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MEDIEVAL PLANT REMAINS FROM THE FORTRESS OF KÄKISALMI, KARELIA (RUSSIA)

Abstract

The macrofossil analysis of the material sampled from the settlement layer of the Fortress of Käkisalmi, was carried out in 1989–1990. The material dated to 12th–14th centuries.

The total number of the identified macrofossil remains was approx. 9000. The study shows that cereals of *Hordeum vulgare*, *Secale cereale*, *Triticum aestivum* and *Avena sativa* were cultivated and berries of many wild plants were collected for food. Hemp, hop, flax and fig were also useful plants. Furthermore, lots of remains of field weeds were found. Species from wet and damp sea or rivershore meadows (Lake Ladoga and River Vuoksi) were used for feeding the animals; the weeds of nutrious soils and damp or wet soils were very common in the present macrofossil material.

The high pollen amount of Cerealia and natural *Poaceae* indicate most evidently that food and fodder was stored inside the Fortress (Vuorela et al. 1992).

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Introduction

There are no earlier investigations of macrofossil plant material from the Karelian Isthmus. The only limited studies have been carried out in Old Ladoga and Novgorod (Kir'janov 1959), there the plant material was dated to the Viking Age. Pollen analyses of the soil profile of Fortress of Käkisalmi covering the period from the early 14th to the 17th century were carried out from the same site as macrofossil analyses (Vuorela et al. 1992).

The origin of the present material was the yard of the Fortress of Käkisalmi on the western shore of Lake Ladoga, Russia (Fig. 1). The studied layers were deposited under a wooden floor dated approx. to the 12th–14th centuries. The present samples were collected in 1989 and 1990 in connection with archaeological excavations directed by Aleksandr Saksa of the Russian Academy of Sciences Institute of History of Material Culture (St. Petersburg) in co-operation with Pirjo Uino of the Academy of Finland.

For the history of the Fortress of Käkisalmi see, e.g. Uino (1990, 122–124); Saksa et al. (1990); Vuorela et al. (1992, 187–190); Kuujo et al. (1958).

Material and methods

The soil samples for macrofossil analysis were taken from five sites of the excavation (see Table 1). The macrofossil material was extracted in the laboratory from the settlement layers by means of flotation in a saturated salt water solution (NaCl, Lempiäinen 1985). Seeds and other remains were separated using a stereoscopic microscope (WILD M5) and identified. The nomenclature employed here follows Hämet-Ahti et al. (1986).

The present material has been dated, according to archaeological finds and dendrochronology, to the 12th–14th centuries (see Kankainen et al. 1995, this volume; Saksa et al. 1990; Uino 1990; Vuorela et al. 1992; Zetterberg et al. 1995, this volume).

Results

The soil samples yielded 8281 remains of seeds and fruits, and 84 unidentified remains, which were e.g. numerous remains of mosses, insects and pieces of bone (Appendix 1). The finds could be classified into about 150 taxa.

Table 1. The soil samples. *The eastern/western part of the excavation area.

Sample no.	Sample size [l]	Depth [m]	Contents	E/W*
1.	0.8	2.30–2.40	Manure with mineral soil and pieces of wood	E
2.	2x2.0	1.80–2.00	Sandy coarse settlement soil with pieces of wood	E
3.	0.7	2.00	Coarse mineral soil with dirty settlement soil	W
4.	1.0	2.5	Sandy settlement soil with manure	W
(5.	0.5	2.60	Sandy soil under and inside a mortar; no identified plant remains)	E

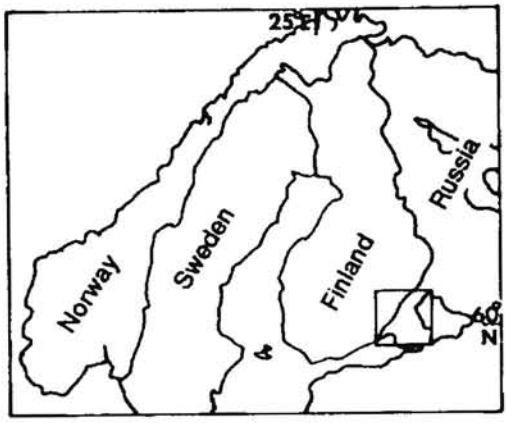

Fig. 1. The location of Käkisalmi.

Plants used by man

Thirty-four (34) charred cereal grains were identified along with 165 unidentified pieces of grain. The most common finds were the remains of *Hordeum vulgare* (Fig. 2); 13 charred grains and 3 grain bases. Six grains of *Secale cereale*, 5 grains of *Avena sativa* and one grain of *Triticum cf aestivum* were found. They were all charred.

The remains of *Cannabis sativa* (Fig. 2) were very common in this material. A total of 53 nutlets of hemp was found. Most of them were in the manure sample (Sample No. 1). Hemp was also mentioned in the material of Old Ladoga (Kir'janov 1959) dated to the Viking Age.

