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SEDENTISM ON THE FINNISH NORTHWEST COAST: SHORELINE REDUCTION AND REDUCED MOBILITY

Abstract
This article focuses on the effects of isostatic land-uplift and shoreline displacement on mobility patterns during prehistory in Ostrobothnia. The northern part of the Finnish coast has been reduced significantly between 8500 and 5500 cal BP. During this period the marine adapted hunter-gatherers seem to be undergoing reduced residential mobility, as can be seen in the archaeological remains at Kierikki, Yli-Ii. This increased sedentary lifestyle was likely one of the consequences of increased population density due to the geographical circumscription on the coast. The reduced mobility also increased long distance contacts and social complexity.

Keywords: Shoreline reduction, reduced mobility, paleoshorelines, land-uplift, prehistory

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INTRODUCTION

In a recent study on global populations, Small and Cohen (2004) quantified population distributions in relation to physiography and climate. Their most important conclusion was that human populations tend to be concentrated in low-lying, coastal regions, preferably close to rivers. Their explanation was that 'localization among coastlines offers economic and strategic advantages' (Small & Cohen 2004: 275), like better access to coastal and marine foods. Localization of populations in coastal regions is not only a recent phenomenon (Turner et al. 2003).

Resources from coastal zones supported some of the major changes in human history (Fitzhugh 1975; Yesner 1980; Bailey & Parkington 1988; McCartney et al. 1998), including the appearance of sedentism and social complexity among hunter-gatherers, the development of agriculture, and the rise of civilizations. Archaeological research along the Finnish coastline has demonstrated a long occupational history stretching back at least nine thousand years (Huurre 2005). This history was significantly influenced by isostatic land-uplift and shoreline displacement.

THE EASTERN COAST OF THE BOTHNIAN BAY

The glacier covering Fennoscandia (Fig. 1) during the last Ice Age (Weichsel Ice Age) started to retreat about 18,000 years ago. The Bothnian Bay, at the northern end of the Bothnian Gulf, was freed from the ice about 9300 years ago. After the weight of the ice was lifted, the earth's crust began to rebound. This rebound, which still continues at a rate of 7,5–9mm/year, is faster along the shores of the Bothnian Bay than anywhere else in Fennoscandia (Eronen 2005).

The temporal and spatial variation of shoreline displacement is summarized in Figure 2, which contains information on the current elevation of ancient shorelines at 500 year intervals between 5500 and 1500 cal BP. The schematic representation of ancient shorelines clearly identifies a greater emergence (in terms of elevation) of land in the region north of Vaasa and a sharp decrease of emergence towards the south. The decreasing rates of land-uplift from 5500 cal BP to 1500 cal BP are also clearly visible in the figure. In Ostrobothnia, the eustatic rise, in other words the rise of the sea level, never exceeded the isostatic rebound (Kakkuri 1990; Nicholls et al.

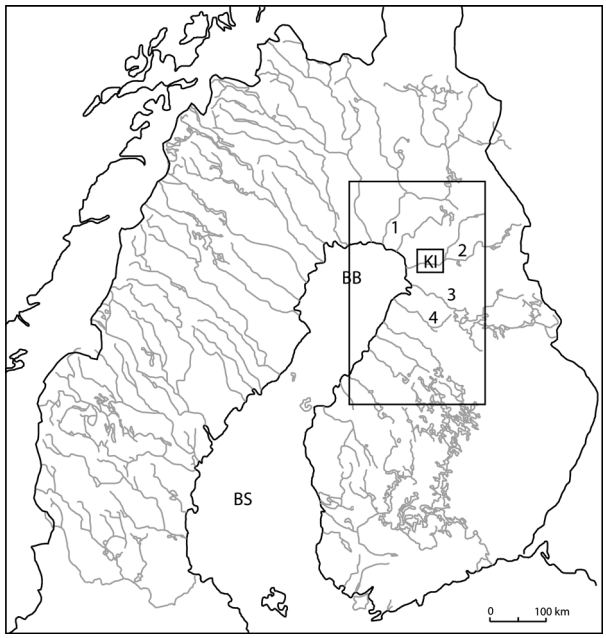

Fig. 1. Map of the study area with the rivers and lakes flowing into the Gulf of Bothnia. Key: KI: Kierikki, BB: Bothnian Bay, BS: Bothnian Sea, 1: Kemijoki, 2: Iijoki, 3: Oulujoki, 4: Siikajoki

1999). Thus, shoreline displacement on the eastern shores of the Bothnian Bay has been and still is a process of continuous regression of the sea.

