Descent History of Mesolithic Oblique Points in Eastern Fennoscandia – a Technological Comparison Between Two Artefact Populations

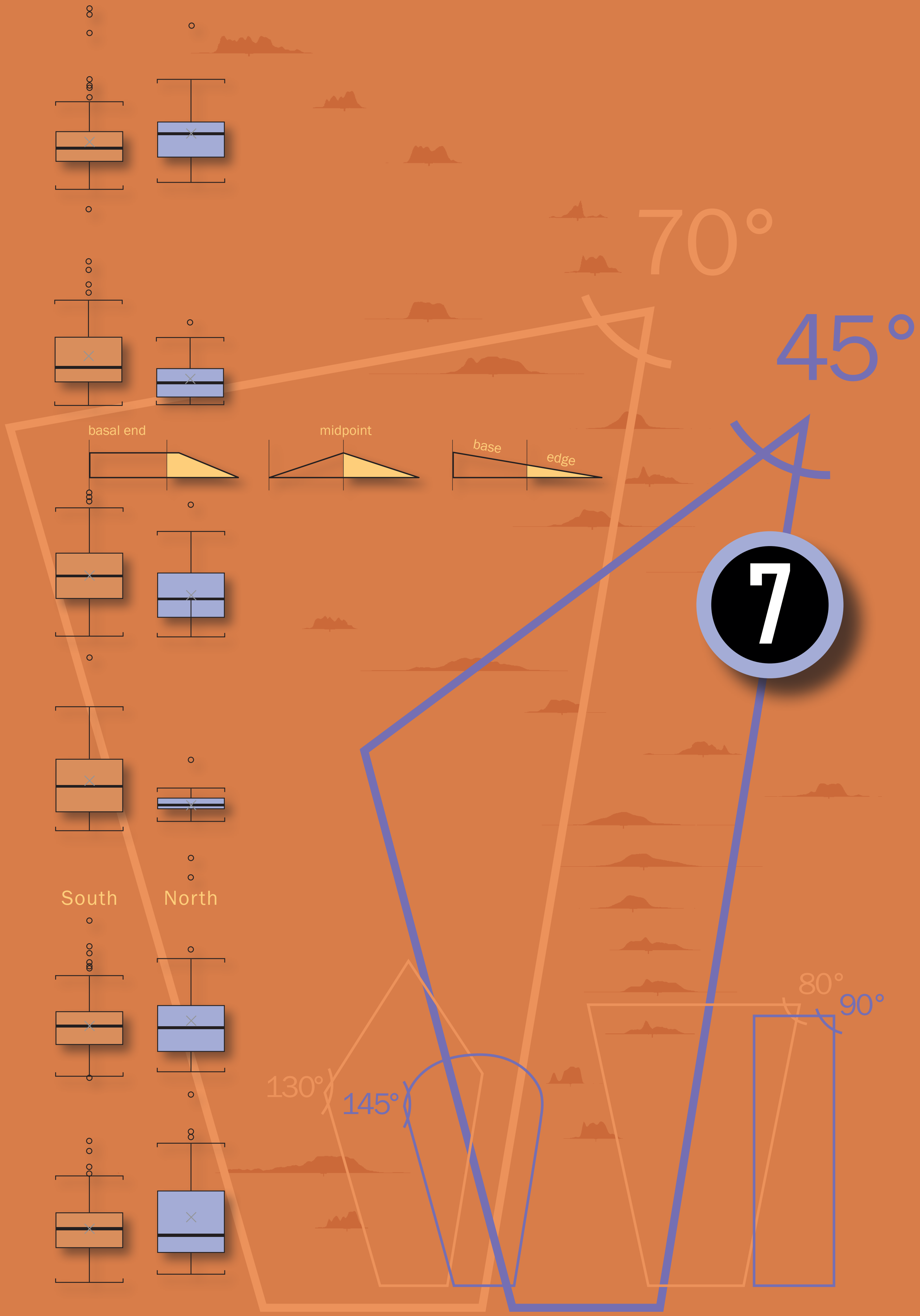
Author(s): Mikael A. Manninen & Miikka Tallavaara

Source: Tuija Rankama (ed.) 2011. *Mesolithic Interfaces. Variability in Lithic Technologies in Eastern Fennoscandia*. Monographs of the Archaeological Society of Finland 1, 176–211.

Published by: The Archaeological Society of Finland

Stable URL: www.sarks.fi/masf/masf_1/MI_07_Manninen_Tallavaara.pdf
ISBN 978-952-67594-0-1 (PDF) ISBN 978-951-98021-9-0 (hardback)

Monographs of the Archaeological Society of Finland
ISSN 1799-8611 (online) ISSN 1799-862X (print)
ISSN-L 1799-8611


70°
45°
basal end
midpoint
base
edge
7
South
North
130°
145°
80°
90°

Descent History of Mesolithic Oblique Points in Eastern Fennoscandia – a Technological Comparison Between Two Artefact Populations

Mikael A. Manninen & Miikka Tallavaara

ABSTRACT **We analyse a sample of 158 Late Mesolithic margin-retouched points from two geographically separate point populations in Finland to determine whether they represent the same technological tradition with a common descent history or separate developments with possible distant common ancestry. We conduct a technological analysis comparing the points according to geographical source area (i.e., northern Finnish Lapland or southern Finland) and according to raw material. Our analysis shows that the differences between the two point populations are best explained by differences in the raw materials used to manufacture the points and that all of the studied points can be considered to represent the same technological tradition. We also study the spread of the margin-retouched point concept within Finland by using radiocarbon dates. The result of this analysis indicates that the concept spread from the north towards the south. Finally, we suggest that two large-scale environmental changes, the 8.2 ka event and the Holocene Thermal Maximum, triggered the changes leading to the spread of the point concept.**

KEYWORDS

Late Mesolithic, Finland, lithics, oblique point, margin-retouched point, quartz, chert, 8.2 ka event, Holocene Thermal Maximum.

Introduction

During the Late Mesolithic, a new arrowhead manufacturing concept, the margin-retouched point, spread throughout the area representing present-day Finland. In addition to Finland, margin-retouched points[1] (e.g., trapezes and transverse points) were contemporaneously used throughout a large part of Europe. In Finland, the points were manufactured from irregular flake blanks with semi-abrupt to abrupt margin-retouch, and the usually unmodified edge of the flake was used as the cutting edge of the point. The resulting point type, *the oblique point*, as well as the manufacturing concept, have no predecessors in the archaeological record in Finland.

However, the known oblique points in Finland have a somewhat bicentric geographical distribution (**Fig. 1**). Broadly speaking, the points are known in the south (including southern Lapland) and in northern Lapland, but they are unknown in a large area in central Lapland. The bicentric distribution is reflected in the archaeological literature as a bicentric research history, and the connection between these point groups has rarely been addressed.

---

[1] In this paper, the expression *margin-retouched point* encompasses points that are manufactured by retouching the margins of a flake or flake/blade segment by abrupt or semi-abrut retouch, while leaving part of the original blank edge as a cutting edge.

In this paper, we study the descent history of the margin-retouched point concept in Finland and discuss scenarios explaining how the concept of margin retouched points spread in Fennoscandia during the Late Mesolithic. We aim to shed light on whether these points represent the same technological tradition with a common descent history or separate developments with possible distant common ancestry. The paper draws on a technological analysis of measurable characteristics in 158 oblique points from the two geographically separate oblique point populations and on radiocarbon dates from oblique point sites in Finland.

The descent histories of artefact types depend on the social transmission of cultural information. In recent years, cultural transmission theory (e.g., Boyd & Richerson 1985) has gained popularity, especially in explaining formal variation in artefact groups (e.g., Bettinger & Eerkens 1997; 1999; Eerkens & Lipo 2007; Jordan & Shennan 2009). Cultural transmission theory is also instrumental to the orientation of this paper. Following Boyd and Richerson's (1985) definition, we see culture as socially transmitted information that is capable of affecting an individual's behaviour. Central to cultural transmission theory are *decision-making forces*, some of which increase population variation and others of which reduce variation (Bettinger & Eerkens 1997; 1999; Boyd & Richerson 1985; Cavalli-Sforza & Feldman 1981; Eerkens & Lipo 2005; Richerson & Boyd 2005). In Finland, because the margin-retouched point concept spread to areas in which directly preceding lithic arrowhead types are not known, differences or similarities in within-population variation could shed light on the transmission mechanisms behind the spread of the manufacturing concept and, consequently, on the descent history of oblique points.

In their study on the dispersion of bow-and-arrow technology in the Great Basin area in North America, Bettinger and Eerkens (1997; 1999) concluded that the different design characteristics of corner-notched points in central Nevada and eastern California reflect different and contrasting modes of cultural transmission behind the spread of bow-and-arrow technology in these areas. However, Bettinger and Eerkens (1997) acknowledge that their study does not consider certain environmental factors, such as the effects of raw material. Boyd and Richerson's definition of culture nevertheless includes an important distinction between culture and behaviour as well as the products of behaviour (e.g., artefacts) because behaviour is always a product of both cultural and environmental factors. This means that two individuals with an identical cultural repertoire behave differently in different environmental settings (see also Binford 1973). The manner in which these individuals react to different environmental settings depends on culturally acquired information. One environmental factor capable of affecting artefact form is the raw material used to produce it.

It is widely acknowledged that the physical properties of raw materials have a strong impact on lithic assemblage variation (e.g., Amick & Mauldin 1997; Crabtree 1967; Domanski *et al.* 1994). Therefore, depending on the properties of the raw material, individuals who have acquired similar information concerning an artefact manufacturing process can produce formally different versions of the same artefact type. Bearing this fact in mind, we will also study the effects of raw material on the observed differences in within-population variation in the northern and southern oblique point groups as well as on the differences observed between the two groups.

The setting

The first notable oblique point site in Finland was published in 1948 (Luho 1948) and since then the point type has been considered mainly to be pre-pottery Mesolithic in the southern part of Finland (e.g., Luho 1967; Matiskainen 1986:Fig.9; 1989b; Siiriäinen 1984; Äyräpää 1950) with only a few occasional points found in possible association with pottery (e.g., Luho 1957). In more recent research, sites with oblique points in southern Finland have been dated to the Late Mesolithic (to *c.* 6500–4900 calBC) (Matiskainen 1986; 1989b; 2002:100). These points are almost exclusively made of different varieties of macrocrystalline vein quartz.

In northern Finnish Lapland, the discussion on oblique points has pursued a different path. Because the points in this region are often made of cherts and quartzites originating from the Barents Sea coast, Norwegian and Finnish archaeologists tend to discuss these points in relation to the North-Norwegian research tradition and connect them with the Late Mesolithic (Finnmark Phase III, *c.* 6400–4400 calBC) points of northern Norway (e.g., Halinen 2005:32; Hood 1988:30; Huurre 1983:86–87; Manninen 2005; 2009; Olsen 1994:40; Skandfer 2003:295–296).

Figure 1. The points in the southern (left) and northern (right) groups of oblique points in Finland organised according to edge shape. Points in the southern group: Alajärvi Rasi, (a, b, t); Askola Puharonkimaa Järvensuo (c); Hollola Kapatuosia, (g, u); Askola Pappila Perunamaa-Saunapelto (h); Pello Kaaraneskoski 1 (i); Lohja Hossanmäki (m); Kuortane Ylijoki Lahdenkangas (n); Loppi Karhumäki (o, s). Points in the northern group: Utsjoki Mávdnaávži 2 (d, e, r, v); Inari Vuopaja (f, j, w); Inari Kaunisniemi 3 (k); Enontekiö Museotontti (l, p, q); Inari Ahkioniemi 2 (x). See Appendix I for catalogue numbers. National Museum of Finland. Photograph by M. A. Manninen.

Because the margin-retouched oblique points in Finland represent the first formal arrowhead type discovered after the post-Swiderian tanged points of the pioneer colonisation phase and have no predecessors or successors, their appearance in the Late Mesolithic demands an explanation. The explanations put forth follow roughly similar paths: the southern points result from diffusion from countries south of the Baltic Sea (Luho 1948:5; 1967:118–119; Matiskainen 1989a:IX, 63) whereas the northern points are a result of demic diffusion in or colonisation of the inland areas of northern Fennoscandia from the Barents Sea coast (Olsen 1994:40), from the southern oblique point area (Rankama 2003) or from both (Halinen 2005:88–90).

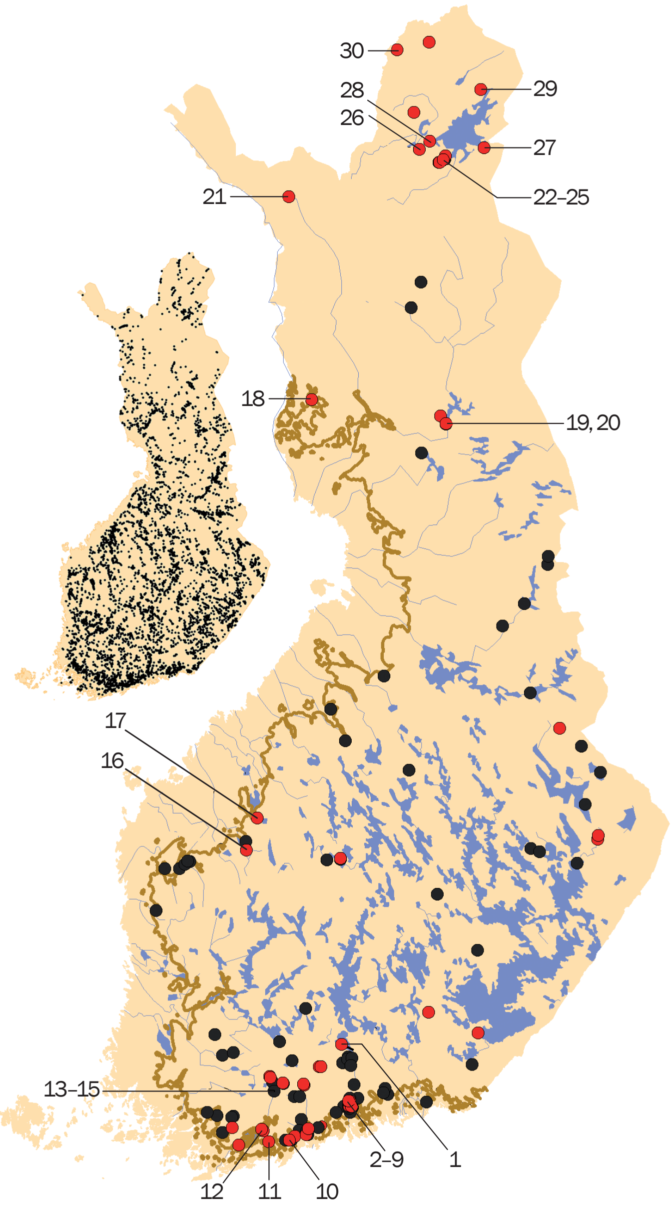


Figure 2. Small map: The distribution of known Stone Age and Early Metal Age dwelling sites in Finland (n= 9188) (MJREK 2008). Large map: The sites with reported oblique points in Finland (see Appendix II). The Litorina Sea shoreline at *c.* 6400 calBC is marked with a brown line. The sites with points confirmed by the present authors are marked with red. The sites included in the technological analysis are numbered as follows: 1. Kapatuosia; 2. Etulinna Ruoksmaa A&B; 3. Rokin Valkamaa; 4. Takalan Ruoksmaa; 5. Pappila Perunamaa-Saunapelto; 6. Siltapellonhaka I; 7. Siltapellonhaka II; 8. Latoniitty Silta-aro; 9. Puharonkimaa Järvensuo; 10. Sperrings Hiekkakuoppa NE; 11. Suitia 1; 12. Hossanmäki, 13. Antinnokka 1; 14. Karhumäki; 15. Lehtimäki; 16. Lahdenkangas 1; 17. Rasi; 18. Kaaraneskoski; 19. Neitilä 4; 20. Lautasalmi; 21. Museotontti; 22. Kaunisniemi 2; 23. Kaunisniemi 3; 24. Satamasaari; 25. Kirakkajoen voimala; 26. Ahkioniemi 1&2; 27. Nellimjoen suu S; 28. Vuopaja; 29. Supru; 30. Mávdnaávži 2.

When oblique points made of quartz, the typical raw material in southern Finland, are found in the north, they are sometimes linked with the southern Finnish points (e.g., Halinen 1995:92; Huurre 1983:86–87; Kehusmaa 1972:76; Kotivuori 1996:58; Rankama 2003). The questions whether the North-Finnish points, let alone the North-Norwegian points, could in fact belong to the same tradition as the points found in southern Finland, and what could explain the virtually simultaneous appearance of the concept of producing margin-retouched points in both areas, however, have not been explicitly addressed.

A survey of the research literature and the archived reports conducted for this study[2] suggests that the number of oblique point finds has increased in relation to the distribution maps published in the 1980s (Huurre 1983:86–87; Matiskainen 1986) and that points have also been reported in the area pointed out by Matiskainen (1986; Koivikko 1999), where lake tilting has submerged sites. However, there is still a gap in the geographical distribution of oblique point finds in central Lapland (**Fig. 2**). The artefacts reported as oblique points in the two sites within the otherwise blank area (Sodankylä Matti-vainaan palo 2 and Sodankylä Poikamella) are single finds that, according to the excavator, may be misclassified (P. Halinen *pers. comm.* 2011). In **Figure 2**, the small map shows a similar distribution of known Stone Age and Early Metal Age dwelling sites in Finland. This distribution suggests that the blank area in the distribution of oblique points may be due to the uneven geographical coverage of field research. Therefore, it may possible to address the vacuum by allocating more survey and excavation efforts to the area. However, we feel that regardless of whether the point populations north and south of the gap belong to the same technological tradition or not, a more rewarding and more warranted approach than simply conducting additional fieldwork is to make a technological comparison between the existing point assemblages from the two areas.

---

[2] This survey is not comprehensive. Most of the data was gathered from publications and we studied unpublished reports mostly from areas that are not discussed in the literature. We examined a sample of reported points from those parts of Finland that are not represented by the sites included in the technological analysis to confirm the geographical distribution of the point finds. The sites in which the existence of points could not be verified in the follow-up were omitted from the map. Nevertheless, the site data may include sites in which the artifacts reported as oblique points have not been retouched and, consequently, in our definition, would not be considered to be intentionally manufactured.

The technological analysis

For our analysis, we selected a sample of 196 artefacts that were reported as intact or broken oblique points from 30 sites (**Fig. 2, Appendix III**). Only the artefacts showing clear backing retouch on the margin(s) were considered to be intentionally manufactured points. As a result, we only accepted 158 of the 196 artefacts for further analysis. Most of the points come from sites south of the blank area in central Lapland (i.e., 121 points from 19 sites), whereas the northern group of points is smaller (i.e., 37 points from 11 sites).

The analysis was designed to gather information on point shape and manufacturing process. We inferred the details of the technology behind each point from the points themselves. Debitage resulting from oblique point manufacture is rarely discerned or even discernable in the assemblages, and consequently was not included in the analysis. We studied the point data statistically to analyse patterning in production technology and resulting point shapes. Additionally, we studied the raw material as well as the localisation and position of retouch for each point. When discernable, we also registered the orientation of the point in relation to the blank and the mode of detachment of the blank. To quantify point shape, the studied variables include basic measurements (i.e., weight, maximum length, maximum width, and maximum thickness), the thickness of the arrowhead's longitudinal middle point, and the edge angles.

Because stone arrowheads generally constitute a replaceable part of the arrow and have a typically short use-life (e.g., Cheshier & Kelly 2006; Fischer *et al.* 1984; Odell & Cowan 1986), they are usually somewhat standardised to facilitate the re-use of the arrow shaft. In particular, the contact point between the shaft and the point base is often standardised because a replacement arrowhead must fit the existing hafting mechanism at the end of the shaft. Because the basal part of a point therefore reflects details about the arrow technology beyond the arrowhead (Hughes 1998), we also measured each point's base thickness and width.

It should be noted, that intra-site analyses suggest that oblique points were often produced several at a time and that many of the oblique points found in excavations are actually rejects from the manufacturing process (Manninen & Knutsson *in preparation*). Thus, many of the intact points in the studied assemblage may have been defective in one detail or another. In addition, we consider it likely that practice pieces are included in the assemblage as well. Although these points create some noise in the statistical analysis, we expect their effects to be averaged out because these points still represent acceptable oblique points in most aspects.

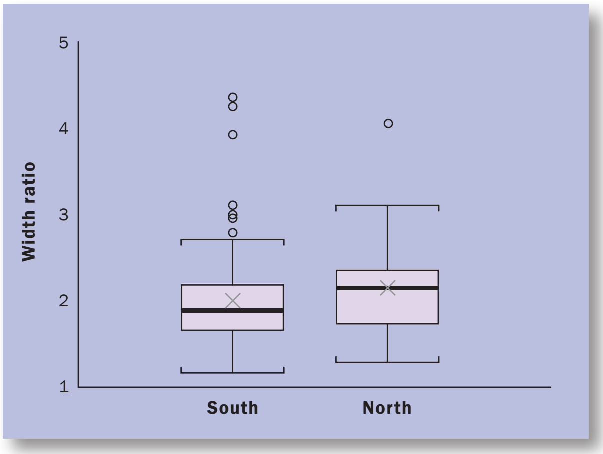


Figure 3. The width ratio (maximum width/basal width) in the studied point groups. South n=103, north n=31. The top and bottom of the box indicate the 25th and 75th percentiles, the black band indicates the data median, and the grey cross indicates the data mean. The ends of the vertical lines indicate the minimum and maximum data values, unless outliers are present. In that case, the whiskers extend to a maximum of 1.5 times the interquartile range. The outliers are marked with circles.

As the studied assemblage consists of finished points, we present the technological details inferred from the point assemblage in reverse order in relation to the manufacturing process. In other words, we start with the finished point and end with primary production and raw material.

Point size and shape

To quantify the overall outline shape of the points (not including the shape of the edge), we first studied the width ratio (i.e., the ratio between the maximum and basal width) (**Fig. 3**). The greater the relative width for a given point, the more triangular or tanged/trumpet-like the point is. A value close to 1 indicates that a point has relatively straight edges (i.e., is nearly as wide at its widest point as it is at its base). As expected, the results show that in both groups, the widest point of the arrowhead is usually not at the base, but also that both the median and mean of the ratio are slightly higher in the northern group. This result indicates that a slightly greater proportion of points in the northern group has a clear basal narrowing.

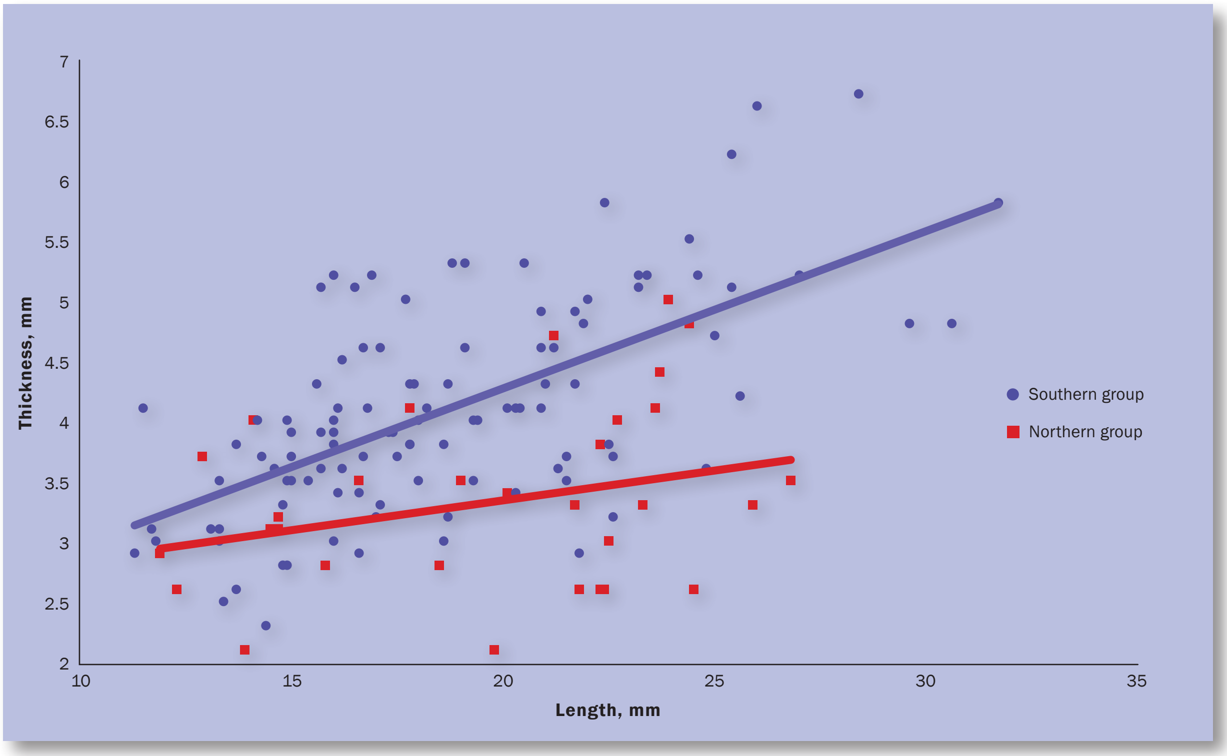


Figure 4. Maximum thickness and length of points in the southern (n=106) and northern (n=32) oblique point populations with linear trendlines of the measured intact points and the points with broken tips (1.5 mm added to length).

