Fennoscandia archaeologica XXXVIII (2021)

Mia Lempiäinen-Avci, Riikka Elo, Teija Alenius, Auli Bläuer, Sanna Huttunen, Elina Saloranta & Tanja Ratilainen

A MEDIEVAL LATRINE AND A YARD IN TURKU, SOUTHWEST FINLAND – A MULTIDISCIPLINARY STUDY OF ECOFACTS

Abstract

Ecofacts from a wooden structure and its surrounding area at the medieval Cathedral School site (Medieval period in Finland AD 1200–1520) were used to compliment the archaeological data from Turku, the oldest town of Finland. The site is of primary importance to the study of Turku's past. The analysed ecofacts consisted primarily of vascular plant seeds, pollen, moss, invertebrates, and animal bones. Ecofact evidence proved that a wooden frame uncovered at the site was a latrine, dating to AD 1450–1520. Additionally, it was found out, that the older layer (AD 1350–1450) surrounding the latrine was part of a yard where domestic waste was being deposited. The results show that medieval residents at Turku had contacts overseas and the resources of local natural environment was exploited. The most interesting find is the presence of melegueta pepper (*Aframomum melegueta* L.), a plant native to West Africa, which had not been found in Finland before. In this study, the natural scientific analysis had an important role in the interpretations of archaeological features. These results deepen current knowledge of the medieval town of Turku, during an early phase of its urbanisation.

Keywords: Archaeology, archaeobotany, archaeozoology, ecofact, seed, pollen, moss, bone, invertebrate, latrine, medieval town, Finland

Mia Lempiäinen-Avci[a,d], mialem@utu.fi
Riikka Elo[b], riaelo@utu.fi
Teija Alenius[c,d], teija.alenius@utu.fi
Auli Bläuer[d,e], aultou@utu.fi
Sanna Huttunen[a], shuttu@utu.fi
Elina Saloranta[f], elina.saloranta@saunalahti.fi
Tanja Ratilainen[f], tanja.ratilainen@turku.fi

[a] Herbarium, Biodiversity Unit, University of Turku, FI-20014, Turun yliopisto, Finland
[b] Zoological Museum, Biodiversity Unit, University of Turku, FI-20014, Turun yliopisto, Finland
[c] Turku Institute for Advanced Studies (Department of Archaeology), FI-20014, Turun yliopisto, Finland
[d] Department of Archaeology, University of Turku, FI-20014, Turun yliopisto, Finland
[e] Green Technology, Natural Resources Institute Finland, Itäinen pitkäkatu 3, FI-20520 Turku, Finland
[f] Museum Centre of Turku, Kalastajankatu 4, 20100 Turku, Finland

Received: 31 May 2020; Revised: 25 September 2021; Accepted: 12 October 2021

INTRODUCTION

Ecofacts, such as plant and animal remain from urban sites, are significant source material for understanding the town's environment, urbanization process, and networks (e.g., Hjelle 2000; Heimdahl et al. 2005; Kozáková et al. 2009; Crabtree et al. 2017). During the medieval period, the first towns were founded in Finland, where the local traditions and new influences from the North-Western Europe met. The city of Turku (in Swedish: Åbo) founded in the early 14th century, is the oldest town in Finland (Pihlman 2007; 2010; Ratilainen et al. 2016; Seppänen 2016; 2019). As a centre of ecclesiastical and secular power as well as of trade, it was the most prominent of the six towns founded in the region, which at the time was the easternmost province of medieval Sweden (Kuujo 1981: 59–60; Pihlman & Kostet 1986: 9; Törnblom 1993: 377–9; Hiekkanen 1997: 377–8; Niukkanen et al. 2014: 28). While Turku was not official member of the Hansa league, it was under its influence and part of Baltic Sea trade network. The medieval archaeological find material from Turku exhibits signs of both local production and trade items. (Gaimster 1999; Gläser 2007; Haggrén 2015: 490–535.)

The study of pollen, seeds, or bones alone provides only a one-sided picture of the past. Analyses from the Natural Sciences provide a useful tool for gaining a comprehensive view of everyday life, including means of subsistence and human utilization of the local environment. To achieve this, it is important to study multiple proxies from the same site (e.g. Heimdahl 2005). In Finland, only a few studies combine both plant macrofossil and pollen analyses. The examples are by Vuorela & Lempiäinen (1988) from Turku, Lempiäinen & Vuorela (1994) from Helsinki, Lempiäinen-Avci et al. (2017) from Lappeenranta, Alenius et al. (2017) for the Uusimaa region, and Tranberg et al. (2021) from Ii. In addition, joint studies featuring bone and plant macrofossil analyses have been made by Bläuer & Lempiäinen-Avci (2011) from Turku and by Lempiäinen-Avci & Kykyri (2017) from Kotka. In addition, Tranberg (2011) has produced a study combining insect and plant macrofossil analyses from Ii. Hence, studies that combine multiple proxies from a single archaeological site are rare in Finland.

Invertebrate and moss fossils are rarely studied, possibly due to their minute size and difficult identification (Schelvis 1990). To our knowledge, invertebrate fossils from an archaeological context have been studied on a large scale in Finland only once before. This took place during the excavation of Mätäjärvi lake in Turku, conducted in 1980s (Kostet & Pihlman 1989). This investigation revealed soil mites (mainly Oribatida, with a few Mesostigmata) which were mostly identified to genus or species level. As regards other invertebrate groups, excavations in Oulu have revealed larger insects, such as Coleoptera, Diptera, and Lepidoptera (Tranberg 2005). Additionally, occasional invertebrate finds are summarized in the short review published by Vihervaara et al. (2003).

Ecofacts are usually abundant and well preserved in the latrines. They are highly significant to our understanding of medieval life as they provide valuable data concerning diet, health, and hygiene, economy, and social distinction. Latrine fill materials can also preserve ecofacts, which do not normally survive in the archaeological record due to the waterlogged conditions of the archaeological layers (Greig 1981; 1982; Wiethold 1995; Brown et al. 2017; Deforce 2017). For example, the analysis of the contents of medieval latrines has revealed a number of human parasites, indicating that hygiene conditions were relatively poor (Hald et al. 2018; 2020; Søe et al. 2018; Graff et al. 2020; Sabin et al. 2020; De Cupere et al. 2021). Another aspect of hygiene relates to the use of moss for cleaning, as some evidence from Roman latrine indicates (Mitchell 2015; Breeze 2017). Additionally, pollen data analysed from medieval cesspits revealed the existence and use of plant species that are usually absent or are underrepresented in the macrofossil assemblages (Deforce et al. 2018). Material studied from an 18th century latrine revealed that the diet based mainly on imported foodstuffs (Lempiäinen-Avci & Kykyri 2017).

Identification of a latrine might be challenging archaeologically (cf. Smith 2013), especially if the seating board has not been preserved. The environmental samples may be used to confirm the function and taphonomic history of waste-filled wooden frames. Finds of medieval latrines

Figure 1. Location of Turku and the timber structure found during the Cathedral School excavations. The latrine shaft is marked with a dashed red line. (Photo: Mia Lempiäinen-Avci.)

are rare in Finland as only two latrines dating to 13th–16th centuries are known from Turku; both of these were found at the Åbo Akademi site. There, only hand-picked bones were collected. They include household waste, representing both slaughter and kitchen waste (Tourunen 2008).

In the heart of the medieval town of Turku, located in the south-west coast of modern-day Finland, archaeological excavations conducted by the Museum Centre of Turku were carried out in 2014–2015. The project was occasioned by the renovation works of the Cathedral School (Sw: *Katedralskolan*). Excavations had revealed the remains of a wooden building and inside, a well-preserved timber structure was discovered, suspected to be a latrine (Fig. 1). This was found to be ca. 2x3 meters in dimension and was filled with a thick layer of smelly organic material. The topmost part of this consisted of coarse fill material, while the bottom consisted primarily of decayed material, probably of faecal origin. In addition, a wooden stave vessel was found in the uppermost layer, indicating that the latrine was also used as a waste pit. Another archaeological feature of interest was an area next to the latrine, stratigraphically earlier in date, which had been interpreted as a cattle yard during the excavations. We conducted in-depth studies on these two features in order to produce detailed insights to supplement current knowledge of this area's past.

We studied the botanical (seeds, pollen, mosses) and zoological (invertebrates, animal bones) content of the wooden structure interpreted as latrine and an older layer interpreted as cattle yard area. We also used AMS radiocarbon and dendrochronology to date the archaeological contexts of this study. Ecofact and archaeological data were compared and combined in order to (1) reconstruct aspects of life in medieval Turku, including human diet, use of local resources, and facilities for long-distance trade, and (2) establish taphonomic histories of the archaeological deposits.

MATERIALS AND METHODS

During the excavations, soil samples were collected from two main contexts: from the fill of the latrine [unit 51] and from the area next to the latrine [unit 59] (Fig. 2). Soil samples were collected for macrofossil, pollen, invertebrate, and bone analyses. Besides the soil samples, bones and mosses were collected when occurring during the excavation process. From the latrine fill [unit 51], soil samples (2–3 liters in volume) were first collected in the course of excavations. Additionally, the wooden stave vessel that was found in the latrine fill [unit 51], included soil that was also collected (0.5 l). Later, when the

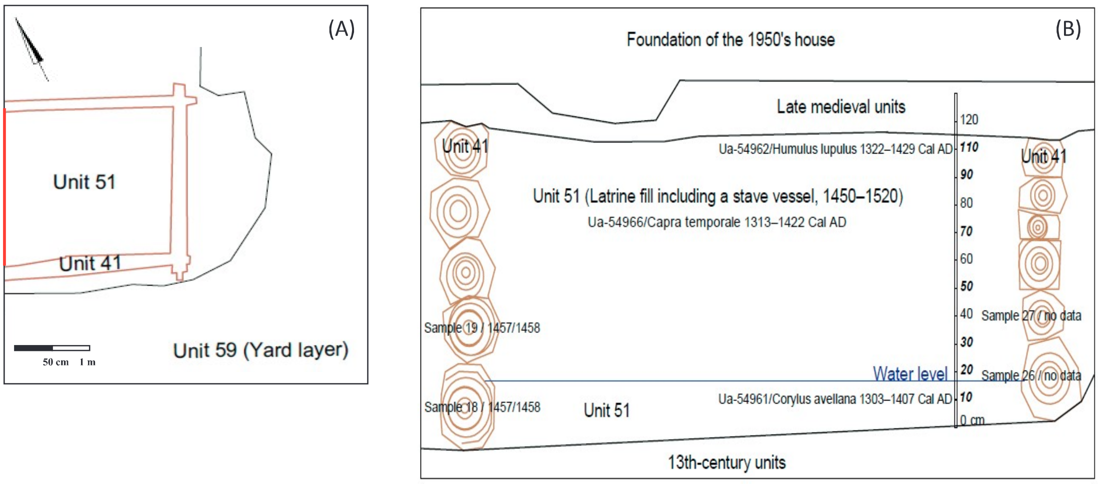

Figure 2. Location of the latrine (Unit 51) and the stratigraphically older yard (Unit 59) in the excavated area. Sampled profile in the north-west indicated with red. (A). Stratigraphy of the latrine and the associated units where the samples are derived (B). (Sketch: Tanja Ratilainen and Elina Saloranta.)

overall profile of the latrine fill was revealed, smaller soil samples (0.5 l) were collected systematically in 10 cm intervals. These profile samples are hereafter referred by their depths: 110 cm (uppermost), 90 cm, 70 cm, 50 cm, 30 cm, 20 cm, and 10 cm (under the water line) (Fig. 2). From the area surrounding the latrine [unit 59], soil samples (2–3 l) were collected from the thick layer constituted of manure and woodchips, covering an area of ca. 16 m^2. The sampled contexts are presented in Appendices 1–6.

