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JÄRVENSUO REVIVAL: REINVESTIGATION OF THE NEOLITHIC WETLAND SITE OF JÄRVENSUO 1, SOUTH-WEST FINLAND

Abstract

The wetland site of Järvensuo 1 is located by the southern shore of the overgrown and drained Lake Rautajärvi in Humppila, south-west Finland. The peatland drainage and small-scale wetland excavations have revealed a rare corpus of organic archaeological and palaeoenvironmental remains from prehistory, which have been preserved in moist anoxic conditions on the lake shore. The reporting and publishing of the preliminary excavations in 1985 were left unfinished and, therefore, the character and context of this extraordinary lake site have remained largely undetermined. After 35 years, the available data associated with Järvensuo 1 has finally been compiled and will now be presented in this paper as a whole for the first time. Even though the contexts and circumstances of recovery have been challenging to reconstruct after more than three decades, and the organic artefacts are badly degraded today, the study will offer a long-awaited update about the site and its investigations. The results will also serve as valuable baseline data for the purposes of new multidisciplinary research underway at Järvensuo 1, potentially revealing more elaborate information concerning the site and its prehistoric inhabitants in a dynamic lake environment.

Keywords: Fennoscandia, Finland, Neolithic, wetlands, lake settlements, organic materials, preservation, sedimentation, excavation

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INTRODUCTION

The Järvensuo 1 site in Humppila, south-west Häme, Finland, has for decades constituted one of the most unique and intriguing of the prehistoric wetland sites in Finland (e.g. Siiriäinen 1983; 1987; Aalto et al. 1985; Koivisto 2011). Situated by the bank of the overgrown and later artificially drained Lake Rautajärvi, it presents the deposition and preservation of rare organic archaeological and palaeoenvironmental materials from prehistory. An extraordinary collection of organic artefacts, including wooden paddles, fishing implements and utensils (e.g. a wooden scoop with a bear's head carved in the handle), together with pottery, lithics, bone, and plant remains, have been deposited under thick layers of peat and gyttja in an overgrown lake shore zone. The site and its extraordinary materials have embroidered a wetland archaeological narrative firmly rooted in the archaeological research history of Finland, incorporating a pile dwelling, eastern Baltic influences and water chestnut 'cultivation' during the early 3rd millennium BC (Siiriäinen 1983; 1987; Aalto et al. 1985; Koivisto 2011; 2017).

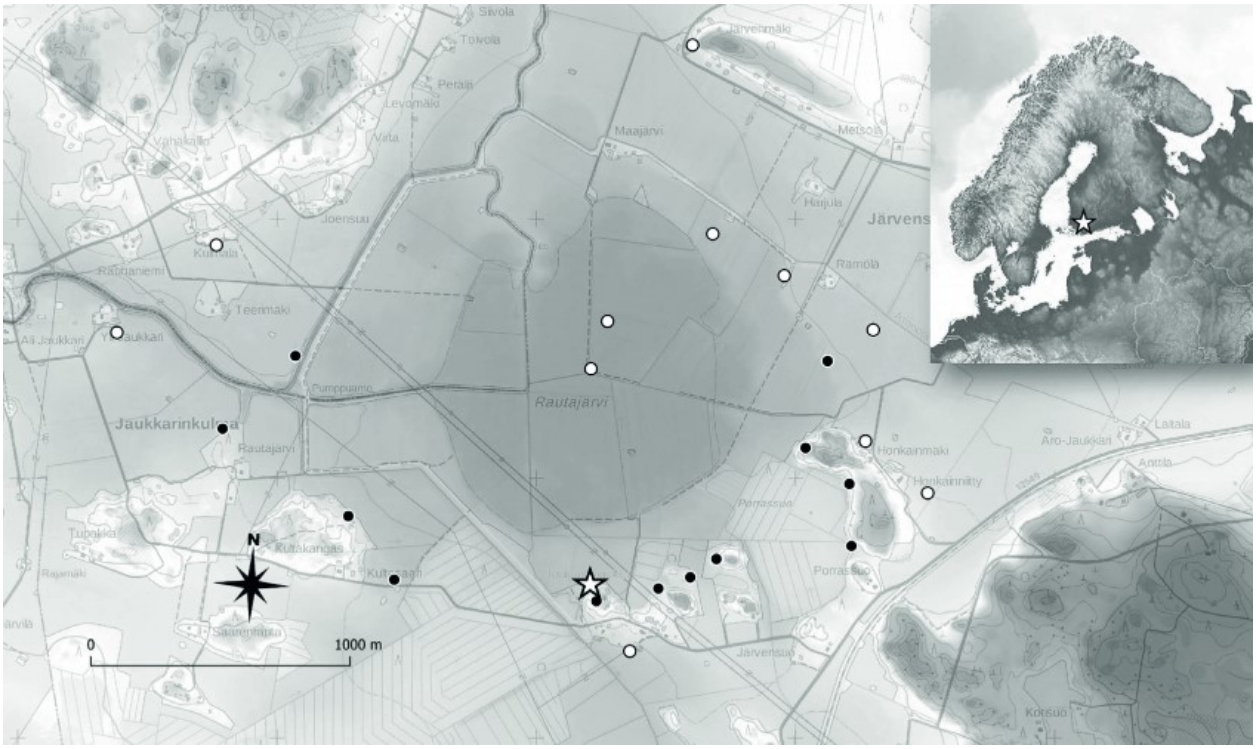

Figure 1. Overview map of the Rautajärvi area. Dots mark archaeological sites (black) and stray find (white) locations. The Järvensuo 1 site is marked with a star. Background data by Finnish Heritage Agency (2020a; 2020b) and National Land Survey of Finland. (Map: Satu Koivisto.)

It is often forgotten, though, that most of these interpretations were put forward already before the small-scale wetland excavations were conducted at the site in 1985 by Professor Ari Siiriäinen (1939–2004). Crucially, this fieldwork was never reported or properly published, or the find assemblage included in the museum collections. There are only two brief accounts available, sparsely describing the fieldwork (Siiriäinen 1987; University of Helsinki 2020), and the initial fieldwork materials and finds were 'lost' and kept in various locations for many years after Professor Siiriäinen's death after the turn of the millennium. Consequently, many of the preconceived ideas about the site and its uniqueness have prevailed, being more or less unchallenged for several decades already.

New research at the Järvensuo 1 site has finally commenced with a multidisciplinary project at the University of Turku (2019–2022). The available data associated with the site and its materials in archives, publications, university collections, and private holdings have been identified, compiled and studied in depth. Therefore, a large body of hitherto unstudied and unpublished materials from the 1985 excavations, including the fieldnotes, maps, drawings, and find materials, are included in this study. Because of its novelty, this data is described in its entirety and in detail, in order to allow future research and further evaluation. The contexts and circumstances of recovery have been somewhat difficult to reconstruct and evaluate due to limited documentation materials and challenges in interpreting them – and because the organic finds are today almost totally degraded. Still, the work offers a long-awaited update about Järvensuo 1. After describing in detail all the available (though rather limited) data, the paper then aims to assess the character, context, find assemblage, and dating of Järvensuo 1 in light of the current archaeological knowledge, setting the stage for future investigations.

ENVIRONMENTAL AND ARCHAEOLOGICAL OUTLOOK

The Järvensuo 1 site (60° 54' 40,687" N, 23° 17' 47,725" E) is located in Humppila, southwest Häme, at the north-west fringe of the

Kuoppanummi moraine hill rising in the middle of the vast Rautasuo peatland (Fig. 1). In the middle of this peatland is located the overgrown and later artificially drained Lake Rautajärvi, c 1.5 km in across, still observable in the contours of the terrain. Paludified through lake terrestrialisation, the Rautajärvi plateau was drained between the 1860s and 1950s to facilitate agriculture (Stén & Moisanen 1994). The completion of soil reclamation in low-lying terrain by the Koenjoki River was difficult and lengthy, and the area remained prone to flooding. Therefore, the drainage operations were conducted in several stages and involved extensive modification of the landscape.

Lake Rautajärvi was isolated from the Baltic Sea during the regression of Lake Ancylus approximately 9800 years ago, when the isostatic land uplift and consequent tilting led to the formation of a basin on a clayey depression on the Rautasuo plain (Hokkanen 2005). Today, the stratigraphy of the lake consists of (from bottom to top): base clay, gyttja (5–190 cm) and peat (max. 6.7 m); within the shore zone, the matrix gradually changes to more mineral-rich mixed (sand and moraine) sediments and bedrock (Stén & Moisanen 1994). Gyttja has been recorded within the former lake area at elevations below 95 m asl, and the outflow channel and threshold were located in the west, near the present channel of the Koenjoki River (Siiriäinen 1983). The lake has been transgressive and its southern shore was especially prone to flooding due to low-lying topography and its threshold situated in the direction of more rapid isostatic rebound.

In addition to the Järvensuo 1 site, a dozen or so archaeological sites and stray find locations are known on the banks of the former Lake Rautajärvi (see Fig. 1) (Saukkonen 1988; Pesonen 2005; 2008; Finnish Heritage Agency 2020b). For example, two stone adzes (KM 21990, KM 27814) and a flint arrowhead (KM 32926) have been found from the southern lake shore. A number of organic artefacts and remains of stationary wooden fishing structures have also been reported by locals during drainage works at various parts of the lake. The archaeological field survey in 2005 (Pesonen 2005; 2008) revealed multiple lake bank sites via intensive test-pitting. Based on archaeological find types, the utilisation of the lake spanned at least from the Mesolithic to the Early Metal Age (c 6000–500 calBC). Several of the sites have also yielded pottery: e.g. Typical and Late Comb Ware (c 3950–3250 calBC), Corded Ware (c 2900–2200 calBC), Kiukainen Ware (c 2300–1500 calBC) and Textile Ware (c 1900–500 calBC) (chronologies according to Nordqvist 2018; Mökkönen & Nordqvist 2019; Pesonen et al. 2019). In sum, the prehistoric utilisation of Rautajärvi was long-lasting and intensive, and it spanned for more than 5000 years.

