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# ON EARLY AGRICULTURE IN THE ARCHIPELAGO OF LAKE LADOGA

*Abstract*

This article briefly discusses the history of settlement on the island of Kilpolansaari off the northwest coast of Lake Ladoga (Hiitola, Republic of Karelia, Russian Federation) in the light of archaeological discoveries. A pollen diagram of the bottom sediments of Suuri Kokkolampi pond presents the history of cultivation practices on the island. The earliest indications of slash-and-burn agriculture are from the Early Roman Iron Age. The respective bodies of archaeological and biostratigraphical evidence are compared and a brief evaluation of the representativeness of these sources is presented. Particular reference is made to the initial stages of agriculture in connection with the formation of the River Neva ca. 3100 radiocarbon years ago when fertile deposits were revealed.

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## *1. Introduction*

Lake Ladoga and its environs have fascinated Finnish archaeologists and geologists since the nineteenth century. As opportunities for research have again opened up, a geological-archaeological expedition was organized in March 1992 to the island of Kilpolansaari in Lake Ladoga, in former Finnish territory and currently in Republic of Karelia (Fig. 1).[1] The purpose of the expedition was to establish the date of the formation of the River Neva, a major event in the shore displacement chronology of Lake Ladoga. The geological results of the expedition have been reported elsewhere (Saarnisto et al. 1993; Saarnisto & Grönlund 1994), and they are briefly summarized below. In the present article, pollen-analytical studies relevant to early agriculture are presented and correlated with archaeological data. Because of the close connections between shore displacement and the various stages of prehistoric occupation, collaboration between archaeologists and geologists has long-established traditions (Inostranzeff 1882).

Small lakes and ponds are the key to defining the date when the River Neva formed. This event was followed by a rapid drop in water levels. Sudden variations of water level can be traced and dated with precision in the bottom sediments of small lakes and ponds, which contain large amounts of organic deposits, while the sediments on the bottom of Lake Ladoga contain a larger amount of mineral deposits, clay and sand. In the lake sediments, isolation from Lake Ladoga should be observable as a sudden change from grey clayey gyttja to brown gyttja – in other words, from the sediment of a large lake to that of a small one. The composition of the microscopic diatom flora of the gyttja also changes radically.

The rocky and sharply contoured northwest coast of Lake Ladoga is the site of a number of small bodies of water, which were part of Lake Ladoga before the formation of the Neva. The topography of the south coast is more even, and there are hardly any small ponds suitable for research purposes. Accordingly, the rocky island of Kilpolansaari, off the northwest coast, was chosen as the site of the

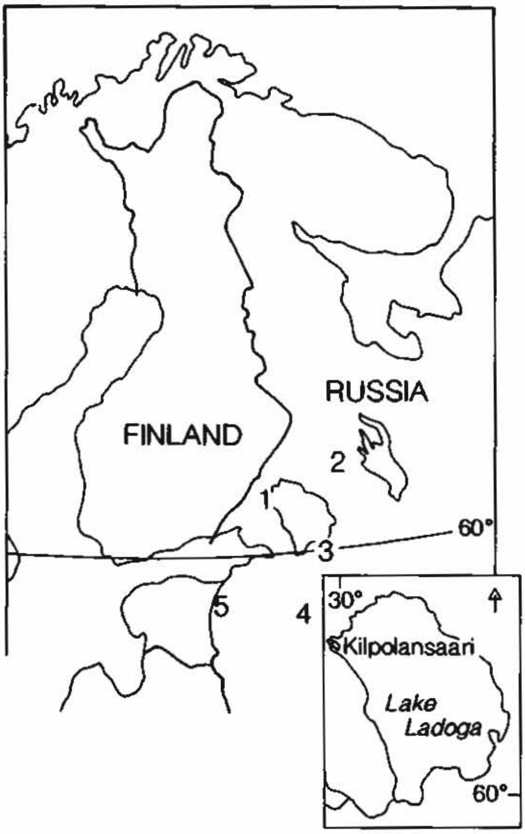


*Fig. 1.* General location of the study area and the sites mentioned in the article. 1. Kilpolansaari, 2. Jessoila, 3. Staraya Ladoga, 4. Novgorod, 5. Izborsk.

study. On the island were several small ponds suited to studying the formation of the River Neva and the history of local agriculture.

With its numerous prehistoric finds, Kilpolansaari is also of archaeological interest. The research project especially focused on the preconditions of the spread of permanent settlement that were created through geological processes. As a result of the formation of the Neva, the lowered lake revealed fertile fine-grained sediments. The purpose of the research was to establish how rapidly the local population had begun to practise cultivation on the newly available soils. Of further interest is a comparison of the picture provided by the archaeological material with palynological evidence of consolidated settlement not only on Kilpolansaari Island but also in its environs.

## *2. The Study Area*

The study area of Kilpolansaari Island is in the parish of Hiitola, approximately 20 km north of Käkisalmi (Figs. 1 & 2). The island is 6 x 8 km in area. The landscape is highly varied in altitude, the highest hill-tops rising up to 60 m a.s.l. The lower levels are covered with late glacial clay and silt deposits (Niemelä et al. 1993). The bedrock consists mainly of migmatized mica gneiss (Koistinen 1994).

## *3. Geology*

The early phases of settlement history in the Ladoga area are closely connected with the geological history of the region. The deglaciation of the area took place 12500–11500 radiocarbon years ago. Before the formation of the Baltic Ice Lake local high-level ice lakes followed the retreating ice. During the Baltic Ice Lake phase, prior to its drainage at 10200 BP, the shoreline in the northern Ladoga area was situated at 70–80 metres above present sea level. During the Yoldia phase (10200–9500 BP) a rapid regression of the Baltic water body continued, and it is possible, though not certain, that the Ladoga basin became isolated at some time before 9500 BP. The isolation threshold was at Heinjoki at an elevation of 15 m above sea level. The connection between the Baltic and Ladoga basins was through the Viipuri area. The subsequent change in the water level of the Ladoga basin took place 9500 radiocarbon years ago, when the waters of the Lake Onega basin, which previously flowed towards the White Sea, began to drain into Ladoga via the River Svir. During the transition from the Yoldia Sea to the Ancylus Lake, the possibly independent Lake Ladoga again became connected with the Baltic. The transgression of the Ancylus Lake culminated at 9100 BP, and during the subsequent regression Lake Ladoga became isolated around 8800 radiocarbon years ago. A new change in the water level of the lake occurred 5000 radiocarbon years ago, when the waters of the Saimaa lake complex drained into Ladoga via the River Vuoksi resulting in a rise in the lake level of possibly 1–2 metres. The drainage of the Saimaa lake complex accelerated the transgression in the whole lake basin and finally gave rise to a new discharge channel, the River Neva, 3100 radiocarbon years ago. The consequent lowering of the level of Lake Ladoga was rapid, perhaps as much as 10 metres (Saarnisto & Siiriäinen 1970; Saarnisto et al. 1993; Saarnisto & Grönlund 1994).