Botanical analyses

Macrofossil analysis consisted of 10 samples: eight from the latrine fill and profile [unit 51] and one from the area surrounding the latrine [unit 59]. Additionally, the sample from the wooden stave vessel found from the latrine fill [unit 51] was also analysed. The samples were wet-sieved and washed through a series of sieves with mesh sizes of 2, 1 and 0.25 mm (Lempiäinen-Avci & Kykyri 2017). The seed collection at the Niedersächsisches Institut für historische Küstenforschung (NIhK) in Germany and relevant literature (Cappers et al. 2006) was used for reference in the identification of plant remains.

Microfossil analysis of pollen consisted of six samples: five from the latrine fill and profile [unit 51], and one from the area surrounding the latrine [unit 59]. Samples were prepared according to standard methods (Faegri & Iversen 1989). The identification of pollen was based on the publications of Reille (1992; 1995) and Beug (2004). In addition to pollen, non-pollen palynomorphs (NPP), notably relating to coprophilous fungi, where identified (van Geel 1978; van Geel et al. 1983; 2003). Calculations for pollen percentages were based upon the basic sum of P, which includes all terrestrial pollen grains. Percentages of spores and NPP´s were calculated based on the sums P + Spores and P + NPP. Diagrams were constructed using Grimm’s (1991) TILIA and TILIA GRAPH programs.

Two samples were analysed for bryophytes: one from latrine fill [unit 51] and one from the area surrounding the latrine [unit 59]. Samples were washed under running water through a 1 mm and a 0.25 mm-sized net sieves. All shoots and loose leaves were collected on paper and dried between blotting papers at a temperature of 30–40 °C. For bryophytes, herbarium barcode numbers for voucher specimens at Turku University Herbarium (TUR) and links to data of studied specimens in the herbarium database are given in Appendix 3.

Zoological analyses

The same soil samples were used to assess the species of invertebrates and plant macrofossils. For the analysis of invertebrates, six samples from the latrine profile [unit 51] and two samples from the area surrounding the latrine [unit 59] were analysed. No invertebrate remains were observed (by naked eye) in the samples while screening for plant remains, and hence the possible invertebrate remains were assumed to be tiny (e.g. oribatid mites commonly 0.1–1 mm and insect parts i.e. separate legs, wings, head 1–5 mm) (Elias 2009). To avoid losing the smallest invertebrate fossil remains, the samples were wet-sieved and further screened using meshes of diminishing size, the smallest being 0.125 mm. Approximately 0.5 dl of the coarsest material (0.25 mm sieve content) was analyzed thoroughly, while of the finest material (ca. 2 dl) collected using the smallest sieve (0.125 mm) only a small portion (0.15 dl) was analysed. Using additional material, we also tested the saturated NaCl liquid method for the flotation of invertebrate remains, as suggested by Elias (2009), but experienced only a small level of success. This was probably due to the high organic material content in the soil.

Moreover, since we expected to find mainly oribatid mites in the samples, we did not use other flotation methods (e.g. using kerosene or paraffin), as to our knowledge these had not been established methods for study of mite fossils (Solhøy & Solhøy 2000; Elias 2009; Słowiński et al. 2018; Markkula 2020). However, these might have worked for larger insects such as beetles (Khorasani et al. 2015). As a result, the invertebrate remains found mainly consisted of the hard-fore wings (elytra) of beetles (Coleoptera) which were identified as morphospecies using terms Coleoptera 1, Coleoptera 2, etc. Only in a few cases it was possible to extend the identification to assumed family-level (marked in brackets in the Appendix 4), due to the fact that beetles are one of the most diverse insect groups, with ca. 3800 beetle species currently known from Finland alone. Furthermore, to undertake a full identification, the whole body of the animal (i.e., entire body including head, antenna, legs, thorax, and abdomen) is required. In addition to these, exoskeletons (i.e., almost the entire body) of moss mites (Acari: Oribatida), were also recovered and these were identified as far as possible at family, genus, or species level, by using the Weigmann (2006).

Zooarchaeological analysis was undertaken on three samples from the latrine fill and profile [unit 51], and one from the surrounding area [unit 59], as well as faunal material retrieved during the excavation. The samples consisted of ca. 30 l of soil, which was wet-sieved with 1 mm mesh. Bone fragments were then picked out with the aid of magnifying lamp. The zooarchaeological material from the site has already been discussed in Lõugas & Bläuer (2020) and Bläuer (2020).

Radiocarbon and dendrochronological samples

Altogether four short-lived AMS radiocarbon samples (plant remains and bones) were dated from the latrine fill [unit 51] and from the surrounding area [unit 59]. In addition, four samples taken from the timbers forming the latrine structure [unit 41] were dated by dendrochronology. Samples from the different units were chosen based on the relative chronology established by stratigraphy (Harris 1979). All radiocarbon dating results are given with two sigma probability distribution ranges. The Oxcal software v4.4. (Bronk Ramsey 2021; see also Bronk Ramsey 2009) and the IntCal20 calibration curve according to Reimer at al. (2020) was applied. The reference chronology (master sequence) of the Laboratory of Dendrochronology of the Department of Forest Sciences at the University of Eastern Finland obtained from spruce and pine was applied. The samples were cross examined with all dated tree-ring sequences collected from the South of Finland (Zetterberg 2017).

RESULTS

The botanical, zoological and dendrochronological results are presented in Appendices 1–6. In the appendices, the identified taxa for plant macrofossils, pollen, and macrofauna are provided using both their scientific names and by their common names, but taxa for mosses and invertebrates are provided using only their scientific names, because those groups do not have common names.

Plant macrofossil analyses

A total of ca. 82 different taxa and 6880 macrofossil remains of vascular plants was identified from the latrine material. All of the macrofossil material was uncharred. Highest amount of plant remains was recovered from the wooden stave vessel. Identified species from the vessel included for example glumes of common millet (*Panicum miliaceum* L.), foxtail millet (*Setaria italica* (L.) P. Beauv.), fig seeds (*Ficus carica* L.), rye grains (*Secale cereale* L.), seeds of crowberries (*Empetrum nigrum* L.), strawberries (*Fragaria vesca* L.), cloudberries (*Rubus chamaemorus* L.), raspberries (*Rubus idaeus* L.) and bilberries (*Vaccinium myrtillus* L.). In addition, the remains of several species of weeds, meadow plants, and wetland plants were found to be present in the wooden stave vessel. In total, 4085 plant remains from 27 taxa were recovered from the vessel.

The analysis of the latrine's contents (fill and the profile) identified 2019 plant remains from 71 taxa. Plant material from the latrine was slightly different compared to the wooden stave vessel. The grain material composed of barley (*Hordeum vulgare* L.), rye, and oat (*Avena sativa* L.) and common millet, together with remains of hops (*Humulus lupulus* L.), apple (*Malus domestica* L.), opium poppy (*Papaver somniferum* L.), and the same species of berries as were found in the wooden stave vessel. To note, from the latrine fill bilberries were found as seeds and intact berries. Other finds included seeds of carrot (*Daucus carota* L.), grape pips (*Vitis vinifera* L.), and caraway spice seeds (*Carum carvi* L.). Over 30 species of weeds and over 10 species of wetland plants were also identified from the latrine fill.

Finds from the area surrounding the latrine included 775 identified plant remains from 24 taxa. In general, the composition of these plant taxa was similar to finds from the latrine and from the wooden stave vessel. One difference is, however, that charred cereals were found only from samples collected outside the latrine. Additionally, the most interesting find, a melegueta pepper (*Aframomum melegueta* L.) (Fig. 3), was found from the area surrounding the latrine. The identification of the melegueta pepper was confirmed through the use of reference collections of modern seeds located at NIhK and with the help of literature which includes illustrations of melegueta pepper finds from archaeological contexts (e.g. Hellwig 1995; Speleers & van der Valk 2017).

Pollen analyses

The amount of pollen identified in each sample varied, 112 being the lowest sum analysed and 225 the highest (Fig. 4). Overall, the highest species diversity was obtained in the latrine fill, where the percentage of pollen originating from cereals and herbs was high. Among cereals, the most abundant pollen was of *Secale* and *Hordeum*. In the latrine, tree pollen was represented in low percentages.

There is a clear difference between the pollen of the lower part and the upper part of the latrine. Herb pollen was highest (ca. 86% of total) in the lowermost part of the latrine, while in the uppermost part, it amounted to between 66–71% of total pollen. The herb pollen derived mainly from different grasses (Poaceae), which amounted to 43–57% of the total taxa identified from pollen, while the rest originated from different weeds typical for ruderal plant communities. Most abundant were pollen originating from Asteraceae, Ranunculaceae, Scrophulariaceae, Rosaceae, and Brassicaceae. *Centaurea cyanus* and *Convolvulus arvensis* were also found to be common in these samples.

In the lower part of the latrine, cereals represented only ca. 5–6% of total, and were found in combination with spores of the fungus *Sordaria*, indicative of the presence of animal dung. In the upper part, cereal pollens were more abundant, constituting 18–28% of the species identified. In addition, the percentage of *Centaurea cyanus*

*Figure 3. The seed of melegueta pepper (*Aframomum melegueta *L). (Photo: Mia Lempiäinen-Avci.)*

(5.4% of total) was also at its highest at the upper part of the latrine of total percentages.

The yard layer has the highest percentage of pollen originating from tree species. Moreover, the yard layer had a high percentage of fungal spores, mainly *Sordaria*, representing 21% of all pollens identified there. Besides *Sordaria*, fungal spores of *Sporormiella* were also identified.

