INTRODUCTION OF AGRICULTURE IN VALAMO, RUSSIAN KARELIA: PALAEOECOLOGY OF LAKE NIIKKANANLAMPI

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Abstract

Pioneer results of pollen and charcoal analyses and ^{14}C determinations from Valamo, an island in Lake Ladoga, show some evidence of human activity as long ago as during the Pre-Roman Iron Age (500-0 BC), and indicate that grazing in the area started in the Merovingian Period (AD 550/600 – 800) and cereal cultivation – in remote parts of the island – in the late 13th century.

Introduction

The current palaeoecology project on Valamo (Valaam) Island has two principal goals: 1) to study the uplift history of Valamo from the Lake Ladoga basin waters and 2) to study the landuse history of Valamo and its relevance to the history of the monastery of Valamo. The project is a joint exercise between the Geological Survey of Finland and the Institute of Geology, Karelian Scientific Center, Russian Academy of Sciences.

There are several small basins on Valamo (Fig. 1). Situated at different elevations above the present level of Lake Ladoga, their bottom sediments support evidence of the uplift history of the island during the past 3100 years, *i.e.* since the formation of the River Neva, the present outlet of Lake Ladoga (*e.g.* Saarnisto & Grönlund 1996, and the Russian literature cited therein). Before the opening of the Neva outlet the shore line of Lake Ladoga lay at 21 m a.s.l. on Valamo, *i.e.* 16 metres above the present Lake Ladoga level, at 5 m a.s.l. (*e.g.* Ailio 1915, Hyyppä 1943). Most cultivated fields on Valamo are on the former lake bottom, below the 21-m level. Before the formation of the Neva, there was an archipelago comprising dozens of rocky islands within the area of the present island of Valamo. No archaeological finds have been made from this period (Spiridonov 1992).

The sediments in the lakes on Valamo contain evidence – mainly pollen grains – of early land use, forest clearance and agriculture. Pollen analysis of the sediment sequences should contribute to discussion on the controversy surrounding the early history of the monastery of Valamo (*e.g.* Kirkinen 1963, Spiridonov 1992). The sediment lithology shows clear variations related to human activity. Before the Second World War, intensive agriculture was practised at Valamo by the monks and other people, but since the war the fields have been used only for grazing; most are still open meadows but in places they are overgrown with bushes of willow, alder and birch.

The results of lithological, pollen and charcoal analyses and radiocarbon determinations are here reported from Lake Niikkananlampi, where a distinct clay layer in the upper sediment sequence suggests field erosion. To the authors' knowledge, no previous pollen or other palaeoecological studies have been undertaken at Valamo, and pollen studies relevant to early land use in Lake Ladoga area are extremely rare (*e.g.*

Fig. 1. Valamo Island and the sites cored for pollen analysis. The hatched areas were above the ancient Lake Ladoga level (20 m a.s.l.) before the opening of the River Neva at 3100 BP. The densely hatched areas indicate the areas of abandoned fields. X = sample site.

Taavitsainen et al. 1995). The present results of human activity obtained from Lake Niikkananlampi constitute a progress report which will later be completed with the results from the other sites. Data relevant to uplift and possible anomalous neotectonic movements, including postulated Holocene earthquakes (Lukashov 1995), will be discussed elsewhere.

Lake Niikkananlampi: sediment record and methods

All nine lake basins on Valamo were sampled during the Finnish-Russian coring expedition led by M.S. in February 1996. In addition, sediments of two bays of Lake Ladoga were cored using a Livingstone-type piston corer (a P-P corer modified by Seppo Putkinen of the Geological Survey of Finland) with a core diameter of 50 mm and a length of 1.9 m. The first cores at each site were extruded on lake ice for inspection and, in some cases, for subsampling.

Lake Niikkananlampi (61°22'N lat and 30°55' E long) lies in the western part of Valamo, at 8.1 m a.s.l. The lake covers 0.5 ha and its depth at the coring site, in the middle of the basin, is 3.7 m. The lake is now surrounded by old stands of spruce and pine, as it was before the war. A narrow field extends to the south-eastern corner of the lake. The field adjacent to the lake is now covered by bushes. A small brook flows across the field into the lake.

The stratigraphy of the bottom sediments is as follows: 574–550 cm, blue-grey clay with silt bands (not investigated here); 550–531 cm, sand with distinct lower and upper boundaries; 531–502 cm, clay-gyttja with loss-on-ignition increasing from 7 to 18% towards the top ; 502–392 cm, dark brown gyttja with loss-on-ignition increasing from 18 to 30% towards the top, dark sulphide bands in the lower part, a dark band of coarse organic detritus at 484 cm, and a thin clayey horizon at the 403-cm level; 392–380 cm, gyttja-laminated grey clay, distinct lower and upper boundaries; 380–370 cm, dark-brown loose detritus gyttja, sediment surface. The uppermost 10-cm sediment sequence was divided in the field into 2-cm subsamples. This part of the sediment expanded during extrusion and represents an original sediment thickness of approximately 6 cm.