We further studied point shape using measurements of point outline dimensions. Here a difference can be clearly seen in the thickness/length ratios (**Fig. 4**). When compared with the southern points, the northern points are thin in relation to length, whereas the southern points are clearly thicker in this regard. There is almost as clear a difference between the groups if thickness is compared with width, but less clear a difference with respect to the length-to-width ratio. Thus, the data indicate that the northern points are generally thinner than their southern counterparts, but the two point populations are equal in terms of length and width. The thinness of the northern points as a group is also the main reason for their generally lower weight (**Fig. 5**).

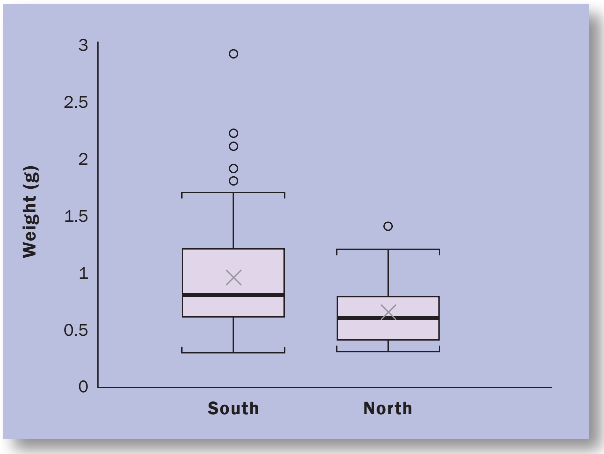


Figure 5. Point weight in the oblique point populations. South n=100, north n=34.

The basal thickness of the points is also generally lower in the northern group than in the southern group. As noted above, the differences in the basal part of the points could indicate differences in arrow technology. As the basal thickness of arrowheads usually correlates with the thickness of the arrow shaft (Hughes 1998), we suspect that basal thickness is one of the variables that determined whether a point was accepted as usable. Evidence supporting this hypothesis can be found in the point data. Specifically, 34 points in the total assemblage show evidence suggesting that the points were thinned by purposeful detachment of small invasive flakes from the dorsal and/or ventral side of the point. This finding indicates that these points were originally considered to be too thick. In 17 points, the thinning is restricted to the base. Judging from the basal thickness of both un-thinned and thinned points, the ideal basal thickness seems to have been approximately 2–3 millimetres (**Fig. 6**).

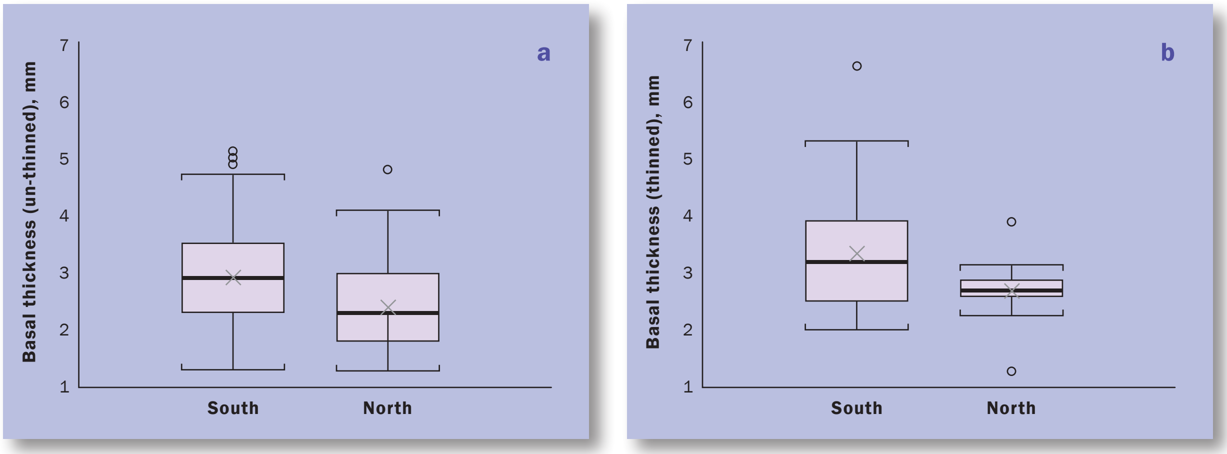


Figure 6. The basal thickness of the un-thinned (a) and thinned (b) points. South, a) n=81, b) n=27. North, a) n=27; b) n=7.

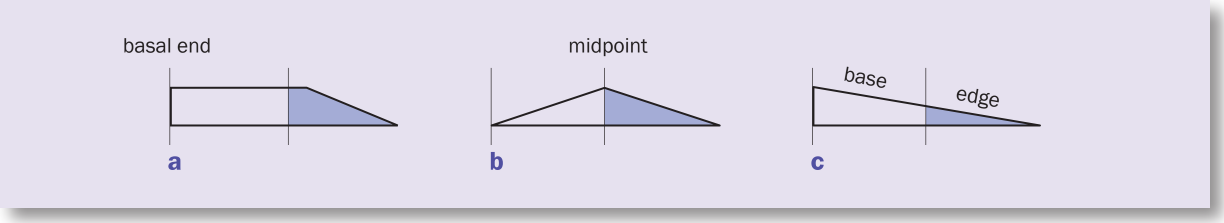


Figure 7. Side view profiles of oblique points: a) point with a base of even thickness , b) point with a tapering base, and c) point with a relatively thick basal end. In addition, the figure shows the variables used to define the midpoint/basal thickness ratio.

We studied the thickness ratio (i.e., the ratio between midpoint and basal thickness) to quantify the side view profiles of the point bases. This value also provides an indication of the overall side view profile, as the point edge usually starts to taper from or close to the midpoint (**Fig. 7**). If the value is close to 1, then the point base is of even thickness for its entire length (**a**). A value over 1 indicates that the thickness tapers toward the basal end (**b**), whereas a value less than 1 indicates that the basal end is thicker than the rest of the point (**c**). The results show that no great difference exists between the two groups in this respect, although slightly more variation exists in the northern group (**Fig. 8**). Points with the thickest point near or at the middle of the point are the most numerous in both groups.

The edge angle measurements also show a slight difference between the two groups. The smaller of the two angles between the point edge and the retouched sides of the point can be used as a proxy for edge angle (**Fig. 9**). An angle of *c.* 70–90 degrees indicates a transverse edge (**b**), an angle below 70 degrees indicates an edge that lies at an acute angle to the longer side of the point (**a**), and an angle above 90 degrees indicates that

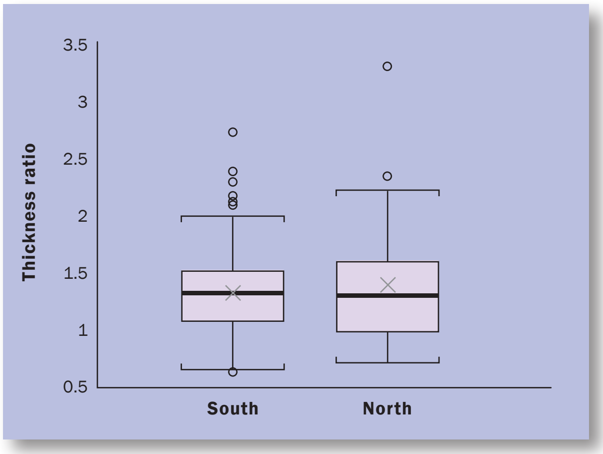


Figure 8. Point midpoint thickness to base thickness ratio. South n=121, north n=37.

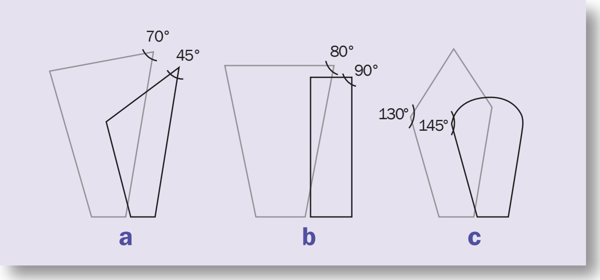


Figure 9. A schematic representation of the smaller edge angles taken from the various point outline shapes. Drawing by M. A. Manninen.

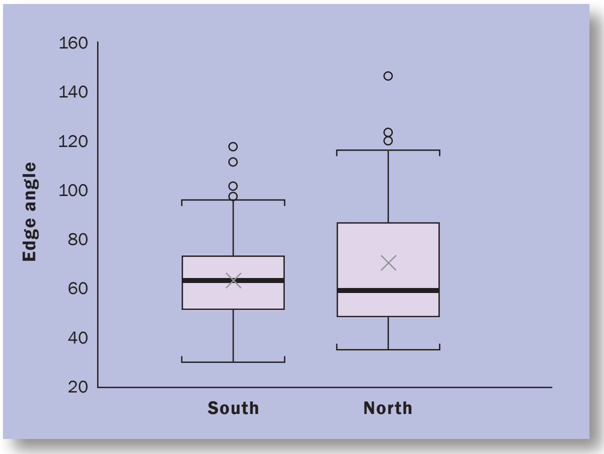


Figure 10. Edge angle variation (smaller edge angle) in the studied point populations. South n=110, north n=31.

both angles between the edge and the retouched sides are obtuse, which means that the edge is pointed or round (**c**). The results (**Fig. 10**) show that the northern points are more heterogeneous in this respect. However, the oblique and transverse edges are most common in both groups.

Retouch

We also studied the modes of blank modification from each point. Because we only accepted artefacts that showed margin modification, in addition to correct general shape, all of the studied artefacts had at least one of four types of margin modification types: 1) semi-abrupt to abrupt backing retouch (n=156), 2) semi-invasive retouch on the margin (n=9), 3) abrasion of point margin (n=13), and 4) snapping of the basal end (n=7). Of these types, types 3 and 4 probably also include examples of alteration caused by use. All four types are present in both the southern and northern groups, except for types 2 and 4, which were observed only in the southern group. However, types 2, 3, and 4 are too rare among the studied points to be used in inter-group comparisons of the two point populations.

The direction of backing retouch varies within both groups (**Fig. 11**). Most of the points show backing done from only one direction (southern group 55% and northern group 69%), but a considerable number of points also show both direct and inverse retouch (southern group 43% and northern group 30%). In general, the data on point margin modification do not seem to indicate any cultural or traditional predetermination or significant inter-group differences.

As mentioned earlier, some points in both groups show evidence of thinning: 27 points (25%) in the southern group and 7 points (21%) in the northern group. Thinning has been done with semi-invasive to invasive retouch and usually consists of less than five detachments. In the analysis, we considered thinning to be clear when the detachments have been made after the final backing retouch has been done. Another 15 points show detachments that may have been made to thin the point but are less clear and sometimes antedate the backing. One of the two slate points in the southern group has a polished dorsal surface, which can also be seen as a sign of deliberate thinning. However, it could also indicate a flake blank detached from a ground slate artefact (see Rankama & Kankaanpää *this volume*).

Blank production and point orientation

We were able to infer the orientation of the point in relation to the blank in 108 of the 158 points. If the flake edge has been used as the cutting edge of the point, then in practice, the points are oriented either perpendicular or parallel to the flake. A comparison of point orientation suggests that a significant difference exists between the two groups (**Fig. 12**). The southern points are almost exclusively oriented perpendicular to the blank (see also Matiskainen 1986; Pesonen & Tallavaara 2006), whereas in the north, over 40% of the points are oriented parallel to the blank.

All of the points in both groups seem to have been produced using flake blanks. During the Stone Age in Finland, flake production has usually followed simple opportunistic methods, especially with quartz (Rankama *et al.* 2006). These methods can be divided into bipolar and platform reduction, and more distinctive technological concepts are seldom encountered. This was the case in this study as well, as the points are made from relatively irregular flakes that do not show any signs of standardisation within the groups or even within the individual sites.

We may reliably infer the mode of primary production (i.e., bipolar or platform reduction) from 42 points (28 south and 14 north) that are all made out of platform flakes. In these points, a part of the bulb of percussion is still visible (19 points), and/or a part of the original platform remnant is one of the sides (19 points) or at the base of the point (4 points). In most of the remaining points the signs of flake initiation have been removed. However, also many of these points have the general appearance of platform flakes. Only one point shows characteristics (i.e., crushing of the flake end) that suggest a flake blank deriving from bipolar production rather than platform reduction. In 78 points (66 south and 12 north), the cutting edge is oriented parallel to a dorsal ridge. There is no evidence suggesting that the microburin technique was used to produce any of the analysed points.

Raw materials

The raw materials used to manufacture points differ between the two groups (**Fig. 13**). Quartz has been used to produce the majority of the points in the southern group, whereas chert is the most common raw material in the north. The other raw materials include rock crystal, quartzite, and slate. All of the raw material categories are based on archaeological definitions of raw materials. No geochemical sourcing or petrologic raw material definitions were available.

Most of the quartz raw material consists of different varieties of opaque white and greyish vein quartz (74 points) as well as greyish translucent quartz (32 points). Only three points from the southern group are made of more colourful varieties of quartz. These varieties include a bluish quartz, a rose quartz, and a striped white/transparent quartz. However, a commonly distinguished sub-category of quartz, the transparent rock crystal, has been used relatively often (21 points). The raw material of one rock crystal point in the southern group has a reddish shade.

Also the chert raw materials vary and include different types of black (3 points) and grey chert (21 points). The grey chert category also includes many points that have turned white because of burning and/or weathering. Many of these points come from sites in which their originally grey colour is clear from conjoining and manufacturing debitage (Manninen & Knutsson *in preparation*), but some points may have originally been a different colour. All of the chert points are in the northern group except for one point of black chert, which was found in Kemijärvi directly south of the blank area in central Lapland. In addition, the northern group includes two points made of fine-grained quartzite (one grey and one red), and the southern group has two points made of black slate.

	South	%	North	%
Left inverse, right inverse	30	24.6	14	38.9
Left direct, right direct	5	4.1	6	16.6
Left inverse, right direct	10	8.2	2	5.6
Left direct, right inverse	6	5.7	3	8.3
Left inverse, right both	10	8.2	3	8.3
Left direct, right both	6	4.9	0	0
Left both, right inverse	5	4.1	1	2.8
Left both, right direct	4	3.3	1	2.8
Left both, right both	6	4.9	1	2.8
Left inverse, right no backing	13	10.7	3	8.3
Left direct, right no backing	6	4.9	1	2.8
Left no backing, right inverse	7	5.7	0	0
Left no backing, right direct	4	3.3	0	0
Left both, right no backing	4	3.3	0	0
Left no backing, right both	1	0.8	0	0
Left no backing, right no backing	2	1.6	0	0
Indiscernible direction	2	1.6	2	2.8
Total	121	99.9	37	100

Figure 11. Direction of backing retouch.

Area	Orientation		Sum
	Perpendicular	Parallel	
North	57.1% (n=16)	42.9% (n=12)	100% (n=28)
South	92.5% (n=74)	7.5% (n=6)	100% (n=80)

Figure 12. Point orientation (perpendicular or parallel) in relation to the flake length axis.

	South	South%	North	North%	Total	Total%
Quartz	99	81.8	9	24.3	108	68.4
Chert	1	0.8	24	64.9	25	15.8
Quartzite	0	0	2	5.4	2	1.3
Rock crystal	19	15.7	2	5.4	21	13.3
Slate	2	1.7	0	0	2	1.3
Total	121	100	37	100	158	100.1

Figure 13. Raw materials.

Summing up the technological profiles

The technological comparison indicates that the two point populations are quite similar. The variables initially considered to possibly reflect differences in overall arrow technology (point weight, basal thickness, and basal width) show only small differences between the populations. For example, all other variables held constant, a weight difference of 10 grains (*c.* 0.6 grams) between arrowheads is said to have no significant effect on modern hunting arrow flight (Schuh 1987:30). The difference in the points' mean

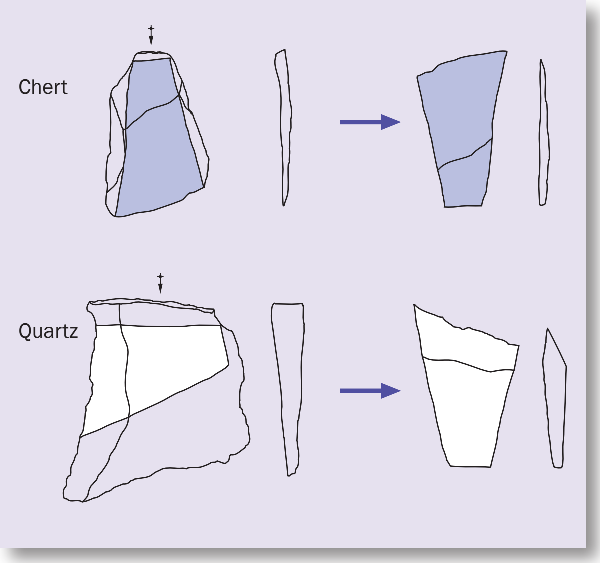


Figure 14. Typical features that distinguish the points in the northern (top) and southern (bottom) group of oblique points. (Note that despite the large number of points oriented parallel to the longitudinal axis of the flake, over half of the northern points were still oriented perpendicularly in relation to the blank). Drawing by M. A. Manninen.

Variable	South	North
Length	23.3	23
Basal width	25.4	24
Max width	16.8	18
Basal thickness	30.8	31.6
Midpoint thickness	21.2	26
Max thickness	21.4	24.2
Weight	51.7	47.9
Thickness ratio (midpoint/base thickness)	27.7	30.7
Edge angle	26.1	41
Relative thickness (thickness/length)	19	28.7
Width ratio (max/basal width)	27.1	26
Mean	26.4	29.2

Figure 15. Comparison of the coefficient of variation ((σ/μ)x100) for the studied measurable variables in the southern and northern groups. Greater values indicate greater variation.

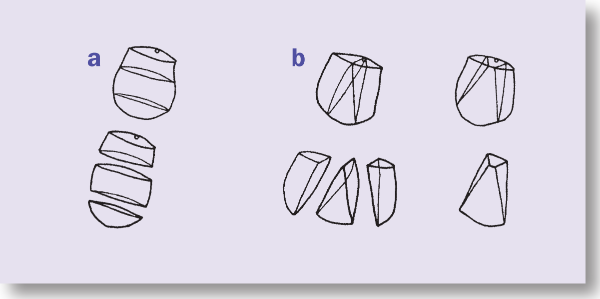


Figure 16. The fragment types most likely to resemble oblique points, from crosswise split flakes (a) and flakes split by radial fractures (b). Based on Knutsson (1998) and Rankama (2002).

weights between the northern and southern point populations is smaller than this value, even though the weights of hunting points made of lithic materials may differ considerably more than 10 grains even when produced by a single skilled person (Shackley 2000:701).

However, some differences between the point groups can be detected, although these differences are not very significant in relation to the overall arrow technology (**Fig. 14**). The clearest differences are seen in the raw materials used, the points' orientations in relation to the blank, and the points' thicknesses and weights. In addition, the northern points are more heterogeneous as a group, as indicated also by the coefficient of variation calculated for the different variables (**Fig. 15**).

The effect of raw material

The fact that the points in the southern group are almost all made of quartz suggests that explanations for the observed differences between the southern and northern oblique points can be found in the differences between quartz and chert. The effect of raw material properties is an environmental factor affecting human behaviour (i.e., a factor independent of cultural choices) and can be tested with the assemblage at hand.

Quartz is known to have a tendency to fragment during flake detachment (Callahan *et al.* 1992), probably as a consequence of its fragility due to low tensile and compressive strengths and the usually high amount of internal flaws. These qualities have affected the design and manufacturing processes of quartz tools when compared with tools made of less fragile raw materials. Quartz artefacts can be manufactured with strategies that to some degree reduce fragmentation and with design criteria that counterbalance the fragility of the raw material (Tallavaara *et al.* 2010a). However, in their ideal form, certain types of flake fragments resemble the typical outline shape of an oblique point (Knutsson 1998). Thus, it could be expected that the proneness to fragmentation of quartz would have been taken advantage of and fragments of these types (**Fig. 16**) would have been selected for point blanks, thereby reducing the amount of necessary retouch.

The effect of these characteristics of quartz on oblique point manufacture and especially on the intergroup differences observed in the technological analysis can

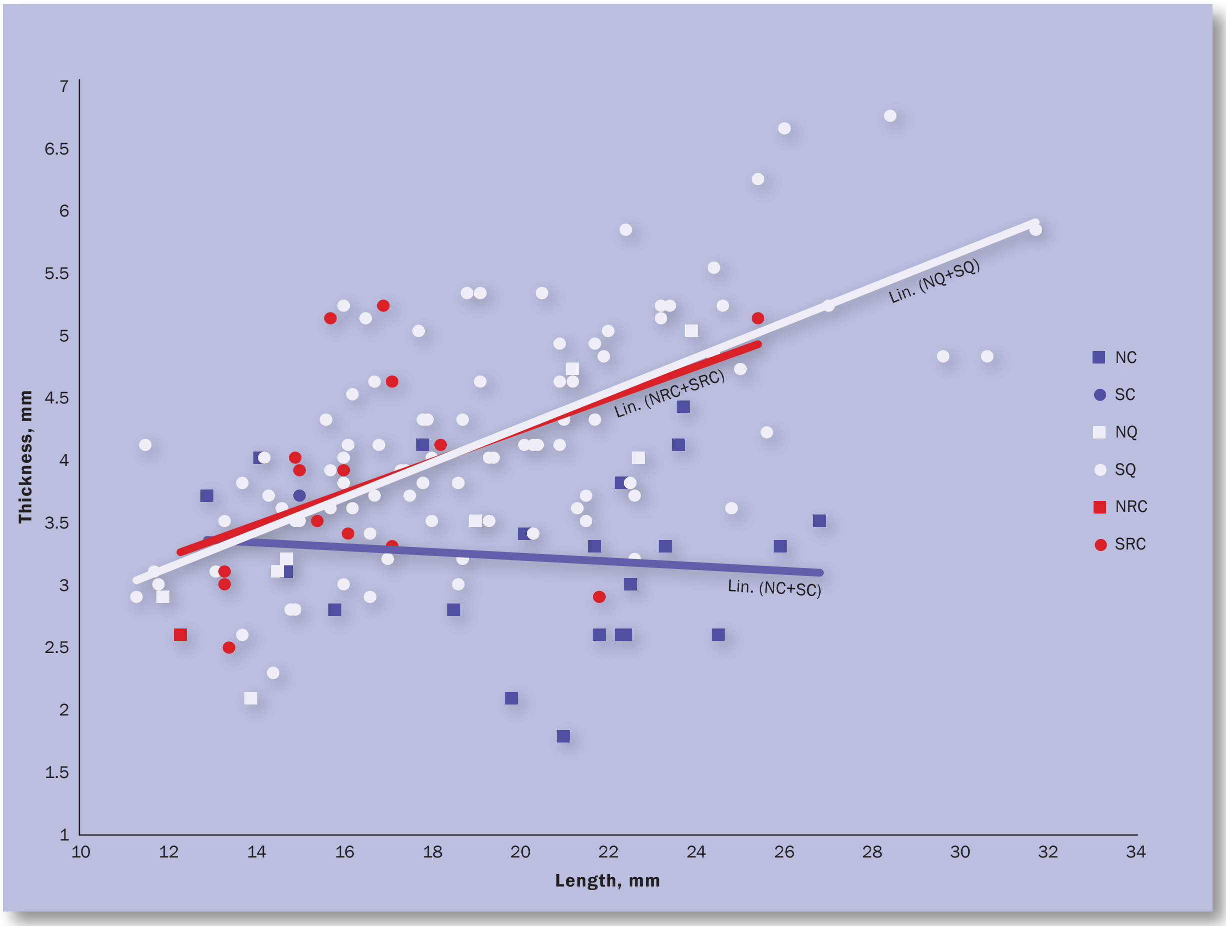


Figure 17. Thickness/length ratios of intact points and points with broken tips (1.5 mm added to length) made of different raw materials in the northern (N) and southern (S) groups of points. Chert (C) n=22, quartz (Q) n=98, rock crystal (RC) n=16.

be studied by dividing the point data by the raw material, and especially by contrasting the quartz point data from the two geographical groups with the chert point data.

