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Testing of archaeological survey at peat extraction sites at Southern Lake Saimaa, South-East Finland

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Abstract

Peatlands constitute central habitats for the occurrence of wetland archaeological sites. Consisting of waterlogged organic soils, they also provide advantageous conditions for the preservation of organic materials. The economic utilisation of peatlands has been extensive and long-lasting in mire-rich Finland. Archaeologists urgently seek to develop viable techniques for detecting, monitoring, and studying peatland archaeological sites, before they are deteriorated. One option is to conduct fieldwalking at commercial peat extraction sites, which was opportunistically tested in the detection of Mesolithic sites at southern Lake Saimaa by the University of Helsinki in 2015. In this paper, the main observations and challenges of the survey are reviewed and suggestions for further testing are presented.

Keywords: Lake Saimaa, transgression, peatlands, Mesolithic, archaeological survey.

36.1 Introduction

Finland is one of the most mire-rich countries in Europe: approximately one third of the total land area is covered in peatland deposits (Seppä 2002). Consequently, peatlands also constitute central habitats for the occurrence of Finnish wetland archaeological sites (Koivisto 2017). Consisting of waterlogged organic soils, they also provide advantageous moist, anoxic conditions for the preservation of organic materials. The paludification history of Finland is closely connected with past climate and precipitation. The initiation of mires has been intensive during climatically moister periods, for example in ca. 10 000–9000 calBP and from ca. 6500 calBP onwards (Korhola 1995: 43–58). In advantageous locations, archaeological sites may have been buried in peat through various natural processes, such as isostatic land uplift and transgressions. The unusual preservation conditions for organic materials within these sites provide valuable sources for investigating past populations and their material culture record, subsistence, and environmental setting.

Peatlands constitute the largest natural carbon store on Earth. Despite this, their economic utilisation for energy production, peatland forestry, and agriculture has been extensive and long-lasting throughout the world. Mire-rich Finland is not an exception in this context – quite the contrary. It

Figure 36.1. An overview map of lower Lake Saimaa and the transgression maximum just before the outburst of the Vuoksi River ca. 5700 BP. Red dots indicate the surveyed peat extraction sites: 1 – Suurisuo. 2 – Vehkataipaleensuo. 3 – Kiihansuo. Map Hannu Pajunen/Geological Survey of Finland. Visualisation S. Koivisto.

has an especially grim reputation for using peat for energy, even though this causes high greenhouse gas emissions and significant water pollution. The majority of peat extraction sites in Finland were established after the Second World War for boosting domestic energy production. In 2021, after several decades of degrading peatlands, the Finnish government finally decided that the use of energy peat is to be at least halved by 2030 as part of its emissions-cutting plan (Ministry of the Environment 2021). From the archaeological point of view, drainage, afforestation, agricultural reclamation, and peat extraction also cause immediate threats to the preservation of archaeological sites situated in peatlands. The areas with the highest potential for encountering hitherto unknown sites are those that have been most heavily disturbed by the above-mentioned actions.

Because of this, archaeologists urgently need to develop viable techniques for detecting, monitoring, and studying peatland archaeological sites. One option is to conduct fieldwalking in vast open areas – at commercial peat extraction sites. This approach has been practised successfully in Sweden for some decades already, and dozens of Mesolithic and Neolithic sites have been found through systematic survey and trial excavations (e.g. Hallgren 2015; Larsson & Sjöström 2013). Taking inspiration from the Swedish example, this approach was also opportunistically tested at southern Lake Saimaa (south-east Finland) in the 'Lost Inland Landscapes' project by the University of Helsinki in 2015. In this paper, the main observations – and challenges – of this novel approach are reviewed and suggestions for further testing and the integration of methods are presented.

36.2 Holocene development of southern Lake Saimaa

After isolation from the Yoldia Sea ca. 11 000 years ago, the water level of Lake Saimaa was much lower than today; in the south-easternmost parts of the lake, it could be almost 20 m below the present levels (Pajunen 2005). Due to uneven isostatic land uplift and the consequent tilting of the lake, the Saimaa basin continued to transgress towards the south-east, which led to the submergence of extensive former dryland areas (e.g. Pajunen 2005; Saarnisto 1970). Between ca. 6000 and 5700 calBP, the south-easternmost part of the lake – the so-called lower Lake Saimaa – reached its maximum extent, ca. 730 km^2 in size, representing an 11-fold increase relative to the earliest lake phase (Pajunen 2005)

(Fig. 36.1). By ca. 5700 calBP, the outburst of the Vuoksi River in the south, i.e. the emergence of a new outflow channel to Lake Ladoga (e.g. Mökkönen & Nordqvist 2014 and references therein), ended the transgression and lowered the water level of Lake Saimaa abruptly.