Bryophyte analyses

Bryophyte samples contained tightly packed plant material that was composed of almost pure cushions of bryophytes. Bryophytes were mostly well preserved, including whole shoots (stems) with leaves, but leaf lamina were often detached from stems and some leaf characters were eroded. Two samples from the latrine comprised of seven species common to southern Finland, which are typical for thin-peated, oligo-meso-trophic mires or slightly paludified heath forest, as well as herb-rich heath forest. The most abundant species in the samples were *Polytrichum commune* Hedw. and *Hylocomium splendens* (Hedw.) Schimp. Other species present were *Aulacomnium palustre* (Hedw.) Schwägr., *Dicranum polysetum* Sw., *Pleurozium schreberi* (Brid.) Mitt., and *Rhytidiadelphus triquetrus* (Hedw.) Warnst. Furthermore, some shoots of *R. squarrosus* (Hedw.) Warnst., a species typically found in rural habitats, such as gardens, moist roadsides, meadows, were also identified.

The species composition of the yard layer sample was slightly more diverse than that of the latrine. It included mostly the same forest and mire bryophytes as in the latrine but also a few shoots of *Thuidium assimile* (Mitt.) A. Jaeger, a species favoring open meso-eutrophic moist or mesic herb-rich forests or forest pastures, and *Schistidium* sp., an epilithic species. *Hylocomium splendens* and *P. schreberi* dominated in the sample.

Invertebrate analyses

Finds at the micro-scale consisted of remains of small arthropods. When identification was possible at group/family/species-level, the three most abundant invertebrate groups were identified: soil mites (Acari: Oribatida, Mesostigmata/ whole body), beetles (Coleoptera/ elytra only) and two-winged insects (Diptera/ fly pupae and larval skins). Barely any other invertebrate groups were observed except few fractions of roundworms (Nematoda) and a wing of parasitic wasp (Ichneumonidae).

Altogether 29 specimens (exoskeletons) of soil mites (26 Oribatida and 3 Mesostigmata) were found: 18 inside the latrine and 11 in the yard layer. The specimens represented 13 species: four species were found in both environments, with eight species in total found inside the latrine and nine in the yard layer. The soil mites were ca. 0.15–1 mm in size. Altogether 26 forewings of beetles (elytra) were found; 15 in the latrine and 11 in the surrounding yard area. Beetle elytra represented 18 species: 10 species from the latrine and 11 species from the yard, with three species found in both. This included members of the Staphylinidae, Lathridiidae, Anobiidae, and Silphidae families (Appendix 4). The elytra were ca. 1–3 mm in size.

Fragments of larval skin and pupae of the Diptera group were also present in both the latrine and the yard layer, but since those were mostly fragmentary, these were not counted. However, in material terms, the Diptera remains were equally abundant in all samples studied.

While six samples altogether were analysed from the latrine and only two from the yard (6:2). When the number of finds was taken into count, the total abundance of invertebrate fauna was twice as high in the yard as in the latrine.

Zooarchaeological analyses

A total of 3511 bones or bone fragments were found in the latrine and the yard. They included mammal, bird, and fish bones. In the latrine cattle (*Bos taurus*) bones predominated, while in the yard sheep (*Ovis aries*) or goat (*Capra hircus*) bones were the most abundant. The highest proportion of fish bones was found in the latrine, while bird and mountain hare (*Lepus timidus*) bones were especially numerous in the yard area. The other domestic animals identified were pig (*Sus scrofa*), cat (*Felis catus*), and chicken (*Gallus domesticus*). The taxa of wild mammals identified were mountain hare, red squirrel (*Sciurus vulgaris*), seal (Phocidae), and rat (*Rattus* sp.). Samples also included bird bones, originating from black grouse (*Lyrurus tetrix*), common raven (*Corvus corax*), unidentified merganser (*Mergus* sp.), mallard/duck (*Anas platyrhynchos*/Anatidae), goose (*Anser* sp.), swan (*Cygnus* sp.), and unidentified duck species (Anatidae). Among the fish bones, European perch (*Perca fluviatilis*), herring (Clupeidae), pike (*Esox lucius*), burbot (*Lota lota*), European whitefish (*Coregonus lavaretus*), cod (*Gadus morhua*), cyprinids (Cyprinidae), and salmon (Salmonidae) were identified.

In general, animal bones from the yard are very well preserved. Most exhibit a dark, shiny surface. Only one bone with an abraded surface was recorded. Seven pairs of loose epiphyses with adjacent metaphyses were found. Bones identified as belonging to large ungulates (cattle and large ungulates) and small ungulates (sheep, goat, pig, and small ungulates) were divided into three anatomical regions: trunk (vertebral region excluding tail, ribs, and sternum), upper limbs (from scapula/pelvis to radius/tibia) and head, tail, and feet (skull, mandible, teeth, hyoideum, lower limbs, tail). Elements from the trunk dominate in the yard.

A total of 26 abraded bones, 18 bones with signs of rodent gnawing and 43 tooth marks likely to have been caused by dogs (*Canis familiaris*) or pigs were recorded in the latrine. There are no loose epiphyses with adjoining metaphyses. This bone material exhibits an even distribution of different anatomical regions. During the excavation, several clusters of bones was noted and recovered as separate entities. These include the partial skeleton of a kitten, an almost complete sheep skull (including the mandible), the partial skeleton of a juvenile chicken and the skull, mandible, and wing bone (carpometacarpus) of common raven. It is plausible that at least the raven skull and mandible belonged to the same individual. Within the latrine, each of the bone samples exhibit different characteristics. Bones from the hand-picked sample from the fill consist predominantly of bones of mammals and birds. Fish bones recovered from this sample consist of large bones of pike and cod. The sieved bone sample from the lower part of the latrine exhibits a high number of small fish bones and low number of bones of large mammals.

AMS and dendrochronological dating results

According to their dendrochronology, the two lowest, unworked and likely original timbers from the latrine structure were felled in the winter AD 1457/1458 (Zetterberg 2017, dating data is summarized in Appendix 6). A fragment of a hazelnut shell (*Corylus avellana* L.) collected from the lower part of the latrine profile (10 cm) gave an AMS date of Cal AD 1303–1407 (Ua-54961). A hop seed (*Humulus lupulus* L.) from the upper part of the latrine profile (110 cm) was dated to Cal AD 1322–1429 (Ua-54962). A goat bone (*Capra hircus* cranium) from the latrine fill gave a result of Cal AD 1313–1422 (Ua-54966). A goat bone (*Capra hircus* metacarpale) found in the yard gave a date of Cal AD 1320–1429 (Ua-54967).

DISCUSSION

The analyses confirm that the wooden timber structure inside the house was a latrine containing not only the remains of botanical and faunal foods, for example, but also of domestic waste. During the archaeological excavations, the area surrounding the latrine was interpreted as a cattle yard as it contained manure and it was a relatively large and unbuilt. However, animal bones recovered from it do not exhibit any sign of trampling. Moreover, faunal material and macrofossil evidence seem to derive from domestic waste. Thus, the layer could be described as a backyard deposit that includes both waste from animal shelters and from households. In general, the botanical and zoological material studied reveal that inhabitants in medieval Turku mainly utilized local resources nearby town but exotic food items were also imported.

Latrine

The shaft for timber frame (Unit 41) was cut through several stratigraphically older layers, including yard layer (Unit 59). When the latrine (Unit 51) fell out of use, it was filled with secondary older material dating to ca. 14th century. The organic material in the bottom layer resembles results from other latrines from Northern Europe (e.g., Økland 1988; Hall & Kenward 2015; Lempiäinen-Avci & Kykyri 2017; Hald et al. 2018; Sabin et al. 2020). Based on the differences in archaeological and ecological material, at least two deposition events are apparent in the latrine. The lower part (10–60 cm) of the latrine is characterized by large amount of *Sordaria*

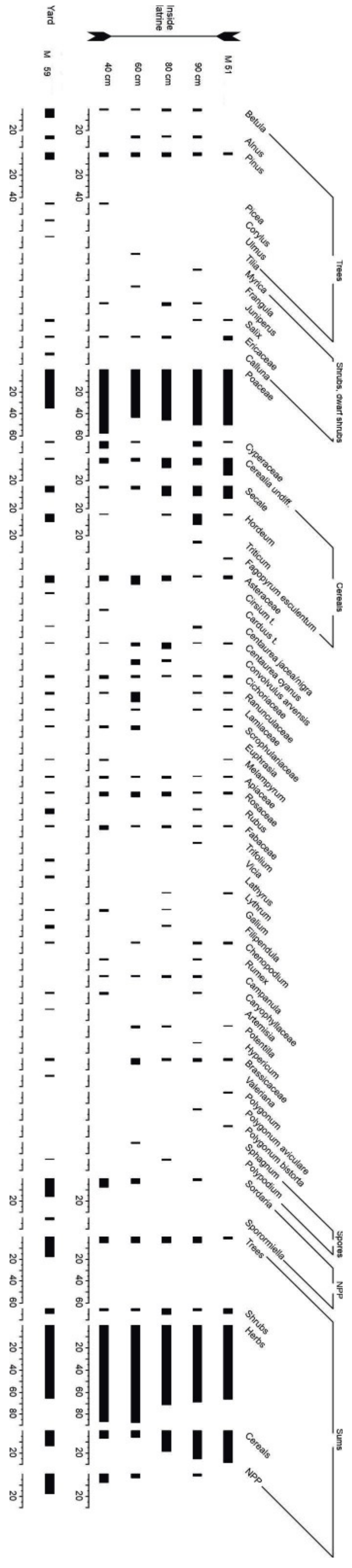

Figure 4. Pollen diagram showing the relative percentages of pollen, spore and NPP taxa from inside the latrine and from the yard.

spores. According to van Geel et al. (2003) the records of spores of coprophilous fungi (such as *Sordaria*) can be used as an indication for the presence of the animals and can be a source of information, especially in case where animal bones are not preserved. Seeds and pips of fruits and berries are a sign of consumed food. To add, the bone material studied from this layer retained a strong smell of ammonium, and it can be hypothezised that the lower part of latrine (10–60 cm) contained (in addition to soil from the surrounding area) human faeces and perhaps of animal dung. The majority of the fish bones are small enough to pass through the human digestive track and few bones of large mammals are present.

The upper part (70–110 cm) of the latrine contains several bones of large animals, large pieces of wood and the layer did not emit any particular smell. However, most of the bones are likely to be secondary depositions, as indicated by the abraded surfaces of some bones and the lack of epiphyseal-metaphyseal pairs. The presence of gnawing marks on the bones indicates that they were first deposited within the reach of animals. Their species and anatomical distribution fit those found in common household waste from medieval Turku (Tourunen 2008: 132–3). The majority of the bones could represent the filling of the latrine with soil from a yard, with the invertebrate and pollen data providing similar results, with the same species being found in both environments. Fungal spores are absent, indicating that animal dung was not the dominant element. Instead, pollen from cereals and herbs are predominant in the upper part.