According to historical sources from the 16th century AD and onwards, Lake Rautajärvi constituted an important resource base and a boundary between three villages and a parish (Digital Archives of the National Archives of Finland 2020). Its abundant resources – freshwater fish, in particular – were procured intensively by nearby villagers for centuries. The lake is illustrated on historical maps until the first part of the 20th century, when the drainage operations were successfully terminated after considerable modifications of the landscape, for instance, involving transferring the river channel, terracing the lake banks and establishing a pumping station (Anttila 1967). After this, a watery meadow still kept emerging in the lake centre, but today the main drainage channel traverses the plateau in a north-south direction and peaty farmland is cultivated in its entirety due to an extensive subsurface drainage network with pumping facilities, which maintains the groundwater at desired levels.

HISTORY OF RESEARCH IN BRIEF

At the final stage of the soil reclamation in 1958, a wooden paddle was uncovered in the course of ditching work conducted between the Kuoppanummi Hill and the peatland farmland by the southern lake shore. The paddle was lying ‘between lake mud and clay at the depth of a furrow’ (c 30 cm) (Edgren 1984). The astonishingly well-preserved artefact – initially reckoned to be a few centuries old – was sent to Helsinki to be included in the National Museum’s ethnological collections (K10496). Some years later, direct radiocarbon dating (Hel-1004) revealed the paddle to be Neolithic 4210±140 BP (Siiriäinen 1983; Edgren 1984; Aalto et al. 1985), 3331–2462 calBC (at 95.4 %) (Bronk Ramsey 2009;

Reimer et al. 2020). In the early 1980s, locals found some more artefacts in the same ditch (KM 21493), including a wooden bailer (missing/deteriorated), a broken scoop with a bear head handle, pottery, fishnet bark floats, and lithics.

Consequently, archaeologist Ari Siiriäinen and Eero Naskali inspected the find area in 1982, extracted a few samples for palaeobotanical and radiocarbon analyses and named the site Järvensuo ('Lake's Mire') after a nearby farm. The ditchers described that the archaeological finds had been observed in a belt of c 20 m, starting from a bend in the ditch (where the paddle had been found in the 1950s) and continuing towards the north-east along the perimeter of peatland. During the inspection, some more pottery and fragments of unworked wood were discovered in the same area. The c 10-cm-thick archaeological find horizon was observed to lie within coarse detritus gyttja underlying peat and overlying lakebed moraine at a depth of c 50–60 cm from the surface (Siiriäinen 1982; 1983). Some natural pieces of wood were discerned in the upper gyttja, but all the artefacts, along with charcoal and visible plant remains, were lying within the cultural horizon. The inspection observations were reported (1982) and published along with preliminary palaeobotanical results (Siiriäinen 1983; Aalto 1983). Later, Aalto et al. (1985) and Vuorela (2002) published more comprehensive palaeobotanical works accompanied by a brief archaeological synopsis.

Based on preliminary palaeobotanical results, the cultural layer was dated to the Late Atlantic chronozone, which was in accordance with the suggested Typical and Late Comb Ware pottery styles recovered from the site (Aalto 1983; Siiriäinen 1983). Uncharred plant macrofossils (e.g. fruit, berries, nuts, and fibre-yielding plants) were identified in the cultural horizon. The insect remains were preliminary grouped (by M. Pulkkinen), but further entomological work was left undone (Aalto 1983; Aalto et al. 1985). The c 13-cm-thick cultural horizon in the lower gyttja was determined more precisely as constituting of coarse detritus gyttja (8 cm) and overlying the first 5 cm of the fine detritus (Aalto et al. 1985). Based on the stratigraphy and occurrences of aquatic plant pollen and macrofossils, the water level of Lake Rautajärvi was suggested to have been transgressive, which led to inundation of the shore zone. A distinct boundary between gyttja and peat was considered an indisputable sign of abrupt lake regression, caused either by natural factors or by artificial damming or ditching (Aalto et al. 1985).

Altogether, these observations were thought to point towards a discovery of a Neolithic paludified settlement site, unique in Finland by that time, situated by the transgressive shore of Lake Rautajärvi, with its pottery representing 'a transitional stage between Typical and Late Comb Ware', dated then to the early 3rd millennium BC (Siiriäinen 1982; 1983; Aalto et al. 1985). Certainty about the nature and context of the site was not achieved yet, but prehistoric habitation was considered the most relevant explanation for the deposition of the cultural horizon within the gyttja, referring either to a: (1) peatbog site, (2) pile dwelling, or (3) 'over-transgressed' dryland site (Siiriäinen 1982: 4; 1983). At that time, the third option seemed the least likely, because the moraine base on top of which the archaeological finds were lying was too rocky and steep on a gradient for a typical open-air settlement. The lighter artefacts (such as wood and bark floats) were assumed to be *in situ* and not fallen down from the upper layers. Therefore, the most probable explanation was then a pile construction, which had been located on a shallow and clear-watered lake shore. The construction had been inundated in the course of transgression and its wooden remains deposited within coarse detritus gyttja (Siiriäinen 1982; 1983). Some of the (unworked) wood fragments in the ditch section were assumed to represent dismantled parts of the construction. Still, the possibility of Stone Age habitation on wooden platforms on top of peat could not be completely ruled out (Aalto et al. 1985). The extent of the site was considered much larger, with its find areas continuing especially in the direction of the spruce bog in the south-west. Proper excavations, however, were deemed essential to reveal the full potential, extent and character of the site.

Since its discovery in the 1980s, the Järvensuo 1 site has been considered extraordinary by Finnish archaeologists in many respects. The preservation of rare organic materials from the Neolithic on this scale is not the only factor, as Siiriäinen (1982; 1983) further considered that

the site bore many characteristics of some contemporary eastern Baltic wetland settlements, such as Sārnate, Piestene, and Osa in Latvia and the Šventoji site complex in Lithuania (Šturms 1940; Vankina 1970; Semyontsov et al. 1972; Rimantienė 1992; 2005). The very existence of a lake settlement with a suggested pile dwelling was considered a supportive element, he thought, in addition to the types of organic artefacts and a few sherds of pottery, which he found related to contemporary eastern Baltic traditions (Siiriäinen 1982; 1983).

Luckily, in 1985, Siiriäinen received funding to conduct small-scale trial excavations at the site. The results of this fieldwork, however, never reached the scientific community, because the post-excavation work, including cataloguing the finds, reporting and publishing the results, was left undone. Only one brief summary of the fieldwork was published in NewsWarp (Siiriäinen 1987) in addition to a short description for the funder, the Academy of Finland (University of Helsinki 2020). In these two accounts, Siiriäinen described the fieldwork as successful, but also complained that the trenches were too small to reveal the full extent and character of the site.

The wetland part of Järvensuo 1 has remained untouched for more than three decades, but a few small-scale fieldwork projects associated with land use planning have been conducted in its vicinity (Finnish Heritage Agency 2020b). In the early 2000s, the landowner of Järvensuo 1 made a small test pit on the moraine plateau of Kuoppanummi, c 100 m south-east from the wetland find area, and found a few sherds of pottery, quartz (including a small scraper) and fragments of burnt bone (KM 32928: 1–4). The local Forssa museum conducted small-scale trial excavations at the find spot (Pohjakallio 2004; 2005), which yielded a few more sherds of Late Neolithic (Corded Ware and Kiukainen Ware) pottery, quartz and fragments of burnt bone (KM 34489: 1–55). The possible contemporaneity of the dryland find area, c 10 m uphill from the former lake shore, remained undetermined. Later, a few more pottery sherds with coarse mineral temper (KM 33385: 1–3) and a sandstone whetstone (KM 38398: 1) were discovered on the western hill slope of Kuoppanummi (Finnish Heritage Agency 2020a).

MATERIALS AND METHODS

Excavations in 1985

The description of the fieldwork in this paper is based on Ari Siiriäinen's fieldnotes and a few excavation maps found in the collections and archives. In addition, interviews with locals and Juha Laurén, who took part in the excavations as an archaeology student in 1985, have provided valuable background information concerning the progress of the fieldwork. No excavation photographs have been identified yet. The locations of the trenches and test pits have been estimated through field maps and a couple of corner stakes (of *Trench 1*) still visible in terrain at the site, which were mapped with a total station in 2019. The average depths of the finds and the documented levels have been estimated from the levelling values on field maps and notes. The coordinate system used in the mapping of the excavation is incoherent and does not match with the find recording data. Therefore, the 'decrypting' of the documentation system and its incoherence must be taken into consideration when evaluating the results. The excavated areas, however, – especially in the wetland part – covered only a few square metres and, therefore, the horizontal inaccuracy of c 50–100 cm is not crucial in this context.

Corpus of archaeological finds

The find materials described in this paper are from the wetland part of Järvensuo 1. The finds recovered from the nearby plateau and slopes of Kuoppanummi are not included because of their character as dryland finds. However, along with the materials from the whole Rautajärvi area, they provide valuable background data for the characterisation and dating of human occupancy in this region. The first paddle (K10496), found during ditch digging in the 1950s, has been published by Edgren (1984) and it was reinvestigated for this study. The archaeological assemblage collected by local ditchers and signed away to Siiriäinen during inspection in 1982 has previously been described only in a preliminary and rather repetitive manner (Siiriäinen 1982; 1983; Aalto et al. 1985). For some unknown reason, this assemblage has been included in the

archaeological collections only partially until its re-examination and cataloguing for this study in 2019 (KM 21493:1–16). The 1985 excavation assemblage is hitherto completely unstudied and unpublished and, therefore, it constitutes the most essential part of this paper. The finds have been 'lost' and kept in various locations for more than three decades until their rediscovery and cataloguing in 2019 (KM 23822: 1–82). However, the materials have been stored in normal room conditions, which has led to considerable drying out and deformation of the organic finds.

Palaeoenvironmental data

In addition to knowledge of the local environmental history, the preliminary pollen and plant macrofossil studies of the 1980s provide valuable information concerning the stratigraphy and dating of Järvensuo 1. Along with the already published data, relevant background information (e.g. the sample site locations and extraction methods) has been discovered in the 1985 fieldnotes, and these may now be reviewed.