In Finland other macrofossil remains of *Cannabis* have been found from Ahvenanmaa dated to the Viking Age (Nunez & Lempiäinen 1990), as are the seeds of Varikkoniemi in Hämeenlinna (Lempiäinen 1993). There have also been medieval finds in Turku (Lempiäinen 1991b) and in Kuusisto (Lempiäinen 1991a). According to pollen records, hemp was cultivated in South Finland as early as in the Pre-Roman Iron Age (Dörfler 1990; Tolonen 1978).

The nutlets of hop (*Humulus lupulus*) (Fig. 2) were very common in the manure sample (No. 1). In the Middle Ages hop was an important cultivated plant in South Finland. For beer-making it was an important plant also in Karelia. It is interesting that the native hop is completely missing at all in the Eastern Karelia. On the shores of Lake Ladoga, *Humulus* grows but it might be of cultivated origin (Hultén 1971, 606; Linkola 1916, 258; Suominen 1982, 7). It was also brought by merchants (see Kuujo 1981; Soininen 1974; Suominen 1982).

In Finnish literature, hop is found already in old folk poetry, but it was mentioned for the first time in the Finnish botanical literature in 1673, in a plant catalogue of the Turku region, "Catalogus Plantarum", by Elias Tillandz (Tillandz 1673;

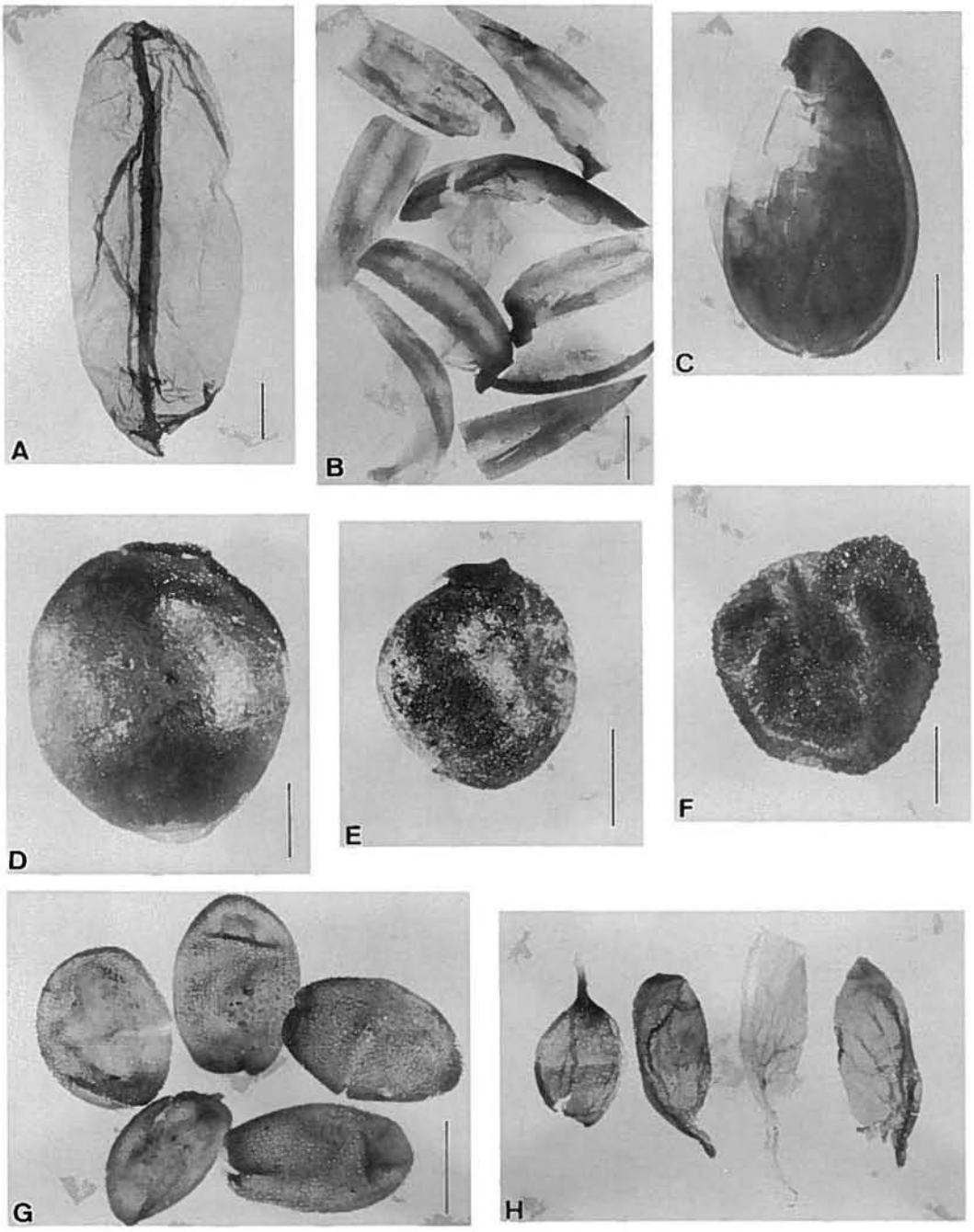

Fig. 2. Some plant remains from the Fortress of Käkisalmi. (Scale = 1 mm). A: *Hordeum vulgare*, B: *Linum usitatissimum*, pieces of capsules, C: *Linum usitatissimum*, D: *Cannabis sativa*, E: *Humulus lupulus*, F: *Agrostemma githago*, G: *Camelina sativa*, H: *Trifolium album*, petals.