Land-uplift and shoreline displacement of the eastern shore of the Bothnian Bay

Eronen (2005) provides a complete account on land-uplift in Fennoscandia. This paper will focus on those aspects of the uplift that were especially significant for prehistoric human populations. The eastern shore of the Bothnian Bay is concave and has the shape of a half-circle, while the Finnish coast between Tornio and Virolahti has the shape of a reversed 'S'. The southern part of the coast, between Virolahti and Vaasa, is convex and will provide a contrasting region for the following discussion (Fig. 1). As mentioned earlier, the effects of the land-uplift in Fennoscandia are greater (Fig. 2) on the eastern coast of the Bothnian Bay than anywhere else in Fennoscandia. This is due to location of the region in relation to the geographical centre of land-uplift – the location of greatest glacier thickness – and the peculiar topography of the region.

Land-uplift on the eastern shore of the Bothnian Bay resulted in continuous, westward displacement of shoreline. If one conducts a brief imaginary exercise, it can be seen that the shoreline displacement occurred towards the sea, in other words, towards the centre of the 'circle' formed by the Bothnian Bay. Basic geometry dictates that as the radius 'r' of a circle becomes shorter, or when points on the circumference get closer to the centre of the circle, the circumference 'C' decreases ($C=2\pi r$). For the east coast of the Bothnian Bay the significance of this fact is that as the shore moves westwards and diminishes the radius, the concave shoreline gets shorter (C becomes smaller). In other words, as the land emerged, less coastline was available for human occupation.

Paleoshorelines

The first step in trying to understand the effect of shoreline displacement on prehistoric human populations is to reconstruct paleo-shorelines. In order to do this, local land-uplift curves based on dated isolations of lakes from the sea are needed. These curves contain information on the temporal variation of land-uplift in particular regions. What is need for paleo-shoreline reconstructions is not only temporal variation but also spatial variation (Clark & Fitzhugh 1991) of land-uplift at different points in time in different regions.

A map based on the land-uplift curves (Fig. 3) shows the development and location of coastline in Finland through time. The continuous regression and westward movement of the coastline is

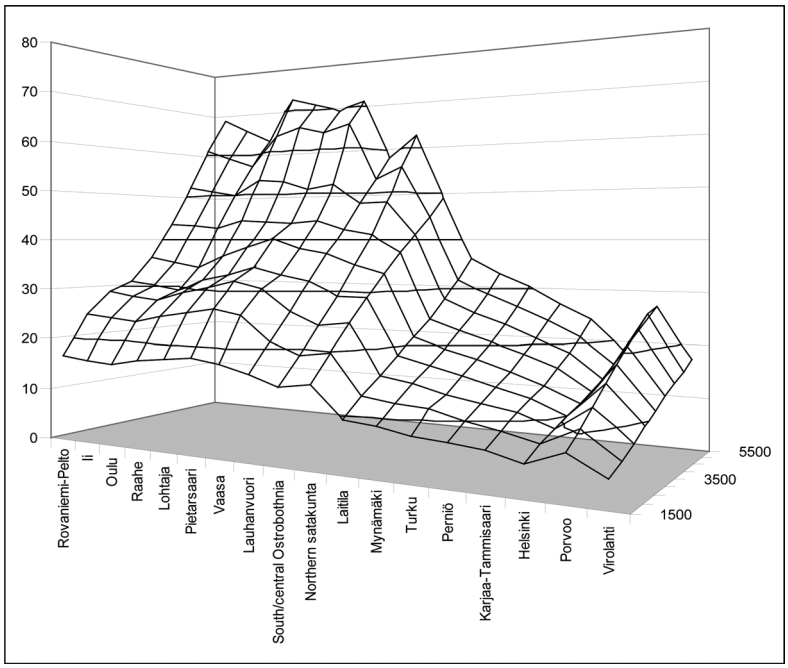

Fig. 2. Schematic overview of the temporal and spatial variation of the land-uplift on the Finnish coast. The graph shows the current elevation above sea level of locations that were coastal 1500 to 5500 calendar years ago.