The study area, the island of Kilpolansaari, is almost on the same land uplift isobase as the Heinjoki threshold area. Therefore, the level of Lake Ladoga remained at a rather constant level for several thousand years, i.e. at ±20 m from the time of isolation from the Ancylus Lake until the forma-

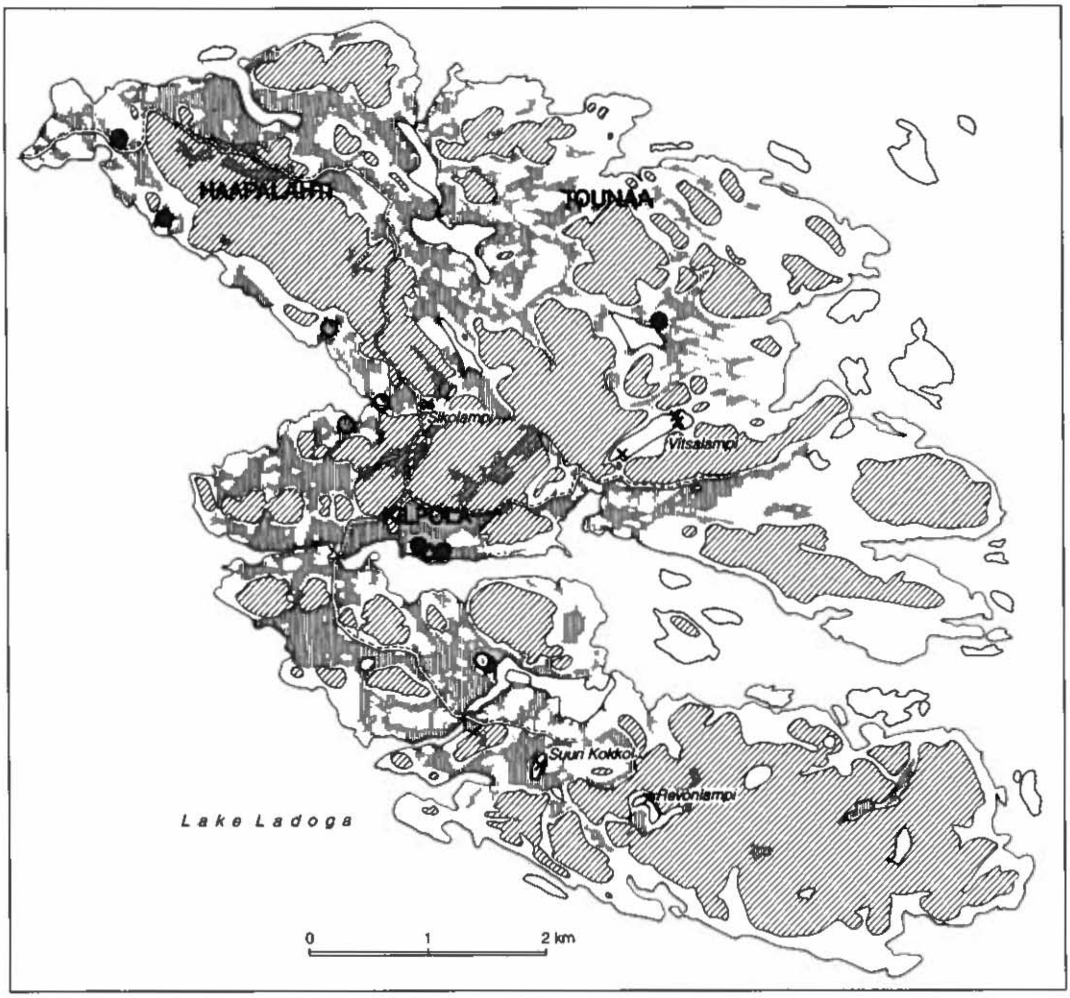


*Fig. 2.* Study area of Kilpolansaari showing areas above 20 m (hatching), fields (vertical lines) and archaeological finds. Black point = stray find of known location, circle = stray find of uncertain location, triangle = cemetery of known location.

tion of the River Neva. Before the formation of the Neva, the shoreline of ancient Lake Ladoga (Fig.2) approximately followed the present 20-metre contour (Saarnisto & Grönlund 1994 in press).

### *4. Vegetation*

In terms of forest vegetation, the study area belongs to the southern boreal vegetation zone (Ahti et al. 1968). In the Russian classification, the western part of the Ladoga area is connected to the southern taiga zone (Sibiryakova 1962). At the end of the nineteenth century the forests of Kilpolansaari were greatly diminished because of swidden cultivation and domestic consumption. The dominant trees in the broadleaved forests were birch and alder. Low pine trees grew only sporadically and spruce had nearly vanished. In later years, the condition of the forests improved through forestry practices, and at the end of the 1920s spruce was planted in the rich forests of the island (Kemppinen 1972). The area of slash-and-burn cultivation (ha/ 10 000 ha forested land) amounted to 60–75 % in the region from 1700 to 1850, but by 1910 the area was reduced to 0.1–14.9 % (Heikinheimo 1915). The present landscape is characterized by low pine trees on the highest hill tops and by pine, deciduous and mixed forests at lower levels, alluvial fields on the coast, and ancient fields which have remained open due to grazing.

## 5. *Settlement history in the light of archaeological finds*

The collections of the National Museum of Finland contain 18 stone artefacts recovered as stray finds from Kilpolansaari Island. The related information, however, is so limited that the finds cannot be given any precise locations. For the most part, only the farm or holding concerned is mentioned. The artefacts were presumably collected in the near surroundings, but they could also have been talismans which were used, for example, as lightning conductors (see e.g. Huurre 1991 87–90). Objects kept for these purposes could have originated in completely different locations.