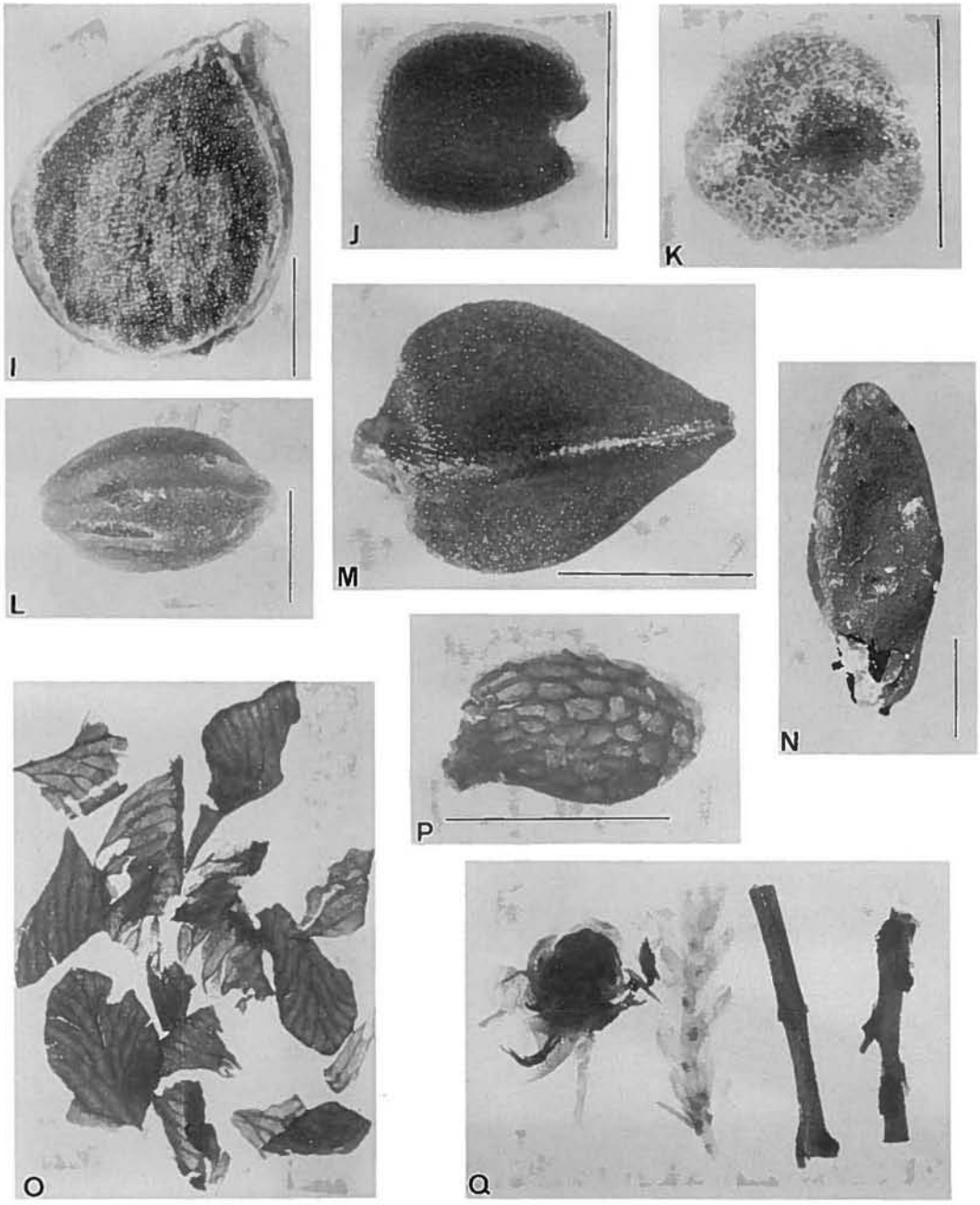

Fig. 2, continued. I: *Ranunculus repens*, J: *Rorippa palustris*, K: *Cuscuta europaea*, L: *Thalictrum flavum*, M: *Polygonum aviculare*, N: *Erodium cicutarium*, O: *Thelypteris palustris*, pieces of leaves, P: *Calluna vulgaris* (scale = 1/2 mm), Q: *Calluna vulgaris* (from left to right): flower, stem with leaves and pieces of stems.

1683). In the manure sample there were very many remains of *Linum usitatissimum*, flax (Fig. 2) in the form of pieces of capsules, seeds and cells of stems. *Linum* was recorded also in pollen analyses from this site dated to the Middle Ages (Vuorela et al. 1992, 192).

