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A glance into the vegetation and settlement of the fortress islands of Suomenlinna, Helsinki.

Pollen analytical study

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Pollen studies were carried out of the sediments from a small pond on Susisaari, the largest island of the fortress of Suomenlinna, Helsinki. Three cores with altogether 80 samples were analysed, but only one core being reported here and additional comments are given on the results from two other cores. As it is most probable that the material has been mixed in several constructional phases during the last 100–200 years, the results were interpreted as one unit representing aerial and local vegetation during approximately that period. The results were compared with the recent vegetation, with the history of imported species, and with three botanical inventories made on the islands during the 20th century. Differences in pollen production and in pollen dispersal properties of different species strongly affect the results.

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As a part of a current series of palynological investigations on the vegetation history of Helsinki carried out at the Geological Survey of Finland, sediments from Piper's Pond, a small pool situated in Susisaari (Wolf Island), the largest island of the fortress of Suomenlinna (Sw. Sveaborg, former Viaborg), offshore of Helsinki (Fig. 1), were analysed. The history of the islands and the history of the local vegetation are described in the repairing plan of Suomenlinna (Helander et al. 1987 and the literature mentioned therein is referred). The plant names follow those used by Hämet-Ahti et al. (1984).

The pollen data is compared with the present-day vegetation of the area and with the vegetation inventories of the Suomenlinna islands, carried out by Hidén in 1918–20, Rintanen in 1957–58, and Vuokko in 1977–1980 (Helander et al. 1987).

THE SITE AND ITS HISTORY

Piper's Pond (60°09'N, 24°54'E) is situated in the southern part of Susisaari, surrounded by a park (Fig. 2). The pond has an area of 65 × 23 m. From the south it is boarded by an artificial wall and, from the west, by a bedrock outcrop. The rest of the shores are gently sloping and covered by the vegetation strongly affected by human activity.

Till the 18th century Suomenlinna was a rocky group of islands, the vegetation of which consisted of shore meadows and shrubs. The sparse forests were strongly dominated by *Pinus*. On the map of 1748, which represents the time when the building of the fortress started by the Swedes, meadow vegetation and some trees mark small depressions.

In the 1760's, the trees were cut and e.g. *Acer*, *Sorbus Crataegus* and *Syringa* were imported to the islands. In early 1700's grazing had taken place on the islands. Before the

present-day park around the pond was founded, the area was used as a cultivated garden with apple, cherry and bullace trees (Rosaceae). At the end of the Swedish period (i.e. the 18th century) *Quercus*, *Tilia*, *Acer* and *Fraxinus* were among the species brought to the island. In the present-day vegetation *Fraxinus* dominates among the trees (*Corylus* may never have grown on the shallow humus layer of the island).

Piper's Pond has always been the centre of the park, which was founded during the Swedish period, in the 1780's. Along with the settlement, it has been reconstructed several times. In early 1800's it was planned to be a fresh water basin and, in 1873, a bridge was built over the eastern part of the pond; but in 1920 that part was filled. Because of all the disturbances during sedimentation no the natural vegetational development can be traced from the deposits and the samples have to be treated as one unit all together.

The history of the islands is also reflected in the composition of the plant communities' vegetation, which nowadays dominates the landscape. The appearance of *Plantago lanceolata*, for instance, is connected with the 18th century while species, like *Bunias orientalis*, *Berteroa incana* together with *Populus tremula*, *Salix*, and several new coniferous plants, were transported to Suomenlinna by the Russian residents during 1808–1917 (Helander et al. 1987).

Among newcomers of the period of independence in Finland (after 1917) e.g. *Hippophaë rhamnoides*, *Sambucus racemosa*, and *Amelanchier spicata* should be mentioned. Among herbs *Lamium album* and *Artemisia vulgaris* are typical of this period.

According to Helander et al. (1987) most trees and shrubs around the pond today are newcomers of last 80 years. *Fraxinus excelsior* dominates among the tree species on the island of Susisaari (and no *Picea* species can be found today). Nowadays, *Pinus* is very rarely met, while *Larix*



Fig. 1. The location of the fortress of Suomenlinna (view from Helsinki). Photo Satu Moberg.