There is some information on the original sites of three finds.[2] As these artefacts were discovered at elevations below the highest known shoreline of Lake Ladoga, they were either dropped in the water or were originally from transgressive sites. The objects themselves do not provide much data on the age of early settlement. Definitions and datings of the artefact types provide a better, albeit restricted, idea of the development of local settlement.

The types of Stone Age artefacts discovered on Kilpolansaari Island and their approximate periods of use are given in Table 1. They appear to span the whole Stone Age. This is as expected, as the archaeological record of Karelia begins at the emergence of land after the Ice Age.[3] The later periods of the Stone Age are also represented.

*TABLE 1.*
*Stone Artefacts from Kilpolansaari Island*

| Type | Number |
|---|---|
| Curved-backed gouges<br>– mainly pre-ceramic (Luho 1948 47) | 1[1] |
| South-Karelian adzes<br>– pre-ceramic – end of Comb Ware Period (Luho 1948 92) | 3[2] |
| East-Karelian even-bladed adzes<br>– Early Comb Ware – end of the Stone Age (Heikkurinen 1980 55; cf. Vikkula 1986 241–2) | 3[3] |
| Cradle-runner shaped stone artefacts<br>– mainly Comb Ware Period (Matti Huurre, oral communication, cf. Luho 1948 93) | 1[4] |
| Unclassified and undated stone artefacts | 10[5] |
| Total: | 18 |

[1] NM 2590:15 (atypical specimen)
[2] NM 2298:57; 2520:22–23
[3] NM 1922:373; 2298:56; 2520:25
[4] NM 5418:18
[5] NM 2298:55, 58–61; 2520:20–21,24; 3247:4–5

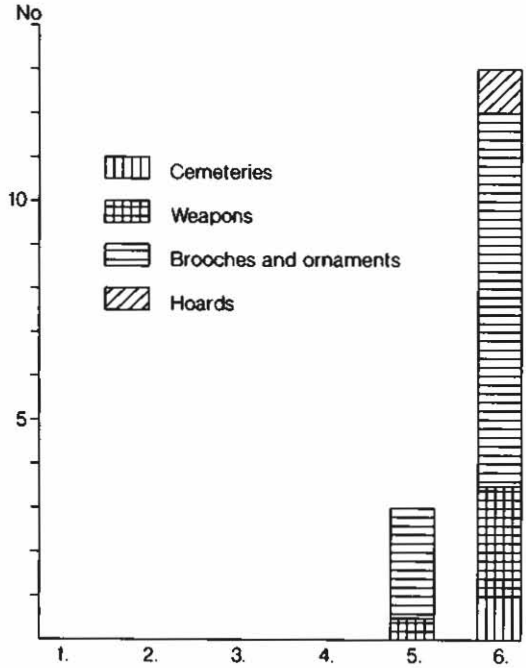


*Fig. 3.* Quantitative development of Iron Age finds on Kilpolansaari Island. 1. Early Roman Iron Age, 2. Late Roman Iron Age, 3. Migration Period, 4. Merovingian Period, 5. Viking Age, 6. Crusade Period.

There are no finds that can be dated to the Bronze Age (1500 – 500 B.C.) or to the Early and Middle Iron Age (500 B.C. – A.D. 800). In this respect, the island is typical of Karelia as a whole, with only few finds from these periods, and only a couple of known burials from the latter stages.

On the other hand, there are numerous Late Iron Age finds from the island (on the finds from Hiitola parish, see Schvindt 1893 103–5; Kuujo 1958). Fourteen sites of seventeen stray finds are known[4], in addition to a hoard (Nordman 1924 19) and a cemetery (Schvindt 1893 103–4). These finds naturally provide more data than the Stone Age material, as more information is available on them. Some of the sites can even be given fairly definite locations (Fig. 2). The island also has a hill known locally as *Linnamäki* ('Hillfort'), but no wall structures were observed by A. Saksa when he inspected the site, which must be included among the indefinite hillfort sites of Karelia.

Evidence of human activity reappears during the Viking Age (A.D. 800 – 1025)[5] and continues throughout the ensuing Crusade Period. The latter is also represented by a cemetery, which attests to the final consolidation of settlement. Local affluence is evinced by the hoard (Fig. 3). The quantitative development of finds is highly similar in the mainland parts of Hiitola. In fact, developments on Kilpolansaari Island mirror the Late Iron Age of Karelia as a whole. Increased activity in the Viking Age and the beginning of the consolidation of settlement are clearly evident, as also the further and deeper development of these phenomena in the Crusade Period (Taavitsainen 1990 71, Fig. 27).

There are also artefacts and cemetery finds dating to historically documented times on Kilpolansaari Island. As they cannot be given any precise dates, they are not considered in the present discussion (see e.g. Schvindt 1893, figs. 518, 520–1), particularly since written sources are much more informative in historically recorded times than archaeological finds.

Taxation records of the Vatja or Vodskaya *pyatina* (administrative region) from 1500 are a main source on the history of settlement, giving the division of the region into *pogosts*, or districts. This administrative system is assumed to have emerged in the thirteenth century at the latest. Kilpolansaari Island belonged to the *pogost* of Kurkijoki. Its subordinate tax collection area *(perevaara)* of Saari included small villages or settlements in the archipelago of Hiitola such as Kauppiaanranta on Kilpolansaari Island, Kurolahti, Tounaa and Haapalahti (Kuujo 1958 63). By that time, village-type settlement had already become established (Ronimus 1906, appendix map). An interesting and special location is Kauppiaanranta, on the shore of a strait dividing the island into two parts. It is the site of the Eerikäinen cemetery and a number of stray finds, the Iron Age antiquities closest to the sampling site of Suuri Kokkolampi pond, which was chosen for the study of cultivation history. Seventeenth-century maps show that the strait served as a passage for shipping.

The Iron Age finds and the settlements from the time of the Vatja *pyatina* are in the same areas as later village-type settlements. These locations are all on clayey soils which emerged after the formation of the River Neva. Even now most of the fields on the island are situated in these areas. Permanent Iron Age settlement is known to have spread into areas of clayey soil and broadleaved forest on the southeast shore of Lake Ladoga as also further to the west in Finland (Kanervo 1937, Orrman 1991, Taavitsainen 1990 65–66).