Starting with a comparison of the relative thicknesses of quartz and chert points (**Fig. 17**), we find that the difference in point thickness between the two populations appears to be due to the relatively larger number of points in the southern group that are made of quartz. The thickness of chert points does not correlate with their length. However, the thickness of quartz points increases with their length, which makes the quartz points thicker as a group. Experimental work indicates that an increased thickness-to-length ratio makes projectiles more durable (Cheshier & Kelly 2006) and that the fragmentation of quartz flakes during detachment can be reduced to some degree by producing relatively thicker flakes (Tallavaara *et al*. 2010a). The greater thickness of quartz points in comparison to chert points can thus be explained as an attempt to compensate for the fragility of the raw material. This conclusion is in accordance with the results from other studies that compare artefacts made of quartz with counterparts made of less fragile raw materials (e.g., Siiriäinen 1977; Tallavaara 2007; Wadley & Mohapi 2008). Although made of a more homogenous raw material than the vein quartz points, the rock crystal points show similar and only in some cases slightly more “chert-like” trends than the vein quartz points when treated separately. For that reason, we henceforth include the rock crystal points in the same group with the other quartz points. As can be expected, the increased average point thickness of the combined quartz group correlates well with the group’s increased basal thickness (**Fig. 18**).

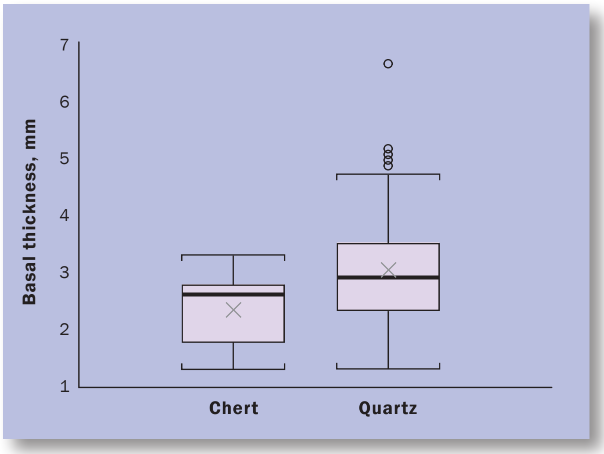


Figure 18. Basal thickness in points from different raw materials. Chert n=25; quartz n=129.

Area	Raw material	Orientation		Sum
		Perpendicular	Parallel	
North	Chert	44.4% (n=8)	55.6% (n=10)	100% (n=18)
	Quartz	87.5% (n=7)	12.5% (n=1)	100% (n=8)
South	Chert	100% (n=1)	0%	100% (n=1)
	Quartz	92.4% (n=73)	7.6% (n=6)	100% (n=79)

Figure 19. Cross-tabulation of point raw material (quartz and chert), and point orientation in the studied groups.

The effect of raw material on point orientation in relation to the blank can be studied by contrasting point population, raw material, and, when discernable, point orientation (**Fig. 19**). The cross-tabulation reveals that quartz points are oriented perpendicularly in relation to the blank regardless of the area of origin, whereas the northern chert points are oriented parallel to the longitudinal axis of the flake as often as they are oriented perpendicularly to the axis. This finding indicates that a quality inherent in the raw material was a major factor in the orientation of the quartz points. We suggest that this quality is the aforementioned fragility of the material. A perpendicular orientation in relation to the blank can be used to create a steeper and more durable edge than the usually gently feathering edge at the distal end of the flake.

The typically perpendicular orientation of the quartz points also reveals that if flake fragments were used to produce quartz points instead of intact flakes, then the fragments from crosswise split flakes were used almost exclusively, whereas the oblique-point-looking middle fragments caused by radial fractures do not seem to have been used. This suggests that fragmentation, at least by radial fractures, was not desired in oblique point blank production.

The correlation amongst variables in the different groups can be studied for the purpose of evaluating the possible effects of different transmission mechanisms *versus* the effects of raw materials on the within-group variation. The logic behind the comparison of paired correlations is that variables acquired as a package by a mechanism akin to indirect bias are more strongly correlated than variables affected by guided variation (Bettinger & Eerkens 1999:237). The data in this study indicate that more interdependence exists among the variables in the southern group than those in the northern group (**Fig. 20:A**). In 33 of the 55 paired correlations, the southern value exceeds the northern value. The correlation in the southern group is significantly larger in five of these cases ($p < 0.05$), but there are no cases in which the northern correlation is significantly larger. This result supports an interpretation that the differences between the southern and northern groups reflect different transmission mechanisms.

However, when the points are divided according to raw material, even though the number of cases in which the quartz value exceeds the chert value is smaller than when comparing the southern and northern points (28 of the 55 paired correlations), a significantly stronger correlation amongst variables is found in nine cases in the quartz group and in two cases in the chert group (**Fig. 20:B**). Thus, more significant correlation exists amongst the variables in the quartz points than amongst those in the southern group of points. Furthermore, in the two cases, where the correlation is significantly stronger in chert points (i.e., relative thickness (thickness/length) to length and relative thickness to maximum width), it is caused by the fact that the thickness of the quartz points increases with increasing length and width. These results indicate that the properties of quartz reduced the degree of variation in the southern group, and therefore the differences in the degree of within-population variation cannot be attributed directly to differing transmission mechanisms.

The fragility and proneness to fragmentation of quartz seems to force a more standardised and robust point shape in comparison with chert. Because of its greater resilience, chert allows for more diverse point orientations and shapes as well as smaller blanks. Moreover, the perpendicular orientation alone renders quartz

A

	Group	**Length**									
Basal width	south	**0.176**	Basal width								
	north	0.159									
Maximum width	south	0.568	**0.509**	Maximum width							
	north	0.621	0.296								
Basal thickness	south	**0.462**	**0.341**[a]	**0.538**	Basal thickness						
	north	0.221	0.061	0.143							
Midpoint thickness	south	**0.587**[a]	**0.220**	**0.463**	**0.451**	Midpoint thickness					
	north	0.303	0.148	0.312	0.431						
Maximum thickness	south	**0.629**[a]	**0.237**[a]	**0.525**	**0.653**	0.900	Maximum thickness				
	north	0.283	0.118	0.287	0.598	0.964					
Weight	south	**0.865**[a]	**0.354**	**0.710**	**0.576**	**0.768**	**0.809**	Weight			
	north	0.670	0.289	0.627	0.438	0.755	0.748				
Thickness ratio	south	**-0.075**	**-0.158**	**-0.224**	**-0.705**	0.207	-0.011	-0.059	Thickness ratio		
	north	0.057	0.071	0.100	-0.596	0.414	0.254	0.225			
Edge angle	south	**-0.292**	0.025	**-0.084**	**-0.260**	-0.058	-0.126	-0.087	**0.230**	Edge angle	
	north	0.069	-0.057	0.081	0.024	-0.169	-0.149	-0.108	-0.123		
Relative thickness	south	-0.485	**0.110**	-0.091	0.189	0.312	0.351	**-0.123**	0.070	**0.217**	Relative thickness
	north	-0.630	0.025	-0.338	0.303	0.493	0.541	-0.014	0.122	-0.108	
Width ratio	south	0.157	**-0.734**	0.112	0.014	**0.088**	**0.114**	0.071	0.007	-0.041	-0.121
	north	0.271	-0.679	0.465	0.037	0.022	0.032	0.138	-0.045	0.121	-0.277

B

	Raw material	**Length**									
Basal width	quartz	0.171	Basal width								
	chert	0.229									
Maximum width	quartz	**0.579**	**0.505**	Maximum width							
	chert	0.575	0.228								
Basal thickness	quartz	**0.460**	**0.335**	**0.507**[a]	Basal thickness						
	chert	0.225	0.090	0.193							
Midpoint thickness	quartz	**0.620**[a]	**0.245**	**0.519**[a]	0.453	Midpoint thickness					
	chert	-0.155	-0.014	-0.162	0.464						
Maximum thickness	quartz	**0.655**[a]	**0.252**	**0.559**[a]	**0.654**	0.907	Maximum thickness				
	chert	-0.129	-0.043	-0.133	0.540	0.990					
Weight	quartz	**0.867**[a]	**0.362**	**0.728**[a]	**0.564**	**0.785**[a]	**0.820**[a]	Weight			
	chert	0.654	0.252	0.397	0.466	0.473	0.471				
Thickness ratio	quartz	0.003	-0.116	-0.108	**-0.669**	0.263	0.041	0.017	Thickness ratio		
	chert	-0.356	-0.146	-0.333	-0.612	0.376	0.304	-0.074			
Edge angle	quartz	**-0.312**	0.041	-0.079	-0.269	**-0.097**	**-0.152**	-0.111	0.206	Edge angle	
	chert	0.198	-0.114	0.114	0.349	-0.057	0.002	0.136	-0.259[a]		
Relative thickness	quartz	-0.450	**0.144**	-0.052	0.214	0.313	0.356	-0.096	0.042	**0.218**	Relative thickness
	chert	-0.766[a]	-0.100	-0.518[a]	0.223	0.720	0.710	-0.163	0.396	-0.094	
Width ratio	quartz	**0.183**	**-0.725**	0.136	0.012	0.113	**0.134**	**0.092**	0.038	-0.062	-0.127
	chert	0.133	-0.705	0.490	0.048	-0.172	-0.123	0.001	-0.171	0.180	-0.251

[a] Significantly stronger correlation.

Figure 20. A) Pearson's r Correlation Coefficients for the point variables in the southern and northern groups of oblique points and B) for the oblique points made of quartz (vein quartz + rock crystal) and chert. Thickness ratio = midpoint thickness/ base thickness, relative thickness = thickness/length, and width ratio = maximum width/basal width.

points more standardised, as the number of pointed or round tips is reduced. Chert points are generally thinner, often have relatively thin and/or narrow (**Fig. 21**) bases, and have more diverse edge shapes (**Fig. 22**).

Thus, our evaluation of the effects of raw material properties indicates that, although quartz points differ from chert points, they have similar dimensions and were made in the same manner in both of the studied point groups. The differences in raw material composition and properties appear to explain most of the intergroup differences observed in the point data. Hence, from a technological point of view, there are no differences in the manufacturing processes behind these points that would suggest separate technological traditions or necessitate differing arrow technology. However, that the same or at least very similar technology arrived in the area of present day Finland through different routes remains possible.

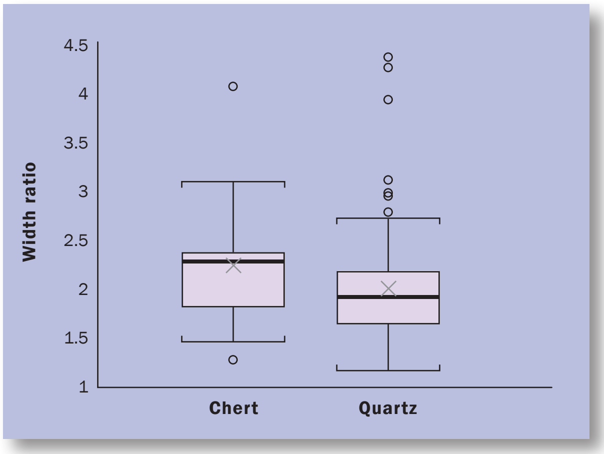


Figure 21. Width ratio (Maximum/basal width). The greater the value, the more triangular or tanged/trumpet-like the point is. A value close to 1 indicates a point with straight edges. Chert n=21, quartz n=111.

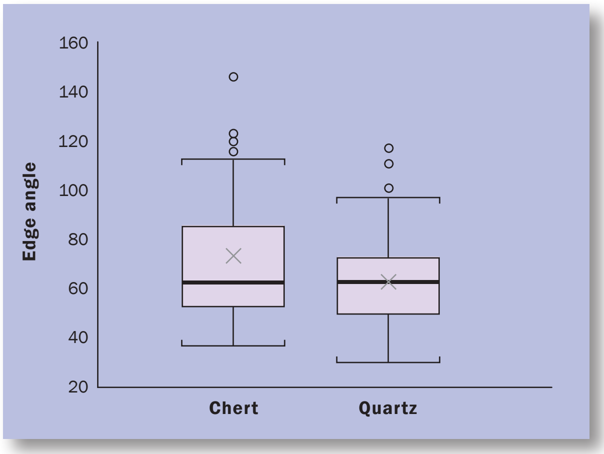


Figure 22. Edge angle variation according to raw material. Chert n=21, quartz n=118.

Origin and dates

To facilitate the evaluation of possible source areas for the oblique point technology in Finland a brief survey of margin-retouched points and related technology in neighbouring areas during the Mesolithic is required. In this study, we do not distinguish between specific types of arrowheads or microliths. Instead, the survey concentrates on the occurrence of the general concept of manufacturing a projectile from a flake, flake fragment or blade segment by shaping most of the points' margins with a backing retouch while leaving part of the sharp margin of the blank as a cutting edge. Thus, the survey includes such generally used classes as transverse and oblique points, trapezoidal microliths (trapezes), and single-edged points. Because indigenous artefact types, such as Mesolithic leaf-shaped slate points and globular mace heads (see Matiskainen 1989a) are known in the study area, the possibility of local innovation cannot be ruled out while discussing new technologies. However, in this case the existence of the margin-retouched point concept in nearby regions prior to its appearance in Finland makes it more reasonable to look for outside influence.

In the areas of present-day Belarus, Lithuania, Poland, and the Central Federal District of Russia, there are margin-retouched points from Upper Paleolithic and Early Mesolithic archaeological cultures, such as Bromme-Lyngby, Ienevo, and Desna (Galimova 2006; Kobusiewicz 2009; Kozłovski 2006:Fig. 2; Sorokin 2006; Zhilin 2005:166–167). Later in the Mesolithic, margin-retouched trapezoidal microliths appear by *c.* 6100 calBC at the latest in the Meso-Neolithic Janislawice and Neman cultures in the south-eastern part of the Baltic region (Kozłovski 2002:Fig.13; Perrin *et al.* 2009:175; Zalinznyak 1997:30–45; Zvelebil 2006:179). However, between this area and Finland, there is a zone consisting of Latvia, Estonia and a large part of north-western Russia from which Mesolithic margin-retouched points or trapezes have not been reported (see, e.g., Kriiska & Tvauri 2002; Oshibkina 2006; Zagorska 1993).

The current understanding of Late Mesolithic point types and chronology on the southern shores of the Baltic Sea is mainly based on materials found in southern Scandinavia (i.e., Denmark and southernmost Sweden), but largely congruent developments are known also from Germany and western Poland (e.g., Hartz *et al.* 2007; Jankowska 1998; Larsson 1993; Schmölcke *et al.* 2006; Vang Petersen 1984; 1999). The research situation is partly due to the geographical changes that have occurred since the Mesolithic. In the southern Baltic area, most of the Stone Age coastal sites are currently some 1–25 meters below the present sea level due to a mainly transgressive shoreline from the Mesolithic onwards (Schmölcke *et al.* 2006:428). However, in parts of Denmark and in most of Sweden, Mesolithic sites are found on dry land (Larsson 1993:261–263).

The typo-chronology of flint points from the Late Paleolithic to Bronze Age in southern Scandinavia is widely known and well established in the literature (e.g., Fischer 1990:38; Vang Petersen 1999). Small margin-retouched oblique and transverse points/trapezes are dominant in the area during the Kongemose and Ertebølle periods at *c.* 6400–3900 calBC (Edinborough 2009; Fischer 1990; Larsson 1993; Sjöström 1997; Vang Petersen 1984; 1999). Similar points are also found in eastern and western Norway at *c.* 5000 calBC (Bjerck 2008:80; Glørstad 2004:53–55). Somewhat similar forms that were retouched from blade segments and flakes are found already among the Late Paleolithic Ahrensburgian points (Prøsch-Danielsen & Høgestøl 1995:Fig. 4; Vang Petersen 1999:77–78), whereas early trapezes are found in the later part of the Maglemose period (Larsson 1993; Sjöström 1997). In eastern Middle Sweden, where transgressions have generally left Mesolithic sites undisturbed (Åkerlund 1996), margin-retouched points from *c.* 5300–4000 calBC have not been reported, and if the earliest known margin-retouched points, dated by shore displacement chronology to *c.* 6500–5300 calBC, are correctly classified and dated, then they have no counterparts in the adjacent areas (Guinard & Groop 2007).

According to current understanding, the first post-glacial colonisation of the Swedish west coast and the Norwegian coast all the way to Varangerfjord in northernmost Norway took place *c.* 9500–8000 calBC by people using margin-retouched points of the Ahrensburgian tradition or other local traditions probably deriving from the Ahrensburgian (i.e., the Hensbacka, Fosna, and Komsa) (e.g., Bjerck 2008; Freundt 1948:14–16; Fuglestvedt 2007; Helskog 1974; Odner 1966; Prøsch-Danielsen & Høgestøl 1995; Schmitt *et al.* 2006; Waraas 2001; Woodman 1993). Later in the Mesolithic, points that were similar and contemporaneous with the Late Mesolithic oblique points in northern Finland were made in a large area consisting of northern Sweden as well as the counties of Finnmark and Troms in northernmost Norway. According to typo-chronologies, the more recent points found in northern Norway belong to the Mesolithic Phase III (*c.* 6400–4400 calBC), while published radiocarbon dates indicate that these points were widely in use in the inland areas of northernmost Fennoscandia in approximately 5500 calBC and later and possibly in use as early as 6500 calBC. (Hesjedal *et al.* 1996:184–185, 198; Knutsson 1993; Manninen & Knutsson *this volume*; Olsen 1994:31, 39; Skandfer 2003:281–283; Woodman 1999:301.)

However, existing typo-chronologies diverge on the question of whether margin-retouched points were in use in Finnmark during the Mesolithic Phase II (*c.* 8000–6400 calBC) (Hesjedal *et al.* 1996; Olsen 1994). It seems certain that the mid-Holocene Tapes transgression that peaked at *c.* 6500 BP (*c.* 5500 calBC) greatly reduced the number of preserved sites on the Barents Sea coast (Fletcher *et al.* 1993; Hesjedal *et al.* 1996:134; Møller *et al.* 2002). As a result, the use of margin-retouched points, especially from *c.* 7000–6000 calBC, is difficult to assess as archaeological fieldwork in the area has concentrated mainly on coastal sites. Nevertheless, there are indications that margin-retouched points could have also been in use during this time period, as suggested by Olsen (1994: 31, 39; Manninen & Knutsson *this volume*). Evidence pointing in this direction has also been recently published from Skarpeneset (Troms) where the use-period of two houses with finds of margin-retouched points has been dated by a large series of radiocarbon dates to 7060–6480 calBC (Henriksen 2010; Nielsen & Skandfer 2010).

Judging from the data presented above, the southern shores of the Baltic Sea and the Norwegian Barents Sea coast (i.e., the two areas suggested by earlier research as the origins of the oblique points in Finland) still remain the most likely candidates. In these areas, there is evidence of use of margin-retouched points that predates or coincides with the *c.* 6500 calBC (7700 BP) date, which marks the introduction of margin-retouched points in the area of present-day Finland (Matiskainen 1982; 1989b Manninen & Knutsson *this volume).* Using this situation as a starting point, we formulate three alternative scenarios for the oblique point technology in the study area: *the south-to-north scenario*, *the north-to-south scenario*, and *the south-and-north scenario* (**Fig. 23**). As the date of the Kongemose trapezes seems too early to be connected with the spread of the Late Mesolithic "Tardenoisien" trapezoidal points (see Perrin *et al.* 2009), these simplified scenarios assume a technological sequence from the Ahrensburgian points to the Kongemose trapezes.

These alternative scenarios can be evaluated to some degree using radiocarbon-dated oblique point contexts in Finland, as it can be expected that the technology in the area with earlier dates does not originate in the area with later dates. For this purpose, we dated seven samples from oblique point contexts in Finland. We selected these samples from contexts that we considered firstly to date the associated oblique points as reli-

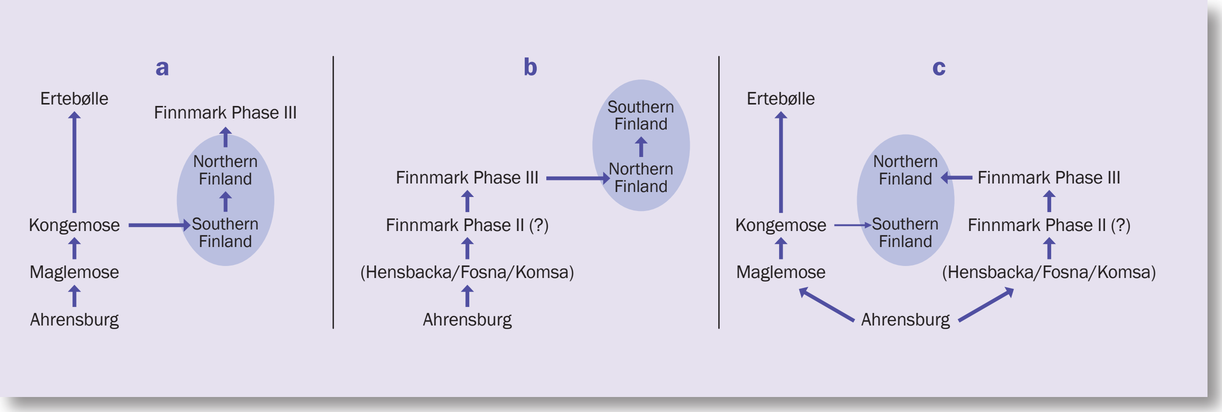


Figure 23. Alternative descent scenarios for the arrival of the margin-retouched point concept in Finland: A) the south-to-north scenario, B) the north-to-south scenario, and C) the south-and-north scenario.

ably as possible and secondly to secure as early a date as possible from both of the studied areas. This series was supplemented with the few published dates from reliable oblique point contexts.

The radiocarbon date data consists of seventeen dates from nine sites (**Fig. 24**). Four of the sites are from the area of the southern group of points (Riihimäki Arolammi 7D Sinivuokkoniemi, Vantaa Hommas, Kuortane Lahdenkangas 1, and Alajärvi Rasi), and the remaining five are from the northern point area (Utsjoki Jomppalanjärvi W, Inari Kaunisniemi 3, Utsjoki Mávdnaávži 2, Enontekiö Museotontti, and Inari Vuopaja). The sample contexts, sample materials, and the calibration curves used for each sample are specified in **Appendix IV**.

Considering the oblique point use-period of 6500–5600 calBC (7700–6700 BP) in southern Ostrobothnia and 6400–4900 calBC (7500—6000 BP) in southernmost Finland suggested by shore-displacement chronology (Matiskainen 1982; 1989b), the dates from Hommas (Koivisto 2010a) and Arolammi 7D Sinivuokkoniemi (Matiskainen 2002) are relatively late (median values 5570–4950 calBC). The dates from Rasi and Lahdenkangas 1 are complementary to these dates. According to the shore displacement chronology, these two sites are among the earliest sites with oblique points, and the samples dated in this study indicate that oblique points were used at these sites at 6230–6060 and 6030–5680 calBC.[3]

With regard to the northern sites, the choice of the radiocarbon dated sites is determined solely by the reliability of the contexts with oblique points found in surveys and excavations in the area (see Manninen & Knutsson *this volume*). Shore displacement dating is either inapplicable or inaccurate in this part of the study area. For the purposes of this study, we selected and dated samples from two contexts with previously obtained dates (Mávdnaávži 2 and Museotontti, area 11A) as well as samples from three undated contexts with oblique points (Jomppalanjärvi W, Kaunisniemi 3, and area 129–134/977–980 at Vuopaja).

Mávdnaávži 2 and Vuopaja are both dated to *c.* 5500 calBC and, thus, are relatively late compared with the earliest dates from the southern sites. However, the 6220–6050 calBC date from Jomppalanjärvi W is as early as the earliest date in the south, and the dates from Museotontti and Kaunisniemi 3 are even earlier. An earlier date on charcoal (7030–6410 calBC) from Museotontti has been considered tentative by Manninen & Knutsson (*this volume*), but a similar date on burnt bone from the same context rules out the effect of old wood and supports a *c.* 6500 calBC date for the oblique points at the site. The date 7060–6710 calBC from the Kaunisniemi 3 site in Inari is even earlier than this.

Thus, the radiocarbon dates indicate an earlier presence of the technology in northern Finland than in southern Finland. It should be noted, that although there are few radiocarbon dated contexts with oblique points in the southern part of the country, shore displacement chronology indicates that sites containing oblique points earlier than the ones already found are unlikely

---

[3] There is a *c.* 500 years discrepancy between the *c.* 7700 and 7500 BP (6500 and 6400 calBC) dates suggested by the existing shore displacement curve (Matiskainen 1982; Salomaa & Matiskainen 1983) and the radiocarbon dates from the Rasi and Lahdenkangas 1 sites.