Climatic conditions, groundwater levels, and geological characteristics have regulated the paludification history of Lake Saimaa. The seepage of groundwater through the two end-moraine formations demarcating the lower part of Lake Saimaa – the First and Second Salpausselkä ridges – has also promoted paludification at their perimeters. The carbon content of the lake sediments has been observed to be higher at Saimaa compared with other Finnish lake environments because of considerable erosion and run-off from lakeshores (Pajunen 2005: 268). Because of the transgression, the lower Lake Saimaa area contains very few archaeological sites predating the outburst of the Vuoksi River, i.e. sites from the Mesolithic and Early Neolithic (ca. 10 700–5700 calBP). In theory, if preserved, such sites would be found under water or buried in peatlands surrounding the lake. Signs of these 'lost inland landscapes' have been discerned in the present-day lakebed in the form of, for example, underwater peat layers and submerged tree stumps that are still *in situ*. The underwater features yield valuable information on changes in the shoreline position and earlier lake levels. Geologists have investigated the extent and dating of some of these features in order to discover the early Holocene sedimentation history of Lake Saimaa (Pajunen 2005). However, the preserved underwater habitats would also provide excellent subjects for the detection of Mesolithic archaeological sites (e.g. Bailey et al. 2020).

Research focusing on the submerged Mesolithic and Early Neolithic archaeology at lower Lake Saimaa has been strikingly scarce despite the fact that all the securely dated underwater tree stumps have yielded early and middle Holocene dates, ca. 9500–6700 calBP (Heikkinen 1971; Koivisto 2018a). Based on palaeobotanical data (Vuorela & Kankainen 1993), anthropogenic impact on the local environment began ca. 8000 calBP. Interestingly, the majority of the hitherto known Stone Age sites in this area (although in dryland locations) are from ca. 6000 calBP and onwards (Finnish Heritage Agency 2021), post-dating the transgression and the outburst of the Vuoksi River. Based on the known Early Mesolithic (ca. 10 000 calBP) coastal Ancylus Lake sites further south-east of the study area (Jussila et al. 2012), it may be presumed that earlier human habitation has been present also at lower Lake Saimaa. A few sporadic clusters of quartz have been discerned in shallow water conditions in this area (Jussila 2007; Koivikko 2000), but it has not yet been possible to confirm whether they represent actual cultural layers *in situ* or eroded and redeposited materials from nearby dryland sites (from later periods) (Koivisto 2018a). In sum, to date there has been no certainty – or consensus – about the existence and preservation potential of submerged and paludified Stone Age sites at lower Lake Saimaa.

36.3 In search of lost inland landscapes

A three-year project by the University of Helsinki, 'Lost Inland Landscapes LIL' (in 2015, 2017–2018; principal investigator Marcus Hjulhammar), aimed to open a new chapter in the prehistoric lake archaeology of Finland (Koivisto 2018b). The overarching goals of the project were to: (1) explore and evaluate the preservation potential of submerged Stone Age archaeology at southern Lake Saimaa, (2) test the applicability of underwater and wetland fieldwork methods in lake environments, and (3) outline directions for future research.

The first part of the project, in 2015, consisted of a desk-based evaluation and field survey concentrating on peatland and shallow water conditions at lower Lake Saimaa. Geophysical testing, peat coring, underwater survey, and wetland excavations followed in 2017–2018 at Lake Kuolimo in

Savitaipale. This lake was a part of the ancient Lake Saimaa during transgression. Underwater survey and wood sampling at the submerged 'Mesolithic forests' at the Sarviniemi cape in Taipalsaari were performed in 2017.

The aims of the desk-based evaluation and field survey were to create an overall picture of the study area and to locate potential areas for conducting more targeted fieldwork. Some less ordinary approaches were also tested during the survey in 2015, such as fieldwalking and coring at three commercial peat extraction sites at lower Lake Saimaa.

36.4 Peatlands and archaeology

The same factors that preserve and protect organic archaeological remains in moist, anoxic conditions also make them very hard to locate via archaeological survey. So far, very few attempts have been made in Finland to systematically detect and prospect archaeological sites buried under peat (Koivisto 2017 and references therein; Koivisto et al. 2018). On the northern European scale, a number of wetland evaluations and palaeolake studies have been conducted with the help of methods such as archaeogeophysics and topographic modelling and by allocating fieldwork to potential areas (see Bergman et al. 2003; Lagerås 2003). Another possibility has been introduced by cooperation between archaeologists and peat extraction companies with the aim of creating opportunities for systematic fieldwalking and trial excavations between peat extraction periods (Hallgren 2015; Larsson & Sjöström 2013).