A bryophyte sample in the latrine fill is composed of a virtually pure patch of loose *Polytrichum commune* shoots. This species, with long (up to 1 m) and tough stems, is known to be used as bedding or for stuffing mattresses, as well as for making brushes, plaited mats, and baskets (Linné 1737; Thieret 1956). However, no dramatic difference is observed when comparing the macrofossil seeds and insect finds from lower or upper part of the latrine fill. Due the relatively small size of the latrine, and probably due to the smell, the latrine may have been emptied at certain periods, which would partly explain multiple filling events. Interestingly, pieces from the same ceramic vessel were found in the latrine and outside it, inside the foundation trench dug for the latrine structure, suggest that the latrine was at least partly filled with waste immediately after its construction in or after 1457/58.

Within the latrine's secondary fill, there are several finds indicative of separate deposition events. The wooden stave vessel, containing a large amount of millets and berries, was discarded in the latrine along with the kitten, juvenile chicken, and skulls and mandibles of sheep and raven. The kitten, chicken, and raven remains might represent the disposal of deceased animals, while the sheep skull and vessel with berries could represent the disposal of decayed domestic waste. However, the possibility that these primary depositions among bulk fill could be ritually placed cannot be excluded. While the ritual deposits during the historical period are well documented in both archaeological and ethnographical sources, the interpretation of the archaeological finds is often challenging especially with find without exact in situ-context (Haasteren & Groot 2013; Hukantaival 2016: 82–3).

The interpretation and chronology of the archaeology beneath the Cathedral School is not a straightforward task. The timber frame of the latrine was built after the mid-15th century, according to its dendrochronology. This dating accords with the stratigraphic information and the artefacts found in the fill. These artefacts include stained window glass and fragments of beakers as well as pottery sherds, leather shoes, and fragments of wooden objects. However, the plant and animal remains from the latrine fills (from bottom to the top) date to the earlier medieval period (Appendix 6). Thus, it seems that the latrine was filled with old midden deposit.

Cattle yard or midden for kitchen waste?

The yard layer seems to be combination of animal husbandry, household activities, and a cesspit. The invertebrate data and the presence of coprophilous fungi indicates the presence of animals at the site, which is in accordance with the observations of dung made during the excavation. The presence of animal dung indicates keeping domestic animals on the site, likely to produce milk and meat. On the contrary to wind and insect transported pollen, the dispersal and transport of the fungal spores is less efficient indicating local source. In the invertebrate data, the beetle and soil mite remains were two-fold in the yard context than in the latrine indicating that the environment was rather "dirty". Moreover, both contexts revealed remains of Diptera (pupae and larvae skins) which development requires moist environment or even standing water pits, which can originate from rainfall, but also from open water bowls for animals. According to the stratigraphy, finds and the radiocarbon result from goat bone it was in use in the second half of the 14th century (Saloranta 2018).

However, part of the bone and plant material is likely to represent predominantly waste from kitchen and human consumption. Abundance of bones from the trunk of large animals, as well as bird and hare bones from all anatomical regions also indicate disposal of kitchen waste (Bläuer 2020). The bone remains are likely to be in their primary deposition and they were not trampled by animals as loose epiphyses–metaphyses pairs are present and preservation of the bones is good. Among the plant material, rare and exotic find of melegueta pepper was now recorded for the first time in Finland. The melegueta pepper from the Katedralskolan derives from layers that date to AD 1350–1450. Melegueta pepper is a plant native to West Africa and it was used as a substitute for the more expensive black pepper (*Piper nigrum* L.), of which there is several finds in Europe (e.g., Hellwig 1995; Wiethold 2007; Livarda 2011). Melegueta was traded to Europe with Venetian traders in the early 13th century (Hellwig 1995). However, it lost its value by the end of the 15th century (Livarda 2011). In Scandinavia, there is no publications concerning archaeobotanical finds of melegueta. However, in Poland melegueta pepper has been found from 16th century contexts (Badura et al. 2014). Both black pepper and melegueta pepper are rare finds in Finland. Reason for this may be, that they were not traded in large quantities or they were consumed so, that there is not identifiable remains left in the samples.

Ecological indicators and human interaction

The studied remains are a mixture of flora and fauna naturally present on the site, and those brought to the site deliberately. They can be used as an indicator of the past environment and human activities in the medieval town of Turku. Millet, grape, fig, and melegueta pepper, which cannot be cultivated in Finland, have been imported to Turku from further away, while cereals may be local or imported. Bones from black grouse, mountain hare, and red squirrel, mosses as well as abundant remains of berries indicate utilization of local resources outside Turku town boundaries.

Mosses found herein may have been used for various purposes: caulking log houses, wiping, stuffing, wrapping fragile material, storing vegetables, sanitary purposes, or bedding for animals (Thieret 1956; Koponen 1979; Økland 1988; Flatberg 2013). Species composition and amount of mosses in samples was such that mosses could not derive from bryophyte communities naturally growing in the yard but they were collected from forests and mires surrounding the town or further away and brought to town. Because their abundance in boreal forests the *H. splendens* and *P. schreberi* have been important in caulking log houses in Finland and, more recently, as isolating layer between birch bark and clay in attics (Koponen 1979). In medieval towns mosses used e.g. for wrapping or storing may have also been recycled for other purposes such as bedding for animals or for sanitary purposes.

The invertebrate remains, although rather few in number, provide some insights into the past conditions of the latrine and outside environment. The development of Diptera, mainly flies, requires wet condition and the presence of Diptera larval skins and pupae suggests the presence of both moisture and a suitable organic food source both in the latrine and in the yard. Moreover, the Lathridiidae beetle family is generally known as "mold beetles" (feed on mold), and their presence indicate mold, the growth of which is accelerated in moist conditions. Additionally, the Anobiidae beetles are called as "wood beetles" (larvae feed on wood such as timber) and are therefore pests, and the Silphidae beetles are called as "carrion beetles" (feed on carrions). Moreover, the presence of predators (Mesostigmatid mites, Staphylinidae beetles) and parasitoids (Ichneumonidae) indicate variety of prey species (the soft-bodied groups that were not preserved) i.e. well-functioning food webs, and hence indicates rather poor hygiene conditions with swarming invertebrate fauna.

The data shows, that only 2–4 % pollen originated from cereals, mainly barley. In addition, Brassicaceae may also include pollen of cultivated varieties. The pollen from Cerealia are likely to result from food, fodder, domestic waste, or from threshing of cereals close by. Pollen from grasses (Poaceae) may well originate from animal fodder or bedding for cattle. However, it cannot be completely ruled out that pollen from Cerealia and Poaceae originate also from the cultivated fields and meadows close by.

Many herb pollen are both wind and insect transported pollen types. Therefore, the origin of herbs such as Asteraceae, Ranunculaceae, Scrophulariaceae, Rosaceae, Brassicaceae, Cichoriaceae, Apiaceae, Poaceae, *Rubus*, and *Filipendula* is difficult to pinpoint, because pollen from these taxa can also be transported into the area (Sugita 1994). Because of this, they are not necessarily associated with activities in the town area. However, they are all typically growing in fallow land and pastures, footpaths, and ruderal communities (Behre 1981), and especially *Convolvulus arvensis* can be associated with yards, gardens, wasteland, and roadsides (Hämet-Ahti et al. 1998). It is reasonable to assume that pollen of trees cannot be directly associated with activities in the town area, but they reflect trees in the town area or (and) forests nearby.

Besides human activities and local consumption animal, plant, and moss remains from the latrine and from the yard area at the Cathedral School reflect natural flora at surroundings of town. For example, when mosses are used large quantities for caulking, stuffing, wrapping, and bedding for animals, local supply usually dominates; species diversity in our findings rather reflects local flora, not utility of specific species for a certain purpose. Unlike Zechmeister et al. (2019) findings from early 17th century latrine in Austria, bryophytes from the Cathedral School includes species are still nowadays common in hemiboreal region in South West Finland. There is thus no evidence on climatic or other environmental change that would have affected availability of these bryophyte species at Turku area. Regarding invertebrate fauna, some species may have ended up in the latrine by accident when mosses, kitchen waste or trashes were thrown to the latrine. Some species may have sought the conditions of the latrine as a source of organic material (e.g., food for Diptera larva), but it is also evident that animal dung in the yard area also supported swarming invertebrate fauna.

Turku Cathedral School: typical latrine in local context

The latrine from the Cathedral School shares several common features with other latrines excavated in Northern and Western Europe, such as mixture of faecal material with domestic rubbish, the abundance of fish bones, and excellent preservation of organic material (e.g., Lempiäinen-Avci & Kykyri 2017; Hald et al. 2018; 2020; Søe et al. 2018; De Cupere et al. 2021). In the Cathedral School example, we were able to separate two phases of use: firstly, the depositing of faecal material in the bottom layers and later the filling of the latrine with domestic rubbish. While fish bones are often found in great quantities in latrines, they are often interpreted as discarded food waste, rather than as evidence for consumed and digested fish (Hald et al. 2018; 2020). In the Cathedral School example, small fish bones such as vertebrae from herring were especially abundant in the earliest fill layer, and are likely to include consumed fish bones. Due to their good preservation, the latrines provide a likely source of evidence for new cultivates or exotic plants, such as melegueta pepper, as noted in this paper, and cucumber (*Cucumis sativus* L.), rhubarb (*Rheum* sp.) in Denmark (Hald et al. 2020). For the same reason, latrine samples also provide evidence of local variations in human diet and in the use of plants (Lempiäinen-Avci & Kykyri 2017; Hald et al. 2020). For example, it seems that while moss is often found in latrines in Northern and Western Europe, in the Cathedral School sample there is evidence for an especially extensive and variable use of this.

CONCLUSIONS

The data from the Cathedral School show that combining different types of ecofacts with archaeological results is efficient tool for interpretation of deposition history of the studied layers. None of the materials alone could have been used to gain the same results. The ecofacts studied have also given new information on the formation of the units. The area surrounding the latrine, dating to AD 1350–1450, was originally interpreted as a cattle yard. However, the ecofact data challenges this interpretation. Namely, the bone and plant material consisted of remains from cooking and eating but also from feeding and keeping animals. Therefore, this could imply that the area is not a yard for domestic herd, but rather it was a yard used as a common midden, a cesspit and where some animals also could be kept from time to time. Then, a timber framed latrine was built on the site, and it was in use ca. AD 1450 onwards. Through ecofact data it was confirmed, that the timber structure has been used as a latrine as in the bottom plant and animal remains were found, originating from human excrement. However, the upper part of the latrine fill consisted mostly of domestic waste and material from the yard, dating to the earlier medieval period. Soils from surrounding areas, and probably also originating from the yard, had been used to fill and cover the latrine, when it fell out of use in the 1520s.