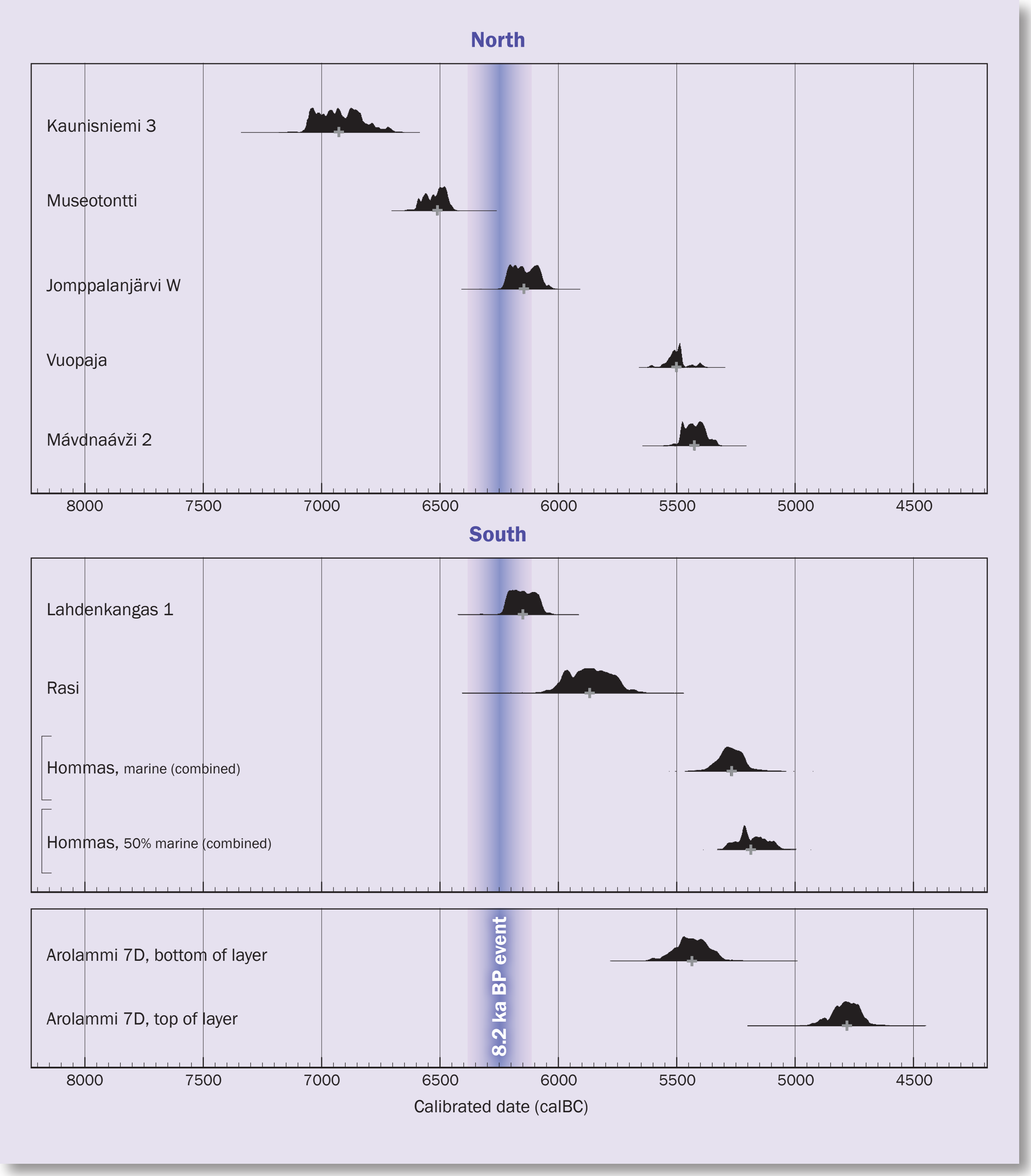


Figure 24. Calibrated dates from oblique point contexts in Finland. Dates on burnt bone are preferred when available. The dates from Arolammi 7D are on charcoal from the find layer with oblique points. See Appendix IV for details and specific dates. Calibrated with OxCal v4.1.7. Atmospheric and marine data from Reimer *et al.* (2009).

to be discovered, at least among the coastal sites. At the same time, the dates from northern Finland are in good agreement with the aforementioned dates from Skarpeneset in Troms (**Fig. 25**). Therefore, it can be concluded that the radiocarbon date dataset does not fit the south-to-north scenario for the introduction of the margin-retouched point concept in Finland, whereas both the north-to-south scenario and the south-and-north scenario remain possible.

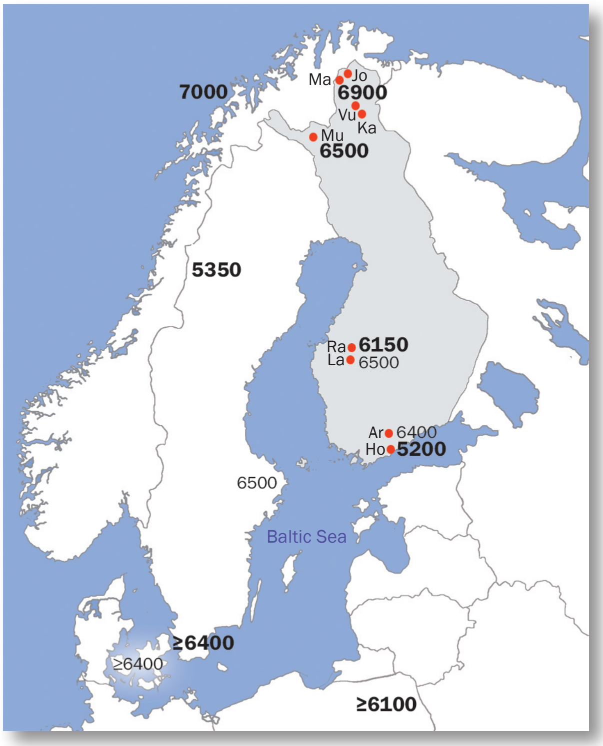


Figure 25. Margin-retouched points around the Baltic Sea, *c.* 7000–5000 calBC. The map shows the earliest shore displacement dates (in italics) and the median values of the earliest radiocarbon dates in the relevant parts of Finland, Sweden, and Norway. The locations of the radiocarbon-dated oblique point contexts in Finland (red dots) are as follows: Utsjoki Jomppalanjärvi W (Jo), Utsjoki Mávdnaávži 2 (Ma), Inari Vuopaja (Vu), Inari Kaunisniemi (Ka), Enontekiö Museotontti (Mu), Alajärvi Rasi (Ra), Kuortane Lahdenkangas 1 (La), Riihimäki Arolammi 7D Sinivuokkoniemi (Ar), and Vantaa Hommas (Ho). The dates in Scania and Denmark indicate the beginning of the Kongemose period according to radiocarbon dates and the date in Poland indicates the earliest dated secure trapeze context in the south-eastern Baltic area. See text for references.

Discussion

To evaluate the outcome of the analyses from the perspective of oblique point descent history in Finland, we must first summarise the main results and discuss their implications.

The technological analysis indicates that, although oblique point finds in Finland form two geographically separate groups, there are only slight differences between these groups and furthermore, that these differences can be explained by the differences in raw material characteristics and composition. Therefore, we conclude that the technological processes behind these points, as far as it is possible to infer from the finished products, are basically identical in both areas if raw material specific differences are not considered.

Since the geological formations in Finland are largely devoid of flint, chert, and other flint-like raw materials, vein quartz from glacial deposits and quarries was by far the most common raw material used to produce small lithic artefacts in the area throughout the Stone Age (e.g., Rankama *et al.* 2006). However, in northernmost Fennoscandia, different types of cherts and fine-grained quartzites are found not far from the border between Finland and Norway, especially near the Barents Sea coast (Halinen 2005:27; Hood 1992). Although quartz has also been utilised to some degree, most of the known northern oblique points are made of cherts. In the area of the southern group, where chert was not available, quartz is the dominant raw material.

Because the use of certain raw materials in the two groups of points correlates with the availability of these materials and because the differences in the raw materials explain the slightly different approaches to manufacturing points, variation-inducing factors observed in earlier studies of variation in arrowheads, such as isochrestic style (e.g., Wiessner 1983) and diverging technological traditions (e.g., Darmark 2007), cannot explain the inter-group differences observed in this study. However, the technological analysis also indicates that there is more variation in the northern points. This observation is not directly explained by the differences in raw materials. Just because the use of quartz forces the production of relatively standardised points does not mean that chert points should be any less standardised. This is true especially in the south-to-north scenario, in which the perpendicular orientation of the southern points could be seen as a trait that was copied from the perpendicular orientation of margin-retouched points in the southern Baltic area and therefore, to a large degree, unrelated to raw material properties. The observation is important if the evidence is considered from the standpoint of cultural transmission theory.

In their study on Great Basin projectile points, Bettinger & Eerkens (1999) hypothesise that differences in intra-group variation within two point populations are explained by different transmission mechanisms: in eastern California, the technology was maintained through a mechanism that caused technological experimentation and, consequently, less correlation between point variables, whereas in central Nevada, point technology was acquired as a package and maintained by copying the successful concept, consequently resulting in less variation.

In the case of the oblique points in Finland, for the south-to-north scenario to hold, the margin-retouched point concept should have been transmitted from the southern Baltic area to southern Finland and then further onwards to northern Finland. As the point concept in Finland spread to areas in which directly preceding lithic arrowhead types are unknown, most likely through copying of a single successful model, one would expect the same transmission mechanism throughout the area and the same perpendicular orientation dominant in both the southern Baltic area and in southern Finland also in the northern points. The greater variation within the northern group of points observed in our study, however, could indicate the intervention of a differing decision-making force if and when the technology spread from southern Finland to the north. In a similar vein, it could be suggested that in the case of the north-and-south scenario, the greater variation in the northern group suggests a different transmission mechanism.

A transverse flint point and two microliths of flint found in excavations at coastal sites in southernmost Finland (Europaeus 1927:Fig. 11; Manninen & Hertell *this volume*) suggest that some contact between southern Finland and the more southern parts of the Baltic Sea shores existed during the Late Mesolithic/Pottery Mesolithic. These artefacts, however, do not derive from radiocarbon-dated contexts The above survey on the usage of margin-retouched points around the Baltic and especially the absence of earlier points in Estonia and Middle Sweden increases the probability that especially the transverse point is later than the spread of the margin-retouched concept to southern Finland and is possibly associated with the spread of margin-retouched points from southern Scandinavia to the Swedish east coast in approximately 4000 calBC (Guinard & Groop 2007). It should also be noted that the so-called Tardenoisien expansion, which has been considered in the past to be the source of oblique point technology in Finland, is too late to be the primary source of the technology according to radiocarbon dates presented here and elsewhere (Perrin *et al.* 2009). Hence, these artefacts do not give much support to the south-to-north or south-and-north scenarios.

Therefore, the north-to-south scenario appears to best fit the available evidence. The radiocarbon data indicate an earlier presence of margin-retouched points in the north, and the technological analysis shows that the quartz points were manufactured in the north in a manner successfully adapted to the specific raw material. This adaptation would have facilitated the transmission of the technology to the south, quite possibly as a package. Although little archaeological evidence exists from the area between the northern and southern regions, the raw material of the single chert point within the southern group (i.e., the point made of black chert found in Kemijärvi, just south of the blank area) resembles chert types found in northern Norway. If the raw material does originate from these sources, it supports the hypothesis that the gap in oblique point distribution between the northern and southern points is artificial and that contact between the areas existed. Earlier contacts between the areas are suggested by, for instance, the similar blade technology and point types in some Early Mesolithic site assemblages in both areas (Rankama & Kankaanpää 2008) and possibly the leaf-shaped slate point from Enontekiö (Erä-Esko 1957), that is similar to southern slate points dated by shore-displacement chronology to *c.* 8300–6900 calBC (9000–8000 BP) (Matiskainen 1989b).

If the north-to-south scenario is accepted as the working hypothesis, then we need to address the reasons behind the spread of the margin-retouched point concept at this point in prehistory. The above discussion leaves open the question of why the new point concept was so readily adopted over a large and ecologically diverse area, although it seems clear that certain design criteria, such as easy replaceability, and the ease of manufacturing from diverse raw materials (including quartz), may have contributed to the proliferation of this concept.

One way of approaching the question of how and why the technology spread from the North-Norwegian coast to southern Finland is to search for marked changes in the natural environment that could have caused changes in subsistence and land-use strategies. Although there is evidence in the archaeological record that culturally transmitted traits, represented by persistent artefact traditions, can survive considerable environmental fluctuation due to cultural inertia (Boyd & Richerson 1985:56–60), there is also increasing evidence suggesting that environmental change has operated as a stimulus for cultural change in many instances in prehistory (e.g., Munoz *et al.* 2010). In the case of Mesolithic northern Fennoscandia, with two groups with differing material culture descending from colonisation waves that originally spread to the area from west and south-east of the Scandinavian Ice Sheet, marked environmental changes could ultimately have led to an increase in inter-group contact. Increased contact, in turn, could have resulted in cultural exchange and horizontal transmission of technology over the likely interface between the two historically distinct populations.

According to recent studies, some major environmental changes coincide with the spread of oblique point technology. Especially the abrupt 8.2 ka cold event caused by the outburst of pro-glacial lakes in North America into the North Atlantic that began at *c.* 6250 calBC (8200 calBP) and lasted roughly 150 years (e.g., Alley & Ágústsdóttir 2005; Barber *et al.* 1999; Kobashi *et al.* 2007; Seppä *et al.* 2007) and the subsequent rapid increase in temperature that marked the beginning of the Holocene Thermal Maximum, are of interest here.

The 8.2 ka event had a major impact on the Barents Sea and caused several interdependent changes. For instance, the freshwater pulse disturbed the thermohaline circulation, reduced the salinity of the North Atlantic surface waters, spiked the wintertime freezing of the Nordic Seas, and caused a major expansion of sea-ice cover in the North Atlantic in general (e.g., Alley & Ágústsdóttir 2005; Renssen *et al.* 2002). For example, the annual duration of sea-ice cover is estimated to have increased by approximately six months in the south-eastern Barents Sea during the event (Voronina *et al.* 2001). At the same time, the pollen-based climate records in northern Fennoscandia show less distinctive evidence of the effect of the 8.2 ka event than the records in more southern areas, where a rapid, large-scale temperature cooling was also seen during the summer months. It therefore seems that in the northern Fennoscandian mainland the event primarily caused cooler temperatures during the cold part of the year. (Seppä *et al.* 2007.)

Modelling the effects of environmental changes to ecosystems is not always straightforward, especially at a regional level (e.g., Wookey 2007). Nevertheless, studies on the modern Barents Sea indicate that primary productivity is inversely correlated with ice cover. The influx of warm Atlantic waters keeps the Barents Sea coast free of ice as far east as the Murmansk region throughout the year.[4] In the years during which large amounts of warm Atlantic waters flow into the Barents Sea, primary productivity can be 30% higher than the productivity in years with a low influx of water (Slagstad & Stokke 1994 in Sakshaug 1997). The extent of sea ice cover in the Barents Sea is largely associated with small variations in the seawater temperature, and during recent cold periods, the ice cover has advanced from north-east to the coast of the Kola peninsula, although the drop in seawater temperature has been only in the magnitude of a few degrees Celsius (Vinje 2009). The increased sea ice cover initiates processes that result in a food shortage throughout the marine ecosystem (Cochrane *et al.* 2009; Sakshaug 1997; Sakshaug & Slagstad 1992).

Currently, years with low primary production are followed by crashes in capelin populations (Naustvoll & Kleiven 2009). One such crash was documented from 1988–1989 and was also reflected higher in the food chain as a mass death of capelin-feeding sea birds and a mass migration of harp seals southwards along the Norwegian coast (Sakshaug 1997). Although the Early Holocene ecosystem in the Barents Sea may have differed from the present situation, the general patterns are likely to have been the same. It therefore seems clear that the major cooling caused by the 8.2 ka event markedly reduced primary productivity and probably also pushed the extent of wintertime ice cover to the previously ice-free Barents Sea coast. This type of change would have inflicted a serious disruption in both the marine ecosystem and in the marine hunter-gatherer-fisher subsistence economy.

After the 8.2 ka event, the climate became markedly warmer, and the Holocene Thermal Maximum followed. In the study area, annual mean temperatures reached their Holocene maxima roughly between 6000–4000 calBC (e.g., Heikkilä & Seppä 2003; Korhola *et al.* 2002; Luoto *et al.* 2010). Paleoecological studies conducted in northern Fennoscandia indicate that large, previously (and currently) treeless areas became covered in birch forests, whereas pine forests spread to areas that were previously dominated by birch (e.g., Hyvärinen 1975; Kultti *et al.* 2006; Seppä & Hicks 2006). Corresponding changes in vegetation zones took place also in more southern parts of Fennoscandia, as ecosystems were affected by the warming climate (e.g., Miller *et al.* 2008). For the Barents Sea, a temperature maximum is indicated at *c.* 5900–4800 calBC (Duplessy *et al.* 2001). The warmer climate, as well as a coinciding salinity peak

---

[4] The situation was the same in the early 20th century (Granö 1918), i.e., already prior to the major warming observed during the past 30 years.

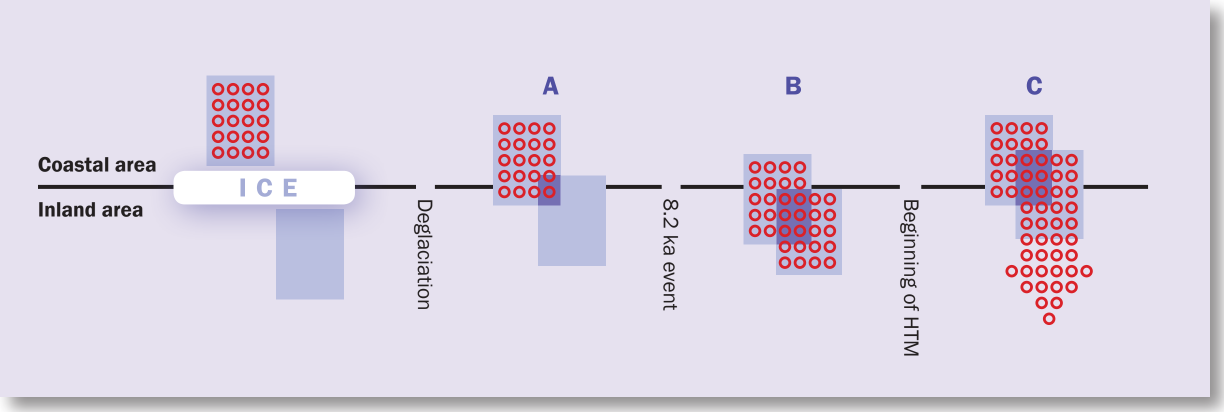


Figure 26. Schematic representation of changes that would have facilitated the transmission of the oblique point technology from the Barents Sea coast to southern Finland across the coast/inland interface between the two historically distinct populations (blue squares). The size of the dark blue areas indicates the amount of contact, and the red circles indicate the margin-retouched point technology. A) Deglaciation and first contact. B) Increased contact and likelihood of horizontal transmission due to the 8.2 ka event. C) The beginning of the Holocene Thermal Maximum and the consequent rapid spread of the new technology to the south due to increasing population size.

in the Baltic Sea, suggests generally increasing environmental productivity especially in the southern parts of the study area after the 8.2 ka event. This increased productivity is also reflected by the gradual growth of human population density starting at *c.* 6200 calBC. (Tallavaara *et al.* 2010b.) It can be assumed that a drop in productivity during the 8.2 ka event led to increased mortality, lower fertility, and reduced human population density, whereas the increasing productivity after the event had an inverse effect.

That ecosystems, the location of most productive areas, and consequently also land-use, hunting, and mobility strategies throughout Fennoscandia were affected by these changes is evident and allows the formulation of a scenario that explains the spread of the oblique point technology to the south (**Fig. 26**). It is generally believed that during the early Holocene, coastal groups of the North-Norwegian coast were maritime hunter-gatherers (e.g., Bjerck 2008). However, examples from south-western Norway indicate that, although they were mainly focused on coastal resources, the Early-Mesolithic groups living in this area also utilised the inland mountain areas (Bang-Anderssen 1996). Indicating a similar pattern, in north-eastern Finnish Lapland non-local lithic raw materials, and in some cases also artefact types, deriving from the Barents Sea coast are repeatedly found in Mesolithic assemblages dated to *c.* 8500–5000 calBC. Regardless of how these artefacts ended up in the inland sites, they indicate that coastal resources were already familiar to the groups that used the area before the earliest known margin-retouched points appeared in the interior (e.g., Grydeland 2005; Halinen 2005; Kankaanpää & Rankama 2005; Rankama & Kankaanpää 2008). As it thus seems probable that contact between the coastal and inland groups occurred already prior to the spread of the oblique point concept in the Late Mesolithic, the transmission of this technology cannot be simply explained as a consequence of contact between these groups (**Fig. 26:A**).

The 8.2 ka event and the subsequent changes in the marine environment, however, would have had a major impact on the subsistence strategies of maritime hunter-gatherers and likely increased, at least at first, the importance of inland resources, especially as the environmental production on dry land during the summer months was not as severely affected by the cold event. Despite its archaeologically short duration, the length of the marine cold period was long enough to force these groups to adapt to the new situation and change their subsistence and mobility strategies accordingly by shifting their foraging focus more to the inland areas. Marked changes towards a less specialised raw material economy, most notably the increased use of quartz, during the Mesolithic Phase III that has been observed on the North-Norwegian coast (Grydeland 2005:57; Hesjedal *et al.* 1996:159) can be linked to this kind of increase in the importance of the inland areas. As the inland areas were also used by groups that had arrived into the area from the south (Manninen & Knutsson *this volume*), the increased use of the interior by groups originating from the coastal areas would have meant increased interaction between individuals and groups (**Fig. 26:B**) and, consequently, facilitated the transmission of the oblique point concept (see also Grydeland 2005:69–71). After the 8.2 ka event, as the climate became gradually warmer and population started to grow especially in the more southern parts of Finland, the technology was rapidly transmitted southwards through established forager networks that likely connected the various hunter-gatherer-fisher groups with shared ancestry residing in the area (**Fig. 26:C**).

Conclusion

In this paper, we have discussed several aspects of Late Mesolithic margin-retouched points and their implications. The study touches upon a number of themes, such as manufacturing technology, dating, geographical distribution, and origin, while focusing on the descent history of the margin-retouched point concept in eastern Fennoscandia. Although much of the reasoning presented here remains to be tested and evaluated in future studies, we can draw the following conclusions from the data:

1. The oblique points in the two geographically separated point groups known in Finland represent the same technological tradition.

2. The differences observed between the northern and southern groups of oblique points are primarily caused by the different properties of the main raw materials used in the north (chert) and the south (quartz).

3. Radiocarbon dates from oblique point contexts are in accordance with the shore displacement dates of the point type in Finland and indicate that the point concept was present in northern Finland during *c.* 6900–5400 calBC and in southern Finland during *c.* 6100–5200 calBC.

4. The present evidence suggests that in Finland the margin-retouched point concept spread from the north to the south.

We suggest that the spread of the margin-retouched point concept in Finland can be explained by changes in hunter-gatherer-fisher organisation triggered by large-scale environmental changes following the 8.2 ka event and the subsequent beginning of the Holocene Thermal Maximum.

These results contribute not only to the study of the Late Mesolithic in eastern Fennoscandia but also to broader fields of study, such as the effect of raw material characteristics on lithic technology, within-population artefact variation, and hunter-gatherer technological organization. In addition, this study contributes to the understanding of the origin and adoption of the margin-retouched point concept throughout all of Europe in the Late Mesolithic. Questions to be answered in future research include the relationship between the margin-retouched points of southern Scandinavia and eastern Fennoscandia and the Late Mesolithic trapezes of southern and western Europe, the processes behind the virtually simultaneous adoption of similar point types in large parts of the European continent and beyond during the Late Mesolithic, and the reasons for the end of margin-retouched point use in eastern Fennoscandia and elsewhere.

Acknowledgements

The work presented in this paper has been supported by the Finnish Cultural Foundation and the Finnish Graduate School in Archaeology. We wish to thank our two reviewers and the members of the Interfaces in the Mesolithic Stone Age of Eastern Fennoscandia project for reading, commenting on, and improving the paper. We would also like to thank the personnel of the National Board of Antiquities' archives and the Riihimäki City Museum for their help.

References

Alley, R. B. & Ágústsdóttir, A. M. 2005. The 8k event: cause and consequences of a major Holocene abrupt climate change. *Quaternary Science Reviews* 24, 1123–1149.

Amick, D. S. & Mauldin, R. P. 1997. Effects of raw material on flake breakage patterns. *Lithic Technology* 22, 18–32.

Arponen, A. 1991. *Inari. Rahajärven arkeologinen inventointi* 1990. Survey report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Bang-Andersen, S. 1996. Coast/inland relations in the Mesolithic of southern Norway. *World Archaeology* 27(3), 427–443.

Barber, D. C., Dyke, A., Hillaire-Marce,C., Jennings, A. E., Andrews,J. T., Kerwin, M. W., Bilodeau, G., McNeely, R., Southon, J., Morehead, M. D. & Gagnon, J.-M. 1999. Forcing of the cold event of 8,200 years ago by catastrophic drainage of Laurentide lakes. *Nature* 400, 344–348.

