Irmeli Vuorela

POLLEN EVIDENCE OF STONE AGE AND EARLY METAL AGE SETTLEMENT IN TAIPALSAARI, SOUTHERN KARELIA, EASTERN FINLAND

Abstract

The peat deposits of a three metres deep esker hole in Taipalsaari, situated in the vicinity of an exceptionally rich settlement of Comb Ceramic II type were analyzed by means of pollen and charcoal analysis and ^{14}C-dated. The aim of the study was to record the palynological indication of the Stone Age settlement and its probable continuation up to the Metal Ages.

Irmeli Vuorela, Geological Survey of Finland, Betonimiehenkuja 4, FIN-02150 Espoo, Finland.

Introduction

Peat samples for palynological analyses were taken from a kettle hole in Taipalsaari in order to investigate the influence on the vegetation of the local Stone Age settlement and its continuation to the Metal Ages. The work was carried out by means of pollen, loss-on-ignition and charcoal analyses supplemented by seven ^{14}C-dates (Vuorela & Kankainen 1993, 1–46).

An exceptionally rich Stone Age dwelling site is located in the area of the present-day Syrjälä, no more than 200 m NE of the pollen investigation site. More than 40 kg of ceramic fragments, of Typical Comb Ceramic type (ca. 5500–4800 BP), have been found from the Syrjälä site (Archives of the National Board of Antiquities). Several undatable stone heaps have also been found about 1 km south of the kettle hole.

The results obtained from the peat deposits of the kettle hole, called "Syrjälä mire", will be discussed in the light of the main development features of the investigation area, which are as follows:

i. The natural forest history, determined by the geographical location, ground water level, and the climatic changes during the last 10 000 years.

ii. The development of Lake Saimaa which, after its isolation from the Yoldia stage of the Baltic Sea, has been strongly influenced by the uneven land uplift (at the present time, 2 mm/year in the southern part of the Saimaa area).

iii. The effects of human activity on the vegetation during the last 6000–7000 years. Charcoal analysis and more refined pollen analysis techniques have made possible the definition of certain indicators of human activity for the Mesolithic Period. Later, in connection with the introduction of agriculture, the number of settlement indicators strongly increases (c.f. Vuorela 1986, 53–64).

Sampling site, material and methods

The investigation area is located between the Salpausselkä end moraines I and II, on the western slope of a sandy ridge which crosses this part of Lake Saimaa in a SE-NE direction (Fig. 1) (Topographical map 3134 05/08). The ridge was already an important traffic route in prehistoric times when movement in the area was difficult because of the high proportion of water to land.

The Syrjälä mire kettle hole (x = 6789 66, y = 3559 60, z = 83 m a.s.l.) is round, about 25 m in diameter, and with a depth of 3 metres. The amount of pollen of aquatic plants in the peat deposits shows that the ground water level has been relatively high throughout. Pollen of *Nuphar*, *Myriophyllum spicatum* and *Sparganium*, for instance, occur in the *Sphagnum* peat right up to

