragments	5
		Cyprinidae	fish scales	37
		Cod (*Gadus morhua*)	burnt bone fragment, vertebra praecaudales	1
5/7	hand-collected	Elk (*Alces alces*)?	tooth fragments	20
	wet-sieved	Cyprinidae	fish scales	2
7	hand-collected	Elk (*Alces alces*)?	tooth fragment	1
	wet-sieved	large ungulate	tooth fragments	2
		Mammalia	bone fragment	1

settlement represented by the battle-axe find at Priedaine.

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Valdis Bērziņš
Institute of Latvian History, University of Latvia
Kalpaka bulvāris 4
Rīga LV-1050, Latvia
E-mail: valdis-b@latnet.lv

Aija Ceriņa
Faculty of Geography and Earth Sciences, University of Latvia
Jelgavas iela 1
Rīga LV-1004, Latvia
E-mail: caija@inbox.lv

Mārcis Kalniņš
Faculty of History and Philosophy, University of Latvia
Aspazijas bulvāris 5
Rīga LV-1050, Latvia
E-mail: marcis.kalninsh@inbox.lv

Lembi Lõugas
Archaeological Research Collection
Tallinn University
Rüütli 10
10130 Tallinn, Estonia
E-mail: lembilgs@tlu.ee

John Meadows
Zentrum für Baltische und Skandinavische Archäologie,
Stiftung Schleswig-Holsteinische Landesmuseen
Schloss Gottorf
24837 Schleswig
Christian-Albrechts-Universität zu Kiel
Leibniz-Labor für Altersbestimmung und Isotopenforschung
Max-Eyth-St 11-13
24118 Kiel, Germany
E-mail: jmeadows@leibniz.uni-kiel.de

Harald Lübke
Zentrum für Baltische und Skandinavische Archäologie,
Stiftung Schleswig-Holsteinische Landesmuseen
Schloss Gottorf
24837 Schleswig, Germany
E-mail: harald.luebke@schloss-gottorf.de

PRIEDAINE – NEOLITO GYVENVIETĖ RYGOS ĮLANKOS IŠKYŠULYJE

VALDIS BĒRZIŅŠ, AIJA CERIŅA, MĀRCIS KALNIŅŠ, LEMBI LÕUGAS, HARALD LÜBKE, JOHN MEADOWS

Santrauka

Neolito laikotarpio Priedaine gyvenvietė (Jūrmala) buvo įkurta ilgo pakrantės kopų ruožo iškyšulyje, šiauriniame tuomet egzistavusio Priedaine ežero krante (1–3 pav.). 1975 m. šį paminklą rado vietinė gyventoja Regīna Ērgle (4 pav.). Nedidelės apimties archeologiniai tyrinėjimai Priedaine buvo vykdyti 2007–2008 m. 2007 m. buvo ištirta 12 šurfų. Kopos papėdėje, 12-ame šurfe, smėlio su gausia organika sluoksnyje buvo rasta keramikos ir medinių objektų. 2008 m. tyrimai buvo vykdomi šlapynėje, kopų papėdėje, išplečiant 12-o šurfo plotą iki 2x3 m dydžio perkasos (5, 6 pav.; 1 lent.). Tyrinėjimų metu buvo pasiektas 0,9 m gylis. Šiame gylyje tyrimai buvo nutraukti, nes vanduo perkasą užpildydavo labai greitai. Nustatyta, kad pati gyvenvietė buvo aukščiau šlaite. Tuo tarpu tirtoje šlapynės dalyje, buvusioje paleoežero pakrantėje, sluoksnis susidarė kaupiantis įvairioms šiukšlėms. Priedaine buvo įkurta

netoli paleoežero pakrantės, bet gyvenvietė buvo arti jūros, todėl buvo eksploatuojami vandens ištekliai. Tyrinėjimų metu 12-o ploto kultūrinio sluoksnio nuogulos buvo sijojamos skirtingo tankumo sietais. Tiriant makroliekanas, buvo rasta įvairių vandens ir žemės augalų rūšių (12 pav.; 9 lent.). Nustatyta, kad artimoje aplinkoje augo lazdynai, vandens kaštonai, avietės, gervuogės, žemuogės ir galimai meškauogės. Nors faunos kaulai buvo prastai išlikę, bet pavyko nustatyti karpinių žuvų žvynų, menkės slankstelį, taip pat rasta briedžio ir tauriojo elnio kaulų ir dantų.

Remiantis radiokarboninėmis AMS datomis, Priedaine datuojama 3 700–3 500 cal BC (7 pav.; 2 lent.). Tyrinėjimų metu rasta šukinės keramikos šukių (8 pav.). Priedaine gyvenvietėje surinktos šukinės keramikos šukės yra artimos šios rūšies keramikai, rastai Sārnate gyvenvietėje, vakarinėje Latvijoje. Priedaine buvo rasta unikalių medinių įrankių ir jų fragmentų, titnaginių dirbinių ir skaldytinių, akmeninių dirbinių, keli gintariniai dirbiniai ir gintaro žaliavos (9–11 pav.).