Bettinger, R. L. & Eerkens, J. W. 1997. Evolutionary implications of metrical variation in Great Basin projectile points. In C. M Barton & G. A. Clark (eds.), *Rediscovering Darwin: Evolutionary Theory and Archaeological Explanation*, 177–191. Arlington, American Anthropological Association.

Bettinger, R. L. & Eerkens, J. W. 1999. Point typologies, cultural transmission, and the spread of bow-and-arrow technology in the prehistoric Great Basin. *American Antiquity* 64, 231–242.

Binford, L. 1973. Interassemblage variability - the Mousterian and the 'functional' argument. In C. Renfrew (ed.), *The explanation of culture change: Models in Prehistory,* 227–254. London, Duckworth.

Bjerck, H. B. 2008. Norwegian Mesolithic Trends: A Review. In G. Bailey & P. Spikins (eds.), *Mesolithic Europe,* 60–106. New York, Cambridge University Press.

Boyd, R. & Richerson, P. J. 1985. *Culture and the Evolutionary Process*. Chicago, University of Chicago Press.

Callahan, E., Forsberg, L., Knutsson, K. & Lindgren, C. 1992. Frakturbilder. Kulturhistoriska kommentarer till det säregna sönderfallet vid bearbetning av kvarts. *Tor* 24, 27–63.

Cavalli-Sforza, L. L. & Feldman, M. W. 1981. *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton, Princeton University Press.

Cheshier, J. & Kelly, R. L. 2006. Projectile Point Shape and Durability: The Effect of Thickness: Length. *American Antiquity* 71(2), 353–363.

Cochrane, S. K. J., Denisenko, S. G., Renaud, P. E., Emblow, C. S., Ambrose, W. G. Jr, Ellingsen, I. H. & Skarðhamar, J. 2009. Benthic macrofauna and productivity regimes in the Barents Sea – Ecological implications in a changing Arctic. *Journal of Sea Research* 61, 222–233.

Crabtree, D. E. 1967. Notes on Experiments in Flintknapping: 3. The Flintknapper's Raw Materials. *Tebiwa*, Vol. 10(1), 8–24.

Darmark, K. 2007. Den flathugna pilspetsens fylogeni. In N. Stenbäck (ed.), *Stenålder i Uppland. Uppdragsarkeologi och eftertanke*. Arkeologi W4 Uppland Studier, 31–65. Uppsala, Riksantikvarieämbetet, UV GAL; Societas archaeologica Upsaliensis; Upplandsmuseet.

Domanski, M., Webb, J. A. & Boland, J. 1994. Mechanical properties of stone artefact materials and effect of heat treatment. *Archaeometry* 36, 177–208.

Duplessy, J.-C., Ivanova, E., Murdmaa, I., Paterne, M. & Labeyrie, L. 2001. Holocene Paleoceanography of the northern Barents Sea and variations of the northward heat transport by the Atlantic Ocean. *Boreas* 30, 2–16.

Edinborough, K. 2009. Population History and the Evolution of Mesolithic Arrowhead Technology in South Scandinavia. In S. J. Shennan (ed.), *Pattern and Process in Cultural Evolution,* 191–202. Berkeley, University of California Press.

Eerkens, J. W. & Lipo, C. P. 2007. Cultural Transmission Theory and the Archaeological Record: Providing Context to Understanding Variation and Temporal Changes in Material Culture. *Journal of Archaeological Research* 15, 239–274.

Erä-Esko, A. 1957. Die steinzeitlichen Forschungen der letzen Jahre in Nord-Finnland. *Suomen Muinaismuistoyhdistyksen Aikakauskirja* 58, 28–40.

Europaeus, A. 1927. Stenålderskeramik från kustboplatser I Finland. *Suomen muinaismuistoyhdistyksen aikakauskirja* XXXVI, 45–77

Fast, J. 1995. *Esbo Oitans Kakola. Boplats från sten- och tidig metallålder*. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Fast, J. 1996. *Espoo Sperrings Hiekkakuoppa NE. Kivikautisen asuinpaikan kaivaus*. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Fischer, A. 1990. Hunting with Flint-Tipped Arrows: Results and Experiences from Practical Experiments. In C. Bonsall (ed.), *The Mesolithic in Europe. III Int. Mesol. Symp. Edinburgh 1985*, 29–39. Edinburgh, John Donald Publishers Limited.

Fischer, A., Hansen, P. V. & Rasmussen, P. 1984. Macro and micro wear traces on lithic projectile points. *Journal of Danish Archaeology* 3, 19–46.

Fletcher, C. H. III, Fairbridge, R. W., Møller, J. J. & Long, A. J. 1993. Emergence of the Varanger Peninsula, Arctic Norway, and climate changes since deglaciation. *The Holocene* 3, 116–127.

Freundt, E. A. 1948. Komsa – Fosna – Sandarna. Problems of the Scandinavian Mesolithicum. *Acta Archaeologica* XIX, 1–68.

Fuglestvedt, I. 2007. The Ahrensburgian Galta 3 site in SW Norway. Dating, technology and cultural affinity. *Acta Archaeologica* 78:2, 87–110.

Galimova, M. 2006. Final Palaeolithic-Early Mesolithic Cultures with Trapezia in the Volga and Dnieper Basins: The Question of Origin. *Archaeologia Baltica* 7, 136–148.

Glørstad, H. 2004. Svinesundmaterialet i lys av annen forskning i Oslofjordsdistriktet og i Vest-Sverige. In H. Glørstad (ed.), Bind 4. Oppsummering av Svinesundprosjektet. *Varia* 57, 47–58. Oslo, Universitetets kulturhistoriske museer, Fornminneseksjonen.

Granö, J. G. 1918. Meri. In T. Homén (ed.), *Itä-Karjala ja Kuollan Lappi*. Osa I, Kuollan Lappi, 16–19. Helsinki, Otava.

Grydeland, S.-E. 2005. The Pioneers of Finnmark – from the earliest coastal settlements to the encounter with the inland people of Northern Finland. In H. Knutsson (ed.), Pioneer settlements and colonization processes in the Barents region. *Vuollerim Papers on Hunter-gatherer Archaeology* 1, 43–77. Vuollerim, Vuollerim 6000 år.

Guinard, M. & Groop, N. 2007: Handtagskärnor och tvärpilar. In N. Stenbäck (ed.), *Stenålder i Uppland. Uppdragsarkeologi och eftertanke*. Arkeologi W4 Uppland Studier. Uppsala, Riksantikvarieämbetet, UV GAL; Societas archaeologica Upsaliensis; Upplandsmuseet.

Halinen, P. 1995. *Ounasjärven alueen esihistoriallisten peuranpyytäjäyhteisöjen asutusmallit*. Unpublished Licenciate thesis. University of Helsinki, Institute of Cultural Research, Archaeology.

Halinen, P. 2005. *Prehistoric Hunters of Northernmost Lapland. Settlement patterns and subsistence strategies*. Iskos 14. Helsinki, The Finnish Antiquarian Society.

Hartz, S., Lübke, H. & Terberger, T. 2007. From fish and seal to sheep and cattle: new research into the process of neolithisation in northern Germany. *Proceedings of the British Academy* 144, 567–594.

Heikkilä, M. & Seppä, H. 2003. A 11,000 yr palaeotemperature reconstruction from the southern boreal zone in Finland. *Quaternary Science Reviews* 22, 541–554.

Helskog, E. 1974. The Komsa Culture: Past and Present. *Arctic Anthropology* XI, 1974, Supplement, 261–265.

Henriksen, S. 2010. ID 104342: En tuft fra Eldre Steinalder. In M. Skandfer (ed.), Tønsnes havn, Tromsø Kommune, Troms. Rapport fra arkeologiske utgravninger i 2008 og 2009. *Tromura,* kulturhistorie 40, 50–71. Tromsø museum, Tromsø.

Hesjedal, A., Damm, C., Olsen, B. & Storli, I. 1996. Arkeologi på Slettnes. Dokumentasjon av 11.000 års bosetning. *Tromsø Museums Skrifter* XXVI.

Hood, B. C. 1988. Undersøkelse av en steinalderboplass ved Aksujavri, Kautokeino kommune, Finnmark. In E. Engelstad & M. Holm–Olsen (eds.), Arkeologisk feltarbeid i Nord-Norge og på Svalbard 1986. *Tromura*, kulturhistorie 14, 23–31. Tromsø museum, Tromsø.

Hood, B. C. 1992. *Prehistoric Foragers of the North Atlantic: Perspectives on Lithic Procurement and Social Complexity in the North Norwegian Stone Age and the Labrador Maritime Archaic. Electronic Doctoral Dissertations for UMass Amherst.* Paper AAI9219445. http://scholarworks.umass.edu/dissertations/AAI9219445

Hughes, S. S. 1998. Getting to the Point: Evolutionary Change in Prehistoric Weaponry. *Journal of Archaeological Method and Theory* 5(4), 345–408.

Huurre, M. 1983. Pohjois-Pohjanmaan ja Lapin historia I. Pohjois-Pohjanmaan ja Lapin esihistoria. Kuusamo, Pohjois-Pohjanmaan, Kainuun ja Lapin maakuntaliittojen yhteinen historiatoimikunta.

Huurre, M., Keränen, J. & Turpeinen, O. 1988. *Hyrynsalmen historia*. Jyväskylä, Hyrynsalmen kunta ja seurakunta.

Hyvärinen, H. 1975. Absolute and relative pollen diagrams from northernmost Fennoscandia. *Fennia* 142, 1–23.

Jankowska, D. 1998. Environmental Conditions during the Neolithization of Pomerania. In M. Zvelebil, R. Dennell & L. Domanska (eds.), *Harvesting the Sea, Farming the Forest: The Emergence of Neolithic Societies in the Baltic Region*. Sheffield Archaeological Monographs 10, 121–128. Sheffield, Sheffield Academic Press Ltd.

Jordan, P. & Shennan, S. 2009. Diversity in hunter–gatherer technological traditions: Mapping trajectories of cultural 'descent with modification' in northeast California. *Journal of Anthropological Archaeology* 28, 342–365.

Jussila, T. 2005. *Luumäki Suo-Anttila Reijonkangas. Kivikautisen asuinpaikan kaivaus 2005*. Excavation report. http://www.dlc.fi/~microlit/tyot2005/LUUMAKI05.htm

Kankaanpää, J. & Rankama, T. 2005. Early Mesolithic pioneers in Nortern Finnish Lapland. In H. Knutsson (ed.), Pioneer settlements and colonization processes in the Barents region. *Vuollerim Papers on Hunter-gatherer Archaeology* 1, 109–161. Vuollerim, Vuollerim 6000 år.

Katiskoski, K. 1994. Kauhajoen ja Isojoen mesoliittisista asuinpaikoista. Iventointihavaintoja 1990-91. *Kentältä pomittua* 2, 30–39.

Kehusmaa, A. 1972. *Kemijärven Neitilä* 4. Helsingin yliopiston arkeologian laitos, moniste 3. Helsinki, Helsingin yliopisto.

Knutsson, K. 1993. Garaselet-Lappviken-Rastklippan. Introduktion till en diskussion om Norrlands Äldsta Bebyggelse. *Tor* 25, 5–51.

Knutsson, K. 1998. Convention and lithic analysis. In L. Holm & K. Knutsson (eds.), *Proceedings of the Third Flint Alternatives Conference at Uppsala, Sweden, October 18-20, 1996,* 71–93. Occasional Papers in Archaeology 16. Department of Archaeology and Ancient History, Uppsala University, Uppsala.

Kobashi, T., Severinghaus, J. P., Brook, E. J., Barnola, J.-M. & Grachev, A. M. 2007. Precise timing and characterization of abrupt climate change 8200 years ago from air trapped in polar ice. *Quaternary Science Reviews* 26, 1212–1222.

Kobusiewicz, M. 2009. The Lyngby point as a cultural marker. In M. Street, N. Barton & T. Terberger (eds.), *Humans, environment and chronology of the late glacial of the North European Plain*, 169–178. Mainz, Verlag des Römisch-Germanischen Zentralmuseums.

Koivikko, M. 1999. *Etelä-Saimaan vedenalaiset asuinpaikat - kivikautisten kohteiden inventointi ja topografisen mallin rakennus*. Unpublished MA-thesis. Univesity of Helsinki.

Koivisto, S. 2010a. Luihin ja ytimiin. Pyyntiä ja elämää Itämeren äärellä noin 7500 vuotta sitten. *Helsingin pitäjä* 2011, 8–21.

Koivisto, S. 2010b. Vantaa Hommas – myöhäismesoliittinen asuinpaikka kehäratalinjalla. *Kentältä poimittua* 7, 5–18. Helsinki, Museovirasto.

Korhola, A., Vasko, K., Toivonen, H. T. T. & Olander, H. 2002. Holocene temperature changes in northern Fennoscandia reconstructed from chironomids using Bayesian modelling. *Quaternary Science Reviews* 21, 1841–1860.

Kotivuori, H. 1996. Pyytäjistä kaskenraivaajiksi. Rovaniemen asutus noin 6000 eKr.–1300 jKr. In V. Kallio (ed.), *Rovaniemen historia vuoteen* 1721. *Kotatulilta savupirtin suojaan*. Jyväskylä, Rovaniemen kaupunki, Rovaniemen maalaiskunta & Rovaniemen seurakunta.

Kozłovski, S. K. 2002. Les premiers hommes modernes et les premiers agriculteurs en europe: Voies de diffusion et interactions entre populations. In M. Otte & J. K. Kozlowski (eds.), *Préhistoire de la Grande Plaine du Nord de l'Europe.* Actes du Colloque Chaire Francqui interuniversitaire au titre étranger, Université de Liège, 26 juin 2001, 9–34. Liège, Université de Liège.

Kozłovski, S. K. 2006. Mapping the Central/East European Terminal Palaeolithic/Earliest Mesolithic. *Archaeologia Baltica* 7, 29–35.

Kriiska, A. & Tvauri, A. 2002. *Eesti muinasaeg*. Tallinn, Avita.

Kultti, S., Mikkola, K., Virtanen, T., Timonen, M. & Eronen, M. 2006. Past changes in the Scots pine forest line and climate in Finnish Lapland – a study based on megafossils, lake sediments, and GIS-based vegetation and climate data. *The Holocene,* vol. 16, 381–391.

Lahelma, A. (ed.) 2002. *Porvoonjoen yläjuoksun esihistoriallisia ja kulttuurihistoriallisia kohteita Lahden, Hollolan ja Orimattilan alueella*. Jyväskylä, Lahden kaupunginmuseo.

Lahti, E.-K. 2004. *Utsjoki Màvdnaàvži 2 Mikael Manninen 2004 Luuanalyysi*. Osteological analysis on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Larsson, L. 1993. The Mesolithic of Southern Scandinavia. *Journal of World Prehistory*, vol. 4(3), 257–309.

Leskinen, S. 2003. *Lohja Harvakkalanlahti. Kivikautisen asuinpaikan kaivaus*. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Leskinen, S. & Pesonen, P. 2008. *Vantaan esihistoria*. Keuruu, Vantaan kaupunki.

Luho, V. 1948. Alajärven Rasin poikkiteräiset nuolenkärjet. *Suomen Museo* 1947–1948, 5–21.

Luho, V. 1957. Frühe Kammkeramik. *Studia Neolithica in Honorem Aarne Äyräpää.* Suomen Muinaismuistoyhdistyksen Aikakauskirja 58, 141–159. Helsinki, Suomen muinaismuistoyhdistys.

Luho, V. 1967. *Die Suomusjärvi-Kultur. Die mittel- und spätmesolitische zeit in Finnland*. Suomen Muinaismuistoyhdistyksen Aikakauskirja 66. Helsinki, Suomen muinaismuistoyhdistys.

Luoto, T. P., Kultti, S., Nevalainen, L. & Sarmaja-Korjonen, K. 2010. Temperature and effective moisture variability in southern Finland during the Holocene quantified with midge-based calibration models. *Journal of Quaternary Science* 25, 1317–1326.

Mannermaa, K. 2010. *Radiohiiliajoitukseen menevän arkeologisen luunäytteen analyysi. Alajärvi Rasi, Inari Vuopaja, Inari Kaunisniemi 3, Enontekiö Museotontti, Kuortane Lahdenkangas, Utsjoki Jomppalanjärvi W*. Helsingissä 19.10. 2010. Unpublished osteological analysis.

Manninen, M. A. 2005. Problems in Dating Inland Sites — Lithics and the Mesolithic in Paistunturi, Northern Finnish Lapland. In H. Knutsson (ed.), *Pioneer settlements and colonization processes in the Barents region.* Vuollerim Papers on Hunter-gatherer Archaeology 1, 29–41. Vuollerim, Vuollerim 6000 år.

Manninen, M. A. 2009. Evidence of mobility between the coast and the inland region in the Mesolithic of Northern Fennoscandia. In S. B. McCartan, R. Schulting, G. Warren and P. Woodman (eds.), *Mesolithic Horizons. Papers presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005. Volume* I, 102–108. Oxford, Oxbow books.

Manninen, M. A. & Hertell, E. *this volume*. Few and far between - an archive survey of Finnish blade finds.

Manninen, M. A. & Knutsson, K. *this volume*. Northern Inland Oblique Point Sites – a New Look into the Late Mesolithic Oblique Point Tradition in Eastern Fennoscandia

Manninen, M. A. & Knutsson, K. *in preparation*. Technology, Mobility, and Site Structure – Five Late Mesolithic Short-term Camps in Northern Fennoscandia.

Matiskainen, H. 1982. *Suomen mesoliittisen kivikauden sisäinen kronologia* 14C-*ajoitukseen tukeutuvan Itämeren kehityshistorian perusteella*. Unpublished Licenciate thesis. University of Helsinki.

Matiskainen, H. 1986. Beiträge zur Kentnisse der mesolithischen Schrägschneidepfeile und Microlithen aus Quarz. *Iskos* 6, 77–98.

Matiskainen, H. 1989a. *Studies on the chronology, material culture and subsistence economy of the Finnish Mesolithic*, 10 000–6000 *b.p*. Iskos 8. Helsinki, Suomen Muinaismuistoyhdistys.

Matiskainen, H. 1989b. The Chronology of the Finnish Mesolithic. In C. Bonsall (ed.), *The Mesolithic in Europe.* III *Int. Mesol. Symp. Edinburgh* 1985, 379–390. Edinburgh, John Donald Publishers Limited.

Matiskainen, H. 2002. *Riihimäen esihistoria*. Hämeenlinna, Riihimäen kaupunginmuseo.

Matiskainen, H. & Ruohonen, J. 2004. *Esihistorian pauloissa*. Hämeenlinna, Riihimäen kaupunginmuseo.

Miller, P. A., Giesecke, T., Hickler, T., Bradshaw, R. H. W., Smith, B., Seppä, H., Valdes, P. J. & Sykes, M. T. 2008. Exploring climatic and biotic controls on Holocene vegetation change in Fennoscandia. *Journal of Ecology* 96, 247–259.

MJREK 2008 = Register of archaeological sites in mainland Finland. National Board of Antiquities. http://kulttuuriymparisto.nba.fi/netsovellus/rekisteriportaali/portti/default.aspx. Accessed in 2008.

Munoz, S. E., Gajewski, K. & Peros, M. C. 2010. Synchronous environmental and cultural change in the prehistory of the northeastern United States. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 107(51), 22008–22013.

Møller, J. J., Yevzerov, V. Y., Kolka, V. V. & Corner, G. D. 2002. Holocene raised-beach ridges and sea-ice-pushed boulders on the Kola Peninsula, northwest Russia: indicators of climatic change. *The Holocene* 12(2), 169–176

Naustvoll, L.-J. & Kleiven, M. 2009. Primær- og sekundærproduksjon. In H. Gjøsæter, A. Dommasnes, T. Falkenhaug, M. Hauge, E. Johannesen, E. Olsen & Ø. Skagseth (eds.), Havets ressurser og miljø 2009. *Fisken og havet, særnummer* 1–2009,30–31. Havforskninsinstututtet. http://www.imr.no/publikasjoner/andre_publikasjoner/havets_ressurser_og_miljo/nb-no

Nielsen, R. A. & Skandfer, M. 2010. ID 104380: En boplass med nedgravde tufter fra Eldre Steinalder. In M. Skandfer (ed.), Tønsnes havn, Tromsø Kommune, Troms. Rapport fra arkeologiske utgravninger i 2008 og 2009. *Tromura,* kulturhistorie 40, 82–115. Tromsø museum, Tromsø.

Nordqvist, K. & Seitsonen, O. 2008. Archaeological research in the former municipalities of Koivisto and Kuolemajärvi, Karelian Isthmus in 2003: results and observations. In M. Lavento (ed.), *Karelian Isthmus – Stone Age Studies in* 1998–2003. Iskos 16, 215–234.

Odell, G. H. & Cowan, F. 1986. Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13, 195–211.

Odner, K. 1966. *Komsakulturen i Nesseby og Sør-Varanger*. Tromsø/Oslo/Bergen, Universitetsforlaget.

Olsen, B. 1994. *Bosetning og samfunn i Finnmarks forhistorie*. Oslo, Universitetsforlaget.

Olsson, I. U. 1980. Content of ^{14}C in marine mammals from northern Europe. *Radiocarbon* 22, 662–675.

Oshibkina 2006 = Ошибкина, С. В. 2006. *Мезолит Восточного Прионежья. Культура Веретье*. Москва.

Perrin, T., Marchand, G., Allard, P. & Binder, D. 2009. Le second Mésolithique d'Europe occidentale: origines et gradient chronologique. *Fondation Fyssen – Annales* 24, 161–170.

Pesonen, P. & Tallavaara, M. 2006. Esihistoriallinen leiripaikka Lohjan Hossanmäellä – kvartseja ja yllättäviä ajoituksia. *Suomen Museo* 2005, 5–26.

Poutiainen, H. (ed.) 2002. *Sukupolvien maisema. Porvoonjokilaakson kansallismaiseman syntyvaiheita*. Jyväskylä, Lahden Kaupunginmuseo.

Prøsch-Danielsen, L. & Høgestøl, M. 1995. A coastal Ahrensburgian site found at Galta, Rennesøy, Southwest Norway. In A. Fischer (ed.), *Man and Sea in the Mesolithic. Coastal settlement above and below present sea level*. Oxbow Monograph 53, 123–130. Oxford.

Purhonen, P. & Ruonavaara, L. 1994. On Subsistence economy at the prehistoric dwelling-site area of Jönsas in Vantaa, Southern Finland. *Fenno-Ugri et Slavi 1992. Prehistoric economy and means of livelihood*, 88–97. Helsinki, National Board of Antiquities.

Pälsi, S. 1937. Pielisensuun Mutalan kivikautinen liesi. Kaivausselostus. *Suomen Museo* 1937, 1–13.

Rankama, T. 2002. Analyses of the Quartz Assemblages of Houses 34 and 35 at Kauvonkangas in Tervola. In H. Ranta (ed.), *Huts and Houses. Stone Age and Early Metal Age Buildings in Finland*, 79–108. Helsinki, National Board of Antiquities.

Rankama, T. 2003. The colonisation of northernmost Finnish Lapland and the inland areas of Finnmark. In L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler & A. Åkerlund (eds.), *Mesolithic on the Move,* 684–687. Exeter, Oxbow Books.

Rankama, T. 2009. Quartz analysyes of the Kaaraneskoski site, Finland. In S. B. McCartan, R. Schulting, G. Warren & P. Woodman (eds.), *Mesolithic Horizons. Papers presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005. Volume* II, 813–819. Oxford, Oxbow books.

Rankama, T. & Kankaanpää, J. 1997. *Utsjoki* 209 *Jomppalanjärvi W. Arkeologisen kohteen tarkastus*. Inspection report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Rankama, T. & Kankaanpää, J. 2008. Eastern arrivals in post-glacial Lapland: the Sujala site 10 000 cal BP. *Antiquity* 82, 884-899.

Rankama, T. & Kankaanpää, J. *this volume*. The Kaaraneskoski Site in Pello, Southwestern Lapland – at the Interface between the "East" and the "West".

Rankama, T., Manninen, M. A., Hertell, E. & Tallavaara, M. 2006. Simple production and social strategies: do they meet? Social dimensions in Eastern Fennoscandian quartz technologies. In J. Apel & K. Knutsson (eds.), *Skilled Production and Social Reproduction. Aspects of Traditional Stone Tool Technologies*. SAU Stone Studies 2, 245–261. Uppsala, Societas Archaeologica Uppsaliensis.

Reimer, P. J., Baillie, M. G. L., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Bronk Ramsey, C., Buck, C. E., Burr, G. S., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kaiser, K. F., Kromer, B., McCormac, F. G., Manning, S. W., Reimer, R. W., Richards, D. A., Southon, J. R., Talamo, S., Turney, C. S. M., van der Plicht, J., & Weyhenmeyer, C. E. 2009. IntCal09 and Marine09 radiocarbon age calibration curves, 0-50,000 years cal BP. *Radiocarbon,* 51(4), 1111–1150.