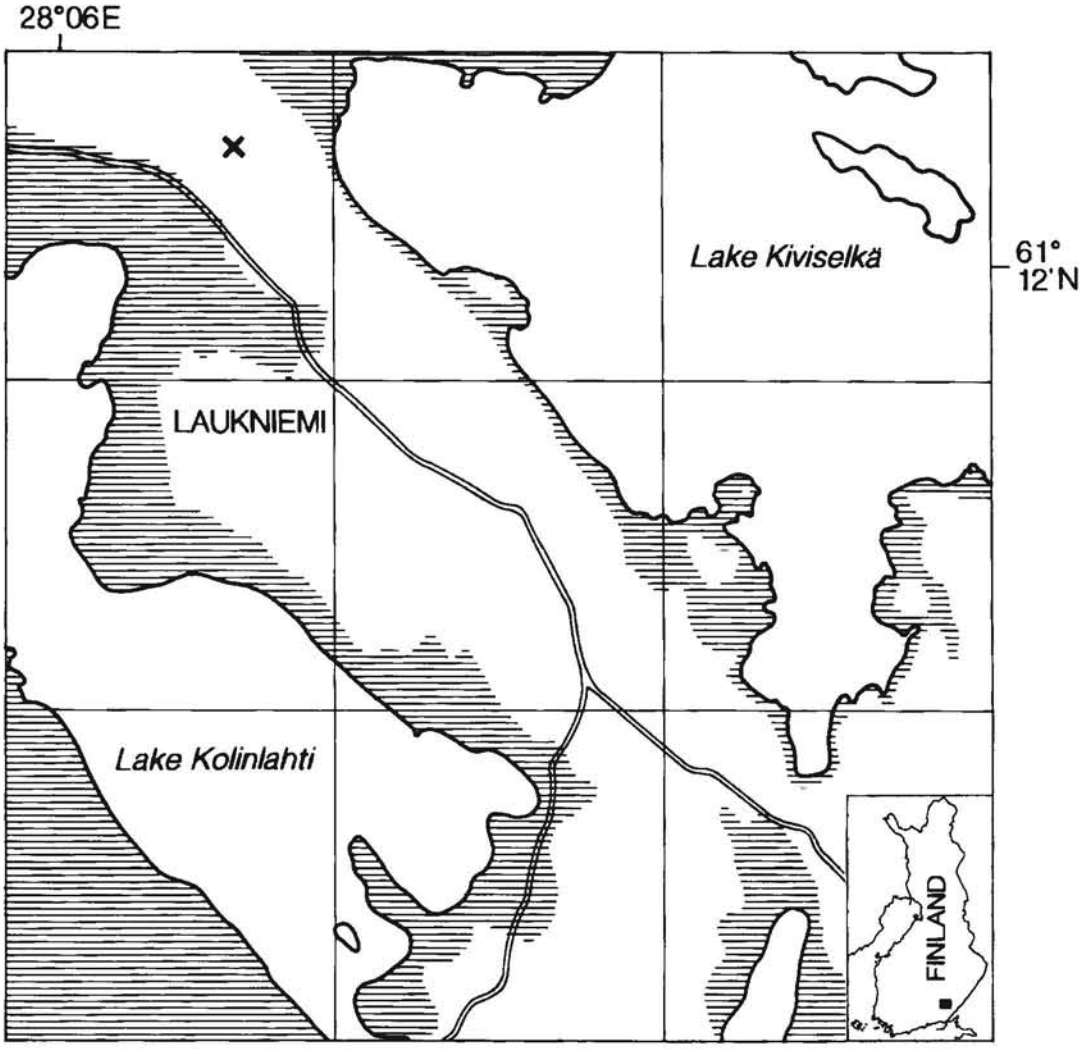

Fig. 1. The location of Syrjälä mire on the sandy ridge in Taipalsaari, north of the town of Lappeenranta. Thin line = present day shore line of Lake Saimaa, hatched area = the land area which came into existence at the birth of the River Vuoksi 5000 yr BP.

the 40–70 cm level (Fig. 2). When the peat core was taken in early June 1992, the ground water level was about 0.2 m below the ground surface.

The stratigraphy of the peat is given in Table 1. Between 0 and 156 cm depth samples were taken at 2 cm intervals, for the section 156–190 cm at 5 cm intervals and between 200–285 cm at 10 cm intervals. Material for pollen analysis was prepared by the KOH and HF methods (Faegri & Iversen 1989, 69–91). For loss-on-ignition calculations the material was dried, ignited at +550°C for 2.5 hours and the resultant ash determined as % of dry weight. The water content of the dried peat was determined as % of its original weight.

Table 1. The stratigraphy of Syrjälä mire.

0–35 cm	Sphagnum peat
35–80 cm	Sphagnum peat and wood fragments
80–100 cm	Sphagnum peat mixed with Carex and wood fragments
100–190 cm	Carex peat mixed with Sphagnum
190–260 cm	Carex peat with Bryales at 250–260 cm and Menyanthes at 190–230 cm
260–280 cm	Bryales peat turning to Carex peat
280–285 cm	clay gyttja and gyttja
285 cm –	clay