In the Finnish peat industry, the main product is milled peat, which is harvested through mechanised milling from the dried-out surface of an extraction site. After milling, the loosened peat is left to dry out for a few days, after which it is harvested and stockpiled. Profitable production requires establishing extraction sites in areas where an adequate amount of high-quality peat is ensured in the long term. The key refining products of milled peat are energy pellets and briquettes, and, to a lesser volume, horticultural peat. Partly decomposed *Sphagnum* peat is also used for litter production in cattle farming and agriculture. The peat investigations conducted and managed by the Geological Survey of Finland (2021) direct the selection and utilisation of peat resources.

Prior to the survey in LIL, the paludification history of southern Lake Saimaa was carefully explored with the help of the coring data provided by the Geological Survey of Finland, as well as other relevant GIS data, reports, and publications. Most of the peatlands in the study area have been deposited on moraine and clayey depressions in the landscape. In places, the peat thickness is rather extensive; for example, peat layers thicker than 8 m with an accumulation rate of ca. 1 mm per year have been recorded at the Kiihansuo mire in Savitaipale (Mäkilä et al. 1984). However, the rate of paludification has varied considerably over time because it depends heavily on prevailing climatic and hydrological conditions. Today, the majority of peatlands in the study area are drained to facilitate forestry and agriculture or they are transformed into peat extraction sites.

Three study sites – the Kiihansuo mire in Savitaipale and the Suurisuo and Vehkataipaleensuo mires in Taipalsaari (see Fig. 36.1) – were chosen and opportunistically surveyed in 2015. They all represent shore mires of the ancient Lake Saimaa, and the transgression maximum has at least partially extended the sites. Vast open surfaces at the extraction plots allowed the inspection of larger areas and deeper surfaces. The state-owned company VAPO (today Neova Ltd) manages all the sites and extracts peat mainly for energy production purposes. Both milled and sod peat are produced at the sites. The company granted archaeologists permission to access the sites and conduct the survey in 2015.

A number of challenges were already acknowledged before accessing the sites, mainly related to 'being in the right place at the right time', namely the chances of inspecting the archaeologically relevant depths and areas at the time of the survey. Even though the mission was deemed uncertain and dependent on many external factors, the approach was considered worth trying in order to be able to evaluate its relevance to Finnish peatland archaeology and identify directions for further testing. An important motivation was the encouraging example from neighbouring Sweden, where dozens of Mesolithic and Neolithic sites (with preserved organics) have been detected by means of similar surveys (e.g. Hallgren 2015; Larsson & Sjöström 2013). However, ongoing peat extraction is destroying the detected sites in southern Scania and Östergötland.

36.5 A needle in a haystack

The first study site, the Suurisuo mire in Taipalsaari, is located at the foot of the Second Salpausselkä Ridge (see Fig. 36.1). This area contains several small mires that have accumulated on the margin plateau of the moraine ridge. The peat extraction site of 390 hectares was established at Suurisuo by VAPO in 1979 (Ritari 2013). The peat depth varies between 1 and 2.4 m, with the greatest recorded depth of ca. 6 m in the middle of the mire (Rainio et al. 1984). The second study site, the Vehkataipaleensuo mire, is located in the village of Paarmala, ca. 10 km north-east of the city of Lappeenranta. Peat production commenced here in 1999, and in 2015, ca. 67 hectares were being actively extracted. The third study site, the Kiihansuo mire, is situated on the southern shore of the Lavikanlahti bay of Lake Saimaa, ca. 5 km south-east of Savitaipale. The ca. 72-hectare extraction site was established in 1999, and its greatest peat depth is ca. 8.3 m. The most common subsoil types here are clay and sand; gyttja has also been recorded in the middle of the mire, suggesting earlier lake phases (Mäkilä et al. 1984).

Figure 36.2. Fieldwalking in progress at the Suurisuo mire in Taipalsaari. Peat mining is extremely sensitive to weather conditions and is carried out only during the summer months. After extensive drainage, the dried-out surface is mechanically milled and harrowed with heavy machines. Photo S. Koivisto.

Figure 36.3. Determining the peat depth at the Kiihansuo mire in Savitaipale in July 2015. Professor Mika Lavento and Satu Koivisto applying a small 'Russian' peat corer. Photo T. Rostedt.