Kilpolansaari became the site of permanent settlement. The main problem of the present study is to investigate how this can be seen in the pollen diagrams of Suuri Kokkolampi pond.

## 6. *Palynological analysis of Suuri Kokkolampi Pond*

### 6.1. Paleoecological material and its limitations

A common problem in trying to find a pond or lake suitable for studying the history of cultivation is to locate such a body of water in an archaeologically optimal setting. Even on Kilpolansaari Island, a suitable pond could not be found in the immediate catchments of archaeological sites. With respect to cultivation history, Suuri Kokkolampi pond proved to be the best sampling site on the island. It is of sufficient depth to assume undisturbed sedimentation. In addition, it is less than a kilometre from the nearest definite locations of prehistoric finds. The limited catchment area, dictated by the local terrain and the small size of the pond are reasons why its pollen is mainly of local composition. As this study focuses on developments in the local sampling environments, the pollen count was not extended as far as would have been required to outline the earliest stages of cultivation. At that time, at the end of the Stone Age and the beginning of the Bronze Age, Suuri Kokkolampi belonged to the large basin of Lake Ladoga. This means that its pollen record is mainly regional. Moreover, the rocky island was most probably not under cultivation before the River Neva formed its discharge channel.

It would also be interesting to follow the various stages of settlement during the historical period, for example, the decrease of settlement after the Treaty of Stolbova and the emigration of the local Greek-Orthodox population to the Tver region of Karelia. The studied pollen series, however, does not appear to contain the very uppermost, probably 5–10 cm long, loose sediment sequence. This could not be collected with the Russian peat sampler which was used at the site.

### 6.2 The development of vegetation as indicated by the Kokkolampi diagram

Suuri Kokkolampi is a small pond (about 200 x 100 m), presently surrounded by ancient cultivated fields. The elevation of the pond is 8 m above sea level. A brook from nearby Pieni Kokkolampi Pond enters the pond on the southeast shore and there is an outflow in the north into Turkinsalmi. The depth of the water is about 4 metres. A sediment core to the depth of 567 cm was taken from the central north-eastern part of the pond revealing the following stratigraphy:
400–424 cm, gyttja
424–425 cm, clay gyttja
425–426 cm, gyttja clay
426–450 cm, gyttja

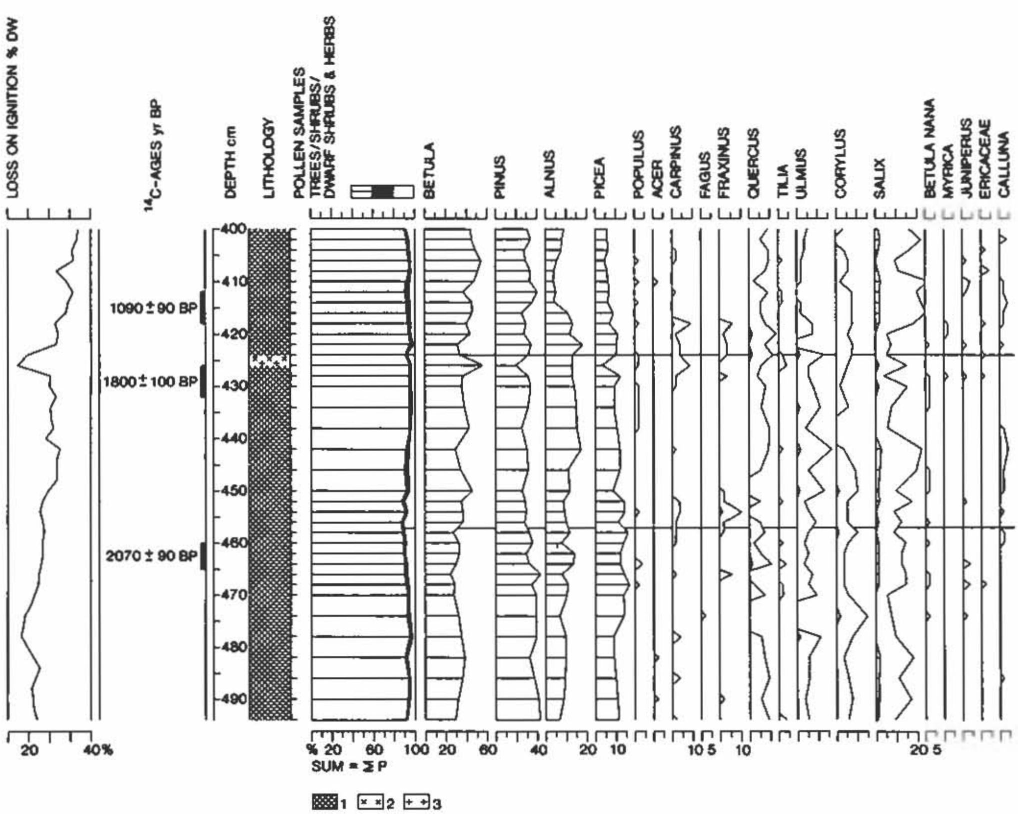


*Fig. 4.* Relative pollen diagram from Suuri Kokkolampi. 1. gyttja, 2. clay gyttja, 3. gyttja clay.

450–567 cm, gyttja, in which clay content gradually increases with depth.
The samples for pollen analysis were taken down to the depth of 496 cm with sampling intervals of 2 and 4 cm.

The loss-on-ignition curve (see Fig. 4) reveals the changes in stratigraphy, the slow decrease of minerogenic matter from the bottom to the surface, reflecting the slow isolation of the pond from a larger body of water. This gradual isolation is also documented in the diatom flora (T. Grönlund 1994, pers. comm.).

## 6.3 Development of vegetation

The Suuri Kokkolampi sequence covers the latter part of the Holocene forest history. In Russian Karelia, this phase is characterized by a dominance of pine and spruce in the forests (Neustadt 1959, Jelina 1985). The pollen strata of Suuri Kokkolampi is characterized more by local than regional influence (Fig. 4). The regional background is reflected in *Pinus* dominance (c. 40 %) in the lower part of the sequence (SK-1 p.a.z.). *Pinus* values declined when the pond became isolated. This is in conformity with the gradual isolation of the pond from a larger body of water, which is registered in the loss-on-ignition curve and also in the diatom data (T. Grönlund 1994, pers.comm.).