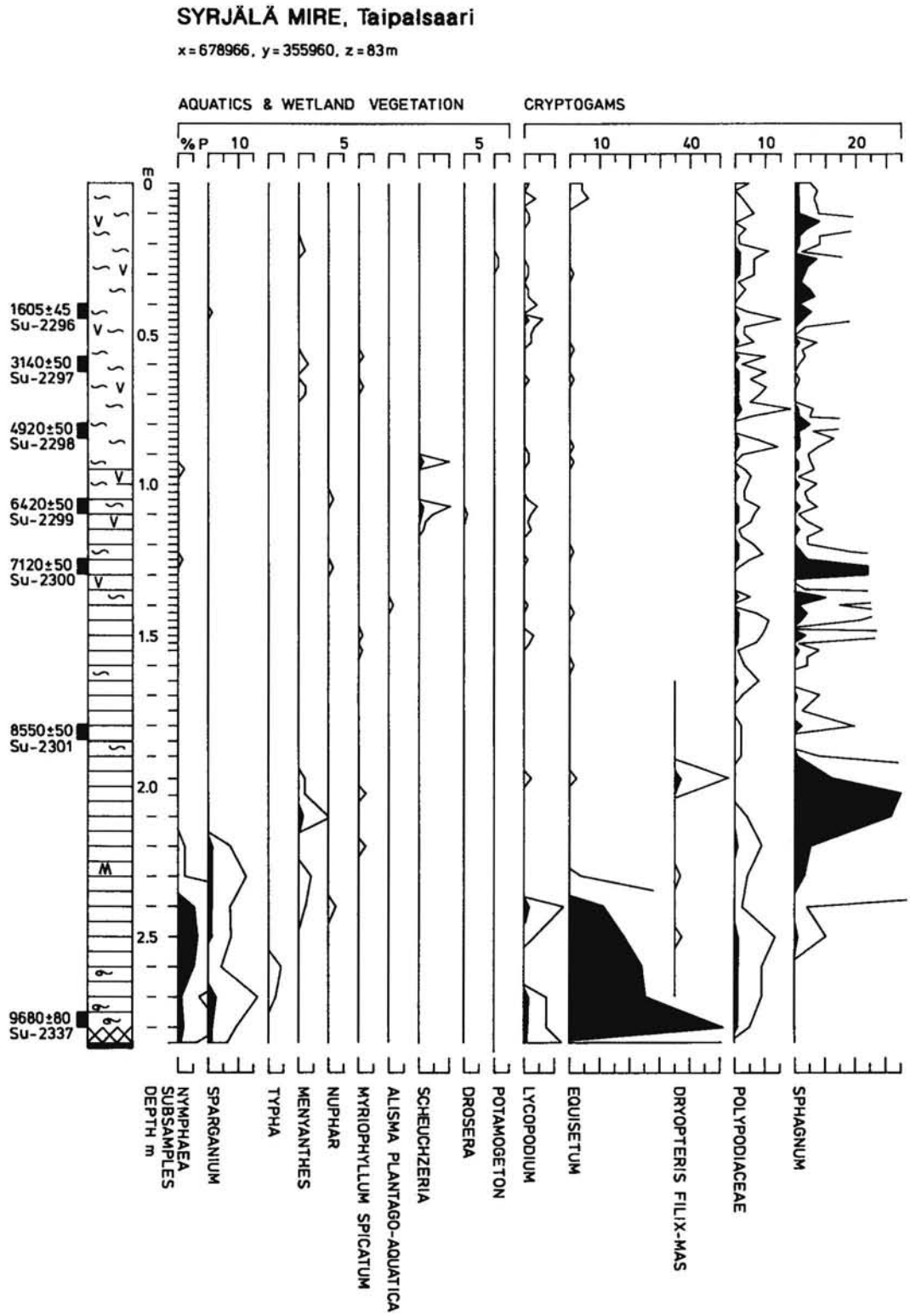

Fig. 2. Relative pollen diagram of local aquatic and wetland species and cryptogams in the kettle hole of "Syrjälä mire".