The bottom clay accumulated when Lake Niikkananlampi was part of the Lake Ladoga basin water body. The formation of the sand deposit can be attributed to the rapid lowering of the Lake Ladoga level in connection with the opening of the Neva outlet at 3100 B.P., and the clay gyttja above the sand to the lagoonal stage when the Niikkananlampi basin was a shallowing bay of Lake Ladoga. The isolation of Niikkananlampi from Lake Ladoga as the result of a further fall in water level can be placed in the sediment at 502 cm, at which point loss-on-ignition starts to rise. The gyttja above the isolation level represents sediment of the isolated Lake Niikkananlampi. Its sedimentation was interrupted by deposition of the distinct clay layer clearly caused by clearance of the nearby field. The uppermost 6 (–10) cm of the sediment sequence must represent post-Second World War time, when the fields have not been ploughed and have been partly overgrown by bushes.

Pollen and charcoal analyses and loss-on-ignition determinations at 550°C were used to trace human impact. The pollen diagram was ^{14}C dated at five levels, three of which are presented here. For pollen analysis the material was treated with cold HF and KOH methods (Faegri & Iversen 1989). Recent *Lycopodium* spores were added for the determination of pollen concentrations (Stockmarr 1971). The material was mounted in glycerolgelatine and analysed at 320 x magnification with a Leitz Diaplan microscope. One thousand tree pollen grains were identified from each level. Tree pollen frequencies are expressed as percentages of arboreal pollen (AP) and herb pollen frequencies as percentages/promilles of the total pollen sum (P). Spores and aquatics are expressed as percentages/promilles of P+n. The herb pollen was divided into groups as follows: dwarf shrubs, natural mineral soil vegetation, cultivated plants, settlement indicators, aquatics and hygrophytes and cryptogams.

The plant nomenclature employed here follows that of Hämet-Ahti et al. (1986).

Dating of the profile

The present objects of ^{14}C determination were the decrease in *Picea* pollen frequencies at the 456–448-cm level, anthropogenic fluctuations *e.g.* in *Alnus* pollen frequencies at the 400–396-cm level, and the first Cerealia occurrence at the 396–392-cm level.

Results

According to the lithostratigraphy and the loss-on-ignition values (Fig. 3), the Niikkananlampi profile also covers the time span preceding isolation of the present-day basin, *i.e.* 3000–4000 years, and thus roughly corresponds to the period from the Early Bronze Age to the present. The ^{14}C dates determined are shown in Table 1.

Table 1. ^{14}C dates of the Lake Niikkananlampi profile.

Lab. no.	Depth (cm)	^{13}C (‰ PDB)	^{14}C date (years BP)	Calibrated time (cal AD)
Su-2742	392–396	–32.9	770±40	late 13th century
Su-2743	396–400	–32.3	1210±50	9th century AD
Su-2744	448–456	–30.8	2390±60	5th century BC

Pollen results

Pollen concentration

The pollen concentration (Fig. 6) in the gyttja and sandy clay gyttja deposits fluctuates between 150 000 and 200 000 pollen grains cm^{-3} except at the 482 and 454–452-cm levels. At the 482–cm level, the pollen concentration falls to some thousands of grains, coinciding, however, with the dark horizon with increased loss-on-ignition and increased herb pollen flora. The 454–452-cm level is included in the ^{14}C-dated material from the 456–448-cm level. These low pollen concentration values together with the pollen data, a slight decrease in the loss-on-ignition values and an obviously somewhat too old ^{14}C date might be attributed to partly older material as a result of anthropogenic erosion.

From the 412-cm level upwards the mean pollen concentration increases to ca 300 000 cm^{-3}, the fluctuation ranging from 100 000 to 500 000 pollen grains cm^{-3}. The lowest values were found in the clay deposit (392–381 cm) and the highest ones in the uppermost 10 cm of loose gyttja.

Relative pollen data

In the sediments deposited before isolation at the 502-cm level, the tree pollen data (Fig. 2) mainly reflect long-distance pollen partly transported by the wind, partly concentrated by floating material. They cannot therefore be directly correlated with climatic conditions. The deterioration in the climate at the Bronze Age/Iron Age boundary (ca 2500 BP) seems, however, to be reflected in the QM data by a decrease starting at the period of isolation.

Even though the continuous decrease in *Picea* pollen frequencies seems to indicate human activity, this cannot be confirmed by the herb pollen data. The AP/NAP ratio and the relatively high shrub pollen frequencies (Fig. 3), however, reflect a relatively open forest type in the pre-agricultural period. The increase in *Alnus* and *Betula* together with the clear decrease in *Picea* at the 432-cm level, could be attributed to anthropogenic activities; even more so at the 392-cm level, in connection with the start of agriculture. Cultivation seems to have been preceded by a period of forest clearance – probably for grazing purposes – as indicated by three short maxima of *Alnus* (403–396 cm) together with a rapid increase in *Betula* pollen frequencies. This level was ^{14}C dated to 1210±50 BP, which corresponds to the 9th century AD, *i.e.* Late Merovingian Period or Early Viking Age. According to the increase in *Juniperus* pollen frequencies, the start of grazing activities could be placed even earlier, starting at the 412-cm level, whereas continuous and relatively high *Salix* pollen frequencies indicate the natural shore vegetation of Lake Niikkananlampi. At the 398-cm and 388-cm levels single *Acer* pollen grains indicate open landscape, as does *Populus* pollen in the upper half of the diagram. One pollen grain of *Larix* was found at the 410-cm level.