In medieval Turku, local and imported traditions and materials met. Inhabitants relied on various sources for subsistence and everyday materials. Abundance of animal dung in the material indicates that animals were kept in the town. The variety of mosses recovered from the site indicate versatile use e.g. in personal hygiene as well as in traditional caulking of the timber structures. Plants and animals from forest, meadows, and sea were utilized locally. Yet also imported foodstuff, fruits, and spices, were consumed. This aspect of the material ties Turku to the urban culture of medieval Sweden, and the trade networks of Baltic Sea region and North-Western Europe.

AUTHOR CONTRIBUTIONS

M. L-A. performed the macrofossil analysis and collected the profile samples from the excavation; R. E. conducted the invertebrate analysis and collected the profile samples from the excavation; T. A. analysed the pollen; A. B. performed the osteological analysis; S. H. analysed the bryophytes; E. S. and T. R. excavated the site and collected the samples on site. All the Authors discussed the results, wrote and edited the manuscript.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ACKNOWLEDGEMENTS

We thank Felix Bittmann (Niedersächsisches Institut für historische Küstenforschung, Germany) for the help in identifying macrofossil plant remains and Veikko Rinne (Zoological museum, University of Turku, Finland) for the assistance in identifying the general groups for beetle and Diptera remains. The final version of the manuscript has benefited from the linguistic revision by Georges Kazan (Department of Archaeology, University of Turku). We wish to thank anonymous referees for insightful corrections and remarks, which helped us to improve our manuscript.

REFERENCES

Unpublished sources

Saloranta, E. 2018. *Turku II, Katedraalikoulu, Kaupunkiarkeologinen kaivaus 2014–2015*. Excavation report, Turun museokeskus, Turku.

Zetterberg, P. 2017. *Turun Katedralskolanin v. 2014 arkeologisten kaivausten puunäytteiden F1T2301-02, F4T2303, F1T2304-08 ja F4T2309-12 dendrokronologinen iänmääritys*. Dendrochronological report 417. Dendrokronologian laboratorio, Metsätieteiden osasto, Luonnontieteiden ja

metsätieteiden tiedekunta, Itä-Suomen yliopisto, Joensuu.
Possnert, G. 2017. Result of l4C dating of macrofossiles, unburned bones and cow hair from Katedralskolan, Äbo, Finland. (p870). Dating report as appendix 19 in the excavation report by Saloranta, Elina 2018. *Turku II, Katedraalikoulu, Kaupunkiarkeologinen kaivaus 2014-2015*, Turun museokeskus, Turku.

Literature

Alenius, T., Haggrén, G., Koivisto, S., Sugita, S., & Vanhanen, S. 2017. Landscape dynamics in southern Finland during the Iron Age and the Middle Ages using pollen based Landscape Reconstruction (LRA) and macrofossil data. *Journal of Archaeological Science: Reports* 12: 12–27.

Badura, M., Możejko, B., Święta-Musznicka, J. & Latałowa, M. 2014. The comparison of archaeobotanical data and the oldest documentary records (14th–15th century) of useful plants in medieval Gdańsk, northern Poland. *Vegetation History & Archaeobotany* 24: 441–84.

Behre, K-E. 1981. The interpretation of anthropogenic indicators in pollen diagrams. *Pollen 503 et Spores* 23(2): 225–45.

Beug, H-J. 2004. *Leitfaden der Pollenbestimmung fur Mitteleuropa und angrenzende Gebiete*. Munchen: Pfeil.

Bläuer, A. & Lempiäinen, M. 2011. Luiden ja kasvijäänteiden säilyminen Aboa Vetus -museon alueella. *SKAS* 4: 32–41.

Bläuer, A. 2020. From intra-site variation to inter-site comparison in medieval faunal material from Katedraalikoulu, Turku, Finland. *Journal of Archaeological Science: Reports* 34: 102583.

Breeze, D. J. 2017. *Bearsden: The Story of a Roman Fort*. Oxford: Archaeopress Archaeology.

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon 51*(1): 337–60.

Bronk Ramsey, C. 2021. <https://c14.arch.ox.ac.uk/oxcalhelp/hlp_contents.html#Licence> Read 12 October 2021.

Brown, A., Badura, M., King, G., Gos, K., Cerina, A., Kalnina, L., & Pluskowski, A. 2017. Plant macrofossil, pollen and invertebrate analysis of a mid-14th century cesspit from medieval Riga, Latvia (the eastern Baltic): Taphonomy and indicators of human diet. *Journal of Archaeological Science: Reports* 11: 674–682.

Cappers, R. T. J., Bekker, R. M. & Jans, J. E. A. 2006. *Digital Seed Atlas of the Netherlands*. Groningen: Barkhuis.

Crabtree, P. J, Reilly, E. Wouters, B., Devos, Y. Bellens, T., & Schryvers, A. 2017. Environmental evidence from early urban Antwerp: New data from archaeology, micromorphology, macrofauna and insect remains. *Quaternary International* 460: 108–23.

De Cupere, B., Speleers, L., Mitchell, P. D. Degraeve, A., Meganck, M., Bennion-Pedley, E., Jones, A. K. Ledger, M. L., & Deforce K. A. 2021. Multidisciplinary analysis of cesspits from Late Medieval and Post-Medieval Brussels, Belgium: Diet and health in the fourteenth to seventeenth centuries. *International Journal of Historical Archaeology*. https://doi.org/10.1007/s10761-021-00613-8.

Deforce, K. 2017. The interpretation of pollen assemblages from medieval and post-medieval cesspits: new results from northern Belgium. *Quaternary International* 460: 124–134.

Deforce, K., Brinkkemper, O., van Haaster, H., & van Waijjen, M. 2018. Small things can make a big difference: A comparison of pollen and macrobotanical records of some food plants from medieval and post-medieval cesspits in the Netherlands and northern Belgium. *Vegetation History and Archaeobotany* 28: 433–45.

Elias, S. A. 2009. *Advances in Quaternary Entomology.* Developments in Quaternary Science 12. Oxford: Elsevier.

Fægri, K. & Iversen, J. 1989. Which plant? identification keys for the Northwest European pollen flora. In K. Faegri, P. O. E. Kaland, & K. Krzywinski (eds) *Textbook of pollen analysis:* 241–85. 4th edn. Chichester: Wiley.

Flatberg, K. I. 2013. *Norges torvmoser*. Oslo & Trondheim: Akademiska forlag.

Gaimster, D. 1999. The Baltic ceramic mart c. 1200–1600: An archaeology of the Hansa. *Fennoscandia Archaeologica* XVI: 59–69.

van Geel, B. 1978. A Palaeoecological study of Holocene peat bog sections in Germany and

the Netherlands. *Review of Palaeobotany and Palynology* 25: 1–120.
van Geel, B., Hallewas, D. P., & Pals, J. P. 1983. A Late Holocene deposit under the Westfriese Zeedijk near Enkhuizen (Prov. of N-Holland, The Netherlands): Palaeoecological and archaeological aspects. *Review of Palaeobotany and Palynology* 38: 269–335.
van Geel, B., Buurman, J., Brinkkemper, O., Schelvis, J., Aptroot, A., van Reenen, G., & Hakbijl, T. 2003. Environmental reconstruction of a Roman Period settlement site in Uitgeest (The Netherlands), with special reference to coprophilous fungi. *Journal of Archaeological Science* 30: 873–83.
Gläser, M. 2007. Lübeck as a centre of Hansa trade: Had Turku and Finland a role in the trade policy of Hansa? In A. Pihlman & M. Söderström (eds) *The European Hansa*. Turku Provincial Museum Report 21: 43–57.
Graff, A., Bennion-Pedley, E., Jones, A. K., Ledger, M. L., Deforce K., Degraeve, A., Byl, S., & Michell P. D. 2020. A comparative study of parasites in three latrines from Medieval and Renaissance Brussels, Belgium (14th–17th centuries). *Parasitology* 147(13): 1443–51.
Greig, J. 1981. The investigation of a medieval barrel-latrine from Worcester. *Journal of Archaeological Science* 8(3): 265–82.
Greig, J. 1982. The interpretation of pollen spectra from urban archaeological deposits. *Environmental Archaeology in the Urban Context* 43: 47–65.
Grimm, E. C. 1991. TILIA and TILIA-GRAPH. Springfield: Illinois State Museum.
van Haasteren, M. & Groot, M. 2013. The biography of wells: A functional and ritual
life history. *Journal of Archaeology in the Low Countries* 5–1: 25–51.
Haggrén, G. 2015. Kaupankäynti ja kontaktit; Esineellinen kulttuuri. In G. Haggrén, P. Halinen, M. Lavento, S. Raninen, & A. Wessman (eds.) *Muinaisuutemme jäljet. Suomen esi- ja varhaishistoria kivikaudelta keskiajalle*: 489–535. Helsinki: Gaudeamus.
Hald, M. M., Mosekilde, J., Magnussen, B., Jensen Søe. M., Haarby Hansen C., & Fischer Mortensen, M. 2018. Tales from the barrels: Results from a multi-proxy analysis of a latrine from Renaissance Copenhagen, Denmark. *Journal of Archaeological Science* 20: 602–10.
Hald, M. M., Magnussen, B., Appel, L., Tue Christensen, J., Haarby Hansen, C., Sten Henriksen, P. et al. 2020. Fragments of meals in eastern Denmark from the Viking Age to the Renaissance: New evidence from organic remains in latrines. *Journal of Archaeological Science: Reports* 31. https://doi.org/10.1016/j.jasrep.2020.102361.
Hall, A. R. & Kenward, H. K. 2015. Sewers, cesspits and middens: A survey of the evidence for 2000 years of waste disposal in York, UK. In P. D. Mitchell (ed.) *Sanitation, Latrines and Intestinal Parasites in Past Populations*: 99–119. Surrey: Ashgate Publishing Limited.
Harris, E. C. 1979. *Principles of Archaeological Stratigraphy*. London - New York: Academic Press.
Hämet-Ahti, L., Suominen, J., Ulvinen, T., & Uotila, P. 1998. *Retkeilykasvio* [Flora of Finland]. Helsinki: Yliopistopaino.
Heimdahl, J., Menander, H., & Karlsson, P. 2005. A new method for urban geoarchaeological excavation, example from Norrköping, Sweden. *Norwegian Archaeological Review* 38: 102–12.
Heimdahl, J. 2005. *Urbanised Nature in the Past. Site Formation and Environmental Development in two Swedish Towns, AD 1200–1800*. Thesis in Quaternary Geology, no. 5. Stockholm University: Department of Physical Geography and Quaternary Geology.
Hellwig, M. 1995. Paradieskomer (*Aframomum melegueta* (Roscoe) K.Schum.) - ein Gewiirz aus Westafrika im friihneuzeitlichen Gottingen. In H. Kroll & R. Pasternak (eds.) *Res Archaeobotanicae – 9th Symposium IWGP*: 39–47. Kiel: Oetker-Voges-Verlag.
Hiekkanen, M. 1997. Present and future urban archaeology in Turku (Åbo). In: M. Gläser (ed.) *Stand, Aufgaben und Perspektiven. Lübecker Kolloquium zur Stadtarchäologie im Hanseraum I:* 377–85. Lübeck.
Hjelle, K. L. 2000. Palaeobotanical investigations in Bergen, Norway: Development of an urban settlement and use of plants in the medieval town. Nordic Archaeobotany – NAG 2000. *Archaeology and Environment* 15: 85–94.