In the upper part of the sequence, the proportion of deciduous trees, especially birch and alder, is prominent, reflecting the dominance of the local component in the pollen strata (SK-2 p.a.z.). Aspen *(Populus),* maple *(Acer),* linden *(Tilia),* elm *(Ulmus)* and hazel *(Corylus)* were also present in the local flora. Both wych elm *(U.glabra)* and European white elm *(U.laevis)* grew in the broad-leaved forests of the area (Räsänen 1937). The pollen of beech *(Carpinus),* ash *(Fraxinus)* and probably oak *(Quercus)* are of long-distance origin. The very high AP/NAP ratios for the whole profile indicate the dominance of a wooded landscape.

In the NAP flora the local aquatic and lake-shore

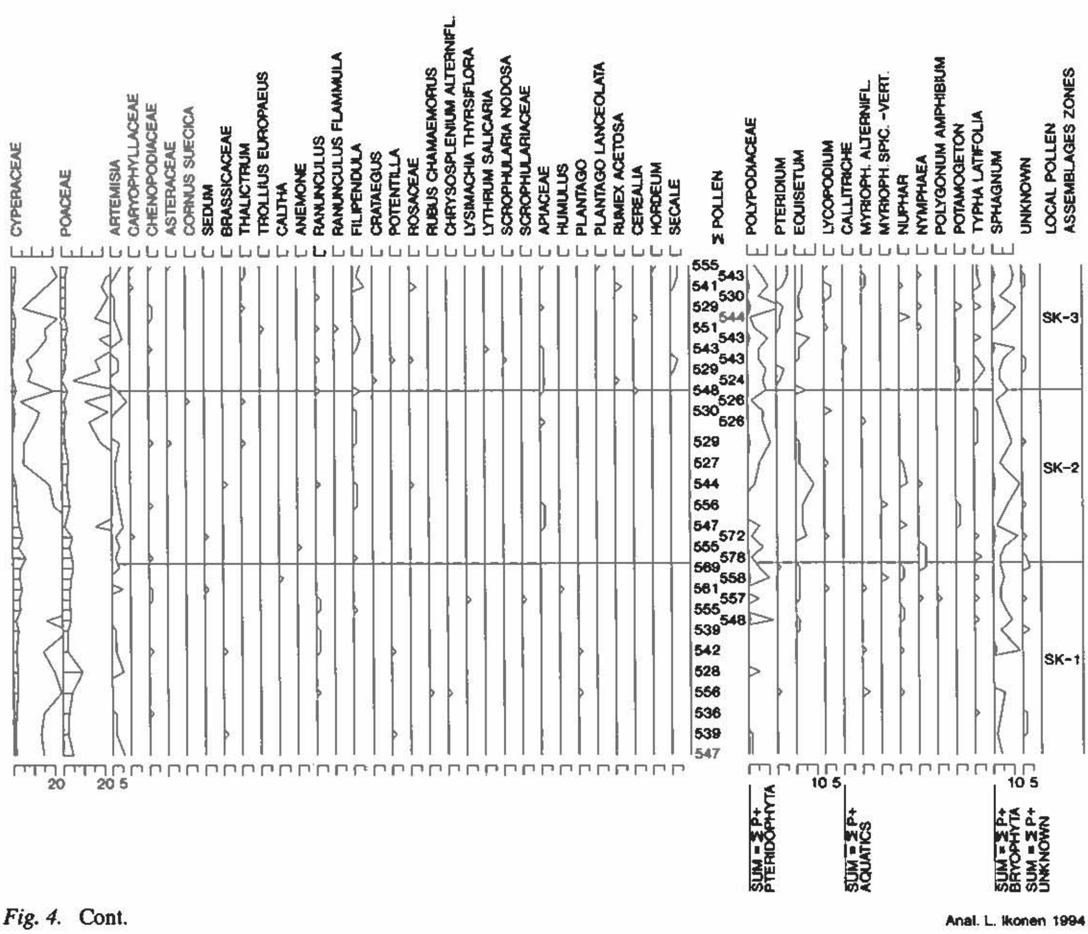

*Fig. 4.* Cont.

vegetation is dominant in the whole profile. Aquatic plants include the following pollen types: *Callitriche, Myriophyllum, Nuphar, Nymphaea, Polygonum amphibium* and Potamogetonaceae. The lake-shore vegetation is represented by the following families and species: Poaceae, Cyperaceae, *Filipendula, Ranunculus, Caltha, Lysimachia thyrsiflora, Lythrum salicaria* and *Scrophularia nodosa.* In addition, a greater part of the Apiaceae pollen probably belongs to the vegetation of shore fields. There are also large amounts of *Salix* pollen in the whole profile. The alluvial land which was exposed when the water level of Lake Ladoga sank was a very suitable habitat for willow and alder.

The greatest change in the pollen composition occurs after the increase of minerogenic matter in the sediment at the depth of 424–426 cm (SK-3 p.a.z.). The reason for the minerogenic pulse is soil erosion caused by forest clearance in the vicinity of the pond. Clearance and burning are evidenced not only by changes in tree composition and the appearance of cultural indicators but also by charcoal particles encountered at the erosion level. There is a decline of *Picea, Alnus* and *Ulmus* pollen, whereas *Betula* and *Populus* values increase. There is no remarkable change in the abundance of *Corylus* pollen. Hazel, which is indigenous only in fertile rich forests (on shores, slopes and esker environments), especially benefits from forest fires, swidden practices, clearance and grazing. Aspen, which has thin-walled and badly preserved pollen, also benefits from forest fires. Forest clearance is also documented by an increase of bracken *(Pteridium).*

The earliest Cerealia pollen grain appears immediately after the erosion level at the depth of 424 cm. The first *Secale* grain is found in the subsequent sample at the depth of 420 cm. No Cerealia pollen were found between depths of 412–418 cm. One Cerealia grain is encountered at the depth of 410 cm. The occurrence of *Secale* begins anew at the depth of 404 cm, after a slight increase in minerogenic matter at the depth of 408 cm. One *Hordeum* pollen was encountered in the uppermost sample.

Other plants associated with various human activities, which appear for the first time or the values of which increase after the erosion pulse, include the following pollen types: *Juniperus, Plantago lanceolata, Rumex acetosa* type and *Calluna*. Because some of these pollen types appear as indicator species of more than one type of human activity or of certain soil variables (Hicks 1985, Gaillard et al. 1994) and their values are also very small, a further subdivision of the activities, whether indicating fallow, pasture or settlement phases, is not valid.