Preliminary palaeobotanical analyses were conducted at Järvensuo 1 in the early 1980s (Aalto 1983; Siiriäinen 1983; Aalto et al. 1985). The plant macrofossil analysis (by Marjatta Aalto) was performed with one single soil sample: a cubic monolith of 14 x 14 x 38 cm, c 2.5 litres in volume, which was cut directly in the drainage ditch section (*Site 1*) (Siiriäinen 1982). In this monolith, plant remains were analysed in 2-cm sequences (Aalto 1983; Aalto et al. 1985). Pollen analysis (by Irmeli Vuorela) was conducted at four sample sites: *Site 1*, *2A*, *2B,* and *3* ('spruce bog') (Siiriäinen 1983; Aalto et al. 1985; Vuorela 2002). At *Site 2A*, two 250-cm-long parallel samples (at depths of 95–250 cm) were extracted with a small 'Russian' peat corer and a piston corer approximately 9 m north from *Site 1* towards the lake centre, presumably in 1983. During the excavations in 1985, two more 170-cm-long monoliths were extracted directly from the excavation trench section (*Site 2B*), located c 4–5 m south from *Site 2A*. Two more 200-cm-long parallel samples were extracted with a peat corer and a piston sampler from *Site 3* at the spruce bog, c 25 m south-west from the initial find area. Pollen was calculated in 2.5 cm sequences in all sample monoliths.

Radiocarbon dates

Altogether ten radiocarbon dates are available from Järvensuo 1 (Siiriäinen 1983; Aalto 1983; Edgren 1984; Aalto et al. 1985; Vuorela 2002). Only one date (Hel-1004) is a direct dating of an archaeological artefact (the paddle K10496); the remaining samples have been extracted from bulk sediment (peat and gyttja), scattered pieces of unworked wood, and charcoal. All dates have now been compiled, calibrated (at 95.4 %; date modelled in OxCal v.4.4, using IntCal20 calibration curve [Bronk Ramsey 2009; Reimer et al. 2020]) and evaluated based on their stratigraphic context, location and the dated material in question.

RESULTS AND DISCUSSION

The 1985 excavation observations

Siiriäinen and archaeology students from the University of Helsinki conducted wetland excavations for four weeks at Järvensuo 1 in June–July 1985. The fieldwork targeted the core find area on both sides of the drainage ditch traversing the area in a south-west/north-east direction. Thick peat was removed manually and the ground water was extracted with a mechanical pump. Excavation was performed on wooden planks and platforms on a watery and sludgy surface to avoid disturbing the fragile organic remains and documentation levels.

Trench 1 (6 x 2 m) was situated on the south-eastern side of the ditch on gently reclining terrain in mixed forest at the foot of Kuoppanummi Hill (Fig. 2). The peaty topsoil and underlying peat were removed and the excavation continued to the sandy/gravely subsoil at a depth of c 60–115 cm from the surface. The stratigraphy in the north-westernmost part of the trench by the ditch was (from top to bottom): c 80 cm peat (with a few thin charcoal-rich horizons), 15–25 cm light greenish gyttja, 10 cm coarse sand, and bottom gravel/clay. Gyttja was observed only in the north-westernmost 1.5 metres of the trench, while the remaining area was composed of gradually thinning peat (towards higher

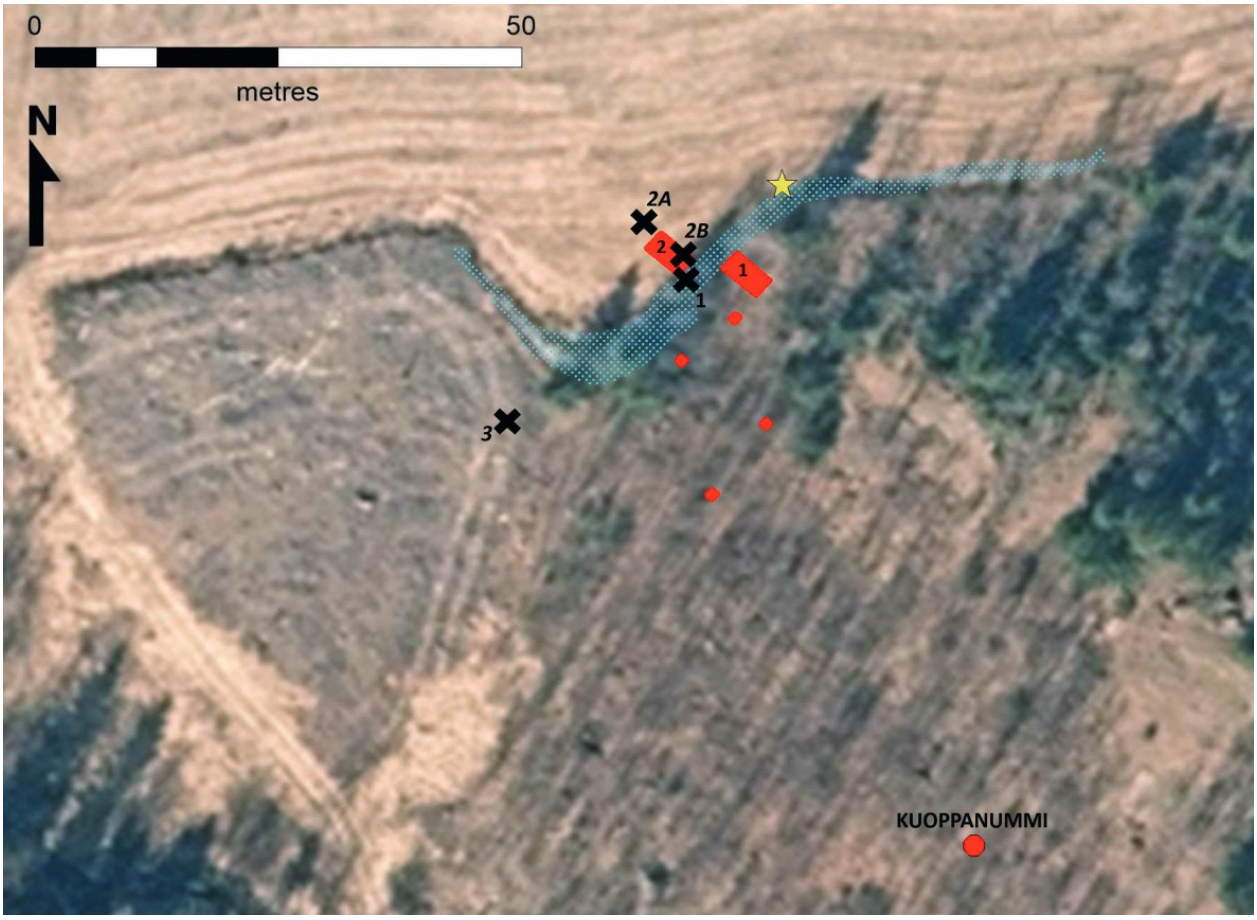

Figure 2. Site plan of the 1985 excavations: trenches (1 and 2), test pits in rectangles, and palaeobotanical sampling sites (1, 2A, 2B and 3) marked with crosses. The dryland site of Kuoppanummi is marked with a dot and the find location of the wooden bear-head scoop with a star. Background data by Siiriäinen (1983; field notes 1985), Aalto et al. (1985), Vuorela (2002), interviews with locals and National Land Survey of Finland. (Photo: Satu Koivisto.)

elevations) and an underlying moraine bottom. Archaeological finds (n=49) were recovered in the entire area and they yielded durable materials: lithics (n=2), pottery sherds (n=10) and quartz (n=36). Most of the pottery was found in peat overlying gyttja, while the lowermost sandy layers were findless.

Trench 2 (4 x 2 m) was situated in the peatland agricultural field on the north-western side of the ditch (Fig. 2). Only the south-easternmost 4 m^2 at the margin of the ditch section were excavated, while the rest of the trench was left undug. The plough-zone horizon and underlying peat were removed and the excavation continued through thick clayey gyttja. The deepest parts extended to the lakebed gravel at a depth of nearly two metres.

In this trench, groundwater was met after a few days of peat removal and a wood-rich layer was discerned in lower peat at a depth of about one metre. A suggested junction structure containing pieces of wood and branches was discerned in horizontal position in *Carex* peat at c 110-cm-depth; later, however, this proved to be natural. A number of birch bark roll fishnet floats, a few sherds of coarse mineral-tempered pottery and an astonishingly well-preserved complete wooden paddle were met in lower peat at a depth of c 90–120 cm. The distinct upper surface of fine detritus gyttja was reached at a depth of c 120 cm. A few pieces of worked wood and pine bark, along with pottery, were recovered within lower gyttja (c 170 cm), presumably representing the same archaeological horizon which had been observed in the drainage ditch

section during the 1982 inspection. The intermediate fine detritus gyttja between these two was findless. A few charcoal pieces and fragments of wood (deriving of suggested dismantled lath screen fish traps) were met in coarse detritus gyttja in the deepest part of the trench, c 180 cm from the surface. One vertical pile, a few water chestnut (*Trapa natans*) shells, lath fragments and pottery were encountered in the bottommost layer. One quartz flake and fragments of (unburnt) bone along with the tip of a vertical pile were met in gravely lakebed at a depth of nearly 230 cm from the surface. *Trench 2* was richer in finds (n=322) and waterlogged organic materials were preserved here. The average depths of the various find materials were: bark 110 cm, wood 95–230 cm, pottery 110–180 cm, quartz 160–230 cm and bone 175–230 cm.

There is no available fieldwork data elucidating the detailed stratigraphy of *Trench 2*. The overall stratigraphy, however, may be deduced from the soil monolith documented for pollen studies, which was extracted directly from the trench section during the 1985 excavations (*Site 2B* in Vuorela 2002: 9–10). Here, the stratigraphy was (from top to bottom): 30 cm peaty ploughzone layer, 75 cm *Carex* peat; 15 cm mixed peat and gyttja (i.e. decomposing horizon), 40 cm fine detritus gyttja (with thin sandy horizons between 150–155 cm), 40 cm coarse detritus gyttja (with layers of coarse sand between 170–180 cm), and lakebed gravel in the bottom.