Flax was known in Finland as a macrofossil in Katajamäki, Salo (Aalto 1982) and in Paimio, Spurila (Seppä-Heikka 1985) dated to the Migration period (ca. A.D. 200–400), in South Häme dated to the 7th century (Tolonen 1978) and in Sund (Ahvenanmaa/Åland), dated to the Viking Age (Nunez & Lempiäinen 1990).

It is known that in Karelia they paid a part of their taxes in flax in some parishes in the 15th and 16th centuries (Forsström 1890; Kaukonen 1946). They also paid flax, alone with hemp, to other parts of Finland. Flax was an important plant both for cloth and also as a folk medicine.

One seed of *Ficus carica*, fig (Fig. 2) was found from the manure sample. This tropical plant was surely imported into the Northern latitude. Seeds of *Ficus carica* were also found from the medieval layers in Turku (Lempiäinen 1991b) and in Helsinki (Vuorela & Lempiäinen 1993).

Fig was mentioned for the first time in literary documents as a medicinal plant in a herbal book of the monastery of Naantali written in the 15th century. Fig has been obviously very rare in Käkisalmi, as was the case also in other places in Finland and in other Nordic Countries (see Griffin 1979). It was more common in the Middle Ages in Central Europe (see Behre 1991).

Only one seed of *Malus sylvestris* was found from the manure sample. Kir'janov (1959) mentioned *Malus* also in Old Ladoga dated to the Viking Age. The remains of many native plants which had been collected by man were found from all samples, e.g. pieces of nuts, *Corylus avellana*, *Sorbus aucuparia* and remains of berries, *Fragaria vesca*, *Rubus idaeus* and *Vaccinium*-species, were very common.

Weeds of cereal fields

Macrofossil finds of *Centaurea cyanus*, *Fallopia convolvulus*, *Lapsana communis* and *Myosusus minimus* refer to winter grops (rye) cultivation. *Agrostemma githago* grows along with *Avena sativa* especially in Karelia (see Linkola 1916).

Nine seeds of *Camelina* (identified as *C. sativa/alyssum*, Fig. 2) were found from the manure sample. *Camelina sativa* was known in Central Europe as a weed in flax fields but also as a cultivated plant because of its oil-containing seeds (Behre 1983). In Finland, especially in the Karelia district, *Camelina*-species were known solely as weeds and ruderals (Hiitonen 1946; Linkola 1916). *Camelina alyssum* was known in flax fields.

Ecological features of environments of macrofossil species

In Appendix 1, the native plants are divided into seven groups: (4) trees and shrubs, (5) weeds of cereal fields, (6) weeds and ruderals, (7) meadow plants, (8) natural vegetation, (9) plants of shore, marsh and water and (10) other remains. The present classification is formulated mainly according to Ellenberg (1979) and Linkola (1916). Fig. 3 presents an ecodiagram of moisture and nitrogen factors of identified plants in the material of the Fortress of Käkisalmi (Ellenberg 1979). According to this diagram, most of the plants belong to the group of dry and nutrient-rich habitats, such as those of typical ruderal soils.

The majority of species belonged to the groups of dry and nitrogen-poor and wet, nitrogen-rich habitats. The former plants were the species of dry, stony slopes and hills and the latter were the plants of dirty ditches and shore waters. According to the diagram, a large number of plants, however, belong to many different groups of ecological factors (value x). This means that these plants can grow in many kinds of habitats. These species were mostly the plants of open habitats, yards, fields, open slopes, meadows, road banks, shores, etc.

These results indicate that plants of many different habitats were gathered together in the yard of the Fortress of Käkisalmi. On the other hand, there were many kinds of habitats in the neighbourhood and as a result of human impact they were introduced to the yard of the Fortress.

Conclusions

The explanation for the relatively high number of plant macrofossils of sample No. 1 can be that, in the same place, both manure and kitchen garbage were thrown on to a waste heap. The remains of useful plants, such as cereals, hop, hemp, flax and fig, all came from domestic waste and the others, mainly from the fodder for domestic animals. The majority of the studied macrofossils were the settlement weeds of fields, small gardens and yards (Appendix 1), but many native plants were carried out in fodder for domestic animals, in this case, perhaps mainly for horses. Traffic was also a very important cause of dispersal of plants to this site.

