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Minerva Piha

SAAMI LANGUAGE POLICIES IN SAAMI ARCHAEOLOGICAL RESEARCH: PERSPECTIVES ON RESEARCH PUBLISHED IN FINLAND

Abstract

This article aims to determine what the use and non-use of Saami archaeological terms – for example, for different types of burials, dwellings, sacred sites, and artifacts – reveal about language policies in Saami archaeological research published in Finland from 1970 to 2019. The research data consist of Saami archaeological works published in scientific publication forums, such as archaeological and multidisciplinary journals, and publication series. The data contained 138 Saami archaeological publications. From the data, I collected the used Saami terms using the method of content analysis. The analysis of the data reveals that 65 different Saami terms were used in 63 publications. Thirty-nine of the terms were used only in one publication, and only five terms were used in more than ten publications. According to analysis, there were no formal policies or norms on how Saami terms should be used in archaeological research.

SAEMIEN GÏELEKONVENSJOVNH SAEMIEN ARKEOLOGIJEN DOTKEMISNIE: PERSPEKTIJVH DOTKEMI BÏJRE MAH LEAH SOEMESNE BÆJJOEHTAMME

Iktedimmie

Daennie artihkelisnie goerehtem maam saemien termi pråvhkoe jïh ov-pråvhkoe arkeologijisnie gïelekonvensjovni bïjre soptseste. Saemien arkeologijen termh, v.g. ov-messie gaelmieh, årromesijjieh, bissiesijjieh jïh artefakth, daeverh mah arkeologijen dotkemisnie gååvnese. Manne daatam – dejtie saemien arkeologijen termide – arkeologijen jïh multidaajroen publikasjovnijste, goh aejkietjaalegijstie jïh dotkemeraajrojste, tjöönghkeme mah Soemesne bæjjoehtamme jaepeste 1970 jaapan 2019. Daatesne 138 saemien arkeologijen publikasjovnh, jïh manne sisvegen goerehtimmien vuekiem nuhtjeme gosse saemien termh tjöönghkeme jïh goerehtamme. Daatan goerehtimmie vuesehte 65 ov-messie saemien termh 63 publikasjovnine nuhtjesovveme. Golmeluhkieuktsie termh ajve akte publikasjovnesne, jïh ajve vïjhte termh jienebe goh luhkie publikasjovnine. Daate goerehtimmie vuesehte ij gååvnese naan byjjes gïele- jallh termenjoelkedassh guktie saemien termh arkeologijen dotkemisnie nuhtjedh.

Keywords: Indigenous Archaeologies, Language policies, Saami archaeology, Sápmi, Terminology

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INTRODUCTION

In this article, I examine the language policies that concern the Saami[1] languages in archaeological research published in Finland. My goal is to determine what the use and non-use of Saami archaeological terms reveal about language policies in Saami archaeological research. To answer this question, I also consider the following questions: Which Saami terms have been used in archaeological research published in Finland? How has the term use changed from 1970 to 2019?

Central concepts in this article are the terms that are used to name different types of archaeological cultural heritage, such as different types of burials, dwelling sites or structures, sacred sites or structures, artifacts, or landscapes. To be more precise, I study the terms in Saami languages that name different types of archaeological cultural heritage. In this study, I call such terms *Saami terms*. *Archaeological cultural heritage* denotes relics, structures, strata, artifacts, and other finds that are discovered in the earth or in the water and have originated as a result of human activity in prehistoric or historical times (Ranta 2021). Thus, *Saami archaeological cultural heritage* refers to such remains that have a connection to the Saami people.

The use of Saami terms is the basis for the language policies examined in this article. The research on Saami archaeological cultural heritage is often conducted by non-Saami archaeologists who have no formal education in any of the Saami languages. The research is often published in English, Finnish, Norwegian, or Swedish.[2] However, different types of Saami archaeological heritage have – naturally – names in Saami languages, as they are parts of the cultures of Saami societies in which Saami language use was the norm in the past, before the forced assimilation of the Saami into the major societies of Finland, Norway, and Sweden (see Huuva & Blind 2016; Lindmark & Sundström 2016; Ranta & Kanninen 2019; Høybråten 2023). The use of foreign languages to research and present the Saami past is also partly the consequence of the forced assimilation and colonization of the Saami.