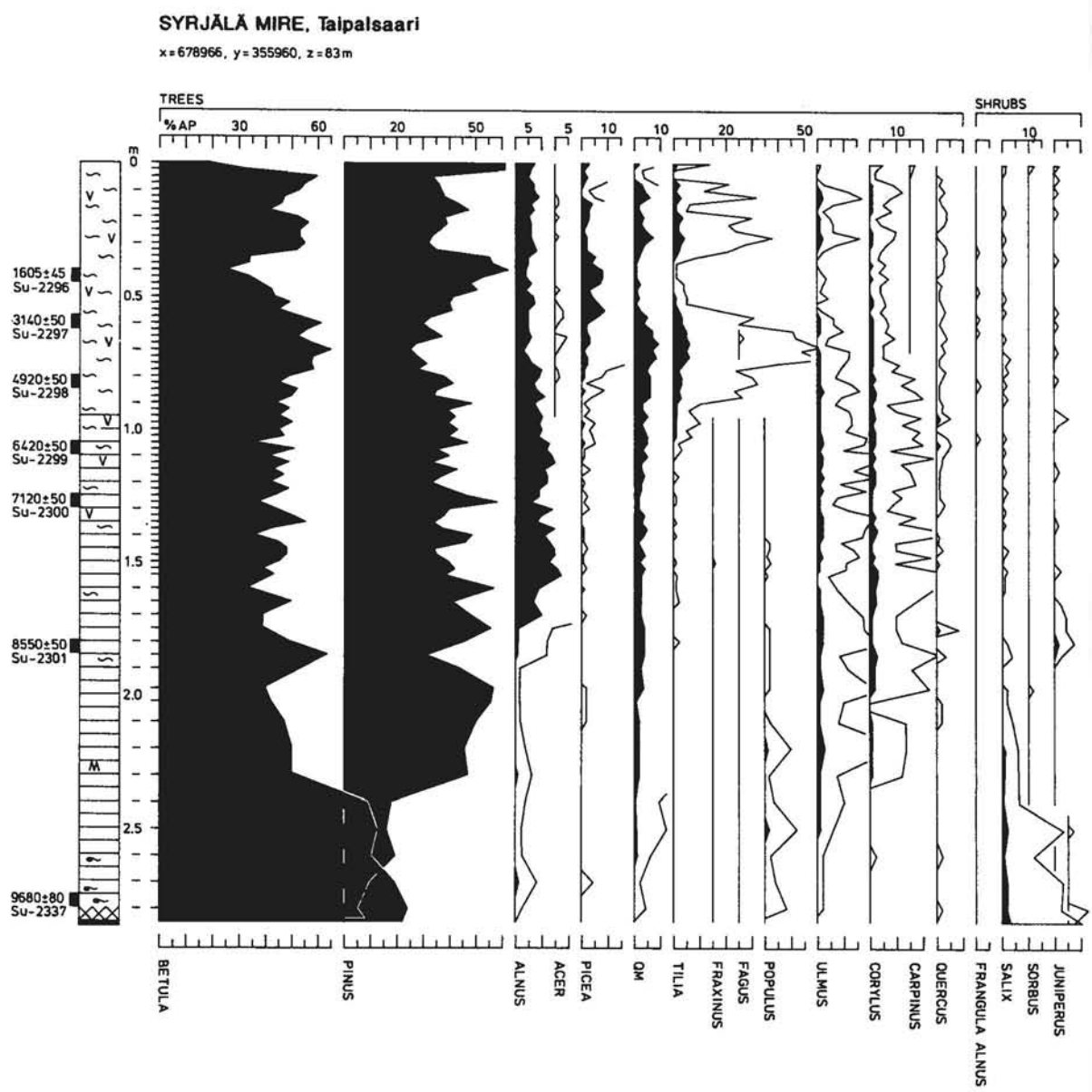

Fig. 3. Relative tree pollen frequencies in the peat deposits of the kettle hole "Syrjälä mire".

Results

Natural forest history seen in the light of ^{14}C-dates

The peat core covers the whole Postglacial period starting from the Preboreal *Betula*-phase and continuing to Medieval times (Fig. 3). The start of peat deposition has been dated to 9680±80 yr BP (8900–8500 cal BC). The relatively high AP/NAP-ratio and the high *Salix* and *Populus* pollen frequencies reflect the open vegetation which existed prior to the forestation of the land area surrounding the kettle hole. Forestation finally took place during the Boreal *Pinus*-phase, the end of which at the 180–185 cm level has been dated to 8550±50 yr BP (7600–7450 cal BC). This is also the date for the arrival of *Alnus*. At the end of the Atlantic chronozone (Mangerud et al. 1974, 119), about 5500 yr BP, *Tilia* pollen increased and later exceeded 6 % AP. The rise of *Picea* at the 80 cm level was dated to 4920±50 yr BP (3780-3670 cal