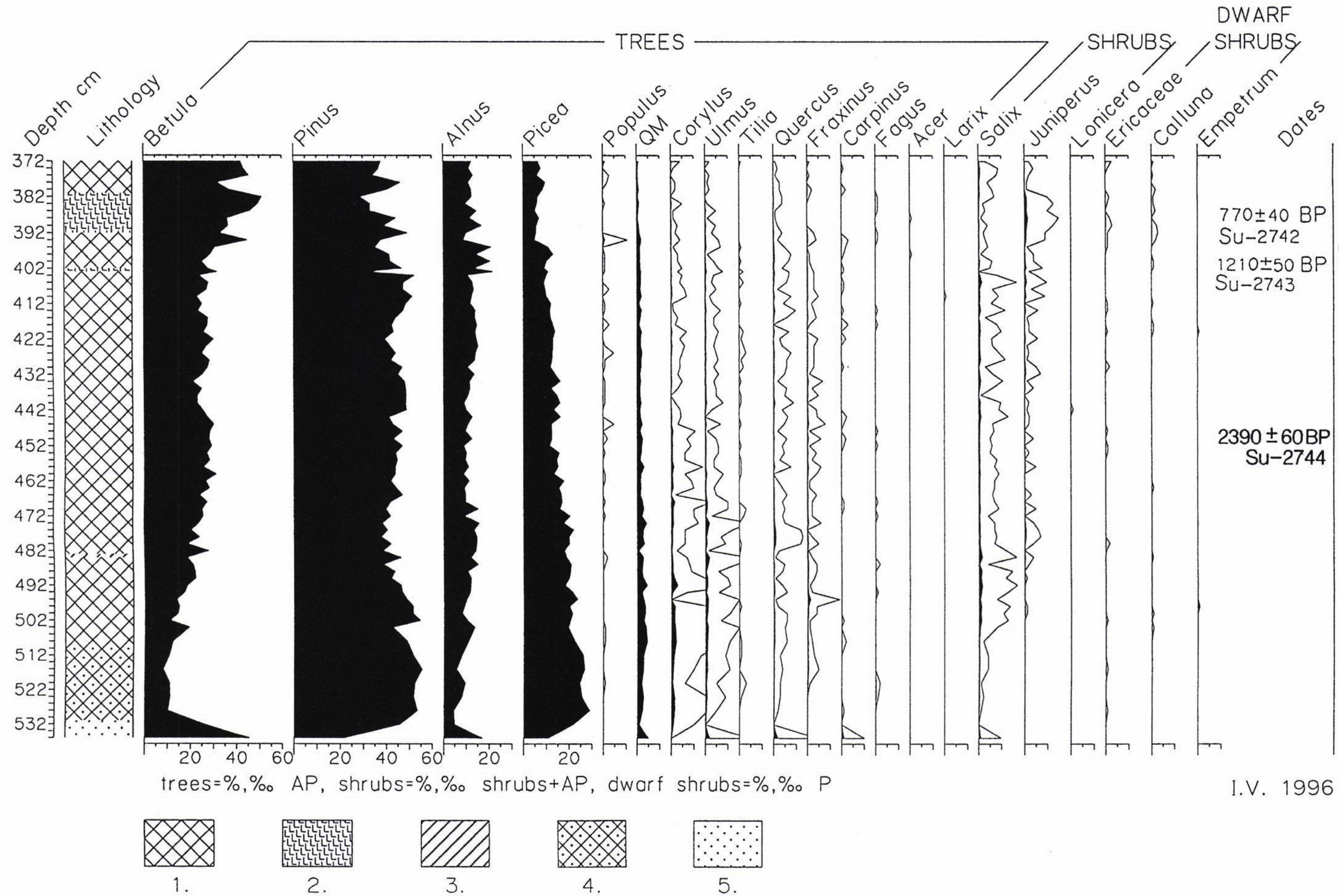

Fig. 2. Relative pollen frequencies of trees, shrubs and dwarf shrubs in the sediments of Niikkananlampi, Valamo Island. Sediment symbols: 1. gyttja, 2. clay, 3. coarse organic detritus, 4. clay gyttja, 5. sand.