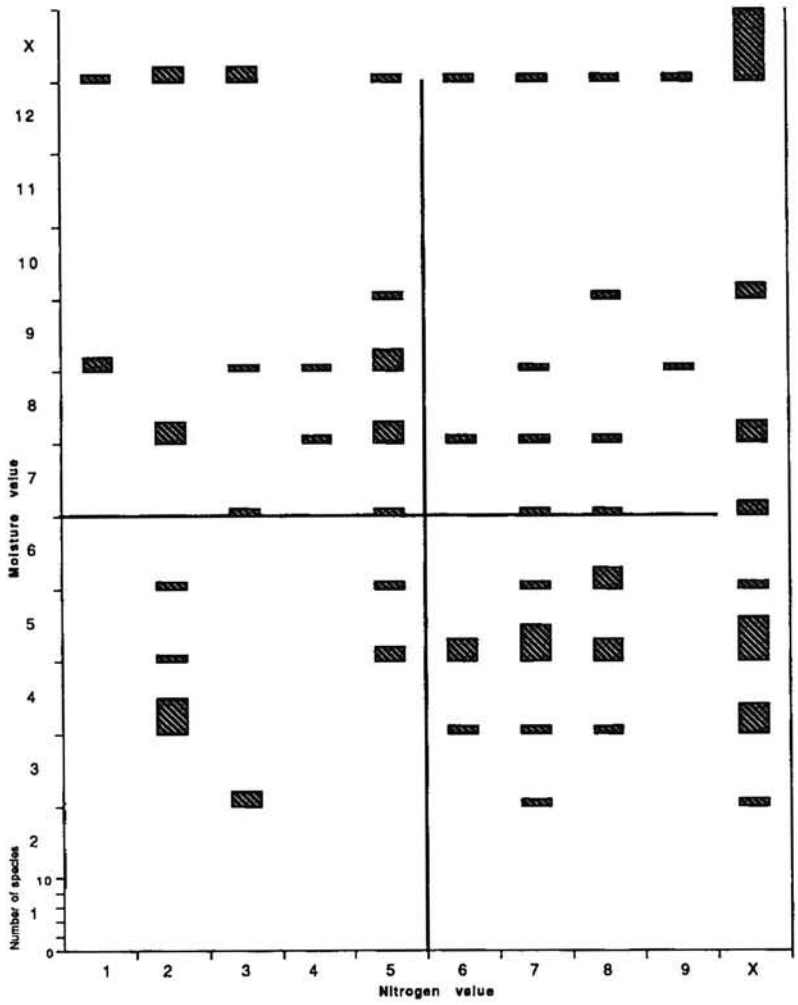

Fig. 3. Distribution of all natural plant species, identified as macrofossils, according to moisture and nitrogen behaviour values after Ellenberg (1979). Moisture value: 1–12 = indicator value (from dry to wet habitats), Nitrogen value: 1–9 = indicator value (from nutrient-poor to nutrient-rich soils). X = indifferent (wide amplitude).

Most of the habitats which were already described by Linkola (1916) in the Ladoga district (see Appendix 2) can also be seen in the present macrofossil flora.

Cultivated plants used in the Fortress of Käkisalmi were *Hordeum vulgare*, *Secale cereale*, *Avena sativa* and *Triticum cf. aestivum* (see also Vuorela et al. 1992). Very few remains were found of other parts of ears, e.g. grain bases. We can suppose that cereals were brought to the Fortress and stored there, because there was no threshing waste at all (see e.g. Behre 1983 and pollen analyses, Vuorela et al. 1992). These cereals were mentioned also by Kir'janov (1959) in Old Ladoga dating to the Viking Age.

Humulus lupulus was a spice for beer and *Cannabis sativa* and *Linum usitatissimum* were known in the Ladoga area in the Middle Ages for both fibre and oil, perhaps also for medicinal purposes, but brought to the Fortress of Käkisalmi (see Kir'janov 1959; Linkola 1916). *Linum* and *Cannabis* were both cultivated in this area, but not necessarily, because they were both important commodities imported from Russia to Karelia (Kaukonen 1946, 37).

Comparing the present macrofossil flora with that of Turku, Old Market Place (Lempiäinen 1991b), dated to the same time, there are many

Table 2. The macrofossil flora of Käkisalmi compared with that of Turku, Old Market Place dated to the same time. The specific plants of both sites.

Site	TURKU	KÄKISALMI
No. of samples	64	7
No. of plant species	150	138
No. of specific plants	35	17
	Aethusa cynapium	Andromeda polifolia
	Arctostaphylos uva-ursi	Anemone nemorosa
	Aster tripolium	Anthemis tinctoria
	Betula nana	Camelina sp.
	Bidens tripartita	Cardamine sp.
	Bromus sp.	Cuscuta europaea
	Caltha palustris	Descurainia sophia
	Capsella bursa-pastoris	Eleocharis uniglumis
	Chenopodium glaucum/rubrum	Erodium cicutarium
	C. suecicum	Hypericum maculatum
	Chrysanthemum segetum	Melilotus albus
	Empetrum nigrum	Myosurus minimus
	Euphrasia sp	Peucedanum palustre
	Glyceria fluitans	Ranunculus reptans
	Hyoscyamus niger	Stellaria palustris
	Juncus articulatus	Thalictrum flavum
	Levistichum officinale	Veronica longifolia
	Myrica gale	
	Papaver somniferum	
	Pedicularis palustris	
	Phalaris arundicea	
	Potentilla anserina	
	Comarum palustre	
	Ranunculus flammula	
	Rhynchospora alba	
	Scleranthus annuus	
	Silene nutans	
	Solanum dulcamara	
	S. nigrum	
	Stachys paluster	
	Taraxacum officinale	
	T. compactum	
	Verbascum nigrum	
	Vicia cracca	
	Vicia tetrasperma	