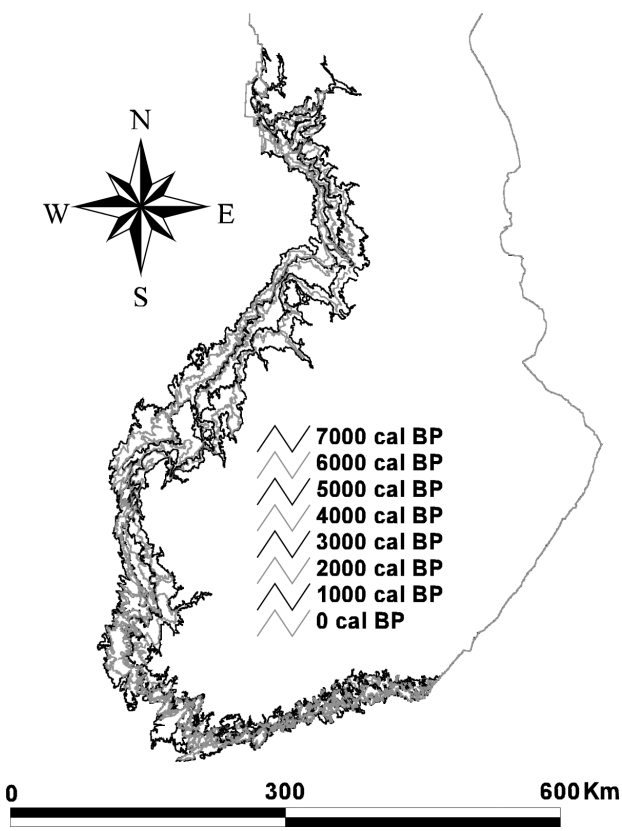

Fig. 3. Map of Finnish coast with shorelines at every 500 years between 7000 calendar years ago and today.

most obvious in the north, while no clear difference can be detected between chronologically different coastlines in the south. When the attention is turned to the change of the coastline between 8500 and 5500 cal BP, it is observed that the total length of the coastline between Vaasa and Tornio is reduced from about 4000 km to less than 2000 km. This reduction in the length of the coastline becomes more comprehensible by comparing the distance between the main river estuaries during the period in question. In the centre of the concave shoreline, the distance between Kemijoki and Iijoki is reduced by 77 km, between Iijoki and Oulujoki by 25 km, and between Oulujoki and Siikajoki by 5 km the period from 8500 to 5500 cal BP.

The combined effect of the three factors – the rate of isostatic uplift, the concave shape of the coast, and the flat topography of the region – caused rapid environmental change. Within three millennia, the shoreline was reduced to half of its original length, which led to the concentration of coastal resources along the shorter coastline. The newly emerged land was wetland, which attracted aquatic birds, while higher salinity levels in the sea brought a diverse range of fish and sea mammals. This must have affected the coastal population of the time. Eronen and others (2001) have discussed some of the effects, and Salomaa and Matiskainen (1985) some of their archaeological consequences.

ARCHAEOLOGICAL MOBILITY

An important question to be asked is how to recognize and define mobility patterns in the archaeological record. In this context, it is important to start with Binford's (1980) distinctions between residential mobility and logistical mobility, and between collectors and foragers. Twenty-five years after the publication of his ideas, they still remain an important starting point for evaluating mobility patterns (Marshall 2006). Kelly (1992) follows Binford's premise by stating that sedentism and nomadism are not a dichotomy but rather a spectrum and a process. To quote Kelly (1992: 60), 'no society is sedentary not even our own industrial one – people simply move in different ways'.

Together with artifact density, site structure is frequently used as an indicator of reduced mobility. Usually, sites occupied for longer uninterrupted periods are more internally differentiated than sites created by more mobile populations. The differentiation of sites seems to be directed towards a privatization of space. This privatization can be seen in the increased distance between dwellings and more substantial architectural traditions which decrease the intervisibility of built structures (Kelly 1992; Blanton 1994; Kelly et al. 2005). Other markers of sedentism include long distance trade, population increase, specialization and the appearance of monuments (Kelly 1992; 1995).