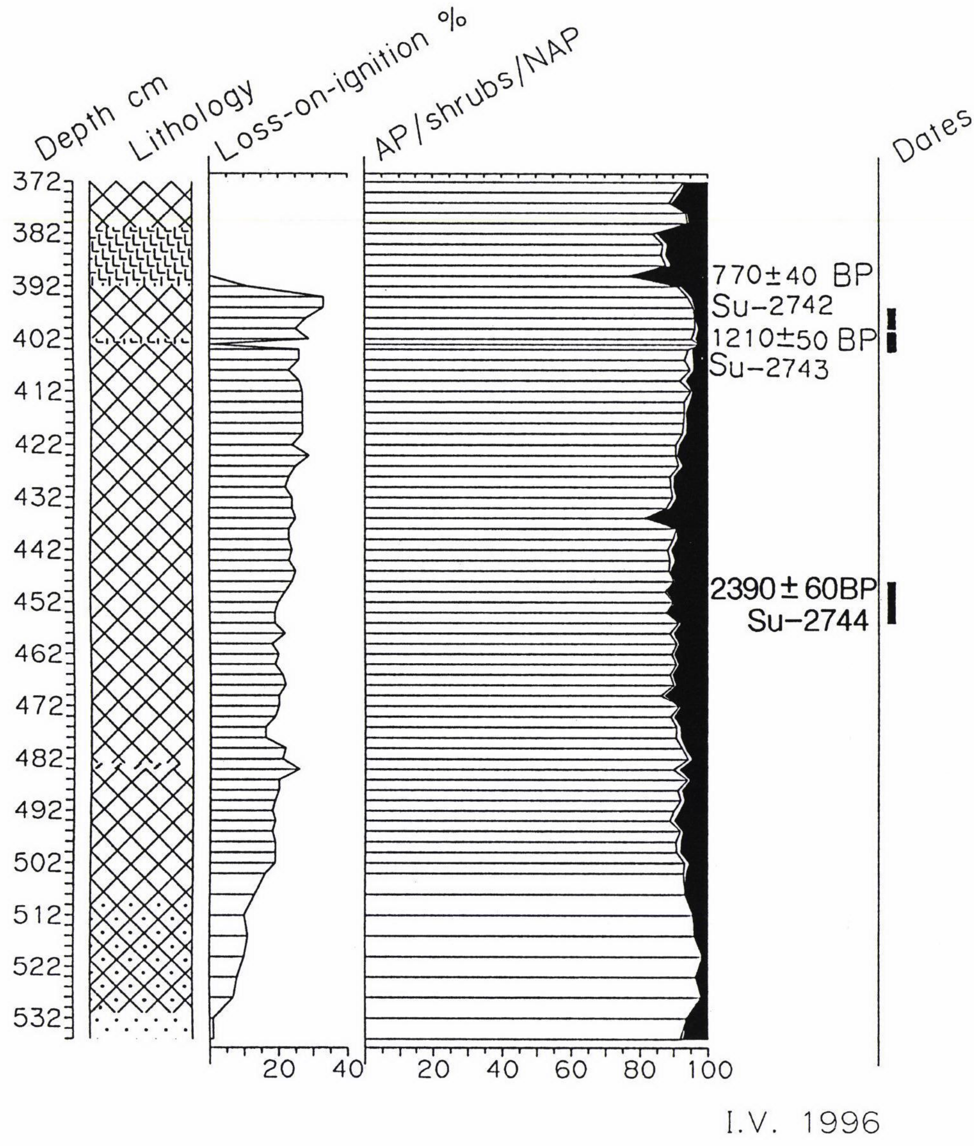

Fig. 3. Loss-on-ignition, AP/SHRUBS/NAP ratio and ^{14}C dates of the sediment sequence of Lake Niikkananlampi, Valamo Island.

Among the dwarf shrubs, pollen of Ericaceae and *Calluna* occurs sporadically throughout the diagram, increasing somewhat, however, in the upper part of the profile, especially in the cultivation period (392–381 cm).

Among the herb pollen data, natural mineral soil vegetation (Fig. 4) is represented by 33 pollen types, the number of pollen taxa increasing steadily towards the surface. The high frequencies of Poaceae, starting before the isolation phase at the 502-cm level and persisting throughout the gyttja sediment sequence until the 414 cm level, mainly indicate light and open forest around Niikkananlampi and abundant shore vegetation. The decrease in this pollen type from the 434-cm level onwards, in connection with