similarities (Table 2), but the number of species in Turku is only slightly higher than in Käkisalmi, in spite of the fact that the number of samples in Turku was 64 and in Käkisalmi only 4. Also the sizes of soil samples did not differ very much from each other. The number of plant species occurring only in Turku or in Käkisalmi was 35 in the former and 18 in the latter. The other species were found in both sites (Lempiäinen 1993). Some eastern plant species were found only in the flora of Käkisalmi, like *Camelina*, *Erodium cicutarium*, *Sisymbrium sp.* and *Melilotus albus*. The high number of settlement weeds indicates, in both sites, very intensive human impact in the Middle Ages. Most of the species of the present macrofossil flora were found in the northern Ladoga district in the beginning of the 20th century as documented by Linkola (1916).

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Appendix 1. Macrofossil remains from the deposit in the Fortress of Käkisalmi. The finds are seeds or fruits, if not otherwise mentioned. Dating A.D. 1100–1300.

Samples	1	2	3	4	Sum
1. Cultivated plants					
Avena sativa*	-	5	-	-	5
Avena/gb	2	-	-	-	2
Hordeum vulgare*	-	6	-	-	6
Hordeum vulgare	7	-	-	-	7
Hordeum vulgare/gb	2	-	-	-	2
Hordeum vulgare/gb*	-	-	1	-	1
Secale cereale*	2	4	-	-	6
Secale cereale/gb	4	-	-	-	4
Triticum cf. aestivum	1	-	-	-	1
Cerealia	121	-	1	-	122
Cerealia*	-	41	-	2	43
Cannabis sativa	45	-	6	2	53
Humulus lupulus	12	-	-	1	13
Cannabis/Humulus	85	-	-	-	85
Linum usitatissimum/ca	65	-	-	9	74
Linum usitatissimum/s	13	1	-	-	14
Linum usitatissimum/ce	+	-	-	-	-
2. Other useful plants					
Ficus carica	-	1	-	-	1
Malus sylvestris	-	-	-	1	1
3. Collected plants					
Corylys avellana	9	4	1	-	14
Juniperus communis/n	1	-	-	-	1
Sorbus aucuparia	18	-	3	-	21
Fragaria vesca	41	12	32	6	91
Rubus idaeus	14	128	2	1	145
Vaccinium sp.	164	-	-	19	183
- myrtillus	10	-	13	-	23
- oxycoccos	+	-	-	+	-
- uliginosum	1	-	1	-	2
- vitis-idaea	+	-	-	-	-
4. Trees and shrubs					
Betula pendula/pubescens	2	2	-	-	4
Betula/Alnus	1	8	3	-	12
Picea abies/n	11	-	-	-	11
Picea abies/s	-	-	1	-	1
Quercus robur/w	1	-	1	-	2
Corylus avellana	9	4	1	-	(14)
Juniperus communis	1	-	3	-	(1)
Sorbus aucuparia	18	-	-	3	(21)
5. Weeds of cereal fields					
Agrostemma githago	1	-	-	-	1
Centaurea cyanus	-	-	-	1	1
Fallopia convolvulus	15	-	4	3	22
Camelina sativa/alyssum	9	-	-	-	9
Cuscuta europaea	-	-	1	-	1
Lapsana communis	42	1	8	20	71
Myosurus minimus	1	-	-	-	1
6. Weeds and ruderals					
Anthemis tinctoria	5	-	-	-	5
Artemisia vulgaris	2	-	-	-	2
Arctium tomentosum	1	-	-	-	1
Atriplex patula	7	-	-	2	9
Brassica/Sinapis	28	-	1	-	29
Brassica/Sinapis/st	1	1	-	-	2
Brassicaceae	-	-	1	-	1
Chenopodium album	359	304	59	353	1075
Cirsium sp.	1	-	-	1	2
Descurainia sophia	-	-	-	3	3
Dianthus deltoides	2	-	-	-	2
Erodium cicutarium	2	-	-	-	2
Euphorbia helioscopia	3	-	-	-	3
Fumaria officinalis	2	1	-	1	4
Galeopsis speciosa	33	-	2	3	38
Galeopsis tetrahit	23	-	-	-	23
Galeopsis bifida	+	-	-	-	-
Galium aparine	84	-	4	1	89
Galium spurium	+	-	-	-	-
Juncus sp.	849	715	314	100	1978
J. articulatus	+	+	-	+	-
J. bufonius	+	+	-	-	-
J. compressus/gerardii	+	+	+	+	-
Lamium purpureum	1	-	-	-	1
Melilotus albus	-	1	-	-	1
Myosotis arvensis	3	1	-	-	4
Plantago major	4	-	-	1	5
Poa annua	10	-	-	-	10
Polygonum aviculare	17	-	-	2	19
Polygonum hydropiper	4	-	1	1	6
Polygonum lapathifolium	35	-	1	2	38
Prunella vulgaris	6	3	2	9	20
Ranunculus repens	8	3	2	2	15
Ranunculus sceleratus	-	1	-	-	1
Rumex acetosella	12	2	5	4	23
Rumex crispus	12	-	-	-	12
Rumex crispus/p	2	-	-	-	2
Sisymbrium sp.	-	-	17	3	20
Sonchus asper	4	-	-	-	4
Spergula arvensis	109	2	10	11	132
Stellaria media	2345	2	8	45	2400
Thlaspi arvense	2	1	2	1	6
Trifolium repens/s	2	1	-	-	3
Trifolium repens/ca	3	-	-	-	3
Trifolium repens/fl	44	-	-	1	45
Tripleurospermum inodorum	1	-	-	-	1
Urtica dioica	4	4	-	4	13
Urtica urens	3	-	-	-	3