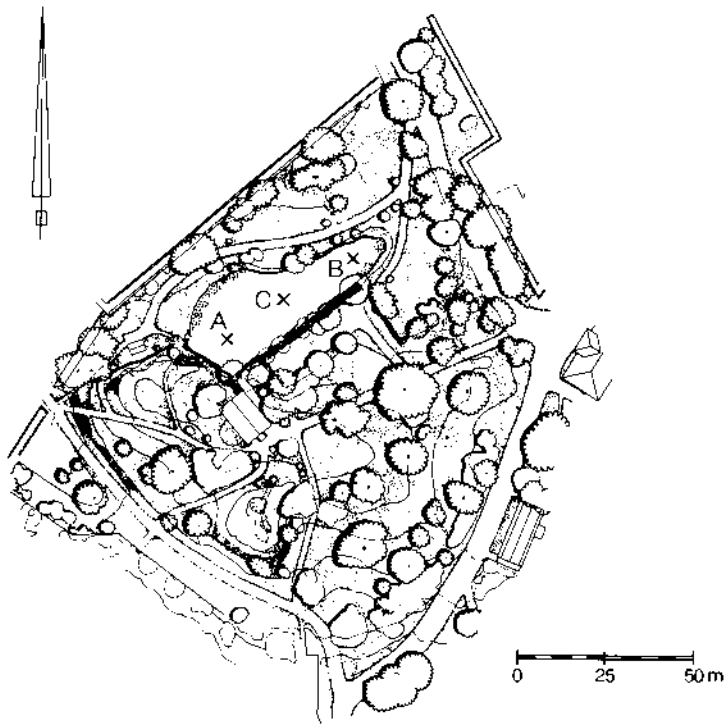


Fig. 2. Piper's Pond in the middle of the present-day park and the position for the cores A–C (drawn after Helander et al. 1987).

sibirica has been growing on the island during this century. The trees growing closest to the pool today consist of *Prunus padus*, *Acer platanoides*, *Sorbus aucuparia* and *Salix caprea*.

Among herbs growing around the pond *Iris pseudacorus*, *Urtica dioica*, *Carex acuta*, *Phalaris arundinacea*, *Arctium tomentosum*, *Artemisia vulgaris*, *A. campestris*, and *Thlaspi arvense* should be mentioned. *Iris* forms plentiful units on the shores of Piper's Pond. Several earlier abundantly growing weeds and species favoured by grazing have, on the other hand, vanished, or at least they grow more sparsely than they did 100–200 years ago. The landscape on the islands is strongly dominated by open fields and, quite recently, growing tourism has increased erosion considerably, especially on the ramparts.

MATERIAL AND METHODS

Samples from Piper's Pond were cored from three points (A–C; Fig. 2) using the small Russian peat sampler. The depth of the water at site A was 1.16 m, at B 1.09 m and at C 1.13 m. The samples for pollen analysis were taken every 2nd cm in the cores and stored in Minigrip bags in +4°C.

The material consists of gyttja mixed with sand and gravel and overlain by pure gyttja. The thickness of the underlying gravel layer could not be investigated. It could be a layer transported into the pond in connection with the repairing phases and, in theory, the gyttja layer could be thought to continue beneath it. The material cored may roughly represent accumulation during 100–200 years only.

The stratigraphy of the cores is as follows:

Core A

0–5 cm gyttja
5–22 cm gyttja mixed with sand
22–28 cm gyttja mixed with gravel
28 cm gravel

Core B

0–12 cm gyttja
12–28 cm gyttja mixed with sand
28 cm gravel

Core C

0–14 cm gyttja
14–24 cm gyttja mixed with gravel
24 cm gravel

The samples were treated with the KOH and HF methods (Faegri & Iversen 1989) and mounted in glycerol jelly. For determination of loss-on-ignition dry samples were ignited in 550°C for 2.5 h. At site A the loss-on-ignition fluctuates between 14 and 28% in the gyttja samples and between 3 and 9% in the more sandy part of the profile. At site B the corresponding values are 23–35% and 2–5%, and at site C 15–27% and 0.6–4%.

300 tree pollen was used as the basic sum counted in each sample. In the diagrams (Figs. 2–4) tree pollen curves are given as percentages of arboreal pollen (AP), shrubs, dwarf shrubs and herbs as percentages of total pollen sum (P) and aquatic pollen and spores of the sum of total pollen and the pollen type concerned (P+n). In the diagrams the plant taxa were grouped as follows: trees, shrubs, meadow vegetation, settlement indicators, hygrophytes, aquatics, and cryptogams. The frequencies of charcoal particles are high but more detailed calculations were not carried out.