In addition to the two trenches, four test pits were excavated in mineral soil (Fig. 2) in order to reveal contemporary habitation on dry land. A dozen or so quartz flakes were found in one of the test pits (*Test pit 2*), c 10 m south-west from *Trench 1*, suggesting possible contemporary habitation on dry land (see Fig. 2). The remaining three test pits, however, were findless.

In sum, the excavated area in 1985 totalled c 20 m^2; of this, only 4 m^2 were located in the wetland part of the site. Based on a short fieldwork summary published in NewsWarp (Siiriäinen 1987), the site was now characterised as a 'stratified multi-component habitation site' and its wetland find area representing 'a sort of boat haven and water chestnut collecting area connected with a minor settlement on the shore of the small and shallow lake'. Based on pottery styles and a few radiocarbon dates, the site was assumed to date to the transition of Typical and Late Comb Ware in the early 3rd millennium BC (according to the Finnish Stone Age pottery chronology in the 1980s). A few sporadic finds in peat were presumed to suggest another, somewhat later settlement phase, presumably originating from the Early Metal Age, c 500 BC. Pile dwellings and eastern Baltic influences, which were referred to in earlier publications (Siiriäinen 1983; Aalto et al. 1985), were no longer mentioned, but a possible post construction was still referred to (Siiriäinen 1987: 12).

Corpus of archaeological finds

The find materials recovered from the wetland part of Järvensuo 1 are compiled in Table 1 and

Table 1. The number of various find materials from the wetland part of Järvensuo 1.

	INSPECTION KM 21493	EXCAVATION KM 23822	STRAY FIND KM 30676
Bark artefact	4	> 8	
Bark fragment	1	24	
Bone burnt		3	
Bone unburnt		> 50	
Lithics	1	3	
Pottery sherd	58	40	1
Quartz	3	71	
Wood artefact	1	25	
Wood charred	4	27	
Wood lath		87	
Wood natural	4	> 30	
Wood worked		3	
TOTAL	76	371	1

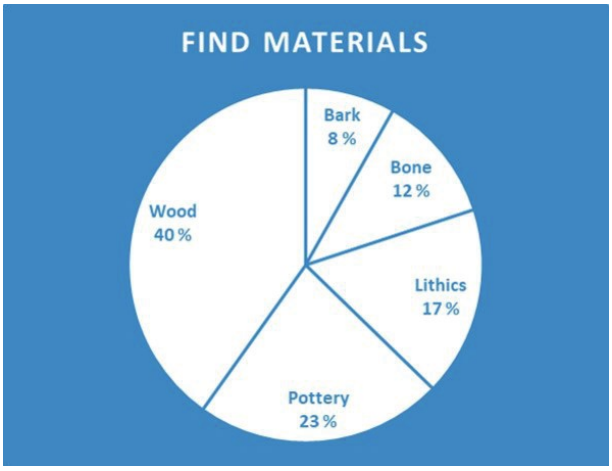

Figure 3. The proportions of various find materials obtained from Järvensuo 1.

Fig. 3. The various material groups are described in detail below.

Bark

The bark artefacts (n=c 37) comprise various forms of intact or fragmentary fishnet floats (Fig. 4C–D). Siiriäinen (1983) and Aalto et al. (1985) described four bark net floats included already in the inspection assemblage (KM 21493:2–5). The small pine bark float is a slim, spindle-shaped artefact with a notch preserved on one end. Another fragmentary piece is a perforated rectangle with rounded ends (the perforation was presumably in the middle). The two remaining floats are simple rolls of birch bark.

Most of the bark artefacts recovered in the 1985 excavations (KM 23822:19, 20, 21, 32, 33, 34, 35) represent pine bark (n=3) and birch bark (n=4) fishnet floats (Fig. 4). They all were found waterlogged in rather good condition, but today the artefacts are more or less flaked and broken. Only one perforated float (KM 23822:32) is still almost intact. Fishnet fragments have not been preserved at the site. A dozen or so collection numbers of broadly similar float types are included in the archaeological collections of the National Museum (Finnish Heritage Agency 2020b): for example, the bark floats from the Neolithic Tuorsniemi net, western Finland, which alone contain over 800 spindle-shaped floats (Kauhanen 1974). Large numbers of similar fishnet bark floats have also been found in the neighbouring areas, in the eastern Baltic and Russian wetland sites, including Sārnate (Vankina 1970; Bērziņš 2008), Šventoji (Rimantienė 2005), and Gorbunovo (Rauschenbach 1956).

Bone

The majority of bone materials from Järvensuo 1 are unburnt (n=c 50 unburnt, 3 burnt) (Fig. 4E–F), which is a surprising feature in Finnish context, where burnt bone is usually only preserved at archaeological sites (e.g. Koivisto 2017 and references therein). A large ruminant tooth (KM 23822:51), preliminarily identified as *Bos* or *Alces*, was found at the lowermost sequence (68 cm depth) of the soil monolith extracted for the palaeobotanical sampling at *Site 1* (Aalto et al. 1985: 172). In addition, dozens of fragmentary pieces of unburnt bone (KM 23822:26, 27, 53, 54, 61) were recovered in lower gyttja in *Trench 2* in 1985. These materials have been kept in normal room conditions inside lumps of dried gyttja, and today they are pulverized and lack any anatomical features, as well as possible tool marks or use wear on their surfaces. In addition, a few tiny pieces of burnt bone (KM 23822:80) were found from the drainage ditch section during the excavations.

Lithics

The head fragment of a four-sided polished stone adze made of grey diabase and three quartz flakes are included in the drainage inspection assemblage (KM 21493:12, 13) (Siiriäinen 1983; Aalto et al. 1985). Knapping waste of quartz and quartzite (n=66), three cores and two artefacts, two fragments of polished stone tools and a scraper made of porphyry were found during the 1985 excavations (KM 23822). The quartz artefacts (KM 23822:71, 72) comprise simple cutting and/or scraping tools. Quartz waste, along with pottery and unburnt bone, were found in the bottommost gyttja over lakebed gravel in *Trench 2*. Most of the quartz material is poor in quality and its technological characteristics have not been examined. The raw material is presumably local, because veins of quartz in bedrock with somewhat similar knapping waste are known on the southern shore of Rautajärvi (Pohjakallio 2005; Finnish Heritage Agency 2020a; 2020b).

Pottery

The pottery sherds total c 100 pieces (Fig. 5). The majority of these (n=57) were recovered

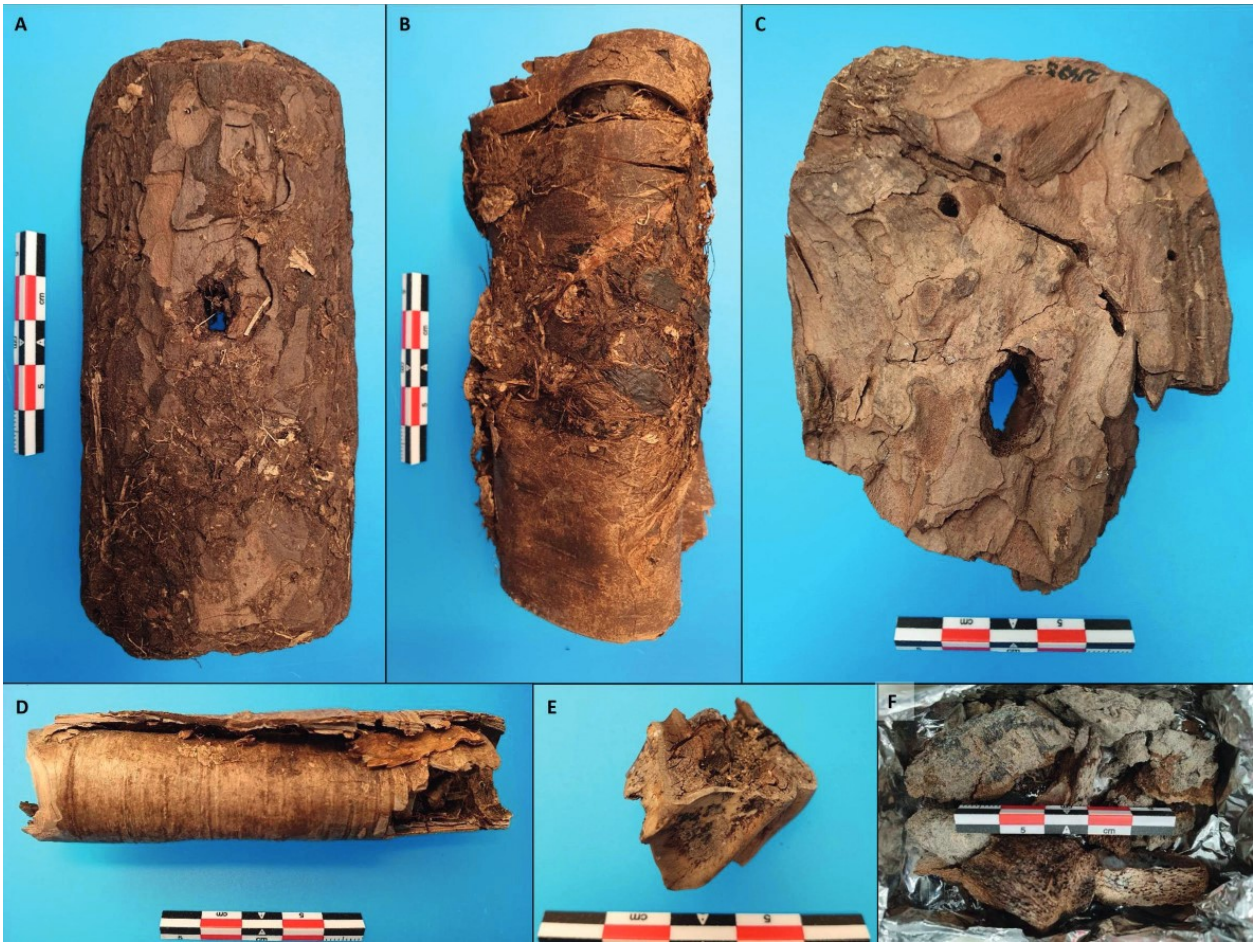

Figure 4. The pine and birch bark fishnet floats and unburnt bone from Järvensuo 1 (A) KM 23822:32, (B) KM 23822:33, (C) KM 21493:3, (D) KM 21493:4, (E) KM 23822:51 and (F) KM 23822:27. (Photos: Satu Koivisto.)

already in the course of ditching work in the early 1980s (KM 21493). Judging from the decorative patterns, there are fragments of four or five individual vessels (Siiriäinen 1983; Aalto et al. 1985). One is decorated with short comb stamps placed in symmetric horizontal zones and some smooth, flat stamp motifs occur as well. Most of the sherds (KM 21493:6, 10, 11) belong to only one vessel, where the upper wall is decorated with pits placed in two horizontal lines, which are connected together with zigzag 'fingernail' imprints (Fig. 5D). The rim top is unprofiled, flat and decorated with imprints. A rim piece (KM 30676) from the same pot was found some years later, c 20 m further east in the same ditch. Locals later also found some more sherds belonging to the same pot. In a thick-walled (15–18 mm) vessel (KM 21493:7), double imprints, comb stamps and pits are placed on the wall and double imprints on the rim top. The clay matrix in all the above-mentioned sherds is grey and porous, rather poorly fired, with mineral and some dissolved organic temper. Especially the comb stamp and nail-imprint sherds were suggested as representing a 'transitional type' of Typical and Late Comb Ware traditions (Siiriäinen 1982; 1983).