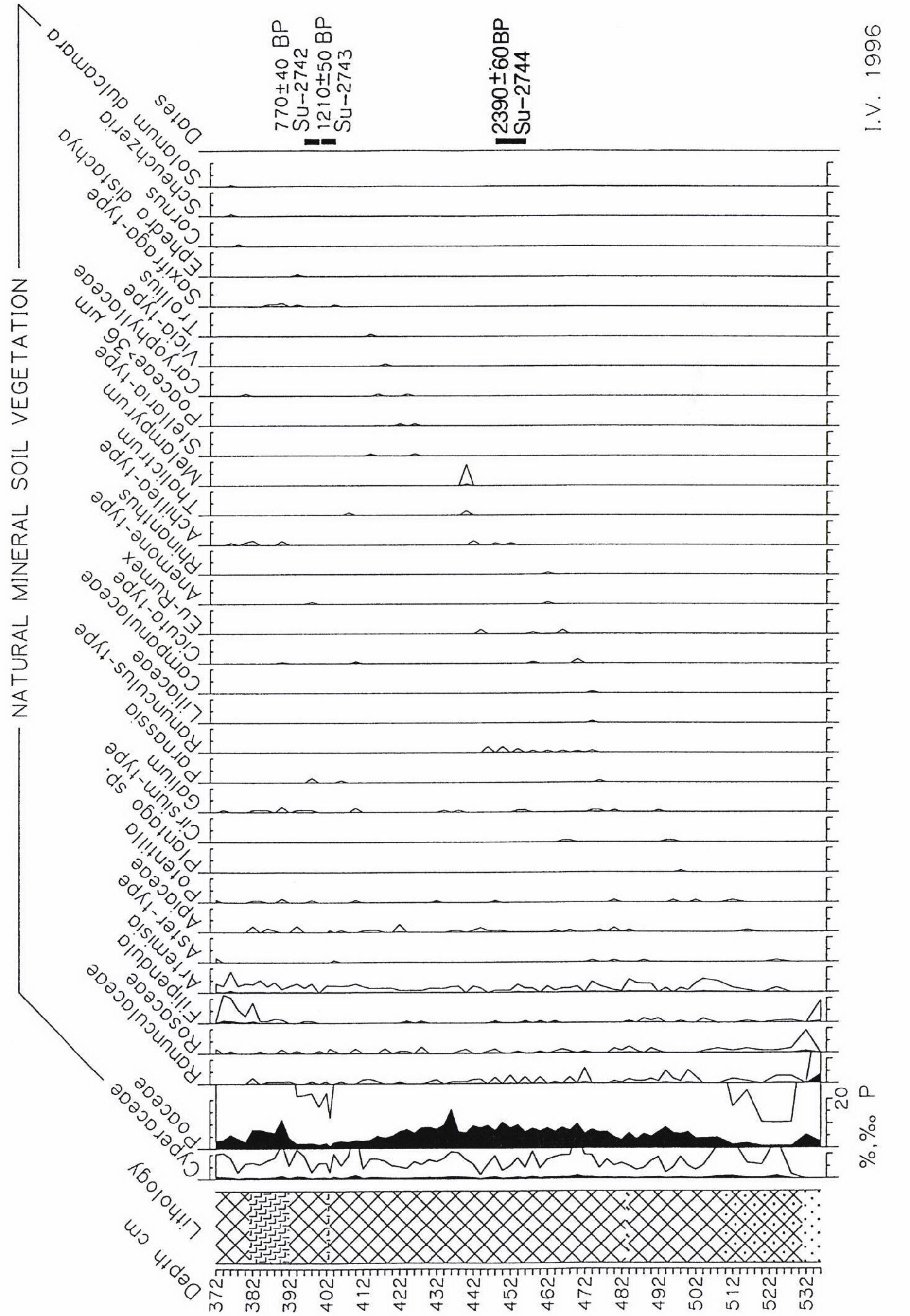

Fig. 4. Relative pollen frequencies of natural mineral soil vegetation in the sediment sequence of Lake Niikkananlampi, Valamo Island.

first indicators of grazing activities, could probably be attributed to intensive sheep grazing, which prevented the grass from producing pollen. The minimum frequency of Poaceae pollen (about 1% P) at the 402-cm level followed by a period of low pol-