RESULTS AND COMMENTS

The results from all three cores are almost identical. They have been reported in detail in an unpublished report (Vuorela 1997a) and, in this context, only the diagram of site C will be presented. Those of the sites A and B will be referred. The priority of site C is based on the thicker gyttja layer. No clear difference can, however, be observed in the pollen data or pollen frequencies of the gravel-mixed gyttja compared with that of the upper gyttja layer (Fig. 3). The monotonous pollen curves in all profiles indicate mixed and, thus, contaminated sediments. That is why the results will be interpreted as if the sub-samples would represent one unit and, as such, be compared with the vegetation history of Suomenlinna (Helander et al. 1987) and with the inventory results reported by Hidén (1921), Rintanen (1958) and Vuokko from 1977–1980 (unpubl.).

Trees and shrubs

Tree pollen (Fig. 3) corresponds approximately to 65–70% of the total P with a relative frequency of 45–50% *Pinus* and 30–40% *Betula*. *Alnus* and *Picea* pollen frequencies remain at c. 10%. In spite of the dominance of deciduous trees in the area during last few centuries, the QM ratio is only 5–10% of sum AP. The result shows the strong influence of the coniferous forests of the continent, at only ca. 2 km distance from the islands. *Fagus* (at cores B and C) and *Carpinus* (at core A) most probably represent long-distance pollen.

Since the Rosaceae pollen most probably partly represent trees and shrubs, such as *Sorbus aucuparia* and *Prunus padus* and only partly herbs, relative frequencies of shrubs have been calculated from the total pollen sum (P). Rosaceae also includes several fruit trees: *Prunus*, *Malus*, *Pyrus*, as well as *Spiraea* species on the island.

Juniperus communis is very sparsely represented on the island. It belongs to the natural local vegetation but it is, perhaps, also an indicator of local grazing, which took place especially during the Swedish period, in the 18th century.

According to the vegetation inventory, several *Salix* species have been growing on Susisaari during this century and a remarkably big *Salix caprea* tree is still growing on the SE shore of Piper's pond. The pollen frequencies of *Salix*, however, stay below 1% of sum P.

Pollen of *Hippophaë rhamnoides* was found at most levels analysed in core C. It is known to be a newcomer of the period of independence (since 1917), and it has been growing on the islands as late as the 1970's (Helander et al. 1987).

One pollen grain of *Myrica gale* was found at in the lower part of core B. The species has not been found on the Suomenlinna islands during this century.

Even though the Suomenlinna islands are famous for an abundance of *Syringa*, which was brought to Finland through these islands during the Swedish period, only sporadic pollen grains were identified in core B. This could be expected because of the low pollen production of this shrub.