At the Suurisuo site, two production plots of ca. 6 hectares in total were fieldwalked by five people (Fig. 36.2). The production of peat was about to end in 2015 because of the abundance of wood and stones at the perimeters of the extraction plots. The surface peat was in an extremely dry and loose state after being milled recently. The archaeological 'hotspots' – the mineral-rich islands and shore formations under peat – were systematically fieldwalked and a series of test pits and corings were made in potential locations. Despite all this effort, very few archaeologically relevant observations were made, including a vein of quartz in a boulder at the south-east edge of a mineral-rich island, where large quantities of quartz were observed scattered in a distinct area. However, already in the field it was concluded that heavy milling machines might have produced most of the pieces.

At the Vehkataipaleensuo site, a systematic fieldwalking regime was developed and tested in an area of about 4 hectares. It was observed that drainage ditches were dug at ca. 15-m intervals in the production plots, which meant that by walking on the ditch margins, 15-meter-wide blocks of the milled surface and the ditch sections could be inspected at the same time. No major discoveries were made at this site either, except for a possible piece of worked wood, which was lying in a strait between two mineral-rich capes. The piece of wood had a tapering end and measured ca. 80 x 25 x 12 cm. It was halved, and its flat surface had several tool marks. It was possibly worked with an axe or a chisel, or it may have been run over by a milling machine.

At the Kiihansuo site, one production plot of ca. 4 hectares was selected and surveyed. Again, the margins of the ditch sections were systematically walked, and a number of potential areas were cored (Fig. 36.3). However, it soon became obvious that only about 1 m of surface peat was extracted from the inspected area, even though the maximum depth of the mire is ca. 8 m in its middle. Thus, the most potential depths for encountering Mesolithic archaeology may be assumed to lie deeper in the peat, if preserved. Similar conclusions were made at the two other test sites as well.

Even though the results of the LIL survey were tentative and preliminary, the work still yielded valuable experiences and useful insights into the potential of this approach to be tested and developed further in the future. One of the greatest challenges was posed by the enormous dimensions of the production sites (see Fig. 36.2), which were surveyed by a small number of people. Another surprising element was how little peat has been removed from the production plots so far, even though most of these plots were established already decades ago. In the shallow harvesting method applied by VAPO, only the topmost 1–2 m of peat accumulated in the last ca. 4000 years or so have been removed as yet. The extensive drainage networks ensure that the uppermost layers are completely dried up, which causes the shrinkage and compaction of surface peat. Consequently, if archaeological organic remains were still deposited within these layers, they would most probably degrade in the course of the drainage process or, at the latest, during peat milling, which breaks the surface systematically with heavy machines. In theory, the archaeologically relevant layers may still be deposited and preserved at greater depths at the study sites, but systematic drainage constantly lowers the water table, and the degradation of the organic remains is only a matter of time.

36.6 Lessons learned and some future prospects

Systematic fieldwalking along with coring and testpitting were preliminarily tested at three commercial peat extraction sites at southern Lake Saimaa (south-east Finland) by the University of Helsinki in 2015. The main aim of the 'Lost Inland Landscapes' project was to detect and study submerged and paludified prehistoric sites in a transgressed lake environment. The majority of Mesolithic and Early Neolithic sites – those predating the outburst of the Vuoksi River ca. 6000–5700 calBP – at southern Lake Saimaa have been submerged or paludified because of transgression. The archaeological survey at peat extraction sites was preliminarily tested in the project in order to investigate its relevance and applicability in Finnish peatland archaeology.

One of the obstacles hindering the survey may be associated with the shallow harvesting method applied by VAPO, where only a thin layer of surface peat is milled per season. After extensive drainage and mechanised milling, the peat is in a very dry state and all organic remains it contains are shattered and degraded. In addition, the enormous sizes of the production areas also present challenges to any systemised archaeological approach. Still, valuable lessons were learned. Careful planning, the exploration of geological data, and the reconstruction of the landscape are essential in the preliminary phase – and a lot of hard work with an adequate number of surveyors is required on site. In addition to these 'manned' approaches, unmanned aerial vehicles (UAV), such as drones, could also be applied to survey and monitor potential areas remotely, but the decomposition and breakage of fragile organic remains would still hamper identification. Archaeological surveillance of the drainage work – prior to the milling of peat itself – could be optimal, but it would require close cooperation and an open atmosphere between archaeologists and the peat extraction industry.

Despite the fact that there are huge peatland areas in Finland, there is still no systematic agenda in the heritage management regime for managing and securing the preservation potential of wetland archaeological sites. Systematic surveys in potential areas (including peat extraction sites), trial excavations, well-designed projects, prospecting the find spots of stray finds, cooperation, and extending dryland fieldwork to nearby wetlands are only some suggestions for how to proceed. The deterioration of the fragile sites due to drainage and the effects of climate change is the most significant reason why wetland archaeology is more topical today than ever before. If we do not respond to this challenge rapidly, future generations may not have much left to study.

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