Kent and Vierich (1989) discuss some of the questions related to the use of architecture to study mobility patterns. They argue that architectural and other structural features are better explained by anticipated mobility than by actual mobility. They show that for ethnographically known hunters, increased investment of time and energy in residential sites tends to be higher in groups who intend to spend a longer time in the area. It is difficult to differentiate between the consequences of anticipated mobility and of actual mobility, but one can assume that there is at least some correlation between anticipated and actual mobility.

In more recent studies of mobility, architectural remains have been singled out as the most important factor for the study of prehistoric sedentism (Sobel et al. 2006). The nature of dwellings and settlements is the 'core element around which other forms of evidence for sedentism are marshalled in support' (Marshall 2006: 157). Recent studies of mobility have also emphasized site distribution, recurrent structure alignment, cemeteries and monumental architecture (e.g. Boyd 2006; Walter et al. 2006). Other signs of reduced mobility are the presence of less portable artefacts (e.g. ceramics), floral and faunal remains indicating multi-seasonal use of a location, and evidence of workshop-level production (Biagi & Nisbet 2006). Most authors agree that while no set of criteria is unproblematic, 'combinations of variables tailored to each specific context do produce robust conclusions' (Marshall 2006: 158).

Thus, it seems logical to study the processes related to mobility and sedentism on the Finnish coast through architectural remains. In this article, the focus will be on the architectural remains of dwelling-sites located at the paleo-estuary of the Iijoki river in Yli-Ii: not only because these

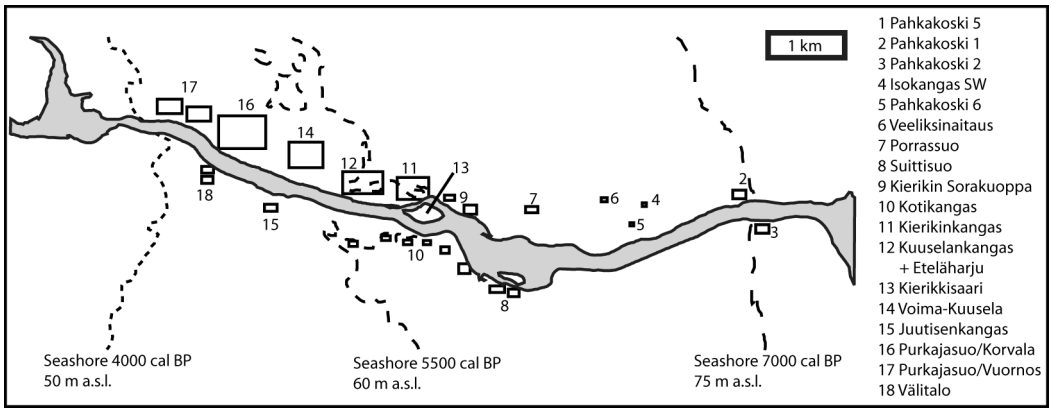

Fig. 4. Overview of sites in the ancient river estuary of the river Iijoki in Kierikki, Yli-Ii.

dwelling-sites lie at the centre of the concave shoreline in the north, but also because they form the best studied cluster of archaeological remains in the region. In addition, some of the above mentioned indicators of changes in mobility will also be discussed in this article.

ARCHAEOLOGY AT KIERIKKI

The data used in this study have been collected from excavation and survey reports, GPS-surveys, and the archaeological literature. An overview on the location of the different sites is given in Figure 4. The relative shoreline chronology will be used to determine the temporal relations of the sites in the ancient river-estuary. Although this relative chronology is not detailed, it is substantially more complete than the one established with radiocarbon dates.

Semi-subterranean dwellings, presence and nature

Evidence of prehistoric occupation at Kierikki was first discovered in the late 1960s during the survey and excavation on the building site of hydroelectric dam and power plant at Kierikki, located approximately 75 m above sea level. These sites are now artificially flooded, but at the time of occupation they were situated on the banks of the Iijoki river. No archaeological features were visible on the surface, and most excavation did not reveal any structural remains. Only at the Pahkakoski 2 site, on the south side of the river, possible signs of postholes were discovered (Sarvas 1960; Kostet 1981). No semi-subterranean dwellings are known from this elevation.