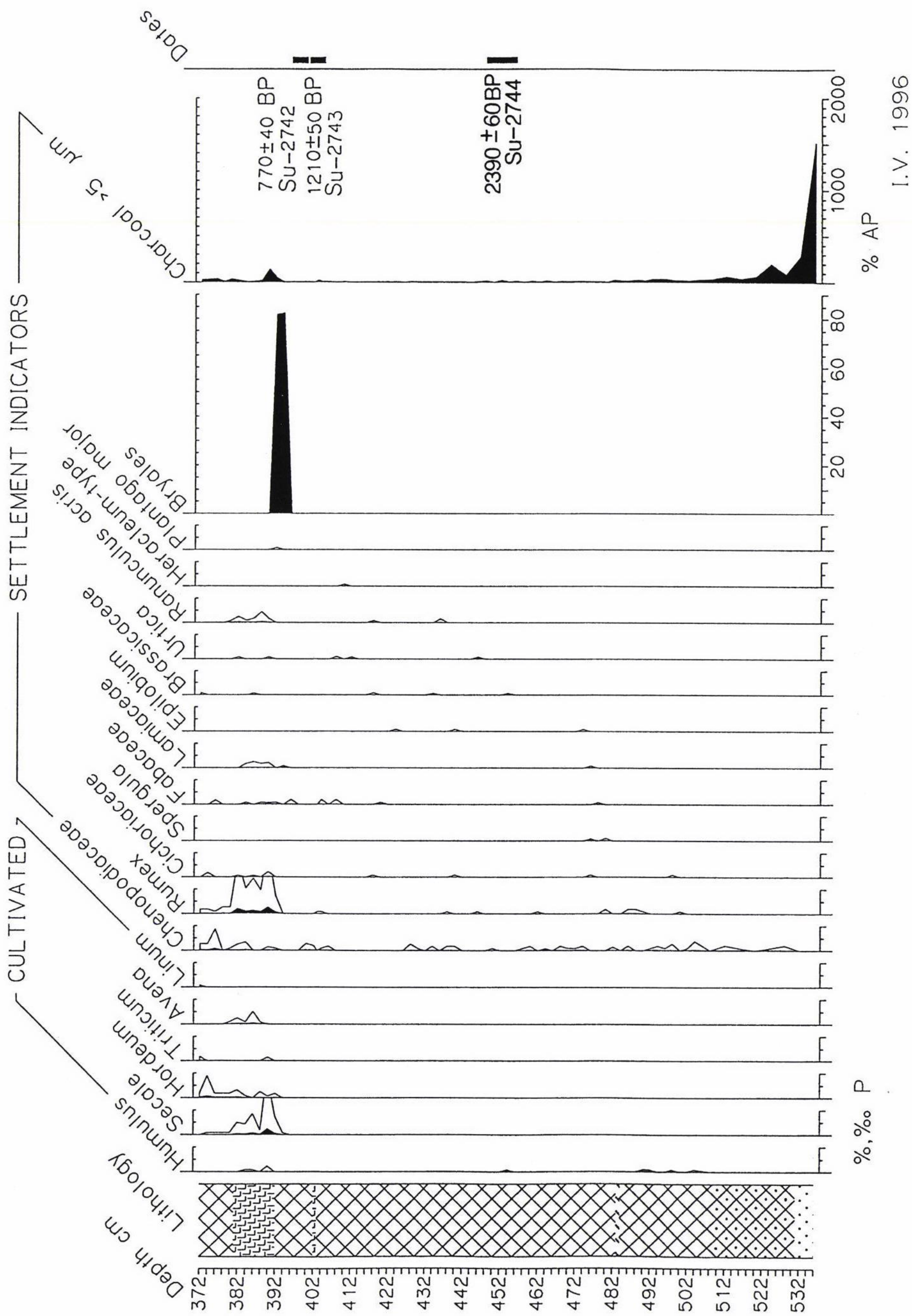

Fig. 5. Relative pollen frequencies of cultivated plants and settlement indicators in the sediment sequence of Lake Niikkananlampi, Valamo Island.

len frequencies, coincides with the clayey horizon indicating erosion. This was also the start of the *Alnus* maxima as interpreted above.

No clear maximum phases were found among other pollen types of natural mineral soil vegetation. The most important horizons were as follows: 500–492 cm, shortly after isolation, pollen of *Plantago* sp., *Cirsium* type and *Galium* are added to the list of shore plants of Lake Ladoga consisting of Cyperaceae, Poaceae, Ranunculaceae, Rosaceae, *Filipendula, Artemisia, Aster* type and Apiaceae. The next clear horizon is at the 472-cm level, where pollen of *Parnassia*, *Ranunculus* type, Liliaceae and Campanulaceae occurs, soon followed by that of *Cicuta* type, Eu-*Rumex*, *Anemone* type, *Rhinanthus* and *Achillea* type. At the 434-cm level *Thalictrum* and *Melampyrum* occur together with Cyperaceae and Poaceae maxima. In the upper part of the diagram the more steadily increasing pollen taxa include *Stellaria* type, together with Poaceae pollen grains exeeding 36µm, Caryophyllaceae, *Vicia* type, *Trollius*, *Saxifraga* type and, in the surface samples, *Cornus*, *Scheuchzeria* and *Solanum dulcamara*. A single pollen grain of long-distance *Ephedra distachya* was found at the 394-cm level.

Among cultivated plants (Fig. 5), some pollen grains of wild *Humulus* were encountered on the shores of Lake Niikkananlampi, at the 504–488-cm level and at the 452-cm level. No connection with human activity was, however, seen until the 388-cm level, where *Humulus* pollen may indicate cultivation of this plant immediately after the first occurrences of Cerealia. All Cerealia types, *i.e. Secale*, *Hordeum*, *Triticum* and *Avena,* are represented and one pollen grain of *Linum* was found in the uppermost subsample. The earliest Cerealia at the 394-cm level was ^{14}C dated to 770±40 BP (Su-2742).