Renssen, H., Goosse, H. & Fichefet, T. 2002. Modeling the effect of freshwater pulses on the early Holocene climate: The influence of high-frequence climate variability. *Paleocenography* 17(2), 10-1–16.

Richerson, P. J. & Boyd, R. 2005. *Not By Genes Alone. How Culture Transformed Human Evolution*. Chicago, University of Chicago Press.

Räihälä, O. 1999 Mesolithic Settlement on the River Emäjoki, North-East Finland. In M. Huurre (ed.), *Dig it all. Papers dedicated to Ari Siiriäinen*, 201–217. Helsinki, The Finnish Antiquarian Society & The Archaeological Society of Finland.

Sakshaug, E. 1997. Biomass and productivity distributions and their variability in the Barents Sea. *ICES Journal of Marine Science* 54, 341–350.

Sakshaug, E. & Slagstad, D. 1992. Sea Ice and Wind: Effects on Primary Productivity in the Barents Sea. *Atmosphere-Ocean* 30(4), 579–591.

Salomaa, R. & Matiskainen, H. 1983. Rannan siirtyminen ja arkeologinen kronologia Etelä-Pohjanmaalla. *Karhunhammas* 7, 21–36.

Schmitt, L., Larsson, S., Schrum, C., Alekseeva, I., Tomczak, M. & Svedhage, K. 2006. 'Why they came'; The *colonization of the* coast of western Sweden and its environmental context at the end of the last glaciation. *Oxford Journal of Archaeology* 25(1), 1–28.

Schmölcke, U., Endtmann, E., Klooss, S., Meyer, M., Michaelis, D., Rickert, B.-H. & Rößler, D. 2006. Changes of sea level, landscape and culture: A review of the south-western Baltic area between 8800 and 4000BC. *Palaeogeography, Palaeoclimatology, Palaeoecology* 240, 423–438.

Schuh, D. R. 1987. *Bowhunter's Encyclopedia*. Mechanicsburg, Stackpole Books.

Schulz, H.-P. 2002. *Juva Päiväranta 1 ja 2. Kivikautisen ja rautakautisen/historiallisen ajan asuinpaikkaryhmän koekaivaus 2002.* Excavation report. http://www.mikroliitti.fi/tyot2002/JUVA02.htm

Seppä, H., Birks, H. J. B., Giesecke, T., Hammarlund, D., Alenius, T., Antonsson, K., Bjune, A. E., Heikkilä, M., MacDonald, G. M., Ojala, A. E. K., Telford, R. J. & Veski, S. 2007. Spatial structure of the 8200 cal yr BP event in northern Europe. *Climate of the Past* 3, 225–236.

Seppä, H. & Hicks, S. 2006. Integration of modern and past pollen accumulation rate (PAR) records across the arctic tree-line: a method for more precise vegetation reconstructions. *Quaternary Science Reviews* 25, 1501–1516.

Seppälä, S.-L. 1993. *Inari 13 Vuopaja. Kivi- ja varhaismetallikautisen asuinpaikan kaivaus* 13.-27.7.1993. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Seppälä, S.-L. 1994. *Inari 13 Vuopaja. Kivi- ja varhaismetallikautisen asuinpaikan kaivaus* 13.6.-18.7.1994. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Shackley, M. S. 2000. The Stone Tool Technology of Ishi and the Yana of North Central California: Inferences for Hunter-Gatherer Cultural Identity in Historic California. *American Anthropologist* 102(4), 693–712.

Siiriäinen, A. 1977. Quartz, Chert and Obsidian, A comparison of Raw Materials in a Late Stone Age Aggregate in Kenya. *Finskt Museum* 1974, 15–29.

Siiriäinen, A. 1984. The Mesolithic of Finland. A Survey of Recent Investigations. In J. K. Kozlowski & S. K. Kozlowski (eds.), *Advances in Palaeolithic and Mesolithic Archaeology*. Archaeologia Interregionalis vol. 5 (1984), 173–191.

Sinisalo, H. 2004. *Kun keramiikkaa ei ole. Kivikautisten asuinpaikkojen ajoittaminen rannansiirtymisen ja esinetyyppien avulla*. Unpublished MA-thesis. University of Helsinki.

Sjöström, A. 1997. Ringsjöholm. A Boreal–Early Atlantic Settlement in Central Scania, Sweden. *Lund Archaeological Review* 3, 5–20.

Skandfer, M. 2003. *Tidlig, nordlig kamkeramikk. Typologi-kronologi-kultur*. PhD thesis. University of Tromsø. http://www.ub.uit.no/munin/handle/10037/284

Sorokin, A. M. 2006. The Final Palaeolithic in Central Russia. *Archaeologia Baltica* 7, 120–135.

Stuiver, M., Reimer, P. J. & Reimer, R. 1986–2010. *Marine Reservoir Correction Database*. http://calib.qub.ac.uk/calib/

Tallavaara, M. 2007. *Vihiä teknologisista strategioista: Tutkimus Rääkkylän Vihin kampakeraamisen ajan asuinpaikan piikivi- ja kvartsiaineistoista*, Master's thesis. E-thesis, University of Helsinki, http://urn.fi/URN:NBN:fi-fe20072153

Tallavaara, M., Manninen, M. A., Hertell, E. & Rankama, T. 2010a. How flakes shatter: a critical evaluation of quartz fracture analysis. *Journal of Archaeological Science* 37, 2442–2448.

Tallavaara, M., Pesonen, P. & Oinonen, M. 2010b. Prehistoric population history in eastern Fennoscandia. *Journal of Archaeological Science* 37, 251–260.

Ukkonen, P. 1994. Inari 13 Vuopaja (KM 27809) / S.-L. Seppälä 1993. In Seppälä, S.-L. 1993. *Inari 13 Vuopaja. Kivi- ja varhaismetallikautisen asuinpaikan kaivaus* 13.-27.7.1993. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Ukkonen, P. 1995. Inari 13 Vuopaja (KM 28365) / S.-L. Seppälä 1994. In Seppälä, S.-L. 1994. *Inari 13 Vuopaja. Kivi- ja varhaismetallikautisen asuinpaikan kaivaus* 13.6.–18.7.1994. Excavation report on archive, National Board of Antiquities, Department of Archaeology, Helsinki.

Vang Petersen, P. 1984. Chronological and Regional Variation in the Late Mesolithic of Eastern Denmark. *Journal of Danish Archaeology* 3, 7–18.

Vang Petersen, P. 1999. *Flint fra Danmarks oldtid*. København, Høst & Son.

Vinje, T. 2009. Sea-ice. In E. Sakshaug, G. Johnsen & K. Kovacs (eds.), *Ecosystem Barents Sea*, 65–82. Trondheim, Tapir Academic Press.

Voronina, E., Polyak, L., De Vernal, A., & Peyron, O. 2001. Holocene variations of sea-surface conditions in the southeastern Barents Sea, reconstructed from dinoflagellate cyst assemblages. *Journal of Quaternary Science* 16(7), 717–726.

Wadley, L. & Mohapi, M. 2008. A Segment is not a Monolith: evidence from the Howiesons Poort of Sibudu, South Africa. *Journal of Archaeological Science* 35, 2594–2605.

Waraas, T. A. 2001. *Veslandet i tidleg Preboreal tid. Fosna, Ahrensburg eller vestnorsk tidlegmesolitikum*? Hovudfagoppgåve i arkeologi. Universitetet i Bergen.

Wiessner, P. 1983. Style and social information in Kalahari San projectile points. *American Antiquity* 48, 253–276.

Woodman, P. C. 1993. The Komsa Culture. A Re-examination of its Position in the Stone Age of Finnmark. *Acta Archaeologica* 63/1992, 57–76.

Woodman, P. C. 1999. The Early Postglacial Settlement of Arctic Europe. In E. Cziesla, T. Kersting & S. Pratsch (eds.), *Den Bogen spannen… Festschrift für Bernhard Gramsch zum 65. Geburstag,* Teil 1. Beiträge zur Ur- und Frügeschichte Mitteleuropas 20, 292–312. Weissbach, Beier & Beran.

Wookey, P. A. 2007. Climate change and biodiversity in the Arctic–Nordic perspectives. *Polar Research* 26, 96–103.

Äyräpää, A. 1950. Die ältesten steinzeitlichen Funde aus Finnland. *Acta Archaeologica* XXI, 1–43.

Åkerlund, A. 1996. *Human Responses to Shore Displacement. Living by the Sea in Eastern Middle Sweden during the Stone Age*. Arkeologiska undersökningar Skrifter 16. Stockholm, Riksantikvarieämbetet.

Zagorska, I. 1993. The Mesolithic in Latvia, *Acta Archaeologica* 63, 97–117.

Zaliznyak, L. 1997. Mesolithic Forest Hunters in Ukrainian Polessye. *British Archaeological Reports International Series* 659.

Zhilin, M. G. 2005. The terminal Paleolithic – early Mesolithic. In H. Knutsson (ed.), *Pioneer settlements and colonization processes in the Barents region.* Vuollerim Papers on Hunter-gatherer Archaeology 1, 163–179. Vuollerim, Vuollerim 6000 år.

Zvelebil, M. 2006. Mobility, contact, and exchange in the Baltic Sea basin 6000–2000 BC. *Journal of Anthropological Archaeology* 25, 178–192.

Appendix I. List of catalogue numbers of artefacts shown in Figure 1

a) KM 11771:3
b) KM 11771:4
c) KM 12159:80
d) KM 32590:2
e) KM 34675:147
f) KM 28365:660
g) KM 31511:816
h) KM 12603:90
i) KM 30721:322
j) KM 28365:889
k) KM 26040:35
l) KM 23877:122
m) KM 34856:335
n) KM 16856:24
o) KM 33461:209
p) KM 23877:411
q) KM 24464:289
r) KM 34675:199
s) KM 33461:160
t) KM 11771:17
u) KM 31511:744
v) KM 34675:225
w) KM 28365:454
x) KM 23363:4

Appendix II. Oblique point sites in Finland according to region

	Municipality	Site	Source	Catalogue number
	LAPLAND			
1	Enontekiö	Museotontti	Halinen 2005; Manninen & Knutsson *this volume*	KM 23877:28 +
2	Inari	Ahkioniemi 1&2	Manninen & Knutsson *this volume*	KM 23363:4
3	Inari	Bealdojohnjalbmi (Peltojokisuu) 1	Nordqvist & Seitsonen 2008	KM 35217:1 +
4	Inari	Kaidanvuono SW	Manninen & Knutsson *this volume*	KM 23354:9
5	Inari	Kaunisniemi 2	Manninen & Knutsson *this volume*	KM 26039:42
6	Inari	Kaunisniemi 3	Manninen & Knutsson *this volume*	KM 26040:2
7	Inari	Kirakkajoen voimala	Manninen & Knutsson *this volume*	KM 26245:1-9
8	Inari	Nellimjoen suu S	Halinen 2005; Manninen & Knutsson *this volume*	KM 24376:454
9	Inari	Saamen museo	NBA find catalogue	KM 27808:1058
10	Inari	Satamasaari	Manninen & Knutsson *this volume*	KM 26010:4
11	Inari	Supru	Manninen & Knutsson *this volume*	KM 22685:13
12	Inari	Vuopaja	Manninen & Knutsson *this volume*	KM 28365:442 +
13	Kemijärvi	Lautasalmi	Huurre 1983	KM 15846:78
14	Kemijärvi	Neitilä 4	Kehusmaa 1972	KM 16145:1750 +
15	Kemijärvi	Neitilä 5	NBA find catalogue	KM 29644:89
16	Pello	Kaaraneskoski/Kaarnes 1-2	Rankama 2009	KM 30721:17 +
17	Ranua	Simojärvi Kujala/Uutela	Kotivuori 1996	KM 26481:6
18	Sodankylä	Matti-vainaan palo 2 (Mattivainaanpalot)	NBA find catalogue	KM 27679:878
19	Sodankylä	Poikamella	NBA find catalogue	KM 27674:668 +
20	Utsjoki	Jomppalanjärvi W	Rankama, T. *pers. comm.*	KM 38078:2
21	Utsjoki	Mávdnaávži 2	Manninen & Knutsson *this volume*	KM 32590:1
	NORTHERN OSTROBOTHNIA			
22	Haapajärvi	Hautaperän Allas Tervamäki	Huurre 1983	KM 19030:32
23	Nivala	Järvenpää	Huurre 1983	KM 14536:55
24	Siikalatva	(Kestilä) Päivärinne	Huurre 1983	KM 17062:57
	KAINUU			
25	Hyrynsalmi	Vonkka II	Huurre *et al.* 1988	KM 21466
26	Kuhmo	Vasikkaniemi SW	NBA find catalogue	KM 29136:2591 +
27	Suomussalmi	Kellolaisten Tuli	Huurre 1983	KM 14831:159a
28	Suomussalmi	Tormuan särkkä	Räihälä 1999	KM 18322:696
29	Suomussalmi	Vanha Kirkkosaari	NBA find catalogue	KM 24729:74
	NORTH KARELIA			
30	Joensuu	(Eno) Häihänniemi etelä	Pesonen, P. *pers. comm.*	KM 34119:4
31	Joensuu	(Eno) Sahaniemi	Pesonen, P. *pers. comm.*	KM 34102:4
32	Joensuu	(Pielisensuu) Mutala (Latola)	Pälsi 1937	KM 10640:8
33	Lieksa	Haasiinniemi	NBA find catalogue	KM 28066:30 +
34	Lieksa	Jongunjoki Pälvekoski	Rankama, T. *pers. comm.*	KM -
35	Lieksa	Törisevänvirta 1	Pesonen, P. *pers. comm.*	KM 35398:1
36	Nurmes	Tetrijärvi 1	Hertell, E. *pers. comm.*	KM 37583
37	Outokumpu	Kaalainsalmi	Matiskainen 1986	KM 20019:1
38	Outokumpu	Sätös	NBA find catalogue	KM 17284:409
	NORTHERN SAVONIA			
39	Pielavesi	Kivimäki	NBA find catalogue	KM 24465:570
	CENTRAL FINLAND			
40	Saarijärvi	Kalmukangas	Matiskainen 1986	KM 18092:3
41	Saarijärvi	Rusavierto (Karjalaispirtti/Rusavierto)	NBA find catalogue	KM 29406:489 +
42	Saarijärvi	Summassaari Moilanen	Matiskainen 1986	KM 12234:3 +
	SOUTHERN OSTROBOTHNIA			
43	Alajärvi	Rasi (Heikinkangas ja Rasinmäki)	Luho 1948, Matiskainen 1986	KM 11617:83 +
44	Isojoki	Rimpikangas	Katiskoski 1994	KM 25937:1
45	Kauhajoki	Koivumäki	Matiskainen 1986	KM 16416:4 +
46	Kauhajoki	Toivakka	Katiskoski 1994	KM 26355:5
47	Kuortane	(Mäyry) Haavistonharju 1	Matiskainen 1986	KM 16163: +
48	Kuortane	(Ylijoki) Lahdenkangas 1	Matiskainen 1986	KM 16856:3 +
49	Kurikka	(Myllykylä) Mäki-Venna/Mäkinen	Matiskainen 1986	KM 17077:34
50	Kurikka	(Pitkämö) Mertamäki/Palomäki	Matiskainen 1986	KM 16564:97 +
51	Kurikka	Topee (Myllykylä)	Matiskainen 1986	KM 17486:100
	SOUTHERN SAVONIA			
52	Juva	Päiväranta 1	Schulz 2002	KM 33235:1-52
53	Mäntyharju	Muurhaisniemi	Pesonen, P. *pers. comm.*	KM 36702:1-958
54	Pieksämäki	Kahvikivi	NBA find catalogue	KM 25275:534
	PIRKANMAA			
55	Punkalaidun	Rautionmaa (=Haukuri Rautee) tai Hankuri	Matiskainen 1986	KM 13669:394
56	Pälkäne	(Luopioinen) Hietaniemi Hietasenkärki	Matiskainen 1986	KM 16822:638 +

	Municipality	Site	Source	Catalogue number
	SOUTH KARELIA			
57	Luumäki	Suo-Anttila Reijonkangas	Jussila 2005	KM 36697:249
58	Taipalsaari	Mielakansaari Simolinna	Koivikko 1999	KM 31387:1 +
	KYMENLAAKSO			
59	Kotka	(Kymi) Saksala Saukko	Matiskainen 1986	KM 17541
	PÄIJÄNNE TAVASTIA			
60	Hollola	Hahmajärvi 3	Lahelma 2002	KM 32676:4 +
61	Hollola	Kapatuosia	Poutiainen 2002	KM 31511:341 +
62	Hollola	Luhdanjoki 1	Poutiainen 2002	KM 31220:4
63	Hollola	Luhdanniitty 2	Lahelma 2002	KM 33186:11 +
64	Lahti	Ristola	NBA find catalogue	KM 31452:100 +
65	Orimattila	Mikkola	NBA find catalogue	KM 31240:5
66	Orimattila	Puujoki 3	Poutiainen 2002	KM 32121:13
	TAVASTIA PROPER			
67	Hattula	Torttolanmäki 3	NBA find catalogue	KM 27723: 302 +
68	Hausjärvi	(Haminankylä) Teuronjoensuu S	Matiskainen & Ruohonen 2004	KM 33460:1-7
69	Hausjärvi	(Haminankylä) Teuronjoki	Matiskainen & Ruohonen 2004	KM 32983:117 +
70	Humppila	Järvensuo 3-4	Pesonen, P. *pers. comm.*	KM 35668:4
71	Humppila	Kuusisto	Pesonen, P. *pers. comm.*	KM 35675:2
72	Janakkala	Taurula	MJREK 2008	KM 24745:1-2705
73	Loppi	Antinnokka 1	Pesonen, P. *pers. comm.*	KM 33017:144 +
74	Loppi	Karhumäki	Matiskainen & Ruohonen 2004	KM 33461:16 +
75	Loppi	Lehtimäki	Pesonen, P. *pers. comm.*	KM 33018:48
76	Loppi	Lopenkylä (kirkonkylä) Saukonnokka	Matiskainen & Ruohonen 2004	KM 33462:131
77	Loppi	Salo Pirttiniemi	Matiskainen & Ruohonen 2004	KM 22642:1
78	Loppi	Terväntö	Matiskainen & Ruohonen 2004	KM 32623:5
79	Riihimäki	Arolammi Sinivuokkoniemi	Matiskainen 2002	KM 33457:79 +
80	Riihimäki	Silmäkenevan saari 3	Matiskainen & Ruohonen 2004, MJREK 2008	KM 34031:1-384
	FINLAND PROPER			
81	Salo	(Kisko, Sillanpää) Kuoppanummi	Sinisalo 2004	KM 33881:8
82	Salo	(Muurla) Hossannummi	Sinisalo 2004	KM 29575:20
83	Salo	(Suomusjärvi) Viitamäki	Sinisalo 2004	KM 33579:133
84	Salo	Mustionsuo NE	NBA find catalogue	KM 31082:143
85	Salo	Vuohikallio	NBA find catalogue	KM 29734:218
86	Salo	(Kisko, Kurkela) Siltapyöli	Sinisalo 2004	KM -
	UUSIMAA			
87	Askola	(Korttia) Lepistö	Matiskainen 1986	KM 12789:37
88	Askola	(Monni) Pöökäri Kotopelto (Monninkylä Kotopelto Pääkäri)	Matiskainen 1986	KM 18568:1
89	Askola	(Nalkkila) Kopinkallio	Luho 1957, Matiskainen 1986	KM 12661:350
90	Askola	(Nalkkila) Rokin Valkamaa	Luho 1967, Matiskainen 1986	KM 12260:17 +
91	Askola	(Nalkkila) Rokki Rantapelto	Matiskainen 1986	KM 18599:3
92	Askola	(Nalkkila) Takalan Ruoksmaa/Taka-Piskulan Ruoksmaa	Matiskainen 1986	KM 13067:278 +
93	Askola	(Nietoo Mattila) Tallikäärö	Luho 1957, Matiskainen 1986	KM 12506:11 +
94	Askola	(Vakkola Latoniitty) Silta-aro	Matiskainen 1986	KM 12431:1 +
95	Askola	(Vakkola) Latoniitty Jungfern	Matiskainen 1986	KM 12273:6
96	Askola	Etulinna Ruoksmaa A + B	Luho 1957, Matiskainen 1986	KM 12929:136 +
97	Askola	Juslan Suursuo	Luho 1967, Matiskainen 1986	KM 12605:22 +
98	Askola	Metsola (Pappila Perunamaa)	Matiskainen 1986	KM 12947:5
99	Askola	Pappila (Siltapellonhaka)	Matiskainen 1986	KM 12613:6
100	Askola	Pappila Perunamaa-Saunapelto	Matiskainen 1986	KM 12603:6 +
101	Askola	Pappila Siltapellonhaka II	Matiskainen 1986	KM 12601:25 +
102	Askola	Puharonkimaa Järvensuo	Matiskainen 1986	KM 12159:80 +
103	Askola	Vakkola Siltapellonhaka 1 (Siltapelto Siltapellonhaka)	Matiskainen 1986	KM 12600:6 +
104	Askola	Vakkola Tyyskä	Matiskainen 1986	KM 13138:6
105	Espoo	Bergdal	NBA find catalogue	KM 30601:91
106	Espoo	Fjälldal	NBA find catalogue	KM 29413:1
107	Espoo	Oittaa Kakola	Fast 1995	KM 29411
108	Espoo	Sperrings Hiekkakuoppa NE	Fast 1996	KM 29902:3 +
109	Hyvinkää	Joentaka	Matiskainen & Ruohonen 2004	KM 33456:402 +
110	Hyvinkää	Rantala 1	MJREK 2008	KM 32636:1
111	Kirkkonummi	Kvarntorpsåkern	Luho 1948	KM 5944:22
112	Lapinjärvi	Antasbacken	Matiskainen 1986	KM 9851:27
113	Lapinjärvi	Backmansbacken	Matiskainen 1986	KM 9106:7
114	Lapinjärvi	Gammelby	Matiskainen 1986	KM 9759:58 +
115	Lohja	Harvakkalanlahti	Leskinen 2003	KM 34278:139
116	Lohja	Hossanmäki	Pesonen & Tallavaara 2006	KM 34856:314 +
117	Nurmijärvi	Alitalo	Matiskainen 1986	KM 19787:10
118	Pornainen	Niemelä	Pesonen, P. *pers. comm.*	KM 30518:6
119	Porvoo	Henttala	Matiskainen 1986	KM 11617:83
120	Raasepori	Finnmalmen	Pesonen, P. *pers. comm.*	KM 28741:32
121	Siuntio	Suitia 1	Matiskainen 1986	KM 20873:3 +
122	Vantaa	(Kaivoksela) Gröndal 2	Matiskainen 1986	KM 18959:75
123	Vantaa	Erikas	Matiskainen 1986	KM 19430:25
124	Vantaa	Gårds	Leskinen & Pesonen 2008	KM 31081:312 +
125	Vantaa	Hommas	Koivisto 2010b	KM 37383:675 +
126	Vantaa	Jönsas	Purhonen & Ruonavaara 1994	KM 19274:349 +
127	Vantaa	Asola/Koivukylä 5	Matiskainen 1986	KM 20164:212 +
128	Vantaa	Myyrmäen Urheilupuisto (Raappavuoren urheilukenttä)	Matiskainen 1986	KM 19423:14 +

NBA = National board of antiquities

+ Indicates more than one catalogue numbers with points at the site

Appendix III. Point data

Table key:

MUN: Municipality
NBA Cat.: National Board of Antiquities catalogue number
G: Point group in the study: sth=southern group, nth=northern group
OR: Point orientation; perp=perpendicular, paral=parallel, other=other, undef=undefined
L: Point length (mm)
BAw: Basal width of the point (mm)
MXw: Maximum width of the point (mm)
BAt: Basal thickness of the point (mm)
MIDt: Midpoint thickness of the point (mm)
MXt: Maximum thickness of the point (mm)
WE: Point weight (g)
RAW: Raw material; c=chert, q=qartz, qe=quartzite, rc=rock crystal, rq=rose quartz, s=slate
INT: Intactness of the point; yes=intact, yesx= almost intact (1.5mm added to length); no=broken
THI: Occurrence of thinning; y=yes, n=no, p=possible thinning
Trat: Midpoint thickness to base thickness ratio of the point
EDa: Edge angle (°) of the point
RELt: Relative thickness (thickness/length) of the point
Wrat: Maximum width to basal width ratio of the point
Rdir: Direction of backing retouch: Li=Left inverse, Ld=Left direct, Lb=Left both directions, Ln=Left no retouch, Ri= Right inverse, Ld= Right direct, Rb= Right both directions, Rn=Right no retouch
Omod: Other modifications: LA=Left margin abraded, RA=Right margin abraded, LRA=Both margins abraded, BA=Abraded base, SB= Snapped base, Sib= Semi-invasive backing