No exceptional change in the AP/NAP ratio occurs along with the appearance of cultural indicators. There are various reasons for the weak reflection of human impact: for example, the filtering effect of the forest around the cleared areas and that of the vegetation cover around the pond itself and the remote location from sites of activity (Vuorela 1973, Hicks 1985). In addition, the clearances must have been quite small. In such cases, the pollen record expressed in percentage terms will show a smaller change than actually took place, because there will still be enough high pollen producers, i.e. trees, to obscure the changes of low pollen producers. Pollen influx results from Kuusamo, NE Finland also suggest that in Boreal forests a sampling site must be within ca. 200 m of a particular activity to be strongly recorded in a pollen diagram (Hicks 1985).

The layer (426–432 cm) below the erosion phase has the radiocarbon date Su-2427 1800±100 BP (cal AD 110 (230) 370; calibrations according to Stuiver & Pearson 1993). As sedimentation was probably somewhat accelerated after fires and clearances, the time scale for the initiation of cultivation based on the mean sedimentation rate may not be absolutely accurate. Since the erosion layer, however, is thin, the time span which elapsed before the initiation of cultivation must be short. Hence, it seems valid to place the beginning of slash-and-burn cultivation in the Late Roman Iron Age. The discontinuity level of Cerealia occurrence at the depths of 412-418 cm is dated to the latter half of the tenth century (Su-2426 1090±90 BP, cal AD 870 (970) 1020). The gap in the Cerealia occurrence, however, does not directly mean that cultivation regressed in the area, but is the result of various factors (see preceding paragraph). The age of the upper erosion level and the subsequent *Secale* occurrence have not been dated nor can be estimated according to sedimentation rate, because the top of the core is evidently missing according to the pollen record. No convincing evidence of the cultivation of the ancient fields adjacent to Suuri Kokkolampi can be confirmed in the pollen strata. There is no change in the abundances of Cerealia and other species regarded as field indicators. The AP/NAP ratio also remains high.

Even though human interference with the landscape is poorly represented in the diagram, the changes both in the loss-on-ignition curve and in the values of trees *(Picea, Ulmus, Alnus, Betula* and *Populus)* and the appearance of Cerealia and other cultural indicators immediately after the erosion pulse clearly verify local human impact in the area.

## 7. *Comparison of eastern and western pollen diagrams and macrofossils*

### 7.1. Pollen evidence of cultivation outside the study area

Indications of cultivation on a minor scale have been recorded in recent years in the regions of Päijänne and Saimaa, the large lakes of Central and Eastern Finland. This evidence has been dated to the Bronze Age and the Early and Middle Iron Age. Signs of continuos cultivation practices appear at the end of the Iron Age or early medieval times. A considerable intensification of agriculture is evident around the transition to the post-medieval period (see e.g. Simola et al. 1988 and 1991, Grönlund et al. 1992, Vuorela 1993).

There are very few pollen data indicating early agriculture from the Karelian Isthmus and the Lake Ladoga area. The nearest site to Kilpolansaari Island where cultivation history has been studied by pollen analysis is the village of Jessoila (Russ. Essojla) on the southern coast of Lake Säämäjärvi (Russ. Sjamozera) on the isthmus between Lake Ladoga and Lake Onega.

The landscape of the Säämäjärvi area is characterized by moraine ridges with pine forests separated by plains and mire areas. The soils are predominantly till and sand. Clay deposits are found only in the southern part of the Säämäjärvi area (Ekman & Zuravlev 1986). In terms of forest vegetation, the area belongs to the middle taiga zone (Sibiryakova 1962).

The Jessoila sequence consists of a minerogenic deposit in the upper part of which a fossil soil above silt layer was found. The soil is covered by organic and minerogenic colluvial material. At the bottom of the fossil soil, wood charcoal was found in abundance (Ekman & Zuravlev 1986).

The forest history of the sequence covers the latter part of the Holocene (SA-2 and SA-3). *Pinus* pollen are in dominance (over 50%) in the AP component. The proportion of *Betula* and *Alnus* varies between 10 % and 25 %. *Picea* and *Corylus* pollen are found only sporadically. Cultural indicators consist more abundantly of grasses, especially of cereals, of which all four species were encountered. In the cereal sum, the proportion of rye *(Secale)* is 70–90 %, of wheat *(Triticum)* 1–5 % and of barley *(Hordeum)* and oats *(Avena)* 10–15 % in total. The other cultural indicators *(Rumex, Centaurea* and *Oenothera)* occur in smaller quantities. However, the proportion of *Calluna* and *Pteridium* pollen, which belong to the pioneer flora after forest fires also diminishes considerably in the upper part of the sequence (Ekman & Zuravlev 1986). The vegetation studies in the northern Ladoga area have demonstrated the dominance of *Calluna* in *Vaccinium-* and *Myrtillus*-type pine forests at the beginning of the clearing phase (Linkola 1916).

Slash-and-burn cultivation in the Säämäjärvi area was initiated in the latter part of the ninth century. The main cereal was rye, which was most suitable for cultivation in the area, because of the poor soils and the cool climate. Evidence from the fossil soil proved that the rye seeds were merely scattered into the ashes after which they were hilled up with a twig harrow. The swidden areas were in use for 3–4 years, after which they were abandoned for 40–50 years for forestation (Ekman & Zuravlev 1986).

The date of the beginning of cultivation given by Ekman and Zuravlev (1986) has not, however, been calibrated. The calibrated date of the radiocarbon age (Ta-1443 1060±60 BP) gives the age cal AD 960 (1000) 1020 (Stuiver & Pearson 1993). The latter date for the age of cultivation is more reasonable, because the large amounts of Cerealia grains and the presence of all the main crop types would rather indicate more intensive farming. It is also possible that the age cal AD 1000 is too old. The presence of wood charcoal at the dated level suggests a possible time gap between the calibrated date of the sample and the death of the tree it represents. The charcoal may also be connected with forest fires prior to swidden clearance. The problem of the chronological relationship of the dated sample and the pollen sequence still remains.

### 7.2. Macrofossil evidence of cultivation from other locations

The earliest signs of arable wheat cultivation (as shown by finds of grains and ard shares) at Staraya Ladoga are from the eighth and ninth centuries A.D. The main cultivated species was *Triticum dicoccum*. The first individual finds of rye grains are also from this period.