Settlement indicators (Vuorela 1986; Fig. 5) are represented by 12 herb pollen types plus a strong Bryales occurrence. Pollen of Chenopodiaceae appears frequently along the profile, reflecting mainly shore vegetation. A clear horizon of new pollen taxa was met at the 478–470-cm level, where pollen of Cichoriaceae, *Spergula*, Fabaceae, Lamiaceae and *Epilobium* occurs. This slight and uncertain evidence of human activity coincides, however, with an increase in natural mineral soil vegetation, with a slight *Juniperus* maximum and a decrease in *Ulmus* and *Picea* pollen and a maximum phase of *Alnus*. According to the ^{14}C dates, the age of the 472-cm horizon goes back to the Pre-Roman Iron Age (500-0 BC).

At the 390–380 cm level, pollen maxima of *Rumex*, Lamiaceae and *Ranunculus acris* type correspond well to the total Cerealia maximum and reflect the main cultivation period, which started with local field clearing in the Merovingian Period (AD 550–800) and ended with the outbreak of the Second World War. The marked occurrence of spores of Bryales (probably *Funaria hygrometrica*) at the 392–394-cm level coincides with the field clearing, most probably by fire. Sporadic pollen of Brassicaceae, *Urtica* and *Heracleum* type occurs between the 452-cm level and the surface, whilst pollen of *Plantago major* occurs in connection with the clearance phase, at the 392-cm level.

Aquatics (Fig. 6) are represented by 13 pollen/spore types, of which only *Nymphaea* and *Myriophyllum alterniflorum* occur in the sandy deposits of Lake Ladoga. From the isolation horizon (502 cm) onwards the steadily increasing pollen taxa contain species and pollen types as follows: *Isoëtes lacustris*, *Sparganium*, *Menyanthes*, *Elatine*, *Alisma*, *Typha latifolia*, *Nuphar*, *Potamogeton*, *Myriophyllum spicatum/verticillatum*, *Ruppia*, *Polygonum amphibium*. Probably due to the sudden start of intensive agriculture in the vicinity of Niikkananlampi, the spores of *Isoëtes* do not indicate increasing erosion as they usually do in connection with slash-and-burn agriculture (Vuorela 1980).

Cryptogams are represented by eight spore types, of which *Sphagnum* and Polypodiaceae have two maxima: one in the sandy bottom deposits and the other close to the surface deposits dated to the cultivation period, thus indicating open landscape. Among other spore types, *Equisetum*, *Lycopodium* and *Pteridium* start to occur in the Lake Ladoga sediments, whilst *Dryopteris* and *Polypodium vulgare* together with *Tilletia*