The earliest signs of semi-subterranean dwellings are located between 70 and 65 m above sea level (Núñez & Uino 1998; Pesonen 2002), at Pahkakoski 6, Porrassuo and Veeliksinaitaus on the northern side and at Suittisuo on the southern side of the river. While these dwellings are situated on relatively steep sand banks, they are still relatively close to the river side. The dwellings have been small and circular in shape, leaving behing only a shallow depression. The excavation of these dwellings has not revealed unambiguous structural remains, such as hearths, pits or postholes.

At lower elevations, around 60 m above sea level, larger and more rectangular dwellings are found. These dwellings also include more structural features than previously. Pits excavated in the bottom of dwelling depressions, stone lined fire places located in and outside dwellings, and postholes were such feature at Kuuselankangas. The excavations at Kotikangas, on the left bank of the river, revealed some remains of log structures. In addition, dwellings with a standardized rectangular structure containing two fire places on the main axis and a garbage/storage pit at the eastern end of the long axis have been uncovered in several excavations carried out on the south side of the river (Costopoulos 2005).

Moving further westwards to elevations around 55 m above sea level, multi-room dwelling depressions and rowhouses are found. The latter are combinations of up to seven large rectangular dwelling depressions, such as the one at

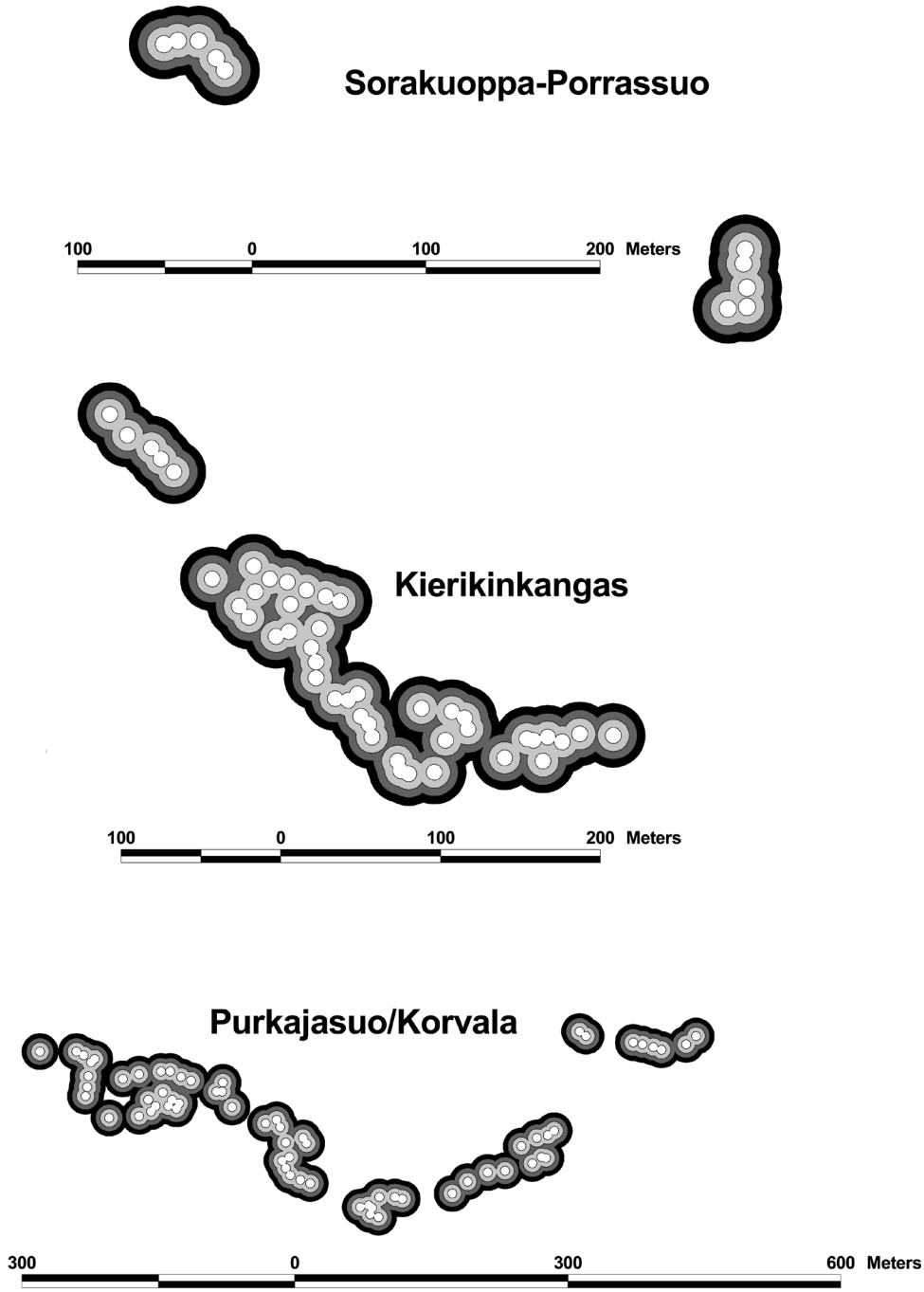

Fig. 5. Distribution of dwelling depressions in four sites in the ancient river estuary of the river Iijoki (based on GPS-coordinates).

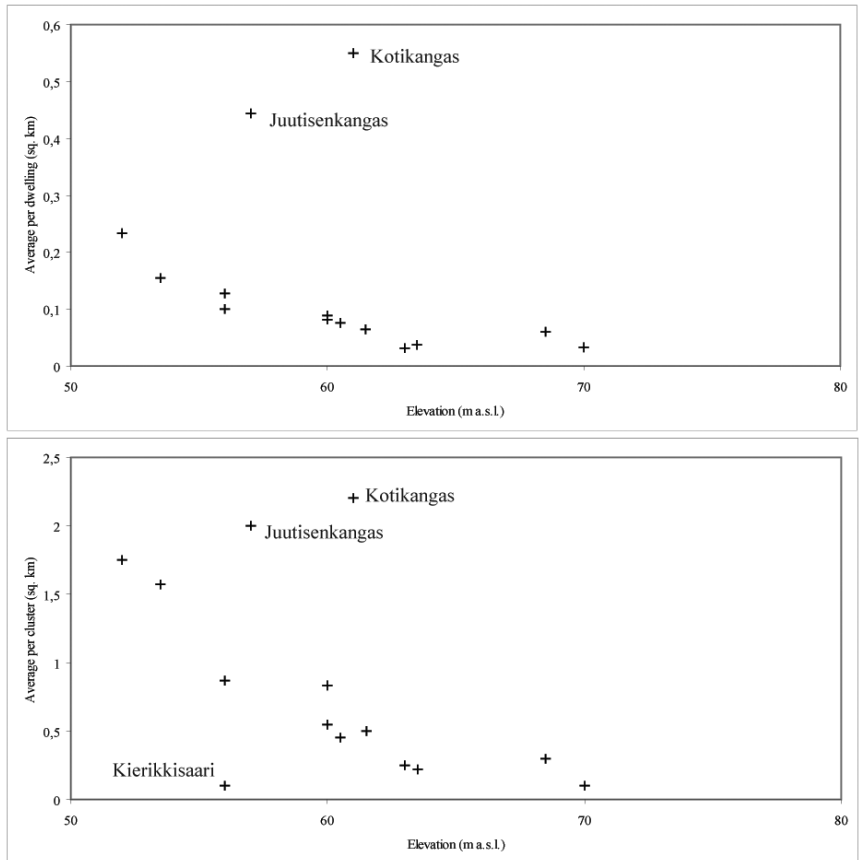

Fig. 6. Graphs with evolution of space/area around dwellings/ clusters of dwellings through time (based on Schulz 1997).

the Voima-Kuusela site. At this elevation, which corresponds with the village sites at Purkajasuo and Korvala, embankments around dwelling depressions are more pronounced than at higher elevations. In some of the dwellings the embankment seems to consist of stones (Núñez & Uino 1998). In addition, during a GPS survey carried out by the author, it was noticed that dwelling depressions located at lower elevations were deeper than the ones at higher elevations. The potential pile settlement on Kierikkisaari is located approximately at 55 m above sea level, we find (Koivunen 2002).

The youngest finds that have been uncovered at Kierikki are located at 52 m above sea level, for example the Purkajasuo/Vuornos site. There, all the dwellings are relatively deep, large, and have a pronounced encircling embankment. Some of the dwellings have multiple rooms. No excavations have been conducted so far.