All major grain species appear in the material from the areas south of Lake Ladoga (Staraya Ladoga, Novgorod, Izborsk) between the tenth and thirteenth centuries. By now rye had become the main species, followed by barley, wheat, and finally oats also as an independent species (Kir'janov 1959; Kir'janova 1979; 1981 & 1989).

## *8. Discussion*

By comparing the biostratigraphical records of the study site on Kilpolansaari Island and those of the Jessoila village in Säämäjärvi an apparent difference emerges concerning the utilization of prevalent forests. On the island, swidden areas were cleared in deciduous forests with demanding broadleaved species or in mixed forests dominated by deciduous trees. In the Säämäjärvi area, on the contrary, clearing plots were situated in coniferous forests or in conifer-dominated mixed forests.

The regions of the northeastern shores of Lake Ladoga were more favourable for vegetation in view of their soils and the regional and local climate than the Säämäjärvi environments where the warming effect of a large water basin is missing. The favourability of the environments undoubtedly also determined the swidden methods. In the Säämäjärvi region, the *huuhta* and on the island of Kilpolansaari probably a normal type of swidden and the Finnish *lehtokaski* (broadleaved-forest swidden) methods were applied.

Arable cultivation cannot be demonstrated in the Suuri Kokkolampi diagram. Macrofossil evidence and archaeological finds from the areas to the south of Lake Ladoga indicate, however, that arable farming practices were already known in the nearby areas in the eighth century. The cemeteries of Karelia and the areas south of Lake Ladoga also point to these practices.

The lake sediment from Kilpolansaari suggests that slash-and-burn clearance began on the island a few centuries after the formation of the River Neva. Since Suuri Kokkolampi pond represents highly local pollen, it is not impossible that cultivation could have begun in advantageous locations on the island immediately after the formation of the Neva. The diagram for the pond contains only weak indications of cultivation at the end of the Iron Age, although the archaeological record shows that settlement was consolidating on the island at this time. It is somewhat surprising that there is no evidence of permanent agriculture from later times.

The archaeological and palynological evidence also contains an interesting contradiction concerning the Late Roman Iron Age. There are clear indications of cultivation at the time, while archaeological evidence of human activity is lacking in the immediate vicinity and on the island as a whole. In this respect, the diagram resembles results obtained in the inland regions of Finland. These also display intermittent signs of small-scale cultivation in the Iron Age, and even in the Bronze Age, both being periods with few or totally absent archaeological finds in the areas concerned. How can we reconcile evidenced cultivation pointing to human presence an archaeological record suggesting little or no activity? The diagrams for the inland regions of Finland display a long interval between the first indications of cultivation and evidence for continuous farming practices. This is in contradiction with the pattern of a fast spread of cultivation which has been observed elsewhere. Various biological, ecological, cultural and environmentally determined explanations have been sought (Taavitsainen 1994), but with no final results. This problem is not discussed further in the present article, but will be reviewed in connection with new material obtained from Northern Savo and Karelia (Taavitsainen et al. 1995). The present research concerning Kilpolansaari Island is part of a project begun by J-P. Taavitsainen and Aleksandr Saksa in collaboration with the University of Joensuu in 1991. The purpose of the project is to investigate the history of early cultivation in Karelia along the northwest coast of Lake Ladoga with reference to a geographically and environmentally more representative and larger body of evidence, mainly containing annually laminated sediments in ponds (Grönlund et al. 1995).

## NOTES

1 The participants of the expedition were Matti Saarnisto of the Geological Survey of Finland, J.-P. Taavitsainen and Aleksandr Saksa.

2 NM (National Museum of Finland) 2298:58, 2520:24, 5418:18.

3 The term 'Karelia' here means the Finnish historical province of Karelia, presently divided among Finland, the Leningrad region (Russia) and the Republic of Karelia (Russia).

4 The number of sites may be smaller, since it is possible that objects discovered at different times may in fact be from the same location. This, however, cannot be verified in the catalogues of the National Museum.

5 The Viking Age finds pose a number of problems. Large glass beads, usually occurring in Viking Age contexts, have been found in Hiitola (NM 2520:42, 2590:16). But as these are sometimes recovered among Crusade Period finds, the beads are assigned to both periods. The weapons, ornaments and brooches also include artefacts of this kind [e.g. NM 2520:47 and 2298:176 (Nordman 1924 126, 139, Fig. 117)]. The bar representing the Viking Age in Fig. 3 consists of these chronologically indefinite finds.

## REFERENCES


Ahti T., Hämeet-Ahti L. & Jalas J. 1968. Vegetation zones and their sections in northwestern Europe. *Annales Botanici Fennici* 5 (3), 169–211.

Ekman I. M. & Zuravlev A.P. 1986. O drevnejšem zemledelii v Karelii po dannym hrono- i biostratigrafičeskih issledovanij. *Geologija dokembrija centralnoj i južnoi Karelii. Operativno-informacionnye materialy. Karel'skij filial AN SSSR Institut geologii,* 51–54.

Gaillard M-J, Birks H.J.B., Emanuelsson U., Karlsson S., Lagerås P., Olausson D. 1994. Application of modern pollen/land-use relationships to the interpretation of pollen diagrams-reconstructions of land-use history in south Sweden, 3000-0 BP. *Review of Palaeobotany and Palynology* 82, 47–73.

Grönlund E., Kivinen L. & Simola H. 1992. Pollen analytical evidence for Bronze-Age cultivation in eastern Finland. *Laborativ Arkeologi* 6, 37–42.

Grönlund E., Simola H., Saksa A. & Taavitsainen, J.-P. 1995. Early Karelian Land-Use History on the Western Shore of Lake Ladoga – A Project Outline. *Fennoscandia archaeologica* (In print)

Heikinheimo O. 1915. Kaskiviljelyn vaikutus Suomen metsiin. *Acta Forestalia Fennica* 4, 1–264.

Heikkurinen T. 1980. Itäkarjalaiset tasa- ja kourutaltat. *Helsingin yliopiston arkeologian laitos. Moniste* n:o 21, 1–101.

Hicks S. 1985. Problems and possibilities in correlating historical/archaeological and pollen-analytical evidence in a northern boreal environment: An example from Kuusamo, Finland. *Fennoscandia archaeologica* II, 51–84.