The pottery previously referred as 'unusual for Finland' and suggesting eastern Baltic influences (Siiriäinen 1983; Aalto et al. 1985) is associated with a few sherds (glued together) from a smaller, thin-walled (c 6 mm) and undecorated pot (KM 21493:8) – possibly a shallow bowl – the outer surface of which is polished and lightly striated in various directions, while the inner surface is strongly scraped horizontally (Fig. 5A–B). The clay matrix is unlike the other sherds; it is dense and grey in colour with very little or no temper or something of dissolved organic kind. The flat angular pores and calcified

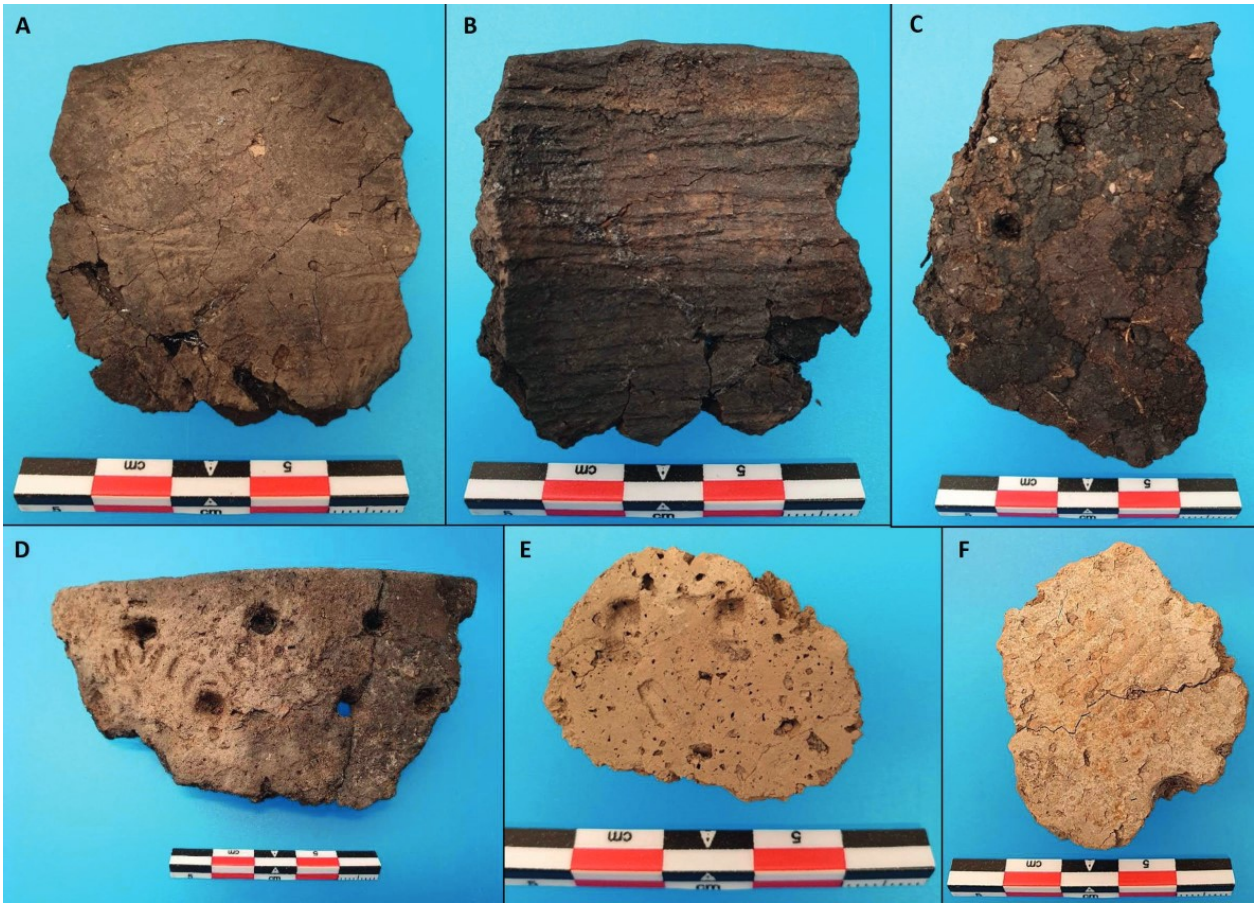

Figure 5. Pottery sherds from Järvensuo 1 (A–B) KM 21493:8, (C) KM 23822:41, (D) KM 21493:6, (E) KM 23822:57 and (F) KM 23822:59. (Photos: Satu Koivisto.)

remains on the outer surface originate from shell temper. Based on current pottery studies, these are not completely unusual characteristics for some Late Comb Ware variants from the interior of Finland; however, comprehensive research on them is still lacking (e.g. Pesonen & Leskinen 2009; Nordqvist 2018). For example, some similar features are known within the Late Neolithic asbestos- and organic-tempered ceramics, such as Pöljä Ware (c 3400–2600 calBC) and Oravnavolok Ware (c 3300–2700 calBC) (Mökkönen & Nordqvist 2017 and references therein).

During the 1985 excavations, some more pottery was recovered (*Trench 1* n=10; *Trench 2* n=30). The sherds found in lower peat and peat/gyttja contact in *Trench 2* are still dark and 'tarnished' in colour today (see Fig 5C), compared to the pieces found in the bottommost gyttja, which are light brown and slightly worn in consistency (see Fig. 5E–F). In the darker pieces, there are abundantly charred crusts adhered to the surfaces. These sherds are decorated with pits, double imprints and comb stamps. Some undecorated and striated fragments occur as well. In *Trench 1*, the majority of sherds were found in dark peat overlying sand at an average depth of c 70 cm. Only one rim piece is decorated with large oval imprints. A few coarse mineral-tempered undecorated sherds were found in greenish gyttja in between *Trench 1* and the ditch section at a depth of c 50 cm. In *Trench 2*, pottery was mostly found within decomposing horizon: for example, a rim piece decorated with pits (KM 23822:41), which contains abundant layers of organic crust (Fig. 5C). A few sherds were also encountered in the bottommost gyttja overlying lakebed gravel at a depth of nearly 2 m. These sherds also yield striations, pits, double imprints, and comb stamps. The pottery found in the lowermost cultural layer has been suggested to represent local Late Comb Ware variants (University of Helsinki 2020); see, for example, the comb-decorated sherd (KM 23822:59) and

fragments with double imprints (KM 23822:57). Coarse mineral, sand and organic temper, or a combination of all these, seem to be a typical feature for the Järvensuo 1 pottery.

While the small number and fragmentary nature of the sherds hamper a more definitive stylistic grouping of the pottery, it is interesting that similar decoration motifs and styles occur at all find depths and their chronological differences are not currently known (due to the lack of pottery AMS datings from Järvensuo 1). The Comb Ware styles that existed after c 3500 BC in most of southern Finland have not been studied in depth even today (see Leskinen & Pesonen 2008; Mökkönen 2011; Nordqvist & Mökkönen 2015) and there has been great variation in the temper materials, decoration, surface treatment, and shape of the vessels (e.g. Mökkönen 2008). The Häme region may be seen as an especially blank page in pottery research. So-called Middle Zone ceramics is often referred to in literature, but it is still a very hypothetical term applied to express an assumed pottery group that has not yet been described or characterised at all (Carpelan 1979; Nordqvist 2018; Pesonen 2021). However, sparse decoration with short comb stamps and shallow pits in some of the Järvensuo sherds are also known features in the asbestos- and organic-tempered ceramics from the Finnish interior, which are dated to the second half of the 4th millennium calBC (Mökkönen & Nordqvist 2017), which is also in accordance with the suggested dating of the site.

Wood

The first paddle (K10496), presumably made of fir (*Picea*) (Siiriäinen 1987), was recovered during drainage operations already in 1958 (Fig. 6A). In the 1970s, the artefact was radiocarbon dated and it yielded a Late Neolithic date of 3330–2460 calBC (Hel-1004 in Table 2). Edgren (1984) has described the paddle in detail, but in general it has not been acknowledged much in archaeological literature in Finland, even though it represents a beautiful and unique piece of carpentry from the Late Neolithic. Moreover, it is hitherto the oldest of the nine securely dated paddles in the whole country (Finnish Heritage Agency 2020b). The handle part is especially interesting, because its head has been carved in the shape of a gouge or a scoop, and the blade is more or less mallet-shaped. Unfortunately, only the blade part is currently available in the collection of the National Museum, and it is not clear whether the handle has degraded or been separated from the blade. Nevertheless, in archaeological literature no direct equivalents for the paddle can be found in Europe, the eastern Baltic, Russia or North America. Only one ethnographic example found is remotely comparable; it comes from Papua New Guinea (from the early 20th century AD, though), and features a similar end scoop used for soil tillage and digging up of edible roots (Finna 2020).