BC), and coincided with the birth of the River Vuoksi. The spread of *Picea* was very slow the relative pollen frequencies staying at about 1–3 % for nearly 2000 years before they temporarily increased to 10–11 %. This long "tail" of the *Picea* curve provides a good example of the difficulties encountered when trying to determine the presence of local *Picea* stands. In several contexts, 10 % of arboreal pollen has been proposed as the limit between long distance transported and local *Picea* pollen. In the present case this would mean a total absence of this tree species from the investigation area. Instead, the low pollen frequencies at the 80–65 cm level could partly be interpreted as an indication of local human activity. In the pollen diagram increasing NAP frequencies, high *Betula* frequencies and several occurrences of *Acer* pollen also indicate a good light factor and confirm this interpretation. Between 60 and 40 cm depth (about 1490 cal BC – cal AD 520) the tree pollen reflects a natural forest development which was interrupted by intense human activity. Deforestation for slash-and-burn cultivation is reflected in the minimal *Picea* frequencies and the high *Betula* frequencies which compensate for the decrease in *Pinus* pollen. This activity which is also reflected in the herb pollen values, led to a regeneration of broadleaved deciduous trees, as seen in the QM pollen values. Distinct fluctuations in the relative tree pollen frequencies characterize the uppermost parts of the diagram.

The indication of the birth of the River Vuoksi in the pollen data

The history of Lake Saimaa has been investigated by several Finnish geologists, including Hellaakoski (1936, 75–119), Lappalainen (1962, 1–125) and Saarnisto (1970, 1–107). Because of the uneven land uplift in the area major transgressions have taken place in the southern parts of the lake and the direction of the outflow of the lake to the sea has varied during the past 8000 years. In the early Holocene Saimaa, together with Lake Päijänne flowed westwards into the Gulf of Bothnia, after about 6000 yr BP through the River Kymijoki into the Gulf of Finland and only during the last 5000 ^{14}C-years into Lake Ladoga. This last event involved enormous natural catastrophes, and it was at this time that the Vuoksi outlet formed through the Salpausselkä ridges (Lappalainen 1962, 1–125; Saarnisto 1970, 1–107; Taipale & Saarnisto 1991, 281).

This development led to great ecological changes, such as a lowering of the ground water level and a 4 m drop in the lake level in the Taipalsaari district. New shore meadows suddenly came into existence on lowland areas, such as the western side of the ridge, close to the present sampling site. These vegetational changes are reflected in the pollen diagram.

The ^{14}C-date of 4920±50 yr BP at the 80–85 cm level corresponds roughly to the period described. The features connected with the lowering of the ground water level are as follows:

- The very rapid rise in pollen concentration values (Fig. 4) which indicate a slowing-down of the rate of peat accumulation.
- A decrease of the water content of the peat.
- In the tree pollen data (Fig. 3) the most evident feature is the fall in *Alnus* values at the 80 cm level as a result of the drier conditions. The corresponding increase in *Betula* pollen may partly result from the forestation of the shore meadows situated at a distance of only 200 m from the kettle hole.
- Among the herbs (Fig. 5), the dominance of sedges (Cyperaceae pollen) ends and grasses (Poaceae) predominate throughout the rest of the diagram; sedges being more typical on wet soils than grasses.

Pollen of Brassicaceae, Chenopodiaceae, *Rumex* and Cichoriaceae (Hämet-Ahti et al. 1984) at the 86–92 cm level indicate open vegetation and bare mineral soil — most probably the new-borne shore meadow. The simultaneous occurrence of Rosaceae (most probably *Rubus idaeus*) fits well with this interpretation.

Indications of human activity

The earliest indication of human activity in the diagram from Syrjälä mire has been ^{14}C-dated to as early as 7120±50 yr BP (about 6000 cal BC). This is the start of the exceptionally high values of *Pteridium* spores at the 130–86 cm level (Fig. 5). Spores of *Pteridium* together with increased charcoal dust frequencies have recently been recorded in several contexts as some of the most prominent indicators of the Mesolithic in Europe. It is most probable that this spore occurrence together with the relatively high Cyperaceae frequencies indicates the local Stone Age settlement.

The continuation of human impact from the Stone Age to the Early Metal Ages is difficult to prove. One of the most reliable indicators, however, is the low *Picea* pollen frequencies discussed above. At the 80 cm level the *Pteridium* spore frequencies clearly decrease giving way to increasing Poaceae, Apiaceae and Rosaceae which