Huurre M. 1991. Satakunnan kivikausi. *Satakunnan historia* I,1, 85–323.

Inostranzeff A. I. 1882. *L'homme préhistorique de l'âge de la pierre sur les côtes du Lac Ladoga.* St. Petersburg.

Jelina G. A. 1985. The history of vegetation in Eastern Karelia (USSR) during the Holocene. *Aquilo, Ser. Botanica* 22, 1–36.

Kanervo E. 1937. Sortavalan seudun asutusmaantieteestä. *Laatokan-Karjalan Maakuntaliiton vuosikirja* I, 3–44.

Kemppinen I. 1972. *Hiitolan kylähistoria.* Vammala, 244–245.

Kir'janov A. V. 1959. Istorija zemledelija Novgorodskoj zemli X–XV vv. (Po arheologičeskim materialam). Trudy Novgorodskoj arheologičeskoj ekspedicii II. *Materialy i issledovanija po arheologii SSSR* 65, 306–362.

Kir'janova N. A. 1979. O sostave zemledel'českih kul'tur drevnej Rusi X–XV vv. (po arheologičeskim materialam). *Sovetskaja arheologija* 4/1979, 72–85.

Kir'janova N. A. 1981. Zernovye materialy Izborska. *Kratkie soobščenija* 166, 109–114.

Kir'janova N. A. 1989. Novye materily po zemledeliju Novgoroskoj zemli. *Estestvennonaučnye metody v arheologii.* Moskva, 228–233.

Koistinen T. (ed.) 1994. Precambrian basement of the Gulf of Finland and surrounding area 1:1 000 000. Espoo: Geological Survey of Finland.

Kuujo E. 1958. Kurkijoen vaiheet asutuksen alusta v:teen 1570. *Kurkijoen kihlakunnan historia.* Pieksämäki, 9–85.

Linkola K. 1916. Studien über den Einfluss der Kultur auf die Flora in den Gegenden nördlich vom Ladogasee, I Allgemeiner Teil. *Acta Soc. Fauna et Flora Fennica* 45 (1), 1–429.

Luho V. 1948. *Suomen kivikauden pääpiirteet*. Helsinki, 1–174.

Neustadt M. I. 1959. Geschichte der Vegetation der UdSSR in Holozän. *Grana Palynologica* 2(1), 69–76.

Niemelä J., Ekman I. & Lukashov A. (eds) 1993. Quaternary deposits of Finland and northwestern part of Russian Federation and their resources 1:1 000 000. Sheet 2: Eastern part. Espoo: Geological survey of Finland.

Nordman C. A. 1924. Karelska järnåldersstudier. *Finska Fornminnesföreningens tidskrift* XXXIV:3, 1–200.

Orrman E. 1991. Geographical factors in the spread of permanent settlement in parts of Finland and Sweden from the end of the Iron Age to the beginning of Modern Times. *Fennoscandia archaeologica* VIII, 3–21.

Ronimus J. V. 1906. *Novgorodin vatjalaisen viidenneksen verokirja v. 1500 ja Karjalan silloinen asutus*. Joensuu, 1–135.

Räsänen V. 1944. Kurkijoen ja sen naapuripitäjien putkilokasvisto. *Kuopion Luonnon Ystäväin Yhdistyksen julkaisuja*, B 2 (2), 1–117.

Saarnisto M. & Grönlund T. 1994. Shoreline displacement of Lake Ladoga- new data from Kilpolansaari. *Hydrobiology*, in press.

Saarnisto M., Saksa A. & Taavitsainen J.-P. 1993. Drevnjaja Ladoga i čelovek na ee beregah. *Ežegodnye Rossijsko-Finljanskie gumanitarnye čtenija "Šegren – akademik Imperatorskoj Sankt-Peterburskoj Akademii nauk. K 200-letiju so dnja roždenija". Sankt-Peterburg, 5 – 7 oktjabrja 1993 g. Tezisy dokladov.* Sankt-Peterburg, s. 27–29.

Saarnisto M. & Siiriäinen A. 1970. Laatokan transgressioraja. Deutsches Referat: Die Transgressionsgrenze des Ladogasees. *Suomen Museo* 1970, 10–22.

Schvindt T. 1892. Tietoja Karjalan rautakaudesta Käkisalmen kihlakunnan alalta saatujen löytöjen mukaan. *Suomen Muinaismuistoyhdistyksen Aikauskirja* XIV, 1–191+1–56.

Sibiryakova M.D. 1962. *Tipy lesa lesorastitel'nykh rayonov evropeyskoy časti SSSR s illyustraciey podlesnoy flory*, Moskva, 1–208.

Simola H., Grönlund E. & Uimonen-Simola P 1988. Etelä-Savon asutushistorian paleoekologinen tutkimus. *Joensuun yliopisto, Karjalan tutkimuskeskuksen julkaisuja* 84, 1–55.

Simola H., Grönlund E., Taavitsainen J.-P. & Huttunen P. 1991. Savolainen väestöräjähdys. *Saimaalta Kolille. Karjalan tutkimuslaitoksen 20-vuotiskirja. Karjalan tutkimuslaitos 1971–1991*. Joensuu, 241–259.

Stuiver M. & Pearson G.W. 1993. High-Precision Bidecadal Calibration of the Radiocarbon Time Scale, AD 1950-500 BC and 2500-6000 BC. *Radiocarbon* 35 (1), 1–23.

Taavitsainen J.-P. 1990. Ancient Hillforts of Finland. Problems of Analysis, Chronology and Interpretation with Special Reference to the Hillfort of Kuhmoinen. *Suomen Muinaismuistoyhdistyksen Aikakauskirja* 94, 1–294.

Taavitsainen J.-P. 1994. Kaskeaminen ja metsästys erämailla. *Kalevalaseuran vuosikirja* 73, 187–207.

Taavitsainen J.-P., Simola H & Grönlund E 1995. Cultivation history beyond periphery – early agriculture in the northern boreal forest. Manuscript.

Vikkula A. 1986. En östkarelsk krummejsel från Pyheensilta. *Iskos* 6, 237–243.

Vuorela I. 1973. Relative pollen rain around cultivated fields. *Acta Botanica Fennica* 102, 1–27.

Vuorela I. 1993. Vuojärven kerrostumat Laukaan historian arkistoina. *Kohisevien koskien Laukaa*. Jyväskylä, 289–293.