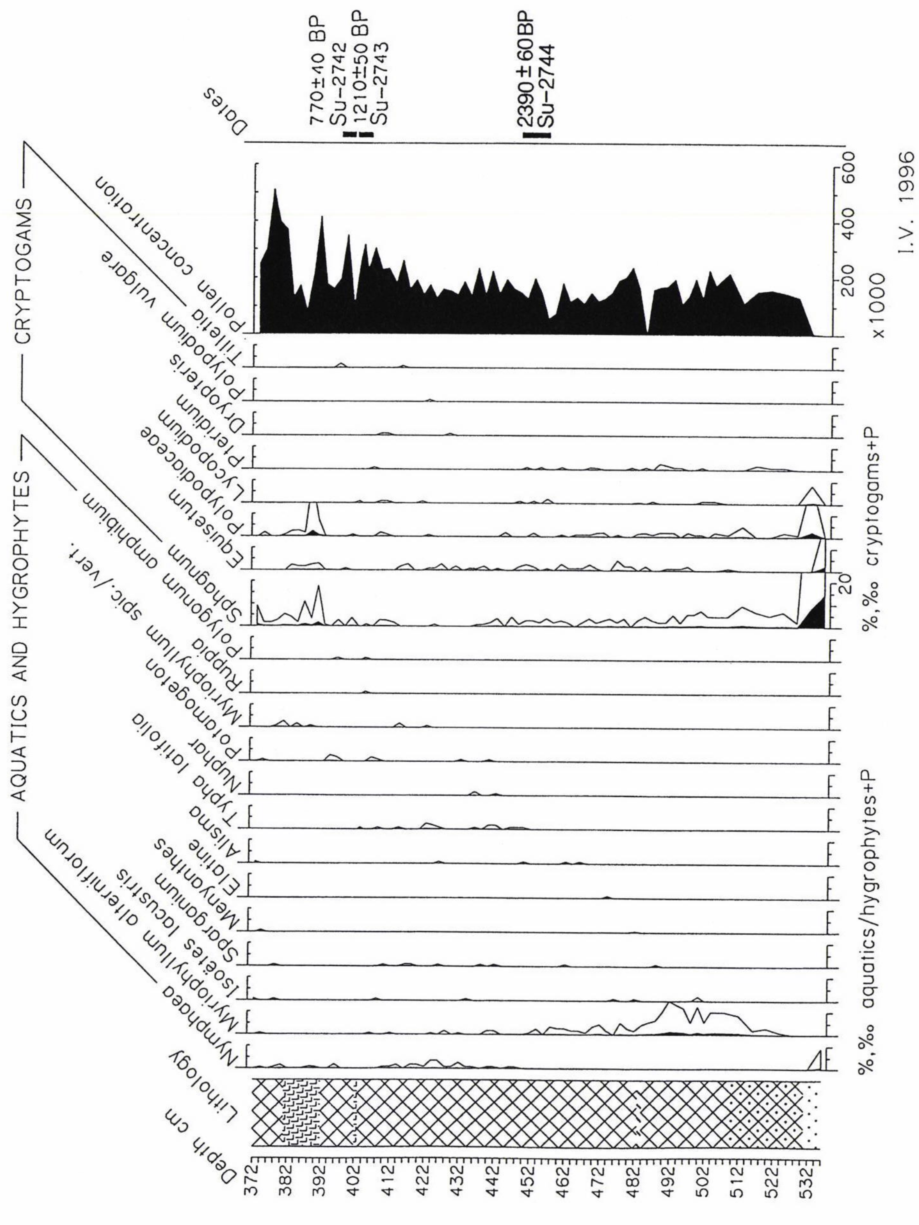

Fig. 6. Relative pollen frequencies of aquatics, hygrophytes and cryptogams in the sediment sequence of Lake Niikkananlampi, Valamo Island.

are concentrated in the layers deposited before the cultivation period. They may indicate open forest probably used for grazing.

Charcoal frequencies

High frequencies of small charcoal fragments reaching 15 x AP were met in the bottom sand material of the profile (Fig. 5). The frequencies decrease rapidly towards the isolation horizon (ca 502 cm) thus reflecting local lake development (cf. Vuorela et al. 1990). For the main part of the gyttja deposits, charcoal frequencies remain extremely low (mostly < 10% AP), increasing suddenly at the 392–390-cm level, immediately after a rich spore occurrence of Bryales. Since Bryales can be expected to indicate the use of fire for clearances, it is important to note the delay in the occurrence of charcoal particles in the sediment. Bryales spores indicate fire immediately, or shortly after, the burning activity, but charcoal particles are washed into the lake with a delay of some years or more. The length of the delay depends on the soil and vegetation in the drainage area.

As the charcoal frequencies in the deposits preceding the absolute Cerealia limit remain low, agriculture in the immediate vicinity of Lake Niikkananlampi seems to have started straight after field clearance, without any period of slash-and-burn cultivation.

Conclusions

The local settlement history of Valamo Island was investigated from the sediments of Niikkananlampi, a lake in the western part of the island that was isolated from Lake Ladoga at ca 2600 BP. The interpretation of human impact was based on 75 subsamples and three ^{14}C determinations. Pollen analysis of Niikkananlampi sediments confirms and augments the interpretation of human influence based on the lithostratigraphy. It is clear that the upper clay layer between 380 and 392 cm represents field clearance.

The first evidence of human impact, based on pollen and charcoal analyses, dates from the Pre-Roman Iron Age, whilst more pronounced indicators of an opening landscape, probably cleared for grazing, date from the 9th century AD, *i.e.* the boundary of the Merovingian Period/Viking Age (1210±50 BP). The earlier landuse history is documented only in the pollen records; visual inspections and loss-on-ignition values are less indicative. This will probably also be the case for sites closer to the monastery, where visible changes attributable to human impact are not so clear as in Niikkananlampi.

Fields were first cultivated near Lake Niikkananlampi in the 13th century (770± 40 BP). The fields are at some distance from the monastery and thus may not represent the first agricultural activity at Valamo. Still, field cultivation near Niikkananlampi indicates an organized and stable society. It would be tempting to correlate this cultivation with the farming activity of the monastery. On the basis of rare written documents, Kirkinen (1963) concluded that the monastery was most probably founded in AD 1160. This view was challenged by Lind (1986), who suggests AD 1329 as the founding date, whereas Spiridonov (1992), on the basis of archaeological data from the present monastery area, is of the opinion that the monastery of Valamo was not an important centre until AD 1400. Spiridonov emphasizes the importance of knowing the early history of the monastery of Valamo because of its considerable influence on the history of the Orthodox church in Karelia. According to the results from Niikkananlampi it would not be surprising if the founding of the monastery were to date back to the 12th century. It is also likely that cultivation at Valamo started earlier than in the neighbourhood of Lake Niikkananlampi. In the north-western archipelago of Lake Ladoga the introduction of slash-and-burn cultivation has been dated to the Late Roman Iron Age (AD 200–400) (Taavitsainen et al. 1994).

The almost total absence of Cerealia pollen in the uppermost loose gyttja, above the clay layer, is also consistent with the fact that cereal cultivation has not been practised at Valamo since the Second World War. The fields are not, however, forested because they have been used for grazing, *i.e.* the area of conifer forests at Valamo has not increased since the war. This explains why no changes in relative spruce and pine pollen frequencies are recorded in Niikkananlampi (*cf.* Dyrenkov 1984, Isachenko 1996).

Thus far, the results at Valamo are based on only three radiocarbon dates. More definite conclusions must await new pollen and radiocarbon data.

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