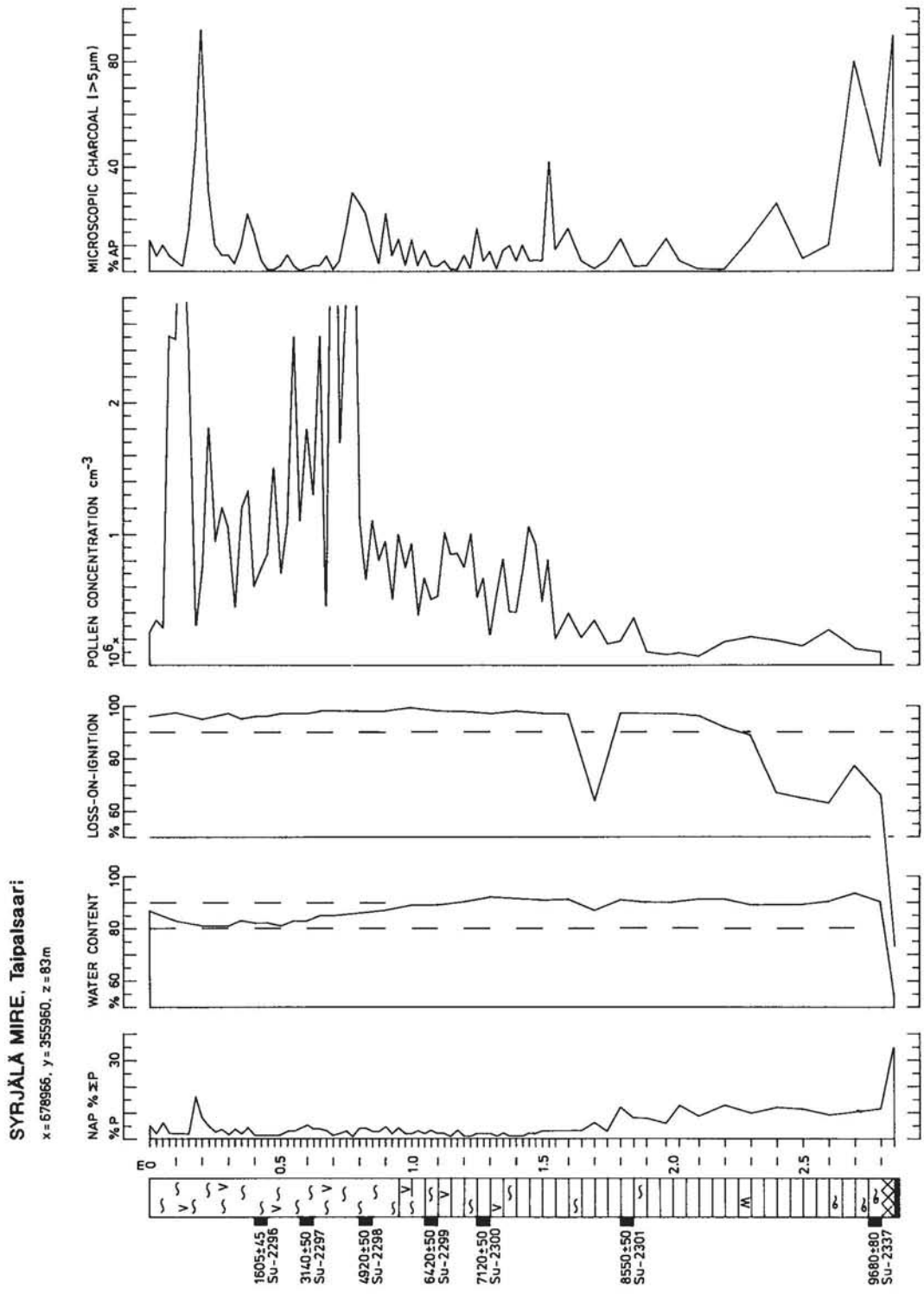

Fig. 4. Relative frequencies of total herb (NAP) pollen, water content, loss-on-ignition, pollen concentration values and relative (% AP) charcoal dust frequencies in the peat deposits of the kettle hole "Syrjälä mire".