MUN	SITE	NBA Cat.	G	OR	L	BAw	MXw	BAt	MIDt	MXt	WE	RAW	INT	THI	Trat	EDa	RELt	Wrat	Rdir	Omod
ALAJÄRVI	Rasi	11771:2	sth	perp	25.4	5.2	13.6	3.6	5.1	6.2	1.6	q	y	y	1.417	43	0.244	2.615	LiRi	LRA
	Rasi	11771:3	sth	perp	29.6	6.4	15.1	4.1	4.6	4.8	2.1	q	y	n	1.122	50	0.162	2.359	LbRb	LRA
	Rasi	11771:4	sth	perp	22.6	6	13.2	3.3	3.7	3.7	1.1	q	y	n	1.121	50	0.164	2.2	LdRd	
	Rasi	11771:6	sth	undef	26	6.8	15	6.6	4.3	6.6	1.9	q	y	y	0.652	52	0.254	2.206	LiRi	
	Rasi	11771:7	sth	perp	24.9	4.8	12.5	3.6	5.2	5.2	1.4	q	yx	n	1.444	53	0.209	2.604	LbRb	
	Rasi	11771:9	sth	undef	16	7.3	12.7	3.3	3.9	3.9	0.7	rc	y	y	1.182	63	0.244	1.74	LbRd	
	Rasi	11771:10	sth	perp	15	6.1	10.1	2.5	3.9	3.9	0.6	rc	y	y	1.56	66	0.26	1.656	LnRi	LA
	Rasi	11771:11	sth	perp	21.9	6.5	14.8	4.4	4.8	4.8	1.5	q	yx	n	1.091	50	0.219	2.277	LdRd	
	Rasi	11771:15	sth	perp	25.4	8.1	11.9	5.1	3.6	5.1	1.6	rc	y	n	0.706	59	0.201	1.469	LiRb	
	Rasi	11771:16	sth	undef	22	5	11.8	5	4	5	1.3	q	y	n	0.8	49	0.227	2.36	LdRi	
	Rasi	11771:17	sth	perp	27	6.5	14.1	3.9	5.2	5.2	2.2	q	y	n	1.333	117	0.193	2.169	LdRd	
	Rasi	11771:18	sth	perp	20.9	6.4	11.7	3.2	4.1	4.1	1	q	y	n	1.281	49	0.196	1.828	LbRb	
	Rasi	11771:25	sth	perp	20	8	13.6	3.7	4.5	4.5	1.3	q	n	n	1.216	36	0.225	1.7	LiRi	
	Rasi	11771:32	sth	perp	14.9	6.3	8.1	2.8	3.5	3.5	0.5	q	y	n	1.25	60	0.235	1.286	LdRi	
	Rasi	11895:2	sth	perp	22.6	6.7	10.9	2.5	3.2	3.2	0.8	q	yx	n	1.28	56	0.142	1.627	LbRi	
	Rasi	11895:26	sth	perp	30.6	7.5	12.7	4.8	4.7	4.8	1.9	q	yx	y	0.979	36	0.157	1.693	LdRb	
	Rasi	11895:51	sth	perp	14.9	5.8	12.7	1.7	2.5	2.8	0.6	q	y	n	1.471	90	0.188	2.19	LnRd	LA
	Rasi	11895:66	sth	paral	16.9	7.4	11.2	3.2	5.2	5.2	1.1	rc	y	n	1.625	66	0.308	1.514	LiRb	
	Rasi	11895:85	sth	undef	22.4	3.4	14.8	4.3	5	5.8	1.5	q	y	n	1.163	65	0.259	4.353	LdRn	RA
	Rasi	11895:91	sth	perp	21.3	4.4	10.9	2.9	3.3	3.6	1	q	y	y	1.138	35	0.169	2.477	LiRi	
	Rasi	11895:116	sth	perp	16.1	4	8.7	2.3	3.4	3.4	0.5	rc	y	n	1.478	74	0.211	2.175	LiRn	
ASKOLA	Etulinna Ruoksmaa A	12929:136	sth	perp	16	5.7	9.2	2.8	4	4	0.5	q	y	n	1.429	51	0.25	1.614	LiRb	
	Etulinna Ruoksmaa A	12929:187	sth	undef	17.4	3.6	9.5	1.8	3.9	3.9	0.6	q	y	p	2.167	97	0.224	2.639	LiRi	BA
	Etulinna Ruoksmaa A	12929:293	sth	undef	11.5	6.4	8.8	3.7	4.1	4.1	0.5	q	y	n	1.108	90	0.357	1.375	LiRd	
	Etulinna Ruoksmaa B	12372:16	sth	undef	17.9	6.5	12.1	4.2	4.3	4.3	0.9	q	y	n	1.024	51	0.24	1.862	LiRn	
	Etulinna Ruoksmaa B	12372:17	sth	perp	16.8	7.1	12.4	2.9	4.1	4.1	0.8	q	y	n	1.414	88	0.244	1.746	LiRd	
	Pappila Perunamaa-saunap.	12603:90	sth	perp	22.5	5.3	9.5	3.1	3.8	3.8	0.8	q	y	n	1.226	30	0.169	1.792	LiRd	
	Pappila Perunamaa-saunap.	13068:146	sth	undef	20.6	3	9.6	1.7	1.9	1.9	0.5	s	n	n	1.118	-	0.092	3.2	LiRd	
	Pappila Perunamaa-saunap.	13068:242	sth	perp	20.9	5	10.5	3.2	4.6	4.6	1.2	q	y	n	1.438	52	0.22	2.1	LiRb	LA
	Puharonkimaa Järvensuo	12159:80	sth	perp	19.3	5.5	12.1	2.4	3.5	3.5	0.8	rq	y	y	1.458	42	0.181	2.2	LdRn	
	Puharonkimaa Järvensuo	12159:81	sth	undef	27.5	5.3	10.8	3.5	5	5	1.7	q	n	n	1.429	55	0.182	2.038	LbRb	
	Puharonkimaa Järvensuo	12788:19	sth	perp	21.5	3.8	9.8	2.4	3.5	3.5	0.7	q	y	n	1.458	41	0.163	2.579	LiRi	
	Puharonkimaa Järvensuo	12940:20	sth	paral	12.8	4.7	8.1	2.3	2	2.3	0.3	q	n	p	0.87	-	0.18	1.723	LiRi	
	Puharonkimaa Järvensuo	12940:20	sth	perp	16	5.3	9.5	2.4	3.8	3.8	0.6	q	y	n	1.583	63	0.237	1.792	LiRn	RA
	Rokin Valkamaa	12260:32	sth	undef	14.9	3.7	11.5	3.5	3.4	3.5	0.5	q	n	n	0.971	-	0.235	3.108	LbRd	
	Rokin Valkamaa	12260:195	sth	perp	12.6	6	9.7	2.7	3.4	3.4	0.5	q	n	n	1.259	-	0.27	1.617	LbRn	
	Rokin Valkamaa	12260:237	sth	undef	18.7	4.9	10.4	2.8	4.3	4.3	0.8	q	y	y	1.536	50	0.23	2.122	LbRd	
	Rokin Valkamaa	12346:17	sth	perp	16.1	6.7	10	1.5	4.1	4.1	0.7	q	y	n	2.733	80	0.255	1.493	LdRi	
	Silatpellonhaka	12601:68	sth	undef	25.5	4.5	12.9	2.8	3.5	3.5	1.1	rc	n	n	1.25	-	0.137	2.867	LiRi	
	Silta-aro	12431:3	sth	paral	25.6	8.2	15.3	5	4.2	4.2	1.8	q	y	p	0.84	46	0.164	1.866	LnRi	
	Siltapellonhaka 1	12600:25	sth	perp	15.7	2.3	9.8	2.7	3.9	3.9	0.6	q	y	n	1.444	73	0.248	4.261	LiRi	
	Siltapellonhaka 1	12600:79	sth	perp	14.8	4.4	7.8	1.5	2.8	2.8	0.4	q	y	n	1.867	76	0.189	1.773	LiRi	
	Siltapellonhaka 1	12600:81	sth	undef	21.7	5.9	11.4	4.3	4	4.3	1.1	q	y	n	0.93	39	0.198	1.932	LnRd	
	Siltapellonhaka 1	12600:95	sth	undef	18.6	3.3	8.6	2.1	3	3	0.4	q	yx	n	1.429	58	0.161	2.606	LiRi	
	Siltapellonhaka 1	12600:126	sth	perp	24.4	3.5	9.7	3.5	5.5	5.5	1.5	q	y	n	1.571	90	0.225	2.771	LiRi	
	Siltapellonhaka 1	12600:187	sth	undef	13.3	4.6	9.5	2.4	2.1	3	0.4	rc	y	y	0.875	70	0.226	2.065	LbRb	LRA
	Siltapellonhaka 1	12933:419	sth	undef	14.4	3.5	8.2	2.1	1.8	2.3	0.3	q	y	n	0.857	67	0.16	2.343	LnRi	
	Siltapellonhaka 1	12933:842	sth	perp	31.7	7	12.3	3.2	5.8	5.8	2.2	q	y	n	1.813	35	0.183	1.757	LnRi	
	Takalan Ruoksmaa	13067:278	sth	undef	18.8	6.6	11	4.1	5.3	5.3	1.2	q	y	y	1.293	55	0.282	1.667	LiRi	
	Takalan Ruoksmaa	13067:302	sth	perp	21.2	5.7	13.1	3.4	4.1	4.6	1.2	q	y	y	1.206	57	0.217	2.298	LbRd	
	Takalan Ruoksmaa	13067:326	sth	perp	15.6	4.2	6.4	3	3.8	3.8	0.5	q	n	n	1.267	86	0.244	1.524	LiRn	
	Takalan Ruoksmaa	13067:358	sth	perp	17.8	2.8	8.3	2.5	3.8	3.8	0.6	q	y	n	1.52	62	0.213	2.964	LiRb	
	Takalan Ruoksmaa	13067:387	sth	paral	15.1	6.2	9	2.9	1.9	2.9	0.4	q	n	p	0.655	64	0.192	1.452	LiRn	
	Takalan Ruoksmaa	13067:445	sth	perp	16.2	4.6	11.4	2.9	4.5	4.5	0.7	q	y	n	1.552	77	0.278	2.478	LiRi	
ENONTEKIÖ	Museotontti	23877:122	nth	perp	23.9	4.9	14.7	2.7	5	5	1.4	q	y	n	1.852	48	0.209	3	LbRi	
	Museotontti	23877:411	nth	undef	14.7	6.6	10.6	3.2	2.8	3.2	0.5	q	y	n	0.875	75	0.218	1.606	Indet	
	Museotontti	23877:455	nth	paral	11.9	5.3	9.2	2.9	2.1	2.9	0.3	q	y	y	0.724	94	0.244	1.736	LiRn	
	Museotontti	23877:491	nth	undef	19	5.6	9.2	2.7	3.5	3.5	0.7	q	yx	y	1.296	40	0.184	1.643	LbRb	
	Museotontti	23877:537	nth	perp	13.9	4.4	8.8	2.1	1.8	2.1	0.3	q	y	n	0.857	58	0.151	2	LdRd	SB
	Museotontti	24464:289	nth	perp	22.7	5.8	12.5	1.7	4	4	1.2	q	y	p	2.353	80	0.176	2.155	LiRi	
	Museotontti	24464:329	nth	perp	14.5	3.9	9	1.8	3.1	3.1	0.3	q	y	n	1.722	101	0.214	2.308	LiRn	
	Museotontti	24464:620	nth	perp	22.2	7	13.6	3.9	4.7	4.7	1.4	q	yx	y	1.205	58	0.212	1.943	LdRd	
ESPOO	Sperrings Hiekkakuoppa NE	29902:3	sth	undef	17.1	7	10.2	3.1	3.9	4.6	0.8	rc	y	y	1.258	38	0.269	1.457	Indet	

MUN	SITE	NBA Cat.	G	OR	L	BAw	MXw	BAt	MIDt	MXt	WE	RAW	INT	THI	Trat	EDa	RELt	Wrat	Rdir	Omod
HOLLOLA	Kapatuosia	31511:95	sth	other	17.1	3.1	12.2	2.7	3.3	3.3	0.6	rc	y	y	1.222	64	0.193	3.935	LiRn	
	Kapatuosia	31511:112	sth	perp	13.3	7.4	13	3.2	2.4	3.1	0.6	rc	y	n	0.75	62	0.233	1.757	LiRi	LA
	Kapatuosia	31511:142	sth	undef	15	8	12.4	3.5	3.1	3.5	0.6	q	yx	n	0.886	64	0.233	1.55	LiRi	
	Kapatuosia	31511:152	sth	undef	19.3	5.5	11.9	3.9	4	4	0.9	q	y	y	1.026	66	0.207	2.164	LdRb	
	Kapatuosia	31511:235	sth	perp	16.5	5.9	11.2	3.5	5.1	5.1	1.1	q	y	y	1.457	90	0.309	1.898	LiRi	
	Kapatuosia	31511:241	sth	undef	20.1	7.2	11	3.2	4.1	4.1	1	q	y	n	1.281	74	0.204	1.528	Indet	
	Kapatuosia	31511:360	sth	perp	20.4	7.5	12.2	2.3	4.1	4.1	1	q	yx	n	1.783	58	0.201	1.627	LdRn	RA
	Kapatuosia	31511:393	sth	perp	24.6	6.9	14.1	3.7	5.2	5.2	2.2	q	y	p	1.405	66	0.211	2.043	LiRb	
	Kapatuosia	31511:396	sth	perp	15.1	7.9	14.7	1.9	3.4	3.4	0.7	q	n	n	1.789	55	0.225	1.861	LiRd	
	Kapatuosia	31511:407	sth	perp	19	6.9	12.9	3.1	5.3	5.3	1.4	q	n	n	1.71	50	0.279	1.87	LbRn	
	Kapatuosia	31511:498	sth	perp	23.2	7.1	13.5	3.1	5.2	5.2	1.6	q	y	p	1.677	75	0.224	1.901	LbRb	
	Kapatuosia	31511:532	sth	perp	15.7	6.7	13.9	2.2	3.6	3.6	0.8	q	y	n	1.636	61	0.229	2.075	LdRi	SB
	Kapatuosia	31511:536	sth	undef	20.6	3.6	8.9	4	4.1	4.1	0.7	q	n	n	1.025	50	0.199	2.472	LiRn	
	Kapatuosia	31511:541	sth	perp	16.7	6.6	13.5	4.8	4.6	4.6	1.1	q	y	y	0.958	49	0.275	2.045	LdRb	
	Kapatuosia	31511:563	sth	perp	21.7	5.7	14	2.9	4.9	4.9	1.8	q	y	y	1.69	68	0.226	2.456	LdRb	
	Kapatuosia	31511:564	sth	perp	16	8.5	14.6	4.3	5.2	5.2	1.3	q	y	n	1.209	68	0.325	1.718	LbRi	SB
	Kapatuosia	31511:572	sth	perp	20.9	5.9	11.8	4.9	3.3	4.9	1	q	y	n	0.673	48	0.234	2	LiRi	
	Kapatuosia	31511:744	sth	perp	21.8	6.7	13.4	2	2.9	2.9	0.8	rc	y	y	1.45	111	0.133	2	LiRd	Sib
	Kapatuosia	31511:753	sth	perp	18.2	5	11.6	2.3	4.1	4.1	0.7	rc	y	n	1.783	42	0.225	2.32	LbRi	
	Kapatuosia	31511:756	sth	paral	24.8	6.2	13.9	2.2	3.6	3.6	1.3	q	y	y	1.636	51	0.145	2.242	LdRi	
	Kapatuosia	31511:763	sth	undef	20.3	8.3	11.5	4.5	4.1	4.1	1.2	q	y	n	0.911	64	0.202	1.386	LnRb	Sib
	Kapatuosia	31511:769	sth	undef	17.8	6.1	11	3.4	3.8	3.8	0.9	q	y	y	1.118	75	0.213	1.803	LdRd	SB
	Kapatuosia	31511:816	sth	perp	19.1	6	9.9	3.2	5.3	5.3	1.1	q	y	n	1.656	55	0.277	1.65	LiRb	
	Kapatuosia	31511:907	sth	perp	13.7	7.1	9	2.3	3.3	3.8	0.6	q	y	n	1.435	86	0.277	1.268	LiRi	
	Kapatuosia	31511:912	sth	perp	16.2	6.2	9.2	2.6	3.6	3.6	0.6	q	y	n	1.385	70	0.222	1.484	LdRd	SB
INARI	Ahkioniemi 1&2	23363:4	nth	paral	19.8	5	10.9	1.3	2.1	2.1	0.4	c	yx	y	1.615	116	0.106	2.18	LiRi	
	Kaunisniemi 2	26039:42	nth	paral	25.9	4.5	10.6	3.3	2.9	3.3	0.6	c	y	n	0.879	146	0.127	2.356	LiRi	
	Kaunisniemi 3	26040:2	nth	perp	14.1	4.2	7.7	2.7	4	4	0.3	c	y	n	1.481	63	0.284	1.833	LdRd	
	Kaunisniemi 3	26040:5	nth	other	17.1	4.9	14.4	1.3	4.3	4.3	1.1	rc	n	n	3.308	-	0.251	2.939	LiRi	
	Kaunisniemi 3	26040:35	nth	perp	16.6	6.8	10.1	1.6	3.5	3.5	0.6	qe	y	p	2.188	61	0.211	1.485	LiRn	
	Kaunisniemi 3	26040:53	nth	perp	12.3	3.4	7.8	2	2.6	2.6	0.3	rc	y	n	1.3	45	0.211	2.294	LdRi	
	Kirakkajoen voimala	26245:1	nth	undef	20.6	4.8	11.1	3.2	5.1	5.1	0.9	c	n	n	1.594	-	0.248	2.313	LiRi	
	Nellimjoen suu S	24375:454	nth	perp	14.7	3.7	8.8	1.5	3.1	3.1	0.4	c	y	n	2.067	101	0.211	2.378	LdRi	
	Satamasaari	26010:4	nth	undef	23.7	5.6	12.9	2.8	4.4	4.4	0.8	c	yx	n	1.571	46	0.186	2.304	LdRd	
	Supru	22685:13	nth	perp	24.4	4	9.7	4.8	4	4.8	1	q	yx	n	0.833	35	0.197	2.425	LdRi	SB, BA
	Vuopaja	28365:442	nth	perp	12.9	7.4	9.5	2.7	3.7	3.7	0.5	c	y	p	1.37	69	0.287	1.284	LiRi	
	Vuopaja	28365:446	nth	paral	21.8	3.5	14.2	2.2	2.4	2.6	0.6	c	y	n	1.091	86	0.119	4.057	LiRi	
	Vuopaja	28365:454	nth	perp	20.1	4.6	12.6	2.6	3.4	3.4	0.7	c	y	y	1.308	76	0.169	2.739	LiRi	
	Vuopaja	28365:660	nth	paral	22.5	3.6	10	2.3	3	3	0.6	c	y	n	1.304	59	0.133	2.778	LbRd	
	Vuopaja	28365:673	nth	perp	23.6	4.6	10.5	2.3	4.1	4.1	0.9	c	yx	n	1.783	48	0.174	2.283	LdRd	
	Vuopaja	28365:692	nth	paral	13.4	4.9	9.6	2.3	3.1	3.1	0.4	qe	n	n	1.348	-	0.231	1.959	LiRd	
	Vuopaja	28365:889	nth	other	21.7	6.4	13.2	1.6	3.3	3.3	0.6	c	y	n	2.063	37	0.152	2.063	LiRi	
KEMIJÄRVI	Lautasalmi	15846:78	sth	perp	15	3.8	8.7	1.6	3.7	3.7	0.5	c	y	n	2.313	78	0.247	2.289	LiRi	SB
	Neitilä 4	16145:1750	sth	perp	15.4	6.6	12.2	3.4	3.5	3.5	0.7	rc	y	n	1.029	60	0.227	1.848	LbRn	
KUORTANE	Lahdenkangas 1	16856:19	sth	perp	18.6	4.2	12.6	2.8	3.8	3.8	0.8	q	y	n	1.357	75	0.204	3	LdRn	
	Lahdenkangas 1	16856:24	sth	undef	14.6	6.7	13.4	3.3	3.6	3.6	0.8	q	y	n	1.091	72	0.247	2	LnRn	Sib
	Lahdenkangas 1	16856:38	sth	perp	17.7	4.1	12.7	4.2	5	5	1.1	q	y	p	1.19	51	0.282	3.098	LdRn	Sib
LOHJA	Hossanmäki	34856:52	sth	other	18.8	4.3	8.4	2.1	3.9	3.9	0.5	q	yx	n	1.857	-	0.207	1.953	LiRb	Sib
	Hossanmäki	34856:314	sth	undef	14.3	5.3	10.2	2.4	3.7	3.7	0.6	q	y	n	1.542	71	0.259	1.925	LbRn	Sib
	Hossanmäki	34856:335	sth	perp	21	7.5	13.9	2.8	4.3	4.3	1.4	q	y	y	1.536	74	0.205	1.853	LnRn	Sib
	Hossanmäki	34856:337	sth	perp	15.7	7.9	13.1	5.1	4.1	5.1	1	rc	y	y	0.804	67	0.325	1.658	LbRi	
	Hossanmäki	34856:366	sth	paral	15.6	11	12.9	4.3	4	4.3	1	q	y	n	0.93	84	0.276	1.173	LiRn	
	Hossanmäki	34856:402	sth	perp	15.2	3.7	7	2	2.6	2.6	0.4	q	n	n	1.3	-	0.171	1.892	LiRi	
	Hossanmäki	34856:460	sth	undef	15	5.3	12.1	2.6	4.4	4.4	0.7	rc	n	n	1.692	-	0.293	2.283	LiRi	
	Hossanmäki	34856:490	sth	perp	13.1	4.1	8.8	2.1	3.1	3.1	0.3	q	y	n	1.476	41	0.237	2.146	LiRi	LRA
LOPPI	Antinnokka 1	33017:144	sth	undef	17.8	5.2	10.4	2.2	4.3	4.3	0.7	q	y	n	1.955	50	0.242	2	LdRi	
	Antinnokka 1	33017:548	sth	perp	18.7	8.1	13	2.3	3.2	3.2	0.9	q	y	n	1.391	72	0.171	1.605	LiRi	
	Karhumäki	33461:16	sth	perp	17	5.9	10.3	2.4	3.2	3.2	0.7	q	y	y	1.333	69	0.188	1.746	LiRi	
	Karhumäki	33461:18	sth	perp	11.8	3.2	6.6	2	3	3	0.3	q	y	p	1.5	88	0.254	2.063	LiRi	
	Karhumäki	33461:145	sth	perp	20.9	6.7	12.1	3.9	4	4	0.8	q	yx	p	1.026	45	0.191	1.806	LiRd	
	Karhumäki	33461:155	sth	undef	13.7	5.7	9.9	1.6	2.6	2.6	0.5	q	y	n	1.625	65	0.19	1.737	LiRd	
	Karhumäki	33461:158	sth	perp	16	5	10	3	2.8	3	0.5	q	y	n	0.933	74	0.188	2	LdRb	
	Karhumäki	33461:160	sth	perp	28.4	7.8	14.3	3.2	6.7	6.7	2.9	q	y	n	2.094	101	0.236	1.833	LnRi	LA
	Karhumäki	33461:161	sth	perp	11.7	7.3	11.5	1.3	3.1	3.1	0.5	q	y	n	2.385	73	0.265	1.575	LdRi	Sib
	Karhumäki	33461:164	sth	undef	18	6.1	11.6	3.2	3.5	3.5	0.8	q	y	y	1.094	69	0.194	1.902	LiRn	
	Karhumäki	33461:165	sth	perp	14.2	6.7	10.7	2.8	4	4	0.7	q	y	n	1.429	86	0.282	1.597	LiRi	
	Karhumäki	33461:169	sth	undef	17.5	7.2	12	3.4	3.7	3.7	0.8	q	y	p	1.088	64	0.211	1.667	LnRd	
	Karhumäki	33461:193	sth	perp	13.4	5.4	8.9	1.5	2.5	2.5	0.3	rc	y	n	1.667	62	0.187	1.648	LiRd	
	Karhumäki	33461:200	sth	perp	26.8	6.8	13.4	3.5	4.7	4.7	1.7	q	yx	n	1.343	61	0.175	1.971	LdRb	
	Karhumäki	33461:208	sth	undef	13.3	5.1	9.3	2.5	3.5	3.5	0.4	q	y	n	1.4	68	0.263	1.824	LbRi	
	Karhumäki	33461:209	sth	perp	11.3	6.1	10	2.1	2.9	2.9	0.3	q	y	y	1.381	86	0.257	1.639	LiRb	Sib
	Lehtimäki	33018:48	sth	perp	23.2	9	13.4	2.4	5.1	5.1	1.4	q	y	p	2.125	35	0.22	1.489	LiRn	RA
PELLO	Kaaraneskoski	30721:322	sth	undef	14.8	3.9	8.4	3.1	3.3	3.3	0.6	s	y	n	1.065	54	0.223	2.154	LiRi	
	Kaaraneskoski	31377:98	sth	undef	7.5	4.8	7.8	2.1	-	-	0.1	q	n	n	-	-	-	1.625	LiRi	
	Kaaraneskoski	31377:146	sth	undef	18.1	2.5	11.7	3.6	3.1	3.6	0.7	rc	n	n	0.861	35	0.199	4.68	LnRd	
SIUNTIO	Suitia 1	20873:3	sth	perp	13.8	7.5	11	1.9	3.4	3.4	0.6	rc	n	n	1.789	-	0.246	1.467	LiRd	
	Suitia 1	20873:110	sth	perp	14.9	8.3	10.8	3.3	4	4	0.6	rc	y	y	1.212	61	0.268	1.301	LnRi	
	Suitia 1	20873:116	sth	undef	20.3	8.7	11.5	3.2	3.4	3.4	1	q	y	n	1.063	69	0.167	1.322	LiRn	
	Suitia 1	20873:122	sth	perp	19.1	6.8	13.9	3.6	4.6	4.6	1.1	q	y	n	1.278	69	0.241	2.044	LiRb	
	Suitia 1	20873:127	sth	perp	21.5	6.2	11.7	2.7	3.7	3.7	0.8	q	y	n	1.37	68	0.172	1.887	LiRn	
	Suitia 1	20873:205	sth	undef	18	5.7	12.3	4	3.4	4	0.9	q	y	y	0.85	60	0.222	2.158	LiRn	
	Suitia 1	20873:207	sth	undef	16.7	5.6	11.2	2.8	3.7	3.7	0.7	q	y	n	1.321	51	0.222	2	LnRi	
	Suitia 1	20873:267	sth	undef	13.6	5.4	9	2.1	3	3	0.4	q	n	n	1.429	-	0.221	1.667	LdRn	
UTSJOKI	Mávdnaávži 2	34675:5+ :21	nth	perp	23.9	6.3	10.8	1.6	2.6	2.6	0.6	c	yx	n	1.625	53	0.109	1.714	LiRb	
	Mávdnaávži 2	34675:7	nth	other	21.8	3	13.9	3	2.6	3.3	0.8	c	n	n	0.867	59	0.151	4.633	LiRi	
	Mávdnaávži 2	34675:13+ :214	nth	perp	24.4	5.5	12.9	1.5	1.8	1.8	0.5	c	yx	n	1.2	-	0.074	2.345	Indet	
	Mávdnaávži 2	34675:147	nth	paral	22.3	4.2	9	1.8	2.6	2.6	0.6	c	y	n	1.444	49	0.117	2.143	LiRb	
	Mávdnaávži 2	34675:164	nth	paral	23	4.2	9.5	2.6	2.6	2.6	0.6	c	n	n	1	-	0.113	2.262	LdRd	
	Mávdnaávži 2	34675:199	nth	undef	17.3	5.5	8.6	2.6	4.1	4.1	0.8	c	y	y	1.577	71	0.237	1.564	LiRi	
	Mávdnaávži 2	34675:222+:104	nth	paral	28.3	7.1	12.7	3.3	3.5	3.5	1.1	c	yx	n	1.061	123	0.124	1.789	LdRn	
	Mávdnaávži 2	34675:223+:234	nth	undef	22.5	7.4	11.5	1.8	1.7	1.8	0.4	c	yx	n	0.944	53	0.08	1.554	LiRb	
	Mávdnaávži 2	34675:225	nth	paral	21.7	4.6	12.1	2.9	3.8	3.8	0.7	c	y	p	1.31	120	0.175	2.63	LiRd	
	Mávdnaávži 2	34675:261	nth	paral	15.9	6.3	9.2	3	2.6	3	0.4	c	n	n	0.867	-	0.189	1.46	LiRi	
	Mávdnaávži 2	34675:317	nth	perp	18.5	4.7	9	2	2.8	2.8	0.5	c	yx	n	1.4	40	0.151	1.915	LiRi	
	Mávdnaávži 2	34675:335	nth	paral	15.8	4.1	11.6	2.8	2.6	2.8	0.4	c	y	y	0.929	58	0.177	2.829	LiRi	