Clusters, size and shape

The earliest dwellings are organized in bow-shaped, isolated clusters containing from three to six dwellings. The bow-shaped pattern is repeated in clusters at lower elevations, and the total number of dwelling depressions per cluster increases while clusters themselves become more difficult to distinguish (Fig. 5). It should be noted that the average area per dwelling and per cluster increases towards lower elevations. The graph presenting the average dwelling area shows that two sites, both located on the south side of the river, seem to differ from the others. In terms of area, three sites differ from the rest. Two of these are the same sites on the southern side of the river, while the third is Kierikkisaari, the island in the middle of the river (Fig. 6).

A map of buffered dwellings shows that groups of two or three dwellings are consistently located

within larger clusters. At higher elevations, this pattern is already visible within five meter range while at lower elevations the range is often ten to fifteen meters. At Kotikangas, the situation is different: the organization in groups of three dwellings is persistent, but larger clusters, such as those found on the north side of the river, are not present.

Finds

At the oldest occupation sites at Kierikki, mostly quartz flakes and tools as well as other stone raw materials, such as local quartzites and metatuffs, are found. The Pahkakoski 2 excavation yielded Säräsniemi 1 ceramics and the oldest Typical Comb Ware styles. The younger dwelling-sites, located approximately 60 m above sea level, have yielded asbestos tempered pottery (Arminen 2002), Baltic amber (Koivunen 1996; Oikarinen 2002), and Russian flint (Costopoulos 2003).

The diversity of raw materials and tool types is more pronounced at lower elevations, although some of the younger sites have yielded very specialized assemblages. The find assemblages at Kuuselankangas (Koivunen & Makkonen 1994; Koivunen & Korolainen 1995; Halinen et al. 1998; Koivunen & Ylimaunu 1998; Pesonen 2000) and Kierikinkangas (Viljanmaa 2006) are more diverse than, for example, at Kierikin sorakuoppa or Pahkakoski (Pärssinen 1987; Schulz 1988). This probably points to a larger range of activities performed at one site or the use of specific tools for some activities. The presence of exotic raw materials points to both long distance relations and increased time investment in their extraction and selection. The first signs of metallurgy are also found at the younger sites (Franzen et al. 1998, Schulz 2000; Costopoulos 2002). In all, the change may be interpreted to reflect an increase in the time spent in and around the dwellings as well as the differentiation of the activities, which in turn increased the variability of tools and raw material available.

Of particular interest are the discoveries from the Purkajasuo bog, where prehistoric fish weirs were found. Besides elucidating fishing practices at Kierikki during the Stone Age, these weirs are also indicative of a long occupation. A potential explanation for the presence of the fishing weirs is that the inhabitants of Kierikki stored their fishing equipment in a protected shallow part of the river over the winter (Koivunen & Viljanmaa 2004).

The south side of the river

Next, the find assemblages from the left bank of the river will be shortly examined. After the excavation of two dwellings, researchers noticed that while their internal structure was very similar, both the composition of the find assemblage and the distribution of finds differed markedly from one another. While one dwelling had yielded lithics, which were evenly distributed, the other contained mostly pottery concentrated at one end of the dwelling. The radiocarbon dates obtained for both dwellings suggest that they were in use for at least two periods separated by a 1000 year gap (Costopoulos 2005)

The excavation of a third dwelling located approximately 60 m a.s.l yielded even more evidence on specialization. A possible ceramic kiln with associated painted pottery was found, and signs of metallurgy were also detected (Costopoulos et al. 2006). Hence, while the internal structure of the two dwellings was very similar, their find assemblages were completely different (lithics vs. pottery). The appearance of specialized dwellings is for a feature also characterizing villages in northern Norway (Simonsen 1975). Although the evidence was scant, Simonsen defined the occupants of different dwellings at Sørøy as people with specialized status in the society: a shaman (sculptures), a potter (asbestos and clay), an arrowsmith (raw material, half-made arrows and tools to make arrows) and a tradesman (exotic materials).

Sites on the north and south sides of the river differ from one another in the distribution of finds in the spaces between the dwellings. On the northern shore a relatively large proportion of finds has been found outside the dwellings, where activities taking place in the public space between the houses were visible to all (Koivunen 2002). On the contrary, only a very limited amount of spent tools, flakes and cores has been found outside the dwelling depressions on the south side of the river (Vaneeckhout 2005).