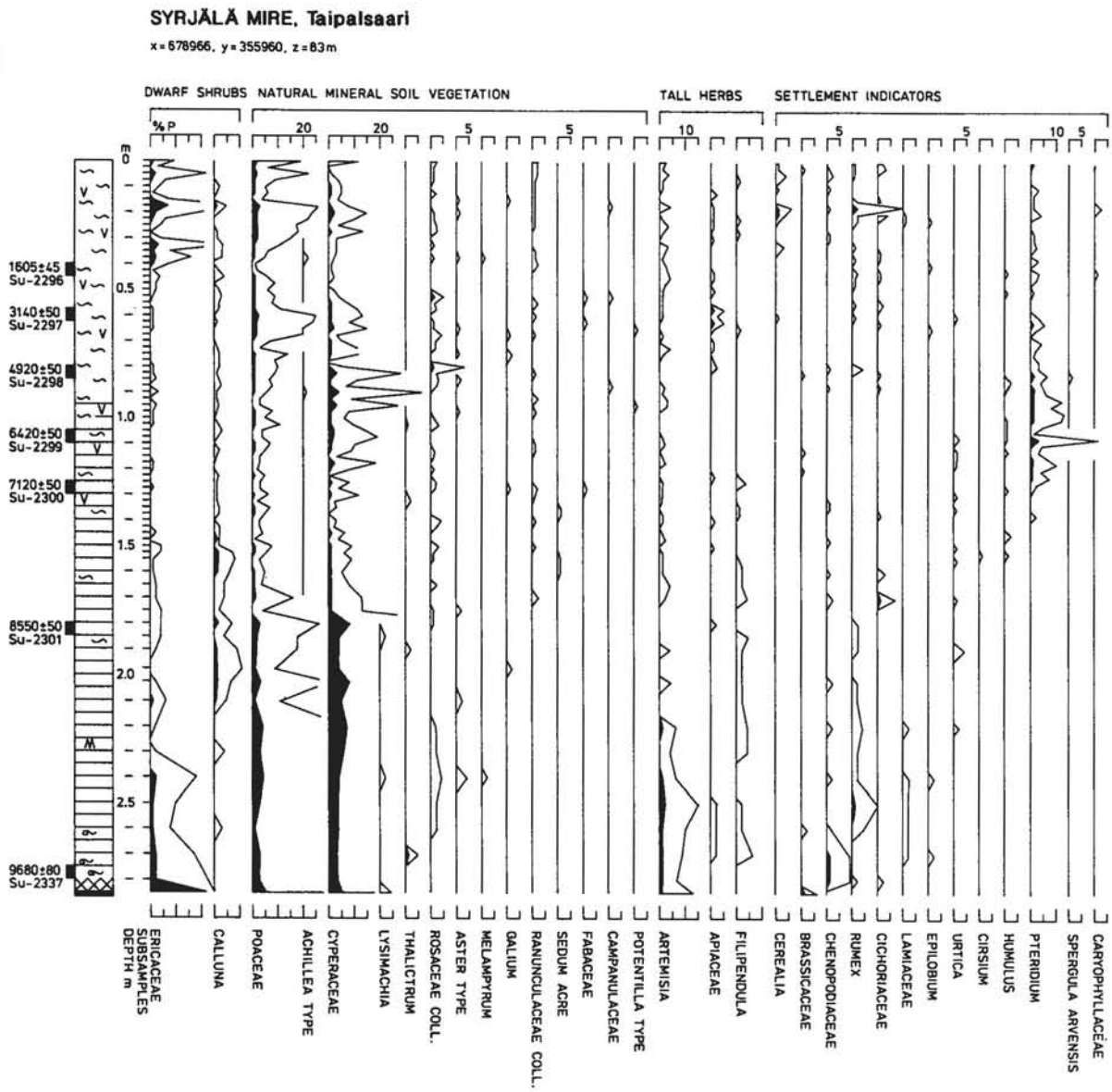

Fig. 5. Relative (% total P) pollen frequencies of dwarf shrubs, species of natural mineral soil, tall herbs and settlement indicators in the peat deposits of the kettle hole "Syrjälä mire".

indicate deforestation. Since, however, the rate of sedimentation was very low, each subsample comprises a relatively long period of time, even hundreds of years.

The earliest occurrence of Cerealia at the 60 cm level dates back to 3140±50 BP (1430 cal BC) which corresponds to the Early Metal Age in SE Finland. The level of the absolute Cerealia limit is characterized in the tree pollen data by high *Betula* frequencies, extremely low *Picea* frequencies and rapidly decreasing QM-frequencies. The presence of *Acer* pollen also indicates increasing light in the surroundings of Syrjälä mire.

Among the herbs (Fig. 5) a distinct increase in Poaceae and Apiaceae pollen and the start of more or less continuous occurrences of *Rumex* and Cichoriaceae, together with the regeneration of *Pteridium*, indicate a local but not very strong hu-

man occupation which seems to have continued from the Early Metal Age onwards. The increase in *Pinus* pollen frequencies, and the tendency of *Picea* pollen to increase at the 55–30 cm level reflect the natural forest development which, however, seems to have been affected by man.