Veronica chamaedrys	1	-	1	1	3
7. Meadow plants					
Agrostis sp.	87	-	6	2	95
Anthriscus sylvestris	1	-	-	-	1
Apiaceae	2	-	-	-	2
Campanula sp.	1	-	-	-	1
:Carex disticha/elongata	+	-	-	-	-
:Filipendula ulmaria	38	1	8	135	182
:Hieracium sp.	2	-	-	-	2
Hypericum maculatum	-	-	1	-	1
:Leontodon autumnalis	-	-	1	-	1
:Luzula multiflora /campestris	3	5	4	6	18
:Poa pratensis/trivialis	50	1	13	1	65
Poaceae/gb	2	-	-	5	7
:Ranunculus acris	15	-	-	-	15
Ranunculus reptans	1	-	-	-	1
:Rhinanthus sp.	3	-	-	1	4
:Rumex acetosa	7	-	-	-	7
Rumex sp.	2	-	-	-	2
Silene vulgaris	14	2	2	-	18
:Stellaria graminea	10	-	1	-	11
:Thalictrum flavum	-	-	1	-	1
:Valeriana officinalis	1	1	1	-	3
Vicia sp./le	19	-	-	-	19
Viola canina ssp. montana	2	-	-	-	2
Viola riviniana	3	1	-	-	4
Viola sp./ca	3	-	2	-	5
Viola sp./s	10	-	-	-	10
8. Natural vegetation					
Anemone nemorosa	1	-	-	-	1
Calluna vulgaris/l+st	135	-	-	1	136
Calluna vulgaris/fl	27	-	1	-	28
Calluna vulgaris/s	5	-	1	-	6
Cerastium sp.	4	-	-	1	5
Fabaceae	12	-	-	-	12
Thelypteris palustris	41	-	-	1	42
9. Plants of shore, marsh and water					
Alisma plantago-aquatica	1	-	-	-	1
Andromeda polifolia	-	1	-	2	3
Cardamine sp.	-	-	-	2	2
Carex flava	-	1	-	-	1
Carex sp./2-sided achene	66	26	15	16	123
Carex sp./3-sided achene	60	68	-	-	128
Eleocharis palustris	2	-	-	-	2
Eleocharis uniglumis	1	-	-	-	1
Elatine sp.	6	2	2	6	16
Lychnis flos-cuculi	-	-	1	-	1
Lucopus europaeus	1	-	-	-	1
Lysimachia vulgaris	-	-	1	-	1
Mentha arvensis/aquatica	1	2	-	-	3
Myosotis sp.	1	-	-	-	1
Odontites rubra	1	-	-	-	1
Peucedanum palustre	-	-	-	1	1
Phragmites australis	2	-	-	-	2
Polygonum persicaria	9	-	-	-	9
Potentilla erecta	4	-	-	-	4
Ranunculus Sect. Batrachium	-	2	-	1	3
Rorippa palustris	1	-	-	-	1
Sagina sp.	20	-	1	1	22
Scirpus sylvaticus	32	35	37	16	120
Spergularia sp.	-	-	-	2	2
Stellaria palustris	3	-	-	-	3
Veronica longifolia	-	-	5	3	8
Indet.	13	-	2	-	15
Total	5447	1403	612	819	8281
10. Other remains					
Bryophyta	+	-	-	+	-
Mnium sp./l	+	-	-	-	-
Sphagnum sp./l	+	+	+	+	-
Fungi/sclerot.	-	3	-	-	3
Wood	+	28	-	-	28
Plant remains	4	+	-	-	4
Cristatella mucedo	1	3	-	-	4
Insecta	22	+	+	+	22
Pisces	1	22	-	-	23
Bones	+	+	+	-	-

*=charred, gb=grain base, ca=capsule, s=seed, ce=cells of stem, l=leaf, st=stem, fl=flower, n=needle, w=wood, le=legume, :=more or less fresh habitat, +=several finds, -=no finds

Appendix 2. Macrofossil plant species classified after Linkola (1916) into their natural habitats in the Ladoga Karelia. x = habitat where a plant species can grow.