Appendix IV. Radiocarbon dated contexts with oblique points in Finland

Riihimäki Arolammi 7D Sinivuokkoniemi

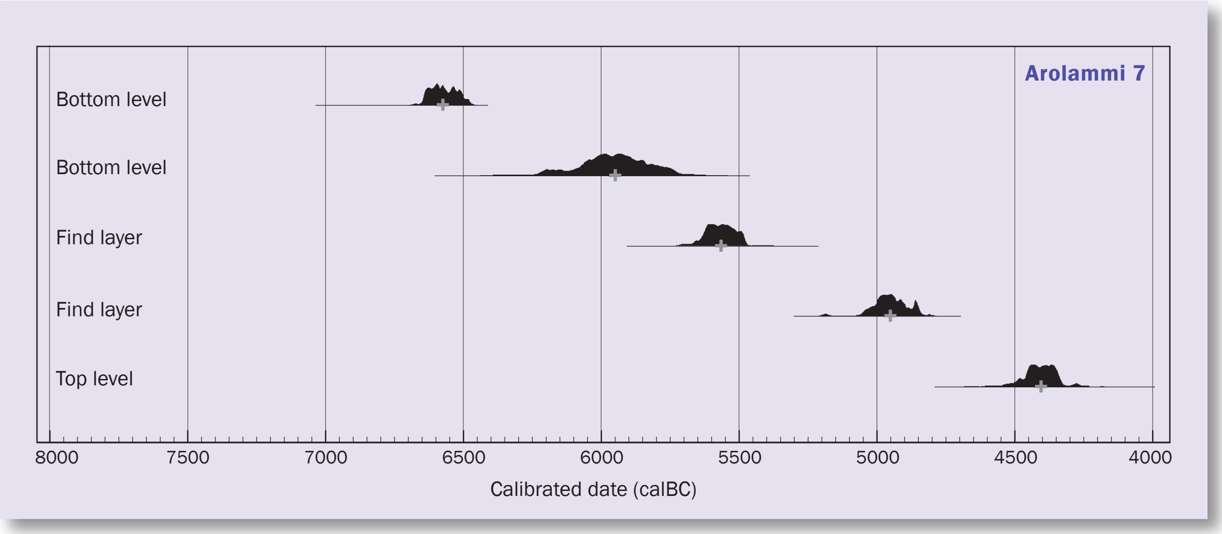
Location (ETRS89): 60° 41' 22.103" N, 24° 46' 53.906" E

General: The Arolammi 7 wetland site has yielded several Late Mesolithic (including pottery-Mesolithic) radiocarbon dates and finds. Excavations have been conducted in different parts of the site. Area 7D has yielded a stratigraphically sealed layer of organic material, Late Mesolithic radiocarbon dates, and lithic artefact types. In total, 45 square metres have been excavated. The lithic artefacts (134 in total) from area 7D include three oblique points (e.g., KM 33457:79). (Matiskainen 2002; Matiskainen & Ruohonen 2004.)

Dated context: Two dates (GIN-11037 & GIN-11042) from area 7D come from the sealed find layer containing the oblique points. These dates are supplemented by three more radiocarbon dates: GIN-11746 and GIN-11039, both of which originate from the bottom level below the find layer, and GIN-11042, which comes from the top level above the find layer. All of the samples except for GIN-11746 come from the same trench with an area of 5 square metres. (Matiskainen 2002.) The dates indicate that oblique points were used at the site sometime around *c.* 5700–4800 calBC.

Lab. number, sample type, and un-calibrated and calibrated (2σ) dates:

1. GIN-11746, charcoal, 7750±40 BP, **6650–6490 calBC**
2. GIN-11039, charcoal, 7080±120 BP, **6210–5730 calBC**
3. GIN-11037, charcoal, 6050±40 BP, **5060–4840 calBC**
4. GIN-11042, charcoal, 6630±70 BP, **5670–5470 calBC**
5. GIN-11038, charcoal, 5560±60 BP, **4530–4270 calBC**



Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Vantaa Hommas

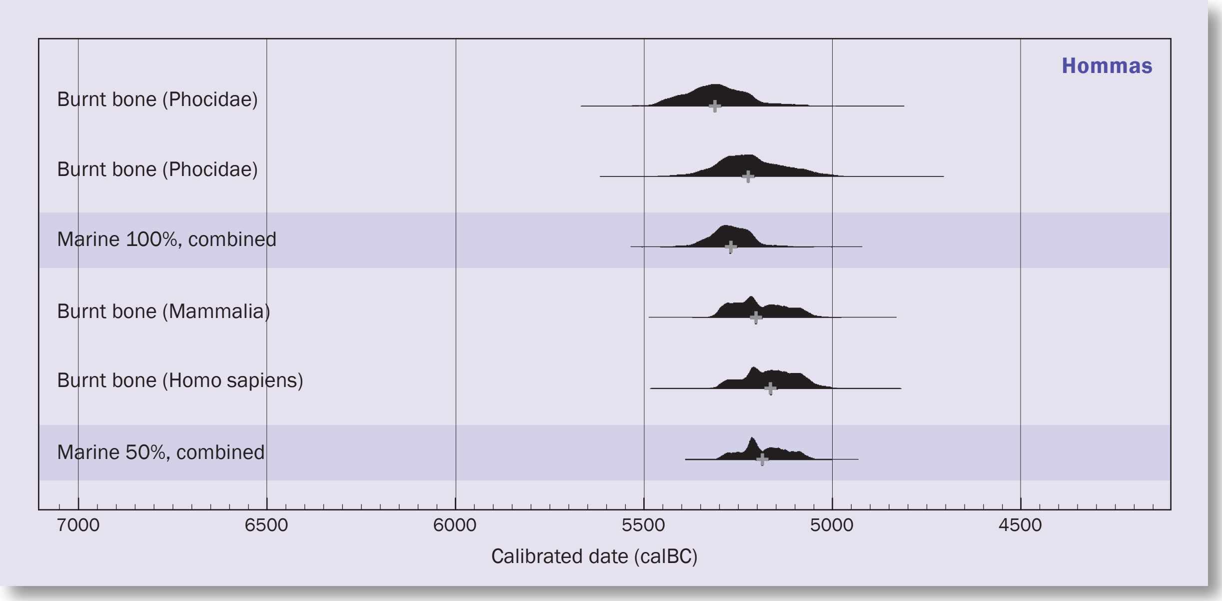
Location (ETRS89): 60° 18' 48.074" N, 24° 53' 21.629" E

General: The site was used in at least two different time periods: a Neolithic occupation mainly located in a lower elevation and a Mesolithic occupation located in a sheltered terrace at *c.* 35 m.a.s.l. Two excavation areas that are roughly 120 square metres in total were excavated in the Mesolithic occupation area. The larger of the two excavated areas (Area 1) yielded a relatively homogenous scatter of quartz artefacts, 19 ground adzes or fragments thereof, and three concentrations of burnt bone. The quartz artefacts include six oblique points and three possible oblique points (KM36869:122; KM 37383:396, :675, :958, :2685, :2884, 2902, :2947, :3103). Four Late Mesolithic radiocarbon dates were obtained from burnt bone in Area 1. A fifth sample from a test pit in the same terrace yielded a Neolithic date, but according to the artefactual evidence, Area 1 was mainly used in the Late Mesolithic and there appears to be only minor later disturbance. The dated samples originate from a 7x7 metres area that included three bone concentrations, a stone hearth, and five oblique points. The dates are in good agreement with the shore displacement date of the site. (Koivisto 2010a, b.)

Dated context: The radiocarbon dates are spread over a *c.* 5 metres long area parallel to the edge of the terrace and can be considered to date the Mesolithic occupation, including the oblique points. Two samples (Hela-2051 and Hela-2054) originate from the same concentration of burnt bone and although only one of the bones has been identified to the species (*Homo sapiens*), the proximity of the samples (*c.* 25 cm apart) and the similarity of the dating results suggest that both samples come from the same individual. Samples Hela-2052 and Hela-2053 originate some five metres north and north-east of the two other samples.

Lab. number, sample type, and un-calibrated and calibrated (2σ) dates:

1. Hela-2052, burnt bone (Phocidae), 6647±41 BP, **5460–5120 calBC**
2. Hela-2053, burnt bone (Phocidae), 6563±41 BP, **5380–5010 calBC**
3. Hela-2051, burnt bone (Mammalia), 6382±41 BP, **5300–5070 calBC**
4. Hela-2054, burnt bone (*Homo sapiens*), 6359±39 BP, **5280–5060 calBC**



Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010). Hela-2052 and Hela-2053 calibrated using Marine09 calibration curve (Reimer *et al.* 2009) with Delta_R LocalMarine -80 (Olsson 1980; Stuiver *et al.* 1986–2010). Hela-2051 and Hela-2054 calibrated using a combination of corrected Marine09 (Delta_R LocalMarine -80) and IntCal 09 curves, with estimated 50% terrestrial and 50% marine diet. Atmospheric and marine data from Reimer *et al.* (2009).

Kuortane Lahdenkangas 1

Location (ETRS89): 62° 42' 34.03" N, 23° 32' 14.39" E

General: The estimated size of the site is 75x10 metres, of which 24 square metres have been excavated. The excavation was conducted and finds were collected in two square metre units. The area included a concentration of burnt bone (*c.* 650 g) extending in four excavation squares. Within these squares also five quartz artefacts reported as oblique points were encountered. No later prehistoric disturbance has been observed on the site. (Luho 1967:84–87.) A fragment of elk bone (KM 16856:23, Mannermaa 2010) from excavation square I:5 within the bone concentration was selected for radiocarbon dating. Three (KM 16856:19, :24, :38) of the five reported points were accepted as oblique points in the analysis conducted in this study.

Dated context: Burnt bone concentration (square I:5). One oblique point made of quartz (KM 16856:19) was found in the same excavation square. Two more points were found in adjacent squares.

Lab. number, sample type, and un-calibrated and calibrated (2σ) date:

1. Ua-40898, burnt bone (*Alces alces*), 7284±42 BP,
6230–6060 calBC

Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Alajärvi Rasi

Location (ETRS89): 62° 59' 38.96" N, 23° 42' 58.791" E

General: The site is part of larger site complex (Heikinkangas ja Rasinmäki/Rasi). Some 217 square metres have been excavated at the Rasi site to date. The excavation was conducted and finds collected in one square metre units. In total, 22 hearths and a pit filled with burnt bones were documented in the excavation. The finds consist of burnt bone and slate and quartz artefacts, including 39 artefacts that were reported as intact or broken points with oblique or transverse cutting edges. No clear later prehistoric disturbance in the find layer was observed during excavation. (Luho 1948; 1967:89–93.) Of the reported points, 25 were included in the analysis conducted for the purpose of this paper, and of these points, 21 were considered to be oblique points. A fragment of burnt bone (KM 11771:134) from a large terrestrial mammal (Mannermaa 2010; *pers. comm.*) was selected for dating. The sample derives from excavation square VI:16 and is part of a concentration of burnt bone covering approximately four square metres. Square VI:16 also yielded two oblique points (KM 11771:6 and :25).

Dated context: Burnt bone concentration in square VI:16.

Lab. number, sample type, and un-calibrated and calibrated (2σ) date:

1. Ua-40894, burnt bone (Mammalia), 6981±92 BP,
6030–5680 calBC

Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Utsjoki Jomppalanjärvi W

Location (ETRS89): 69° 46' 16.661" N, 26° 59' 55.234" E

General: Stretching *c.* 150 metres on sandy soil, this site has yielded lithic artefacts (i.e., grey chert and quartz artefacts) and burnt bones. Among the finds are an oblique point of burnt chert (KM 38078:2) and a potential oblique point made of quartz. However, the quartz point is excluded from this study because of insufficient modification. To date, no later prehistoric disturbance has been observed on the site. (Manninen & Knutsson *this volume*; Rankama & Kankaanpää 1997; T. Rankama *pers. comm.* 2010.) The burnt chert point and 16 fragments of burnt bone (KM 38078:1) were collected in an exposed patch of burnt sand during an inspection of the site in 2009 (T. Rankama *pers. comm.* 2010). The bone fragments (undetermined species, Mannermaa 2010) were dated for the purpose of this study.

Dated context: Exposed patch of burnt sand (probable hearth) with burnt bone and a burnt oblique point.

Lab. number, sample type, and un-calibrated and calibrated (2σ) date:

1. Ua-40899, burnt bone (Mammalia), 7265±40 BP,
6220–6050 calBC

Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Utsjoki Mávdnaávži 2

Location (ETRS89): 69° 42' 3.825" N, 26° 11' 43.692" E

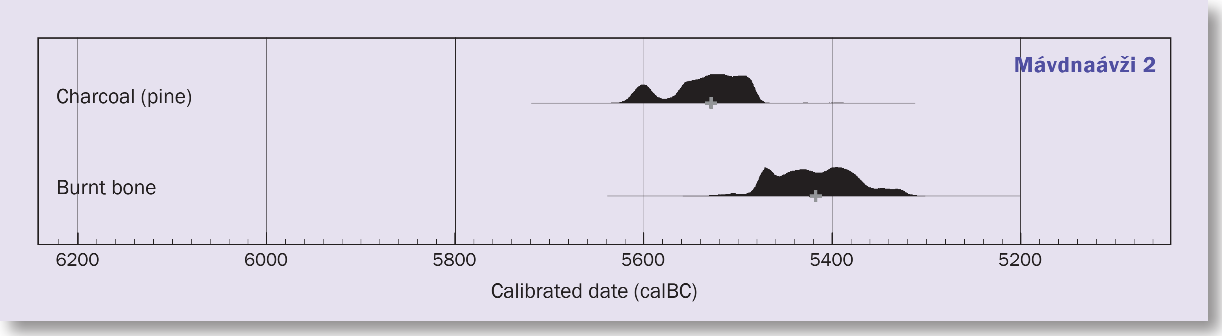
General: The site consists of a small round hut foundation with a *c.* 3 metres diameter and an outside activity area. In total, 52 square metres have been excavated to date. Within the area of the hut foundation, a central hearth surrounded by well-defined lithic concentrations was found. In the hearth and in the concentrations around it, 12 intact and broken oblique points made of grey chert were found (KM 34675:7, :147, :164, :199, :225, :261, :317, :335, :13+:214, :222+:104, :223+:234, :5+:21) along with debitage related to oblique point manufacture. (Manninen 2009; Manninen & Knutsson *this volume, in preparation.*)

A small pit filled with sooty soil, burnt bone, and charcoal was located within the hearth inside the hut foundation. All of the identified bone fragments were reindeer (*Rangifer tarandus*), and the charcoal was pine (*Pinus sylvestris*) (Lahti 2004; T. Timonen *pers. comm.* 2004). Two samples have been dated from the pit. An earlier date on burnt bone (KM 34675:497) from excavation spit 2 (x 111,125/y 504,875) was supplemented in this study with a sample of pine charcoal from spit 3 (x 111,4/y 505,3).

Dated context: A pit filled with sooty soil, burnt bone, charcoal, and burnt lithic artefacts, including oblique points. The difference in age between the samples most likely reflects the own age of the pine sample.

Lab. number, sample type, and un-calibrated and calibrated (2σ) dates:

1. Hela-963, burnt bone, 6455±50 BP, **5490–5320 calBC.**
2. Ua-40900, charcoal (*Pinus sylvestris*), 6580±38 BP,
5620–5480 calBC.



Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Inari Vuopaja

Location (ETRS89): 68° 54' 39.25" N, 27° 0' 56.304" E

General: The site has multiple occupations ranging from the Mesolithic to the Iron Age. Seven oblique points have been found in the 394 square metres that have been excavated. Four of the points (KM 28365:442, :446, :454, :660) derive from excavation squares x129–134/y977–980. The total number of lithics in this area is relatively small, as only 72 artefacts made of quartz, 4 made of quartzite, and 8 made of chert have been found. The chert and quartzite are non-local, and 8 of the 12 artefacts made of these two raw materials originate from an area comprising 3 by 3 metres that also included a small concentration of burnt bone and part of a larger concentration of burnt bone (Manninen & Knutsson *this volume*, *in preparation*; Seppälä 1993; 1994). Fifteen reindeer (*Rangifer tarandus*) bone fragments and one fragment of elk (*Alces alces*) bone have been identified from the 3x3 metre area (Ukkonen 1994; 1995). As the identified elk bone fragments in the 44 square metres excavation area are otherwise found more to the south of the oblique points, a fragment of burnt reindeer bone (KM 28365:448) from square x133/x978 was dated in this study. The finds from this square include 63 fragments of burnt bone (5 reindeer), 1 chert point, and a chert flake. The adjacent squares have yielded 2 more chert points, 2 chert flakes, and a quartzite scraper.

Dated context: Burnt bone concentration in square x133/y978. Sample Ua-40897 from excavation spit 1. Three oblique points made of grey chert have been found within and around the bone concentration.

Lab. number, sample type, and un-calibrated and calibrated (2σ) date:

1. Ua-40897, burnt bone (*Rangifer tarandus),* 6526±39 BP,
5610–5380 calBC.

Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).

Inari Kaunisniemi 3

Location (ETRS89): 68° 43' 33.133" N, 27° 14' 44.108" E

General: The site and the adjacent site Kaunisniemi 2 constitute a large multi-period occupation area that has yielded finds from several time periods. Among the finds from Kaunisniemi 3 are four oblique points (KM 26040:2, :5, :35, :53). The site has not been excavated and is currently submerged. Finds were surface collected from several smaller concentrations exposed by water level regulation. Area 2W was *c.* 20x15 meters in size and yielded burnt bone and lithic artefacts of several raw materials, as well as some Iron Age artefacts. (Arponen 1991; Manninen & Knutsson *this volume*.) The only chronologically diagnostic lithic artefacts from this area were oblique points. Therefore, this area was considered the most suitable for radiocarbon dating. The burnt reindeer bone fragment KM 26040:47 (Mannermaa 2010) that was dated, derives from a hearth within a concentration of lithic artefacts, including an oblique point made of green non-local quartzite (KM 26040:35) and flakes of the same raw material (KM 26040:44).

Dated context: A hearth containing burnt bone and surrounded by lithic artefacts in area 2W.

Lab. number, sample type, and un-calibrated and calibrated (2σ) date:

1. Ua-40896, burnt bone (*Rangifer tarandus*), 8004±46 BP,
7060–6710 calBC.

Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer et *al.* (2009)).

Enontekiö Museotontti

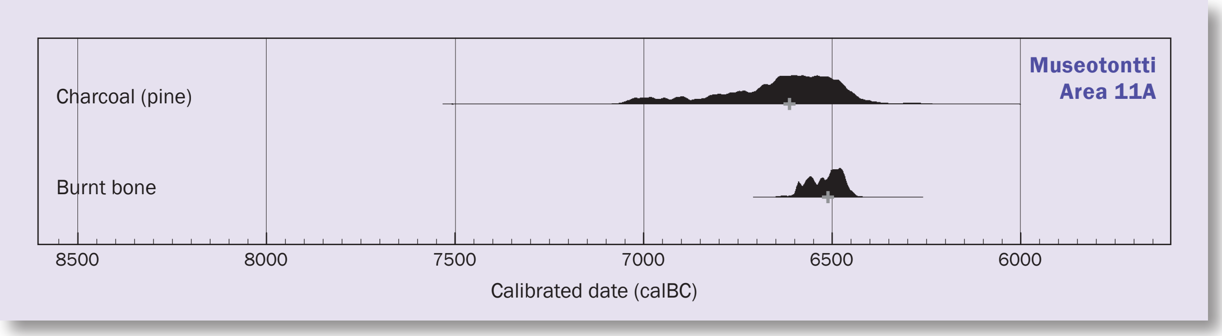
Location (ETRS89): 68° 23' 44.104" N, 23° 41' 53.234" E

General: The site has multiple occupations ranging from the Mesolithic to the Iron Age. A total of 692 square meters have been excavated. Eight oblique points have been identified within the site assemblage. Five of these points (KM 23877:122, :411, :455, :491, :537) originate from find concentrations that have yielded dates of *c.* 6500 calBC. (Halinen 2005; Manninen & Knutsson *this volume*.) The area 11A (Halinen 2005) that included, besides a concentration of lithic artefacts including three oblique points, a pit containing charcoal and burnt bone, can be considered the most suitable for dating the oblique points at the site. Therefore, a sample (2 fragments, KM 23877:492) of burnt reindeer bone (Mannermaa 2010) from the pit was dated in this study to supplement an earlier date on charcoal (undefined species).

Dated context: Bone and charcoal concentration x124.50/y148.60 (Area 11A, refuse pit a). Sample Hel-2564 from excavation spit 5 and sample Ua-40895 from excavation spit 4. The difference in age between the samples most likely reflects the own age of the charcoal sample.

Lab. number, sample type, and un-calibrated and calibrated (2σ) dates:

1. Hel-2564, charcoal, 7750±120 BP,
7030–6410 calBC.
2. Ua-40895, *Rangifer tarandus*, 7668±40 BP,
6590–6450 calBC.



Calibrated in OxCal 4.1.7 (Bronk Ramsey 2010) using the IntCal 09 calibration curve (atmospheric data from Reimer *et al.* (2009)).