Hukantaival, S. 2016. *"For a Witch Cannot Cross Such a Threshold!" Building Concealment Traditions in Finland c. 1200–1950*. Archaeologia Medii Aevi Finlandiae XXIII. Turku: SKAS.

Khorasani, S., Panagiotakopulu, E., Engelmark, R., & Ralston, I. 2015. Late Holocene beetle assemblages and environmental change in Gammelhemmet, northern Sweden. *Boreas* 44(2): 368–82.

Kostet, J. & Pihlman, A. 1989. (eds) *Turun Mätäjärvi – Mätäjärvi i Åbo*. Turun maakuntamuseo, Raportteja 10.

Koponen, T. 1979. Sammalten hyötykäytöstä. *Luonnon Tutkija* 83: 63–8.

Kozáková, R., Pokorný, P., Havrda, J., & Jankovská, V. 2009. The potential of pollen analyses from urban deposits: Multivariate statistical analysis of a data set from the medieval city of Prague, Czech Republic. *Vegetation History & Archaeobotany* 18: 477–88.

Kuujo, E. 1981. *Turun kaupungin historia 1366–1521*. Turku: Turun kaupunki.

Linné, C. 1737. *Flora Lapponica*. Amsterdam: apud Salomonem Schouten.

Lempiäinen, T. & Vuorela, I. 1994. Vanhankaupungin maaperäarkiston paleoekologiset tutkimukset. In P. Kallio, I. Savolainen, & Savolainen, S. (eds) *Helsinki 1550–1640. Narinkka:* 157–197. Helsinki: Helsingin kaupunginmuseo.

Lempiäinen- Avci, M., Laakso, V., & Alenius, T. 2017. Archaeobotanical remains from inhumation graves in Finland, with special emphasis on a 16th century grave at Kappelinmäki, Lappeenranta. *Journal of Archaeological Science: Reports* 13: 132–41.

Lempiäinen-Avci, M. & Kykyri, M. 2017. The 18th century sea fortress of Ruotsinsalmi, Kotkansaari in Finland: Archaeobotanical data of a log latrine. *Estonian Journal of Archaeology* 21(1): 30–51.

Livarda, A. 2011. Spicing up life in northwestern Europe: Exotic food plant imports in the Roman and medieval world. *Vegetation History & Archaeobotany* 20: 143–64.

Lõugas, L. & Bläuer, A. 2020. Detecting medieval foodways in the North-eastern Baltic: Fish consumption and trade in towns and monasteries of Finland and Estonia. *Environmental Archaeology*. DOI: 10.1080/14614103.2020.1758993.

Markkula, I. 2020. *Oribatid mites (Acari: Oribatida) in sub-Arctic peatlands: A multidisciplinary investigation into climate change, permafrost dynamics and indicator values of subfossils*. Doctoral thesis, Annales Universitatis Turkuensis.

Mitchell, P. D. 2015. *Sanitation, Latrines and Intestinal Parasites in Past Populations*. Surrey: Ashgate Publishing Limited.

Niukkanen, M., Seppänen, L., & Suhonen, M. 2014. Kaupunkirakentaminen Suomessa keskiajalla. In H. Lilius & P. Kärki (eds) *Suomen kaupunkirakentamisen historia I:* 28–94. Helsinki: suomalaisen Kirjallisuuden Seura.

Pihlman, A. & Kostet, J. 1986. *Keskiajan kaupungit 3*, *Turku*. *Varhainen kaupungistumiskehitys ja nykyinen suunnittelu*. Turku: Turun maakuntamuseo.

Pihlman, A. 2007. The archaeology of early Turku and the extent of the town. In A. Pihlman & M. Söderström (eds) *The European Hansa:* 85–93. Turun maakuntamuseo, Raportteja 21.

Pihlman, A. 2010. The formation of the town Turku and its extending urban area in the 14th century. In M. Söderström (ed.) *Varhainen Turku:* 45–46. Turun museokeskus, Raportteja 22.

Ratilainen, T., Harjula, J., Immonen, V., & Saloranta, E. 2016. The medieval town of Turku: Its roots, founding and development till the 14th century. In C. Kimminus-Schneider & A. Falk (eds) *Lübecker Kolloquium zur Stadarchäeologie im Hanseraum X:* 559–578. Lübeck.

Reille, M. 1992. *Pollen et spores d'Europe et d'Afrique du nord*. Laboratoire de Botanique Historique et Palynologie: Marseille.

Reille, M. 1995. *Pollen et spores d'Europe et d'Afrique du nord, Supplement 1*. Laboratoire de Botanique Historique et Palynologie: Marseille.

Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R., Friedrich, M., Grootes, P., Guilderson, T., Hajdas, I., Heaton, T., Hogg, A., Hughen, K., Kromer, B., Manning, S., Muscheler, R., Palmer, J., Pearson, C., van der Plicht, J., Reimer, R., Richards, D., Scott, E., Southon, J., Turney, C., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., & Talamo, S. 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* 62(4): 725–57.

Sabin, S., Hui-Yuan, Y., Pluskowski, A., Clamer, C., Mitchell, P. D., & Bos, K. I. 2020. Estimating molecular preservation of the intestinal microbiome via metagenomics analyses of latrine sediments from two medieval cities. *Philosophical Transactions of the Royal Society B* 375: 20190576.

Seppänen, L. 2016. Streets, seals or seeds as early manifestations of urban life in Turku, Finland. *META Historisk arkeologisk tidskrift* 2016: 127–54.

Seppänen, L. 2019. Turun kaupungin perustaminen. In R. Mustonen & T. Ratilainen (eds) *Pitkin poikin Aurajokea - arkeologisia tutkimuksia:* 81–96. Turun museokeskus, Raportteja 23.

Słowiński, M., Skubała, P., Zawiska, I., Kruk, A., Obremska, M., Milecka, K., & Ott, F. 2018. Cascading effects between climate, vegetation, and macroinvertebrate fauna in 14,000-year palaeoecological investigations of a shallow lake in eastern Poland. *Ecological Indicators* 85: 329–41.

Smith, D. N. 2013. Defining an indicator package to allow identification of 'cesspits' in the archaeological record. *Journal of Archaeological Science* 40: 526–43.

Speleers, L. & van der Valk, J. M. A. 2017. Economic plants from medieval and post-medieval Brussels (Belgium), an overview of the archaeobotanical records. *Quaternary International* 436: 96–109.

Sugita, S. 1994. Pollen representation of vegetation in Quaternary sediments - theory and method in patchy vegetation. *Journal of Ecology* 82: 881–97.

Schelvis, J. 1990. Mites (Acari) in archaeology: Experimental and applied entomology. *Proceedings of the Netherlands Entomological* Society 1: 90–5.

Søe, M. J., Nejsum, P., Seersholm, F. V., Fredensborg, B. L., Habraken, R., Haase, K. et al. 2018. Ancient DNA from latrines in Northern Europe and the Middle East (500 BC–1700 AD) reveals past parasites and diet. *PLoS ONE* 13(4): e0195481.

Solhøy, I. W. & Solhøy, T. 2000. The fossil oribatid mite fauna (Acari: Oribatida) in late-glacial and early-Holocene sediments in Kråkenes Lake, western Norway. *Journal of Paleolimnology* 23(1): 35–47.

Thieret, J. W. 1956. Bryophytes as economic plants. *Economic Botany* 10(1): 75–91.

Tourunen, A. 2008. *Animals in an Urban Context - A Zooarchaeological study of the Medieval and Post-Medieval town of Turku*. Annales Universitatis Turkuensis Ser B, Humaniora 308.

Tranberg, A. 2005. Hyönteisfossiileja Oulun kaupungintalon tontilta. In T. Kallio & S. Lipponen (eds) *Historiaa kaupungin alla. Kaupunkiarkeologisia tutkimuksia Oulussa*: 113–119. Pohjois-Pohjanmaan museon julkaisuja 16.

Tranberg, A. 2011. Eläin- ja kasvinäytteitä. In T. Kallio-Seppä, J. Ikäheimo, & K. Paavola (eds) *Iin vanhan Haminan kirkko ja hautausmaa. Arkeologisia tutkimuksia*: 73–6. Oulu: Iin kunta – Oulun yliopisto.

Tranberg, A., Alenius, T., Kallio-Seppä, T., Buckland, P. I., Mullins, P. R., & Ylimaunu, T. 2021. The Late Medieval church and graveyard at Ii Hamina, Northern Ostrobothnia, Finland: Pollen and macro remains from graves. *Journal of Nordic Archaeological Science* 19: 49–61.

Törnblom, L. 1993. Medeltiden. In *Finlands historia* 1: 271–426. Esbo: Schildt.

Vuorela, I. & Lempiäinen, T. 1988. Archaeobotany of the site of the oldest cereal grain find in Finland. *Annales Botanici Fennici* 25: 33–45.

Vihervaara, P., Muona, J., & Vuorisalo, T. 2003. Sontiaisia, liskokuntikkaita ja konnakuoriaisia. In Seppänen, L. 2003 (ed.) *Kaupunkia pintaa syvemmältä. Arkeologisia näkökulmia Turun historiaan*: 351–358. Archaeologia Medii Aevi Finlandiae IX. Turku: SKAS.

Weigmann, G. 2006. *Hornmilben (Oribatida). Die Tierwelt Deutschlands*. Keltern: Goecke et Evers.

Wiethold, J. 1995. Plant remains from town-moats and cesspits of Medieval and post-Medieval Kiel (Schleswig-Holstein, Germany).