a: Dry heath forests
b: Dry heath forests/shores of Ladoga
c: Fresh heath forests
d: Fresh heath forests/shores of Ladoga
e: Deciduous woodland
f: Deciduous woodland with Aconitum
g: Man-influenced forests
h: Rocks
i: Marshes
j: Shores
k: Waters
l: Meadows
m: Fields
n: Ruderal habitats
o: Anthropochores / Ladoga district

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1. Cultivated plants															
Humulus lupulus						x									
3. Collected plants															
Juniperus communis	x							x							
Fragaria vesca			x	x	x	x	x	x		x		x		x	
Rubus idaeus			x			x		x					x	x	
Vaccinium myrtillus	x		x			x	x		x	x	x				
Vaccinium oxycoccos								x							
Vaccinium uliginosum	x		x					x	x	x		x			
Vaccinium vitis-idaea	x		x			x	x		x	x		x			
5. Weeds of cereal fields															
Agrostemma githago													x		x
Centaurea cyanus													x		x
Fallopia convolvulus								x					x	x	x
Camelina (alyssum/sativa)													x	x	x
Cuscuta europaea														x	x
Lapsana communis							x						x	x	x
Myosurus minimus								x					x		x
6. Weeds and ruderals															
Anthemis tinctoria													x	x	x
Artemisia vulgaris								x					x	x	x
Arctium tomentosum							x						x	x	x
Atriplex patula									x				x	x	x
Brassica/Sinapis													x	x	x
Chenopodium album								x		x			x	x	x
Cirsium (arvense)								x		x		x	x		
Descurainia sophia														x	x
Dianthus deltoides							x	x				x		x	x
Erodium cicutarium													x	x	x
Euphorbia helioscopia													x		x
Fumaria officinalis													x		x
Galeopsis speciosa													x		x
Galeopsis tetrahit													x	x	x
Galeopsis bifida					x	x	x	x		x			x	x	x
Juncus bufonius									x				x	x	x
Lamium purpureum														x	x
Melilotus albus														x	x
Plantago major								x		x		x		x	x
Poa annua								x		x		x		x	x
Polygonum aviculare									x			x		x	x
Polygonum hydropiper										x				x	x
Polygonum lapathifolium										x				x	x
Prunella vulgaris								x		x		x		x	
Ranunculus repens								x		x		x		x	
Ranunculus sceleratus														x	
Rumex acetosella								x		x		x		x	x
Rumex crispus															x
Sonchus asper														x	x
Spergula arvensis									x			x		x	x
Stellaria media								x		x				x	x
Thlaspi arvense														x	x
Trifolium repens								x		x		x		x	x
Tripleurospermum inodorum										x				x	x
Urtica dioica								x		x				x	x
Urtica urens										x				x	x
Veronica chamaedrys				x	x	x		x		x		x		x	
7. Meadow plants															
Agrostis sp.												x			
Anthriscus sylvestris												x			
Carex disticha/elongata								x		x					
Filipendula ulmaria				x		x		x		x		x			
Hieracium sp.	x	x						x		x		x			
Hypericum maculatum	x									x		x		x	
Leontodon autumnalis								x		x		x		x	x
Luzula multiflora/campestris								x		x		x		x	x
Poa pratensis/trivialis					x	x		x		x		x		x	x
Ranunculus acris				x		x		x		x		x		x	x
Ranunculus reptans										x	x	x			
Rhinanthus sp.								x				x		x	
Rumex acetosa							x	x		x		x		x	x
Silene vulgaris												x		x	
Stellaria graminea					x	x		x		x					x
Thalictrum flavum							x	x		x		x			
Valeriana officinalis							x								

	a	b	c	d	e	f	g	h	i	j	k	l	mn	o
Viola canina		x	x		x	x	x	x		x		x		
Viola riviniana			x		x	x		x		x				
8. Natural vegetation														
Anemone nemorosa				x	x	x	x							
Calluna vulgaris	x		x		x			x	x	x		x		
Cerastium sp.								x		x				
Thelypteris palustris			x	x				x						
9. Plants of shores, marshes and waters														
Alisma plantago-aquatica										x	x			
Andromeda polifolia									x					
Cardamine sp.						x			x	x		x		
Carex flava						x	x		x			x		

	a	b	c	d	e	f	g	h	i	j	k	l	mn	o
Carex sp.										x		x		
Eleocharis palustris										x	x			
Eleocharis uniglumis										x	x			
Elatine sp.											x			
Lychnis flos-cuculi										x	x			
Lysimachia vulgaris						x	x		x	x		x	x	
Mentha arvensis/aquatica									x	x		x	x	x
Odontites rubra										x		x	x	x
Peucedanum palustre									x	x		x		
Potentilla erecta	x					x	x	x		x		x		x
Ranunculus sect. Batrachium											x			
Sagina sp.								x		x		x		
Scirpus sylvaticus						x	x	x	x			x		
Stellaria palustris									x			x		
Veronica longifolia										x		x		