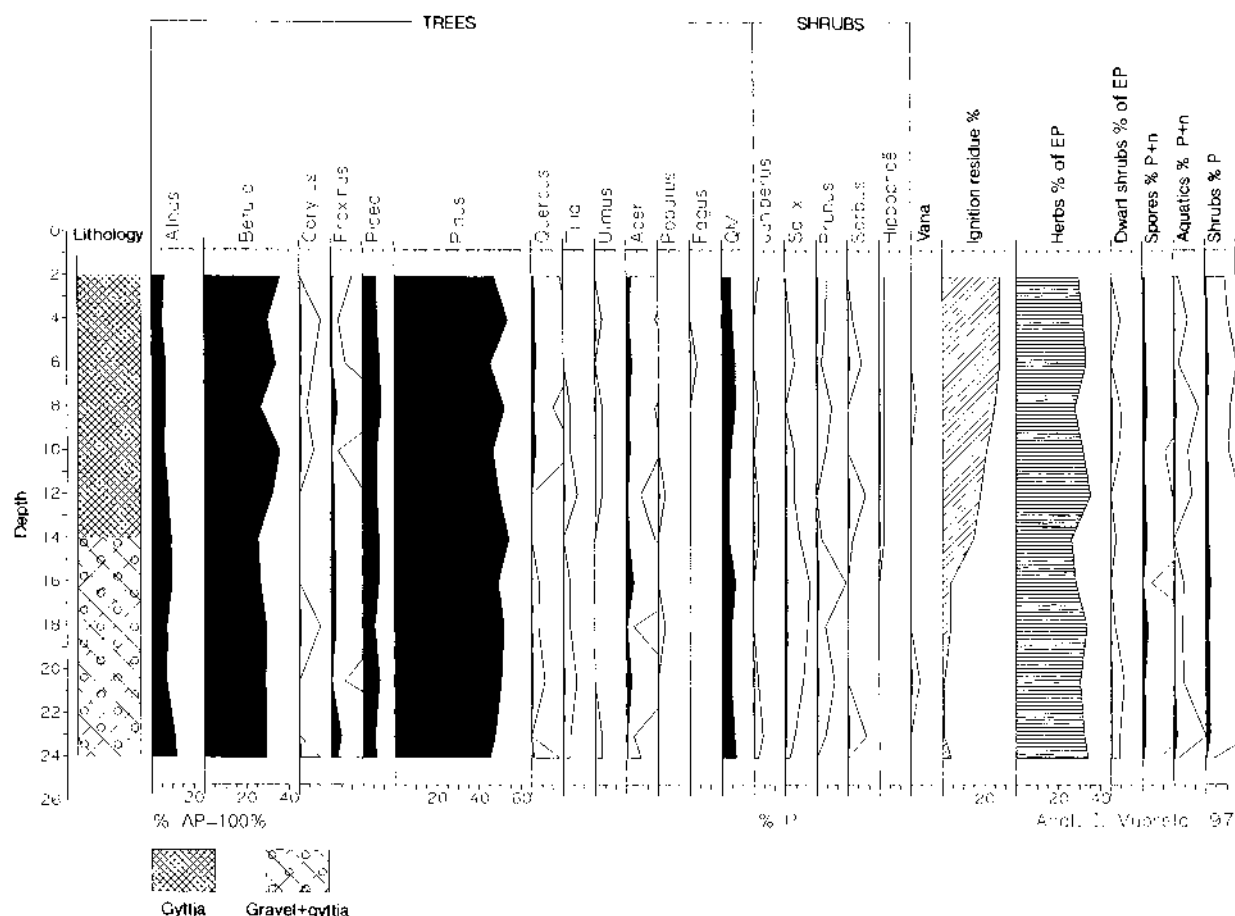


Fig. 3. Relative tree (% AP) and shrub (% P) pollen frequencies and ignition residue of the bottom deposits of Piper's Pond, Suomenlinna, Helsinki.

Herb vegetation

Meadows

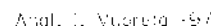
Ecologically, (bare) bedrock outcrops are included in this group. Poaceae, *Artemisia* and Rosaceae dominate by pollen frequencies of less than 10% of sum P each. Additionally, following pollen taxa were identified in core C: Ericaceae, Apiaceae, Caryophyllaceae, *Achillea* type, *Cirsium* type, Cichoriaceae, Fabaceae, *Galium*, *Anemone* type, Schrophulariaceae, *Ranunculus acris* type, *Potentilla*, *Filipendula*, Ranunculaceae, *Plantago lanceolata*, *Aster* type, *Epilobium*, *Antennaria* and *Sedum*. The last five pollen types occur only sporadically and the rest evenly but in frequencies mainly less than 1% of sum P. In addition to these, single pollen grains of *Centaurea jacea*, *Centaurea scabiosa*, *Calluna*, *Melampyrum*, *Valeriana* and *Vicia* were found in core A and those of *Linna borealis*, Campanulaceae and Liliaceae in core B. Among these, *Valeriana*, Liliaceae (most probably *Polygonatum odoratum*) and Campanulaceae (probably *Campanula rotundifolia*) represent the vanishing flora of the islands of Suomenlinna, and *Anemone* type pollen grains may represent *Hepatica nobilis*, which is one of the most recently imported species in the area. Pollen of *Sedum* type most probably originates from the bedrock outcrop situated SW of the pond (Fig. 2).

Settlement indicators

Cereal pollen occurs throughout core A (Fig. 4) accompanied by Brassicaceae, *Plantago major*, *Rumex* and Chenopodiaceae, only that of *Cerealia* and Brassicaceae exceeding 1% P. In sparser occurrences pollen of *Plantago media*, *Fumaria officinalis*, *Solanum dulcamara*, Lamiaceae and *Urtica* was recorded. In core A pollen of *Polygonum aviculare*, *Humulus*, *Centaurea cyanus* and *Spergula* was also found.

All cereal species were represented in the pollen flora. The start of cereal cultivation on the Suomenlinna islands is unknown but as late as the early 1900s rye, wheat and oats were still cultivated on Susisaari. Some *Cerealia* pollen grains may also have entered the pond in bread thrown by tourists for the water birds (Greig 1982). The even distribution of *Cerealia* confirms the disturbance of the sediment.