In H. Kroll & R. Pasternak (eds) *Res Archaeobotanicae – 9th Symposium IWGP*: 359–84. Kiel: Oetker-Voges-Verlag.

Wiethold, J. 2007. Exotische Gewürze aus archäologischen Ausgrabungen als Quellen zur mittelalterlichen und frühneuzeitlichen Ernährungsgeschichte. In M. Fansa, G. Katzer, & J. Fansa (eds.) *Chili, Teufelsdreck und Safran*: 53–71. Landesmuseum für Natur und Mensch Oldenburg/Göttingen: Verlag Die Werkstatt.

Zechmeister, H. G., Kropik, M., Popovtschak, M., & Scharrer-Liška, G. 2019. Bryophytes in a latrine as indicators of climate change in the 17th century. *Vegetation History and Archaeobotany* 28: 575–81.

Økland, R. H. 1988. Moss remains from latrine samples. In E. Schia (ed.) *De arkeologiske utgravningaer i Gamlebyen, Oslo*. *Bind 5. "Mindets tomt" –"Søndre felt". Animal bones, moss-, plant-, insect- and parasite remains*:109–14. Øvre Ervik: Alvheim & Eide Akademisk Forland.

APPENDICES

Appendix 1. Plant macrofossil analyses from the latrine profile, from the latrine fill (Unit 51), from the wooden stave vessel, and from the yard (Unit 59). All macrofossil remains presented are seeds, unless otherwise stated. Abbreviations: u=uncharred, c=charred, b=berry, l=leaf, n= needle.

Macrofossils	Common name		Latrine										Latrine		Yard
			Unit 51 (profile)										Unit 51		Unit 59
			110 cm	90 cm	80 cm	70 cm	60 cm	50 cm	40 cm	30 cm	20 cm	10 cm		Vessel	
Cereals															
Avena sativa	Oat	u						1							
		c													1
Avena cf. sativa	Oat	u													7
		c													2
Cerealia	Cereals, unidentified	u		2		2		2				1	8		
Hordeum vulgare	Barley	u						1					9		20
Secale cereale	Rye	u						1						6	
		c													4
Setaria italica	Foxtail millet	u												24	
Panicum miliaceum	Common millet	u		3									16	385	8
Cultivated fruits and useful plants															
Camelina sativa	Gold of pleasure	u													6
Carum carvi	Caraway	u											2		
Daucus carota	Wild carrot	u											2		
Humulus lupulus	Hop	u	2	2		2				4			33		8
Malus domestica	Apple	u				1							2		
Papaver somniferum	Opium poppy	u											1		
Prunus cerasus	Sour cherry	u				1									
Collected wild fruits and berries															
Corylus avellana	Hazel	u									8	3	8		
Empetrum nigrum	Crowberry	u		1		2					7		8	80	
Fragaria vesca	Wild strawberry	u	23	1		35		25		16	4	11	82	880	112
Rosa cf. canina	Rose	u				1					1		1		8

Macrofossils	Common name		Latrine										Latrine		Yard
			Unit 51 (profile)										Unit 51		Unit 59
			110 cm	**90 cm**	**80 cm**	**70 cm**	**60 cm**	**50 cm**	**40 cm**	**30 cm**	**20 cm**	**10 cm**		**Vessel**	
Rubus chamaemorus	Cloud-berry	u	1	1		28		8		1			48	800	344
Rubus idaeus	Rasp-berry	u		4		1					1		32	520	56
Sorbus aucuparia	Rowan	u				1							1		
Vaccinium myrtillus	Bilberry	b				1					1		8	160	
		u	22	9		49		17		12	50	12	40	584	
Vaccinium oxycoccos	Cranberry	u				1						1			
Imported plants															
Aframomum melegueta	Melegueta pepper	u													1
Ficus carica	Fig	u	1					2			2	5	17	8	83
Vitis vinifera	Grape	u											16		
Weeds															
Agrostemma githago	Corn-cockle	u									1		167	23	
Anthemis arvensis	Field chamomile	u													16
Anthemis cotula	Stinking chamomile	u				1									
Asperula arvensis	Blue woodruff	u						1					1		
Brassica sp.	Cabbage	u									1				
Brassica cf. nigra	Black mustard	u				2					2		5		8
Bromus secalinus	Rye brome	u						1							
Centaurea cyanus	Corn-flower	u										1	27	33	
Chenopodium album	Fat hen	u	2					1			12		104	30	
Echinochloa grus-galli	Cockspur	u													8
Fallopia convolvulus	Black bindweed	u									1		9	8	
Fumaria officinalis	Common fumitory	u											8		
Galeopsis speciosa - type	Large-flowered hemp-nettle	u						1			4		17		
Galium sp.	Cleavers	u				1					3		16	16	
Lamium sp.	Dead-nettles	u												8	

Macrofossils	Common name		Latrine										Latrine		Yard
			Unit 51 (profile)										Unit 51		Unit 59
			110 cm	**90 cm**	**80 cm**	**70 cm**	**60 cm**	**50 cm**	**40 cm**	**30 cm**	**20 cm**	**10 cm**		**Vessel**	
Lapsana communis	Nipplewort	u						1							
Leontodon autumnalis	Autumn hawkbit	u													
Medicago lupulina	Black medick (pod)	u											1		
Persicaria lapathifolia	Pale persicaria	u	2			2				3	6		8	64	
Polygonum aviculare	Common knotgrass	u	2	3		2					6		8		
Potentilla anserina	Common silverweed	u													
Prunella vulgaris	Common selfheal	u		1		1		1					24	16	
Puccinellia distans	Weeping alkaligrass	u													24
Ranunculus flammula	Lesser spearwort	u				3							16		9
Ranunculus repens	Creeping buttercup	u		3		1		2		4	1		32	200	24
Ranunculus sceleratus	Celery-leaved buttercup	u	16	4		1					1	3	56		
Solanum nigrum	Black nightshade	u											1		
Spergula arvensis	Corn spurrey	u												8	
Stellaria media	Chickweed	u		1		3		3		3	6	6	32	8	
Thlaspi arvense	Field pennycress	u												8	
Urtica urens	Small nettle	u									1				
Meadow plants															
Agrostis sp.	Bentgrass	u						1							
Bidens tripartita	Trifid bur-marigold	u									1				
Calluna vulgaris	Heather	l						5							
Dianthus deltoides	Maiden pink	u											1		
Festuca rubra agg.	Red fescues	u						1							
Geum urbanum	Wood avens	u											1		

Macrofossils	Common name		Latrine										Latrine		Yard
			Unit 51 (profile)										Unit 51		Unit 59
			110 cm	90 cm	80 cm	70 cm	60 cm	50 cm	40 cm	30 cm	20 cm	10 cm		Vessel	
Poa annua	Annual meadow grass	u													1
Poa pratensis /trivialis s.l.	Common meadow grass	u											3		1
Poaceae	True grasses	u												112	8
Rumex aceto-sella	Sheep`s sorrel	u	1												
Trifolium pratense	Red clover	u						1							
Viola palustris	Marsh violet	u						1		1					
Wetland plants															
Carex nigra -type	Common sedge	u	24	5		40		16		15			232		
Carex ovalis	Oval sedge	u	8					16		10	1		104	64	
Carex sp.	Sedges (distig-matic)	u		2		2					8				
Carex sp.	Sedges (tristig-matic)	u				2		1					24	24	
Caltha palus-tris	Marsh-marigold	u											1		
Eleocharis palustris	Common spike-rush	u											1		
Filipendula ulmaria	Meadow-sweet	u				1				1					8
Juncus sp.	Rushes	u	5					1		12			8		
Menyanthes trifoliata	Bogbean	u													8
Poa palustris	Swamp meadow-grass	u						1							
Scirpus sylvati-cus	Wood club-rush	u									2				
Trees															
Betula sp.	Birch	s						2							
Juniperus communis	Common juniper	s									4		8	8	
		n									2		8	8	
Picea abies	Norway spruce	n		3		9		1		3			16		
Indeterminata	Unidenti-fied plant taxa	s		2		4		1			1		8		
Total per unit			109	47		200		116		85	138	43	1281	4085	775

Appendix 2. Pollen analyses from the latrine profile, from the latrine fill (Unit 51), and from the yard (Unit 59). Abbreviation: f= fungal spores.

Pollen	Latrine										Latrine	Yard
	Unit 51 (profile)										Unit 51	Unit 59
	110 cm	90 cm	80 cm	70 cm	60 cm	50 cm	40 cm	30 cm	20 cm	10 cm		
Betula		4 (2,0)	3 (2,1)		1 (0,9)		2 (1,3)				1 (0,5)	14 (7,6)
Alnus		2 (1,0)	1 (0,7)		1 (0,9)							4 (2,2)
Pinus		4 (2,0)	4 (2,7)		3 (2,8)		5 (3,3)				3 (1,5)	11 (5,9)
Picea							1 (0,7)					1 (0,5)
Corylus												2 (1,1)
Ulmus												1 (0,5)
Tilia					1 (0,9)							
Myrica		1 (0,5)										
Frangula					1 (0,9)							
Juniperus		1 (0,5)	4 (2,7)				1 (0,7)					
Salix		1 (0,5)									1 (0,5)	3 (1,6)
Poaceae		98 (50,0)	67 (45,9)		46 (43)		86 (57,3)				97 (49,5)	64 (34,6)
Cyperaceae		8 (4,1)			1 (0,9)		9 (6,0)				2 (1,0)	1 (0,5)
Ranunculaceae		1 (0,5)			9 (8,4)		1 (0,7)				1 (0,5)	2 (1,1)
Cerealia undiff.		11 (5,6)	12 (8,2)		3 (2,8)		6 (4,0)				30 (15,3)	2 (1,1)
Asteraceae		1 (0,5)	6 (4,1)		8 (7,5)		6 (4,0)				5 (2,6)	11 (5,9)
Cirsium t.												1 (0,5)
Carduus t.							1 (0,7)					
Cichoriaceae		1 (0,5)	1 (0,7)		1 (0,9)		3 (2,0)				2 (1,0)	2 (1,1)
Lamiaceae		2 (1,0)			1 (0,9)						1 (0,5)	2 (1,1)
Secale		17 (8,7)	13 (8,9)		3 (2,8)		3 (2,0)				21 (10,7)	9 (4,9)
Hordeum		19 (9,7)	2 (1,4)				1 (0,7)				3 (1,5)	13 (7,0)
Triticum		2 (1,0)										
Fagopyrum esculentum											1 (0,5)	
Apiaceae		1 (0,5)	3 (2,1)		1 (0,9)		3 (2,0)				2 (1,0)	3 (1,6)
Rosaceae		1 (0,5)	4 (2,7)		4 (3,7)		4 (2,7)				3 (1,5)	1 (0,5)
Rubus		1 (0,5)										8 (4,3)
Fabaceae		1 (0,5)	2 (1,4)		1 (0,9)		5 (3,3)				1 (0,5)	1 (0,5)
Trifolium		1 (0,5)										
Vicia												3 (1,6)
Lathyrus												4 (2,2)
Lythrum			1 (0,7)								2 (1,0)	
Galium			1 (0,7)				3 (2,0)					2 (1,1)
Centaurea cyanus		1 (0,5)	8 (5,5)		3 (2,8)		1 (0,7)				2 (1,0)	1 (0,5)