Another wooden paddle was found during the 1985 excavations (KM 23822: 31) (Fig. 6B). It was encountered in a horizontal position on the lowermost peat in the middle of *Trench 2*. After recovery, the paddle was progressively air-dried in controlled room conditions (pers. comm. J. Laurén), but its condition and state of preservation were not maintained or monitored over the decades. Therefore, today the artefact is very badly skewed, shrunk and broken into several pieces, with its slender shape and birch bark binding on the handle being still observable. In its current state, the paddle is c 126.5 cm long and its blade c 6.5 cm wide. Presumably, it has been of medium size when intact, 130–40 cm in length and its blade max. 10 cm wide. The cross-section is difficult to estimate due to the state of degradation, but the blade may have been subtriangular. The paddle, probably made of ash (*Fraxinus*) (Siiriäinen 1987), is very light; its blade resembles a slender willow leaf in shape. In comparison to the few Finnish examples (e.g. Edgren 1984; Finnish Heritage Agency 2020b), large numbers of wooden paddles have been found at eastern Baltic and Russian wetland sites, such as, for example, Sārnate (Vankina 1970) and Gorbunovo (Rauschenbach 1956). Altogether 36 paddles have been recovered at Sārnate alone, all of them with long, narrow blades (Vankina 1970; Bērziņš 2008). Slender paddle blades (as in KM 23822: 31) have been useful on reedy lake shores and the mallet-shaped blade of the scoop paddle (K10496) in more open water conditions. The dating of wooden single-piece and composite paddles in north-east Europe falls roughly to c 4000–2000 calBC (Kashina & Chairkina 2017), which is in accord with the dating of Järvensuo 1.

Figure 6. Wooden paddles and the bear-head scoop from Järvensuo 1 (A) K10496, (B) KM 23822:31 and (C) KM 21493:1. (Drawing: P.-L. Surojegin [K10496] and photos: R. Bäckman [KM 21493:1] and Satu Koivisto [KM 23822:31]).

The wooden scoop with a bear's head handle (KM 21493:1) (Fig. 6C) has drawn a relatively great deal of attention in the archaeological literature (e.g. Siiriäinen 1983; Aalto et al. 1985; Taavitsainen 2001; Immonen 2002; Koivisto 2011), and it constitutes one of the most iconic pieces of portable art and/or utensil from the Stone Age in Finland. The artefact was not found from the core find area where Siiriäinen excavated in 1985, but at the foot of the bedrock, c 20 m east in the same ditch (see Fig. 2). The wood species has been somewhat confusingly referred to as pine (*Pinus sylvestris*) (Siiriäinen 1982; 1983) and then later also as fir (*Picea*) (Siiriäinen 1987). The carved animal head on the handle is partially broken, but its short roundish ears are still observable; the broken face presumably formed a hook on the tip of the reverse side of the handle. A wooden spoon from Kurkisuo mire in Laukaa, Central Finland, from the Typical Comb Ware period also features a bear's head on the handle (Ailio 1912; Immonen 2002). The style is slightly different (e.g. the placing of the bear in relation to the handle), but the upright roundish ears are very similar to the Järvensuo example. Parallels may also be found, for example, at Sārnate (Vankina 1970; Carpelan 1974; 1977; Immonen 2002) and Shigir in the Urals (Eding 1940). The position of the bear's head may be assumed to have been similar among the Järvensuo 1 and Sārnate examples. In addition to bears, water birds, elks, snakes – and occasionally humans – are portrayed in Mesolithic, Neolithic and Early Bronze Age portable art made of amber, antler, bone, lithics, wood, and clay in north-east Europe and Russia (e.g. Carpelan 1974; Chairkina 2014; Kashina 2015). Wooden examples are probably less frequent due to preservation issues.

The remaining (fragmentary) wood materials include pieces of pine laths, 2–3-cm wide and 0.5–1-cm thick, representing dismantled parts of lath screen fishing structures. This refers to long, fence-like constructions that were manufactured from narrow pine laths and bound together with ties made from roots, twigs, birch bark strips, and bast cord (Koivisto 2017). At Järvensuo 1, no binding materials have been preserved, but piles and stakes have typically supported the lath screen modules; some other trapping mechanisms, such as nets and wicker screen traps, may have been attached to the lath screen fences. Some of the fragmentary pieces of wood and the vertical pile in *Trench 2* may originate from fishing structures. In addition to Finland, pine lath fishing structures represent a relatively common type of wetland archaeological resource in north-east Europe (e.g. Vankina 1970; Loze 1988; Rimantienė 1992; Bērziņš 2008; Mazurkevich et al. 2010; Piličiauskas et al. 2012; Lozovski et al. 2013; 2014; Kulkova et al. 2016; Bērziņš et al. 2016; Gusentsova & Sorokin 2017; Piezonka et al. 2020). The ages of the securely dated examples range from the Late Mesolithic to the Early Metal Age and Bronze Age.

A few pieces of wood in the inspection assemblage and 20 pieces recovered during the excavations are charred, perhaps comprising firewood that ended up in the littoral zone. A list of worked wood and artefacts is also included in the 1985 fieldnotes, but, crucially, most of this corpus of organics has almost completely deteriorated and the suggested tool marks are no longer observable. This list mentions 13 fragmentary stakes and piles, a tree stump with tool marks, and four peg-shaped objects.

A small number of the organic artefacts from the 1985 excavations – especially the pine lath fragments – are still more or less recognizable, but the majority of this material must be regarded as degraded.

Stratigraphy and palaeofloristic reconstruction

The overall stratigraphy and radiocarbon dates of the palaeobotanical sample monoliths from *Sites 1*, *2A, 2B,* and *3* are compiled and illustrated in Fig. 7.

Sampling *Sites 1*, *2A,* and *2B* were located at the peatland agricultural field and *Site 3* ('spruce bog') in the forested strip of peatland southwest of the cultivated area (see Fig. 2). At *Site 1*, the peat layer was thinner, possibly due to peat shrinkage and compaction by the drainage ditch. *Sites 2A* and *2B* were intended to represent the same stratigraphic sequence (see Vuorela 2002), but in fact they were located at least c 4–5 metres apart; *Site 2A* represents deeper water conditions with thick clayey gyttja and *Site 2B* a more shore-bound location with coarse detritus gyttja accumulated in shallow water. Gravely subsoil was reached at *Sites 1*, *2A,* and *2B*, while the sample monolith at *Site 3* did not reach the bottom. The thickness of fine detritus gyttja ranged between 12.5 cm (*Site 1*) and 100 cm (*Site 3*).

At *Site 1*, the 13-cm-thick cultural layer (at 55–68 cm depth) within coarse detritus gyttja was composed of uncarbonised and carbonised wood and plant remains, hemerophilous pollen flora and low concentrations of mineral matter (Aalto 1983; Aalto et al. 1985). Large amounts of charcoal and seeds of crowberry (*Empetrum nigrum*), wild strawberry (*Fragaria vesca*), common juniper (*Juniperus communis*), red raspberry (*Rubus idaeus*), water chestnut, hazel (*Corylus avellana*), and other useful plants were identified. Both pollen and plant macrofossils suggest a strong occurrence of water chestnut in the cultural horizon in the ditch section. In addition, wild strawberry and raspberry seeds seemed to have been chewed and the hazel and water chestnut shells broken, suggesting their use in human diets (Aalto 1983; Aalto et al. 1985; Siiriäinen 1987; see also Vanhanen & Pesonen 2016). Aquatic plant remains such as water chestnut, water lily (*Nuphar*, *Nymphaea*), pondweed (*Potamoget gramineus*), and lake shore bulrush (*Scirpus lacustris*) were most numerous in the lowest part of the cultural horizon, suggesting a high eutrophication level at Lake Rautajärvi. These species decreased in the upper parts (42.5–55 cm) of fine detritus gyttja and disappeared entirely in the decomposing horizon, suggesting a gradual overgrowing of the southern shore zone. Based on wood remains and tree stumps in peat, the former lake shore became forested over the course of the terrestrialisation process. In addition to plants related to the overgrowing process (e.g. bottle sedge (*Carex*

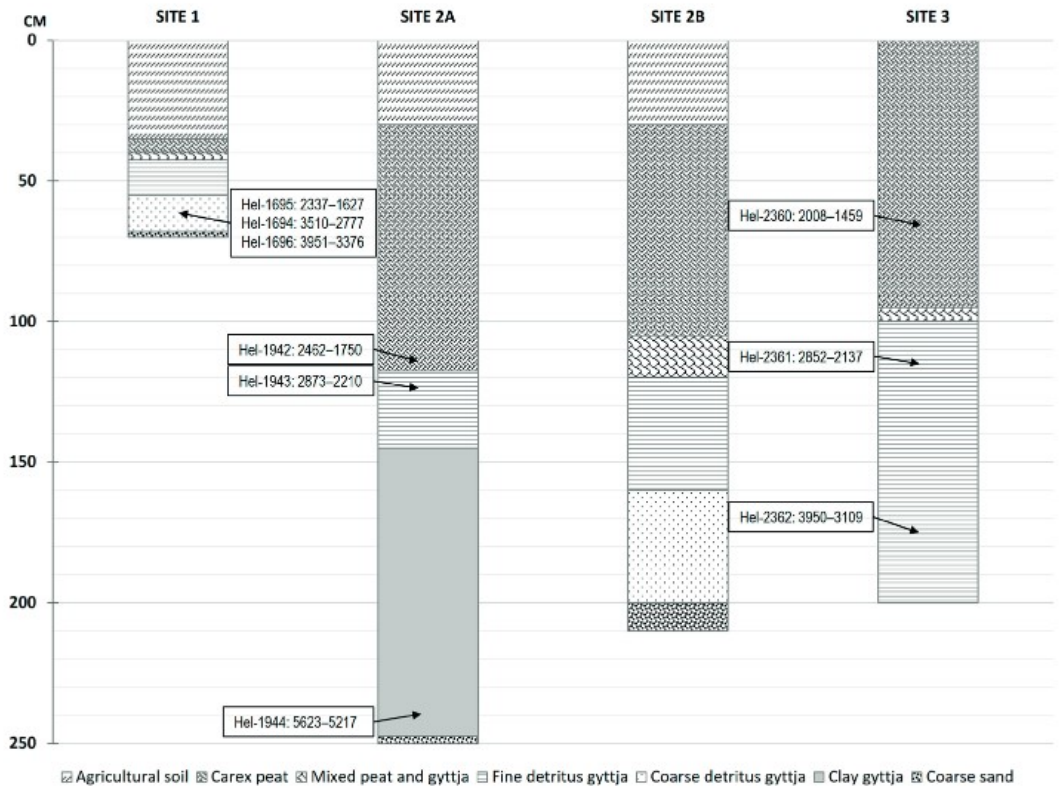

Figure 7. The stratigraphic sequences and calibrated radiocarbon dates calBC (95.4%) at palaeobotanical sampling sites (according to Aalto 1983; Aalto et al. 1985; Vuorela 2002; 1985 field notes). (Figure: Satu Koivisto.)