Dates

The radiocarbon dates for Kierikki given in Figure 7a show that signs of occupation pertain to the

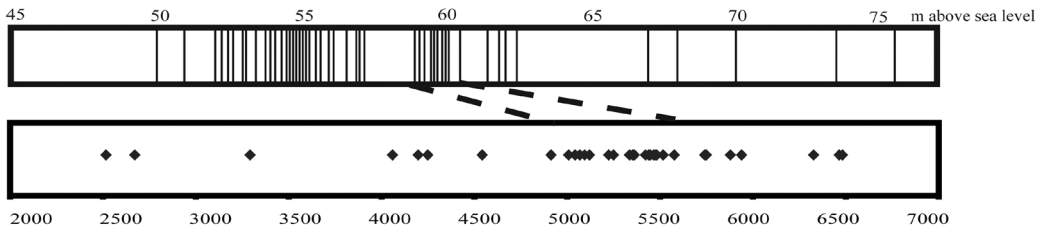

Fig. 7. Distribution of the clusters of dwelling depressions at ancient river estuary of river Iijoki (based on Schulz 1997) and the distribution of available radiocarbon dates (cal BC) from the same region.

period between 6500 and 2000 cal BP. When the chronological distribution of radiocarbon dates is compared, a concentration of dates between 5500 and 5000 cal BP is detected. A major problem with the data yet available is that the main body research has been carried out at sites with an approximate elevation of 60 m a.s.l. elevation. Thus, the now apparent clustering of the dates will probably be altered by future research.

DISCUSSION

The shortening of the coastline of the Bothnian Bay in Finland provides a good example of what Carneiro (1970) called circumscription. Circumscription is the process controlling the expansion of groups through limited space, resources, or social control. I am proposing here that as a result of the reduction of the Finnish coastline, circumscription caused an increase in population density between 8000 and 4000 BP, even in the absence of population growth. The increase in population density would have, in turn, increased the potential for population growth (Siiriäinen 1969) is seen in the concentration of radiocarbon dates (Shennan & Edinborough 2007) and the clusters of dwelling depressions around the elevation of 60 m a.s.l..

The population growth that resulted from intensified sedentism is reflected in the appearance of dwelling depressions and in the increase of structural remains. The archaeological record on the human presence in the Kierikki area both during and after the Holocene Climatic Optimum is thus one of increased sedentism. This is most visible in the presence and appearance of increasingly deep structural elements, for example, semi-subterranean dwellings have been interpreted to reflect such development (Hunter-Anderson 1977; Halén 1994; Räihälä 1997). Kelly (1992; 1995) has demonstrated through ethnographic research that increased sedentism is often the factor triggering long distance trade, specialization (see also Marshall 2006) and social complexity.

Thus, we can compare the situation in the Kierikki area with the one described by Grabert and Larsen (1975) who suggested that for the Fraser lowlands:

> Coastal stabilization played a role in allowing larger and more accessible marine and intertidal food resources, with the possibility of larger human populations exploiting them […] given the reduction of the coastline length, the concentration of intertidal and estuarine resources would also tend to concentrate communities, even if only on a seasonal basis. Such concentrations of populations, although only temporarily, was a recurrent thing and could become an agent in creating new patterns of cooperation, and determining, though only roughly at first, the limits of community territories. (Grabert & Larsen 1975: 236)

At Kierikki, signs of this long distance trade (Zvelebil 2006) are complemented by the appearance of workshop dwellings. Thus, the process of specialization at Kierikki seems to be similar to the one at Sørøy in northern Norway (Simonsen 1975), at least with regard to the archaeological material.

Another effect of sedentism is the increased importance of private space (Kelly et al. 2005). At Kierikki, this is signified by the appearance of more pronounced structural remains and increased distance between dwellings.

Increased sedentism decreases residential mobility and territory, which may imply an increase in logistical mobility (Binford 1980). For Kelly (1995), increased sedentism is associated with a compression of residential territory. Rosenberg (1998) proposed a model in which sedentism is the ultimate product of territorial compression resulting from competition for resources. Thus, on the eastern part of the Bothnian Bay, increased sedentism might have been the outcome of coastal compression, while there is no evidence to see the territorial compression as the result of sedentism.

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