Even though Brassicaceae, Chenopodiaceae and *Rumex* could be mainly connected with the adjacent seashore, they also indicate strong human activity. This is perhaps confirmed by Cichoriaceae pollen, here included in the meadow vegetation, which serves as one of the most reliable indicators of early urban settlement (Vuorela 1997b, Vuorela & Hiekkanen 1991, Vuorela & Lempiäinen 1997).



Hygrophytes and aquatics

Even though *Hippuris vulgaris* grows abundantly in Piperi's Pond today, and *Iris pseudacorus* on its shores, no *Hippuris* pollen was found and *Iris* frequencies never exceeded 1% P+n.

In core C cryptogams are represented by spores of *Equisetum*, Polypodiaceae, *Sphagnum*, *Pteridium*, *Lycopodium* and *Polypodium vulgare* (Fig. 5). In core A, additionally, spores of *Pteridium* and *Dryopteris* type were found. At all sites Polypodiaceae and *Sphagnum* dominate with spore frequencies, however, less than 2 % P + n.

During the last few centuries the changes in political history of Finland are reflected in the vegetation history of the fortress islands of Suomenlinna, situated offshore of Helsinki. In the Swedish (the 18th century) and the Russian (1808–1917) periods several tree and herb species were brought to the islands. Because of the heavy disturbance of the sediment, Piper's Pond can, however, only be interpreted as a pollen trap of the pollen rain of last few centuries, and the vegetation history and history of local cultivation cannot be documented.

The herb pollen flora (c. 30% P) consists of 22 pollen types of meadow plants; 10 pollen types have been classified as indicators of settlement, 6 represent hygrophytes and aquatics, and 6 spore types of cryptogams.

The most important features of results are:

In spite of the isolated location of the islands of Suomenlinna tree pollen do not reflect local vegetation.

Among local tree species *Fraxinus* is only represented on a pro mille level in spite of the dominant position of old ashes in the present-day tree vegetation of the islands.

The relative pollen frequencies of insect-pollinated plants, such as Rosaceae (excl. *Filipendula*), Cichoriaceae and Fabaceae were high in comparison with wind pollinated ones, such as *Rumex* and *Plantago major*, reflecting meadows and urban courtyards (cf. Vuorela 1997b).

The abundance of Brassicaceae pollen most evidently

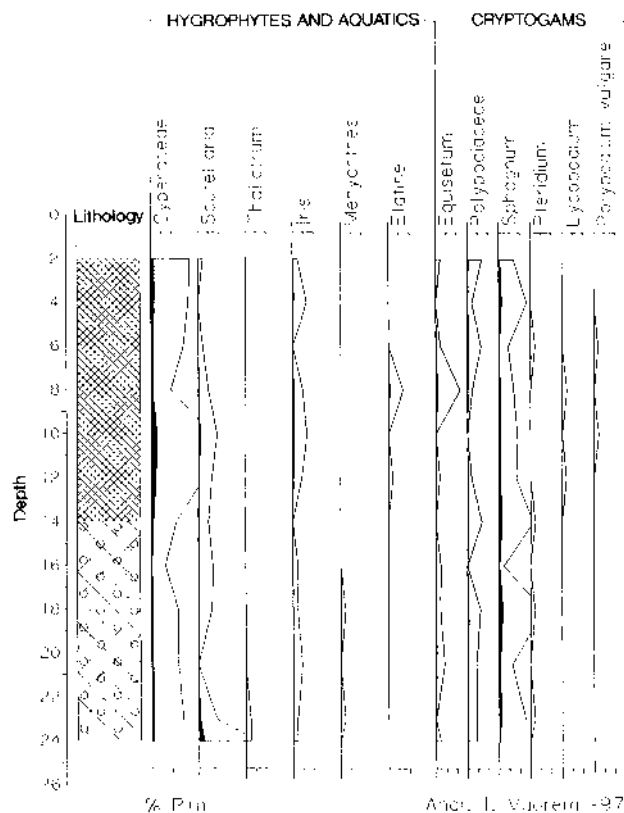


Fig. 5. Relative pollen frequencies (% P+n) of hygrophytes, aquatics and cryptogams of the bottom deposits of Piper's Pond, Suomenlinna, Helsinki.

reflects the huge amounts of *Bunias orientalis* originating from the Russian period and covering the fortress walls in the vicinity of the pond.

The *Iris* pollen representation was low and *Hippuris*

pollen was absent in spite of the strong presence of these plants.

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