rostrate), bladder-sedge (*Carex vesicaria*), yellow iris (*Iris pseudacorus*) and tufted loosestrife (*Lysimachia thyrsiflora*)), waterside plants (e.g. lake shore bulrush and hop sedge (*Carex pseudocyperus*)) were also numerous. Of the local treescape, at least common alder (*Alnus glutinosa*) and some other broadleaved trees grew by the lush lake shore. High concentrations of oak, lime and hazel pollen were also observed in the archaeological horizon. Based on palaeobotanical results, the lake has been transgressive and the shore zone along with archaeological remains (at *Site 1*) has been inundated. This has most probably been caused by uneven isostatic rebound and tilting of the lake (Aalto et al. 1985).

At *Site 2A*, the stratigraphic sequence also suggests transgression and subsequent regression (Aalto et al. 1985). The most distinct lake development events in this sample were radiocarbon dated: peat/fine detritus gyttja contact (Hel-1942; Hel-1943) and base of clay gyttja (Hel-1944) (Fig. 7; see also the Datings section below). Only pollen was analysed at this site (Siiriäinen 1983; Aalto et al. 1985; Vuorela 2002). A regularly occurring group of hemerophilous pollen (e.g. nettle (*Urtica*), Cannabaceae/*Humulus*, sorrel (*Rumex*), Chenopodiaceae and water chestnut) and a single pollen of *Cerealia* type point to eutrophic, nutrient-rich lake vegetation and anthropogenic disturbances.

The remaining pollen results from *Sites 2B* and *3*, along with three more radiocarbon event dates (Hel-2360; Hel-2361; Hel-2362) from *Site 3*, were published later (Vuorela 2002). Again, plant macrofossils were not included in this study. The end of the Atlantic period and progressive climatic deterioration were suggested, according to the proportions of tree pollen, (e.g. the elm (*Ulmus*) decline between 3950–3110 calBC, and the diminishing of broadleaved trees and an increase in spruce pollen between

Table 2. Compilation of radiocarbon dates obtained from Järvensuo 1.

Lab ID	BP	calBC (95.4%)	Sample (dated event)	Collection year	Sample location	Depth below surface	References	Archaeological period
Hel-1944	6470±110	5623–5217	Base of clay gyttja (early lake phase)	1982	Site 2A	235–245 cm	Aalto et al. 1985	Late Mesolithic
Hel-1696	4880±120	3951–3376	Charcoal fragments from archaeological horizon in drainage ditch section (human activity)	1982	Site 1	55–68 cm	Siiriäinen 1983	Middle Neolithic
Hel-2362	4790±140	3950–3109	Fine detritus gyttja (lake transgression)	1985	Site 3	170–180 cm	Vuorela 2002	Middle Neolithic
Hel-1694	4430±120	3510–2777	Unworked wood from archaeological horizon in drainage ditch section (human activity)	1982	Site 1	55–68 cm	Siiriäinen 1983	Middle/Late Neolithic
Hel-1004	4210±140	3331–2462	Wooden paddle (K 10496) from drainage ditch (human activity)	1950s (1977)	Ditch	c. 30 cm	Siiriäinen 1983, Edgren 1984	Late Neolithic
Hel-1943	4000±100	2873–2210	Fine detritus gyttja, limnotelmatic contact (lake transgression, Cerealia type pollen)	1982	Site 2A	120–130 cm	Aalto et al. 1985	Late/Final Neolithic
Hel-2361	3930±100	2852–2137	Fine detritus gyttja (lake transgression)	1985	Site 3	115–120 cm	Vuorela 2002	Late/Final Neolithic
Hel-1942	3690±130	2462–1750	Carex peat, limnotelmatic contact (lake regression, paludification, Triticum type pollen at Site 3)	1982	Site 2A	113–120 cm	Aalto et al. 1985	Final Neolithic
Hel-1695	3610±120	2337–1627	Gyttja from archaeological horizon in drainage ditch section (human activity)	1982	Site 1	55–68 cm	Siiriäinen 1983	Final Neolithic/Early Metal Age
Hel-2360	3410±100	2008–1459	Carex peat (more frequent Picea pollen, paludification)	1985	Site 3	67.5–70 cm	Vuorela 2002	Final Neolithic/Early Metal Age

2010–1460 calBC). The lake level appears to have been transgressive up until 2850–2140 calBC, after which it abruptly fell and exposed a wide shoal zone by the southern lake shore. This event changed the landscape profoundly, even though the littoral zone remained watery (Vuorela 2002). Hemerophilous taxa were identified continuously at both sample monoliths, but a slight increase in their occurrence, accompanied with pollen grains of Cannabaceae and *Cerealia* type, was detected in the decomposing horizon in lower peat (Vuorela & Hicks 1996; Vuorela 2002). Another (single) *Cerealia* type at *Site 3* was determined as *Triticum* (Vuorela 2002).

The dating of these two *Cerealia* types of pollen points to the Late Neolithic (Aalto et al. 1985; Vuorela 2002) between 2870–1750 calBC (see Hel-1943 and Hel-1942 in Table 2). The suggested early cultivation (Aalto et al. 1985; Vuorela & Hicks 1996; Vuorela 2002; see also critiques by Simola 1999 and Lahtinen & Rowley-Conwy 2013) thus falls to the ending of the transgression and the following paludification. There are also some other environmental changes coinciding with this phase, such as an increase in light, a slight increase in charcoal values, an increase in hemerophilous pollen flora and a decrease in loss-on-ignition (LOI) values (Vuorela 2002). The changes in LOI may indicate clearing of the lakeside vegetation, which decrease accumulation of organic matter (e.g. Natlandsmyr & Hjelle 2016). During this time, birch, alder and lush undergrowth in the shoal zone replaced the lake shore treescape previously dominated by pine. Erosion and run-off from the littoral zone – the sandy horizons within gyttja (Vuorela 2002: 10; 1985 field notes) – may be associated with human occupancy on the shore (e.g. trampling and clearance of vegetation), as well as wave erosion. All these phenomena together suggest intensified anthropogenic activity by the lake shore during this timeframe, including possible food production.

Dating

The calibrated radiocarbon dates obtained from Järvensuo 1 fall between 5620–1460 calBC (Table 2). There are rather large measurement errors (>±100 radiocarbon years) in almost all of the dates and it is also noteworthy that only one of the dates is actually a direct radiocarbon dating of an archaeological artefact (Hel-1004). The rest of the dates are from bulk organic sediment (peat and gyttja) elucidating the timing of various natural events, such as transgression, regression, changes in vegetation, and paludification, and only a small proportion are terrestrial sources from the archaeological find horizon (fragments of unworked wood and charcoal). The calibrated dates, which may be assumed to reflect prehistoric anthropogenic activity, including the wooden paddle (Hel-1004) and the samples extracted from the archaeological horizon (Hel-1694; Hel-1695; Hel-1696), range between 3950–1630 calBC and thus span over 2300 years. It is interesting, though, that most of the dated materials – wood, charcoal, and bulk organic sediment – originate from the same very thin (13 cm) and distinct cultural horizon observed in the drainage ditch and still result in this enormous chronological interval. The dating samples from the palaeobotanical monoliths as well were extracted from very thick, c 5–10-cm sequences (see Table 2), which, of course, further weakens the resolution of the dates.

In general, stratigraphic dates from peat and gyttja are problematic, because of the vertical penetration of younger roots inside the sediment; this may result in dates that are c 500–1000 years younger than the dating of the layer itself (e.g. Törnqvist et al. 1992 and references therein). Old carbon effect, however, may bias the results in the other direction as well, because the samples include all the organic material in the sediment (see Simola 1999; Lahtinen & Rowley-Conwy 2013). In sum, the stratigraphic dates from Järvensuo 1 should not be considered as reliable and must therefore be evaluated in a larger context. Furthermore, the degree to which natural and anthropogenic factors, such as bioturbation, wave erosion, run-off from drylands, redeposition, as well as the effects of drainage work itself, have distorted the stratigraphy and deposition of dated materials remains undetermined. The most reliable date thus comes from the paddle (3330–2460 calBC), but its exact stratigraphic position is unknown, because it was a chance find in the ditching work. Therefore, the majority of the radiocarbon dates obtained from Järvensuo 1 so far elucidate natural events

and are only suggestive in relation to prehistoric anthropogenic activity.