A clearer indication of slash-and-burn cultivation, including the presence of cereal pollen, was recorded at three later levels: 4, 20 and 32 cm depths. This activity is very clearly reflected in the Ericales pollen data which increase strongly at these levels. Among the trees *Picea* pollen frequencies remain very low and the spruce is partly replaced by regenerating broadleaved deciduous trees, especially *Ulmus* and *Tilia*. *Betula* frequencies also stay high, indicating an open landscape.

Among the herbs, in addition to the Cerealia occurrences and the clear Ericaceae peaks, the 20 cm level is very clearly indicated by relatively high *Rumex* pollen frequencies. However, the total number of weed pollen in connection with slash-and-burn cultivation stays relatively low.

This activity is also very clearly indicated by the charcoal dust values which increase at the same levels, and by the slight but clear depressions of the loss-on-ignition values. Although these only reflect wind-transported mineral material in the ombrotrophic *Sphagnum* peat, even these modest depressions must be considered as very important and convincing indicators of field erosion (Vuorela 1983, 28; see also Tolonen 1984, 207-219).

Summary

The interpretation of the Syrjälä mire diagrams can be summarized as follows:

- The hydrological changes connected with the birth of the river Vuoksi were indicated by a slowing-down in peat accumulation reflected by the pollen concentration values. The newborne shore meadows were indicated by herb pollen characteristic of the vegetation on bare mineral soils.
- The Mesolithic settlement was indicated by wind-transported charcoal dust, spores of *Pteridium* and relatively high Cyperaceae pollen frequencies.
- The earliest Cerealia pollen was dated to 1490–1370 cal BC (3140±50 yr BP), i.e. the Early Metal Age. The intensity of settlement seems to have varied between 1490 cal BC and 520 cal AD, while the pollen data reflect relatively intensive slash-and-burn activity in Medieval times.

Since the uppermost layer of the peat deposit has, during the last few decades, been transported to the sandy cultivated fields in order to improve the soil quality, the transition from slash-and-burn cultivation to permanent field cultivation was not recorded. Historical documents, however, tell that this took place in the 16th century.

Acknowledgements

The English manuscript was revised by Mrs. Sheila Hicks, Ph.D.

References

Faegri, K. & Iversen, J. 1989: *Textbook of pollen analysis*. 4th Edition, ed. by Faegri, K., Kaland, P.-E. & Krzywinski, K. John Wiley & Sons. London.

Hellaakoski, A. 1936: Das Alter des Vuoksi. *Bull. Comm. Géol. Finlande* 115.

Hämet-Ahti, L., Suominen, J., Ulvinen, T., Uotila, P. & Vuokko, S. 1986: *Retkeilykasvio*. Suomen luonnonsuojelun tuki. Helsinki

Lappalainen, V. 1962: The shore-line displacement on southern Lake Saimaa. *Acta Bot. Fennica* 64.

Mangerud, J., Andersen, S.T., Berglund, B.E. & Donner, J. 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification. *Boreas* 3.

National Board of Antiquities, Archives.

Saarnisto, M. 1970: The Late Weichselian and Flandrian History of the Saimaa Lake Complex. *Societas Scientiarum Fennica, Comm. Phys.-Math.* 37.

Taipale, K. & Saarnisto, M. 1991: *Tulivuorista jääkausiin. Suomen maankamaran kehitys*. Werner Söderström Osakeyhtiö. Helsinki.

Tolonen, K. 1984: Interpretation of changes in the ash content of ombrotrophic peat layers. *Bull. Geol. Soc. Finland* 56.

Vuorela, I. 1983: Field erosion by wind as indicated by fluctuations in the ash content of Sphagnum peat. *Bull. Geol. Soc. Finland* 55.

Vuorela, I. 1986: Palynological and historical evidence of slash-and-burn cultivation in South Finland. In: Behre, K.-E. (ed.): *Anthropogenic indicators in pollen diagrams*. Rotterdam.

Vuorela, I. & Kankainen, T. 1993: Luonnon- ja kulttuurimaiseman kehitys Taipalsaaressa (Development of natural and cultural landscape in Taipalsaari). Geological Survey of Finland. Report P 34.4.107.