Pollen	Latrine										Latrine	Yard
	Unit 51 (profile)										Unit 51	Unit 59
	110 cm	90 cm	80 cm	70 cm	60 cm	50 cm	40 cm	30 cm	20 cm	10 cm		
Filipendula			1 (0,7)									4 (2,2)
Chenopodium		2 (1,0)			1 0,9)						3 (1,5)	1 (0,5)
Ericaceae			3 (2,1)		1 (0,9)		1 (0,7)				7 (3,6)	1 (0,5)
Calluna												4 (2,2)
Melampyrum							1 (0,7)				1 (0,5)	1 (0,5)
Scrophulariaceae					4 (3,7)		2 (1,3)				2 (1,0)	1 (0,5)
Campanula		4 (2,0)	3 (2,1)		1 (0,9)		1 (0,7)					
Caryophyllaceae		1 (0,5)					3 (2,0)					2 (1,1)
Artemisia												1 (0,5)
Potentilla			2 (1,4)		2 (1,9)						1 (0,5)	
Hypericum		1 (0,5)										
Centaurea jacea/ nigra		3 (1,5)										1 (0,5)
Brassicaceae		4 (2,0)	2 (1,4)		5 (4,7)						2 (1,0)	2 (1,1)
Polypodium			1 (0,7)									1 (0,5)
Valeriana												1 (0,5)
Polygonum											1 (0,5)	
Polygonum aviculare		1 (0,5)										
Polygonum bistorta											1 (0,5)	
Sphagnum					1 (0,9)							
Rumex		1 (0,5)					1 (0,7)					
Convolvulus arvensis			3 (2,1)		5 (4,7)							
Sordaria	f	3 (1,5)			4 (3,6)		12 (7,4)					35 (15,6)
Sporormiella	f											4 (1,8)
Pollen, sum		196	147		107		150				196	186
Arboreal trees, sum		10 (5,1)	8 (5,4)		5 (4,7)		8 (5,3)				4 (2,0)	30 (16,1)
Thermophilous deciduous trees, sum					1 (0,9)							3 (1,6)

Pollen	Latrine Unit 51 (profile) 110 cm	90 cm	80 cm	70 cm	60 cm	50 cm	40 cm	30 cm	20 cm	10 cm	Latrine Unit 51	Yard Unit 59
Non arboreal pollen, sum		186 (94,9)	139 (94,6)		101 (94,4)		142 (94,7)				192 (98)	153 (82,3)
Spores, sum					1 (0,9)							
Fungal spores, sum		3 (1,5)			4 (3,6)		12 (7,4)					39 (17,3)

Appendix 3. Bryophyte analyses from the latrine fill (Unit 51) and from the yard (Unit 59) together with the links to data of studied specimens at the Herbarium, University of Turku. Abbreviation: sh= shoots.

Bryophyta		Latrine Unit 51	Yard Unit 59	Herbarium vouchers
Aulacomnium palustre	sh	4	>30	http://mus.utu.fi/TBR.120749 http://mus.utu.fi/TBR.120004 http://mus.utu.fi/TBR.120741 http://mus.utu.fi/TBR.120761
Dicranum cf. *majus*	sh		1	http://mus.utu.fi/TBR.120763
Dicranum polysetum	sh	11		http://mus.utu.fi/TBR.120753 http://mus.utu.fi/TBR.121834 http://mus.utu.fi/TBR.121845
Hylocomium splendens	sh	>30	>30	http://mus.utu.fi/TBR.120738 http://mus.utu.fi/TBR.120766 http://mus.utu.fi/TBR.120755 http://mus.utu.fi/TBR.120764 http://mus.utu.fi/TBR.120745 http://mus.utu.fi/TBR.120746
Pleurozium schereberi	sh	>30	>30	http://mus.utu.fi/TBR.120737 http://mus.utu.fi/TBR.120767 http://mus.utu.fi/TBR.120750 http://mus.utu.fi/TBR.120758 http://mus.utu.fi/TBR.120742 http://mus.utu.fi/TBR.120765
Polytrichum commune	sh	>30	6	http://mus.utu.fi/TBR.120760 http://mus.utu.fi/TBR.120751 http://mus.utu.fi/TBR.120756 http://mus.utu.fi/TBR.120744 http://mus.utu.fi/TBR.120762
Polytrichum juniperinum	sh			http://mus.utu.fi/TBR.120748
Rhytidiadelphus squarrosus	sh	18		http://mus.utu.fi/TBR.120740
Rhytidiadelphus triquetrus	sh	17		http://mus.utu.fi/TBR.120739 http://mus.utu.fi/TBR.120768
Schistidium sp.	sh		3	http://mus.utu.fi/TBR.120757
Sphagnum	sh		few leaves	http://mus.utu.fi/TBR.120759 http://mus.utu.fi/TBR.120747
Thuidium assimile	sh		4	http://mus.utu.fi/TBR.121486
Total per unit		>140	> 104	

Appendix 4. Invertebrate analyses from the latrine profile and from the yard (Unit 59).

Invertebrates	Common name	Latrine										Latrine	Yard
		Unit 51 (profile)										Unit 51	Unit 59
		110 cm	**90 cm**	**80 cm**	**70 cm**	**60 cm**	**50 cm**	**40 cm**	**30 cm**	**20 cm**	**10 cm**		
Acari	Mites												
Furgoribula furcillata		1											1
Achipteria sp.		1											1
Scheloribates sp.					1				1				
Hydrozetes sp.													1
Damaeidae													2
Oppia sp1		1			2				2	3			2
Ramusella sp.					1								
Oppia sp2									1				
Panthelozetes sp.							2		1				1
Banksinoma sp.													1
Mesostigmata 1							1						
Mesostigmata 2													1
Mesostigmata 3													1
Total Acari per unit		3			4		3		5	3			11
Coleoptera	Beetles												
Coleoptera sp1 (Staphylinidae)					1					1			1
Coleoptera sp2 (cf. Anobiidae)		1			1					1			2
Coleoptera sp3		1											
Coleoptera sp4 (Staphylinidae)		1											
Coleoptera sp5													1
Coleoptera sp6 (cf. Anobiidae)									2				1
Coleoptera sp7 (Staphylinidae)													1
Coleoptera sp8 (cf. Anobiidae)													1
Coleoptera sp9													1
Coleoptera sp10					1								
Coleoptera sp11					1								
Coleoptera sp12 (cf. Silphidae)									1				
Coleoptera sp13 (cf. Lathrididae)			1										
Coleoptera sp14									1				
Coleoptera sp15									1				
Coleoptera sp16													1
Coleoptera sp17 (cf. Silphidae)													1
Coleoptera sp18													1
Total Coleoptera per unit		3	1		4				5	2			11

Appendix 5. Zooarchaeological analyses from the latrine profile, from the latrine fill (Unit 51), and from the yard (Unit 59).

Bones	Common name	**Latrine**										**Latrine**	**Yard**
		Unit 51 (profile)										Unit 51	Unit 59
		110 cm	**90 cm**	**80 cm**	**70 cm**	**60 cm**	**50 cm**	**40 cm**	**30 cm**	**20 cm**	**10 cm**		
Domestic mammals													
Bos taurus	Cattle			2								119	108
Ovis aries	Sheep											34	29
Capra hircus	Goat											13	7
Ovis aries/ Capra hircus	Sheep/ goat			3								65	160
Sus scrofa	Pig			2								39	56
Felis catus	Cat			8								12	1
Wild mammals													
Lepus timidus	Mountain hare			3						1		10	86
Sqiurus vulgaris	Red squirrel									1			
Phocidae	Seal												1
Rattus sp.	Rat			6								1	
Birds													
Gallus domesticus	Chicken									39		9	33
Lyrurus tetrix	Black grouse											1	
Galliformes	Galliformes											5	23
Mergus sp.	Unidentif. merganser											1	
Anas platyrhynchos	Mallard												1
Anatidae	Duck											2	
Anser sp.	Goose												4
Cygnus sp.	Swan												3
Corvus corax	Common raven											3	1
Aves	Unidentified bird			7						2		11	72
Fish													
Perca fluviatilis	European perch			7						30			1
Perca fluviatilis/Sander lucioperca	Perch/ Zander			19						108			17
Clupeidae	Herring			3						145			2
?Clupeidae	?Herring			1									
Esox lucius	Pike			12						7		7	34
Cyprinidae	Cyprinids			3						8			7
Lota lota	Burbot									1			
Salmonidae	Salmon family			2									
Coregonus lavaretus	European whitefish									1			

Gadus morhua	Cod		6	1	
Pisces	Unidenti-fied fish	163	1818	2	122
Total per unit		241	2167	335	768

Appendix 6. AMS and dendrochronological dating results with associated units. All radiocarbon dating results are given with two sigma probability distribution ranges. T-value, % of parallel variation or correlation coeffiecient were not presented in the original report.

Context	**Timber structure**	**Latrine fill**	**Yard**
Unit	**41**	**51**	**59**
Context dating based on stratigraphy and finds	1450–1520	1450–1520	1350–1450
Denrochronological dating results, AD			
F1T2307, sample 18, *Pinus sylvestris*, phloem, 84 tree-rings	1457/1458		
F1T2308, sample 19, *Pinus sylvestris*, bark, 94 tree-rings	1457/1458		
F4T2310, sample 26, *Picea abies*, phloem, 52 tree-rings	tree-ring sequence too short		
F4T2311, sample 27, *Picea abies*, sapwood/heartwood, 86 tree-rings	disturbance of growth		
AMS dating results with 95,4 % probability Cal AD			
Ua-54966, bone, *capra* cranium, (570±26 BP)		1313–1422	
Ua-54961, nutshell, *Corylus avellana*, 10 cm, (597±26 BP)		1303–1407	
Ua-54962, seed, *Humulus lupulus*, 110 cm, (549±25 BP)		1322–1429	
Ua-54967, bone, *capra* mc sin, (557±26 BP)			1320–1427