Context and nature of the site

Even though the fieldwork materials are limited and the finds poorly preserved today, it is possible to update and provide more specifics about some of the information concerning the context and nature of Järvensuo 1. According to the available stratigraphic data, only the northernmost corner of *Trench 1* has been waterlogged, with the upper area in the forest representing merely a terrestrial and/or semi-terrestrial part of the site, which has later paludified. All finds in this trench are of durable materials, pointing to dryland conditions and thus degradation of organics. In addition, quartz waste was found in a test pit nearby the trench. These observations suggest prehistoric habitation on the lake shore. Conversely, *Trench 2* in the peatland field has been waterlogged more or less constantly, because of the good preservation of organics. The fieldwork data confirms that one vertical pile was found in this area. The fragmentary pieces of piles, stakes, and worked and unworked wood may represent dismantled parts of wooden constructions, but their dating, interconnection or function is not possible to determine with the available data. Based on artefactual evidence (the pine laths and fishnet bark floats), it may be suggested that stationary wooden fishing structures were located at Järvensuo 1 when the water level was at an adequate level, and some of the wood fragments could originate from these types of structures. Siiriäinen abandoned the pile dwelling theory already after the 1985 fieldwork (Siiriäinen 1987; University of Helsinki 2020), and current evaluation of the available data does not change the situation. The wetland find area of Järvensuo 1 could represent a 'home shore', where various daily activities connected to the lake have been performed, including fishing, gathering of plants, fetching water, going boating, washing, and dumping of waste. During periods of low water, the flat shoal zone would have served as an easily accessible plateau for performing various activities. However, its use for actual habitation and as a base for dwelling constructions is still not supported by the current data.

The scales of inundation and the drying up of the littoral zone have varied through time and the lower archaeological horizon on gyttja/gravely lakebed contact and the upper one on lower peat/gyttja contact suggest anthropogenic activities in the shore zone during periods of low water. Based on the intermediate matrix between these two, the findless and homogenous, fine detritus gyttja, the water level of the lake rose quite rapidly and reached the upper limits of the site during the transgression maximum between 2850–2140 calBC. In small eutrophic lakes like Rautajärvi, the sedimentation rate is usually extensive and the accumulation of gyttja may begin already near the shore (Pajunen 2005). In the course of overgrowing, peat expanded in the mineral soil (in the area of *Trench 1*) through the process of secondary paludification (e.g. Huttunen & Tolonen 2006) and covered the sandy surface. The upper cultural horizon discovered during the 1985 excavations was supposed to represent a later, presumably Early Metal Age habitation phase (Siiriäinen 1987; University of Helsinki 2020). However, according to the available (stratigraphic) dates and find types, this horizon would merely fall to the end of the Late Neolithic, sometime between 2460–1750 calBC. The lower one would extend to the Middle Neolithic, roughly between 4000–2800 calBC (note uncertainties in the dated materials in Table 2). Proper stratigraphic studies and systematic dating of carefully chosen materials, however, would clarify these estimates considerably.

If we consider Järvensuo 1 and its materials in a slightly larger context, some clues may be found about the importance of Lake Rautajärvi and its prehistoric settlement. In the early millennium, a dryland site was discovered on the nearby hilltop of Kuoppanummi, which has presumably been occupied (based on pottery) from the late 4th to the early 2nd millennium BC (Pohjakallio 2005), contemporaneously with the wetlands findings. In addition, the Järvensuo 2 site, c 500 m east from Järvensuo 1, has also been occupied in the long term and together with Järvensuo 1. Based on archaeological materials (Pesonen 2008; Finnish Heritage Agency 2020b), the settlement pattern at Lake Rautajärvi may be suggested to have been mobile and periodic, and the economy related to seasonally abundant lake

resources, especially freshwater fish (e.g. pike and cyprinids) and nutrient-rich plants such as water chestnut and hazel. According to available osteological data (Pohjakallio 2005), beaver, elk and waterfowl also had certain economic importance. In general, sherds of pottery at the dryland sites are very small, fragmentary and mixed in the cultural layer, and they comprise nearly all Neolithic and Early Metal Age pottery traditions of the region (e.g. Early, Typical and Late Comb Ware, Corded Ware, Pyheensilta Ware, Kiukainen Ware, Textile Ware, and possible local variants of these groups) (Pesonen 2008). In general, the number of known Stone Age sites in south-west Häme is rather low. Currently, the densest cluster of findings comes from Lake Rautajärvi (Pesonen 2008) and it may thus be assumed that this type of lake has constituted an important resource base for prehistoric populations and been utilised intensively and actively over the long term (for several millennia).

Eastern Baltic peatland settlements have been referred to in connection to Järvensuo 1 since its discovery in the 1980s (Siiriäinen 1983; Aalto et al. 1985); no similar sites were known in Finland by that time. In the 1990s, a systematic wetland survey in Riihimäki area, southern Finland, yielded a few sites in overgrown lake habitats with some similar characteristics to Järvensuo 1 (Matiskainen & Zhilin 2003; Matiskainen & Ruohonen 2004). After that, practically no new discoveries have been made and, therefore, comparative materials in Finland to Järvensuo 1 are very few or nonexistent. Consequently, it is still easy today to direct attention to the north-east European wetland sites and their rich organic material culture, but this may also be a question of preservation and archaeological activity. We cannot be sure if Järvensuo 1 and its organic assemblages may actually exemplify a very 'standard' lake settlement type for this period in Finland, one that we are simply just not (yet) aware of. Similarities in the design and function of the organic artefacts (e.g. fishnet bark floats, lath screen fishing structures, paddles, and wooden zoomorphic utensils) are conspicuous, and certain cultural familiarity is evident within this region. In addition to the material culture, there are certain similarities in the setting and long-term use of sites located by the shores of shallow and small lakes with fluctuating water levels, which could be associated with certain economic and cultural traditions. In the eastern Baltic and north-west Russia, the phenomenon has been identified to begin in the Early Neolithic and continue to the Early Metal Age and Bronze Age (e.g. Dolukhanov & Miklyayev 1986; Bērziņš 2008; Mazurkevich et al. 2009; Mazurkevich 2014; Charniauski & Kryvaltsevich 2011; Kulkova et al. 2016). Many of the eastern sites have yielded evidence of pile dwellings and the construction and settlement phases have been more active during periods of lower water levels (e.g. Dolukhanov & Miklyayev 1986). Even though we do not currently have any concrete evidence of the existence of pile dwellings at Järvensuo 1, the site bears many other characteristics (e.g. site location, settlement pattern, material culture, economy, and chronological range, to mention just a few) which could be linked within the north-east European lake settlement phenomenon. How typical these types of sites and organic material culture record have been in Finland during the Neolithic is another question, however, and it calls for thorough further study. The active and long-term use of lake environments may be linked to the economic shift towards more intensive utilisation of freshwater resources, beginning already in the mid-5th millennium calBC, as observed, for example, in a number of organic residue studies of Neolithic pottery in Finland (Pääkkönen et al. 2016; Mökkönen & Nordqvist 2019). If preserved, large numbers of similar lake sites must still exist in the inadequately explored Finnish wetlands and Järvensuo 1 may represent only the tip of the iceberg.

CONCLUSIONS

The paper presents an update and evaluation of the archaeological and palaeoenvironmental materials associated with the wetland archaeological site Järvensuo 1, south-west Finland, which was found by chance through drainage work in the 1950s and excavated preliminarily in the 1980s. Most of the ideas concerning the character and context of Järvensuo 1 were put forward already before the small-scale wetland excavations were conducted at the site in 1985. Because of the incompleteness of the post-excavation work, the results of the fieldwork never

reached the scientific community and many of the preconceived ideas about the site have remained unchanged and unchallenged for several decades. After 35 years, in 2019, a new project was launched and the available data associated with the site and its materials has been identified and evaluated and will now be presented as a whole for the first time in this paper. The fieldwork data from the 1980s is scanty and limited, and the organic finds are today in poor condition. Still, its thorough analysis reveals that the excavations in 1985 covered a small area of the core find area (c 20 m^2 in total, of which only four m^2 were situated in the wetland). Two cultural horizons were observed in the shore zone: an older one (roughly c 4000–2800 calBC) in coarse detritus gyttja between lakebed gravel and peat, and a younger one (c 2500–1750 calBC) in lower peat, which accumulated in the southern shore zone after the lake regression. Circa 60 % of the material culture record at Järvensuo 1 comprise (preserved) organic materials, which include two wooden paddles, pine bark net floats, fragments of lath screen fishing structures, and pieces of worked wood, along with pottery, lithics and unburnt bone. The pottery represents mostly organic- and mineral-tempered Typical and Late Comb Ware styles of the interior of Finland, which fall to the late 4th and early 3rd millennia calBC. Two single pollen of *Cerealia* type have been found from the site and suggest Late Neolithic (c 2870–1750 calBC) cultivation; however, there is no plant macrofossil evidence confirming this. Most of the radiocarbon dates obtained from the site reflect natural events and contain huge measurement errors; only one is a direct dating of an archaeological artefact (the paddle K10496), which falls to 3330–2460 calBC. The nature of the Järvensuo 1 assemblage points to various household and economic activities practised in the prehistoric shore zone: fishing, gathering of plants, fetching water, going boating, washing, and dumping of waste. In earlier publications (Siiriäinen 1983; 1987; Aalto et al. 1985), post constructions and even pile dwellings have been referred to in connection to Järvensuo 1. Based on available data, one vertical pile has been encountered in the wetland part of the site, in addition to a few fragmentary pieces of piles and stakes, but their function, interconnection or other characteristics remain undetermined.

In the future, it would be interesting to study whether the utilisation of Järvensuo 1 was continuous or if there were hiatuses in the occupation periods and why. Food crusts in pottery would also yield useful materials for various dietary studies and AMS dating, as well as support isotopic and biomolecular approaches. Morphological identification of the unburnt bone is no longer possible at a species level, but the use of ZooMS (Zooarchaeology by Mass Spectrometry) may still be applicable and allow species determination (Hendy 2021). In addition, studies concentrating on freshwater reservoir effect (FRE) offsets would yield important background material for research concerning the use of terrestrial versus aquatic resources, as well as determining which dates are most accurate and relevant. New fieldwork, wetland monitoring and multidisciplinary research in the ongoing project will potentially reveal novel aspects about the site and its sedimentary archive and – in the end – provide long-awaited baseline data to evaluate the state of preservation and future scientific potential of this interesting and extremely vulnerable archaeological site. Moreover, most importantly, there is enormous potential for similar wetland sites still to be discovered at Lake Rautajärvi. The sedimentation circumstances have been similar in other areas, at least on the southern lake shore, and similar occupation zones could be sought via systematic coring and test pitting, especially in semi-terrestrial areas between peatland and mineral soil. The large number of (organic) stray finds collected by local people during drainage work over the decades bodes well for this field.

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