This article is not archaeological by its methods or data. However, it is related to archaeological subdiscipline *Indigenous archaeologies*. Since the 1990s, Indigenous archaeologies has gained weight in the field of western archaeology. The idea behind Indigenous archaeologies is that archaeological thought is influenced by Western colonialism even today, which influences the research and interpretations of the past of Indigenous peoples. The aim of Indigenous archaeologies is to decolonize archaeological research and reach the views of the Indigenous peoples on their own past and on the research of their past before and after colonization. (E.g., Hart et al. 2012; Martinez 2014.) This article is an attempt to be a part of decolonization of the archaeological research of the Saami people, who are the only Indigenous people in the European Union. It will make visible the ways in which Saami terms have been (or have not been) used. In addition, I hypothesize that changes in the use of Saami terms are most likely connected to the development of Indigenous archaeologies and the (de)colonization of the Saami. Thus, I believe that along with the development of Indigenous archaeologies, Saami term use has increased.[3]

A note on the researcher's positioning and motivation to do this research

Why am I writing this study? I identify as Finnish by ethnicity and mother tongue. Thus, I am a member of the majority population that has, in the past – and to some extent even today – colonized and oppressed the Saami people. Today, I work in an institution as a researcher of South Saami past and a teacher of South Saami language.

My years of work with Saami people, culture, and language have taught me that some of my mental patterns have been that of the majority population, and without knowing it, I have most likely perpetuated such patterns in many situations. This realization has led me to work hard to remove such patterns from my mind and actions, even though I understand that as a non-Saami person, I will never understand wholly what the Saami people have had to go through. However, this research is one way for me to try to change my mental patterns and help other non-Saami researchers working with Saami culture recognize and change similar patterns and, hopefully, advance the decolonization of Saami archaeology and the Saami past.

I have talked with many Saami about the topic of this research, and they find it important that their archaeological cultural heritage is discussed in words they themselves use in their languages. One such occasion arose in the symposium 'Sacred Place Names in Sámi Landscapes' in the Arctic University of Norway in 2019 in which I addressed these questions (Piha 2019). Using Saami terms for a particular concept will reveal much more about its function and nature than terms in foreign languages (see also Kaikkonen 2020: 2–3). Foreign terms are important from an archaeological perspective for ensuring that international archaeological terminology is available and comparison of remains in different areas is made easier.[4] However, Saami archaeology should first and foremost be researched for the Saami people, and such a perspective needs Saami terms.

Structure of the article

The structure of the article is as follows. First, I will present the data of the research, i.e., the Saami terms that I have collected from archaeological research published in Finland, and the method used to collect and analyze the data: content analysis. Then, I will move on to analyze the terms. I will present the Saami terms used in archaeology and examine changes in term use from 1970 to 2019. In the next chapter, I will then discuss what kind of policies there are for Saami term use in archaeological research. It seems, however, that there are no policies or norms for Saami term use at all, or if there are, they are silent and non-systematic. Finally, I will ponder the steps toward decolonized term use in Saami archaeology and present future plans to achieve these steps.

DATA AND METHODS

Data: Archaeological research publications published in Finland

The data of this research are scientific publications that address questions of Saami archaeology. I have limited the data of this paper to archaeological research published in the best-known journals and publication series in Finland. I will conduct similar data collection in Norway and Sweden in the future, as well as in international publication forums that are published outside of these three Nordic countries.

The journals and series included in the data are presented in Table 1. The publication forums included in the data consist of archaeological and multidisciplinary series and journals that contain significant contributions to Saami archaeology. As seen in Table 1, the first solely archaeological journals included in the data were established only in the 1980s in Finland. Before that, archaeological research was published in multidisciplinary journals, such as *Suomen Museo/Finskt Museum* and *Faravid*. The multidisciplinarity of the journals limited the amount of archaeological research published, and perspectives on the Saami past would have been even more limited.

To date, only two purely Saami archaeological PhD dissertations have been published (Äikäs 2011 and Nylander 2023), and only one of these falls within the research period (1970–2019) of this paper. However, I included three other PhD dissertations that are significant to Saami archaeology because they include elements of Saami archaeology in their research in the data although they also handle non-Saami archaeological questions.

Only archaeological research done by researchers with formal education in archaeology (MA or PhD) were included, both in multidisciplinary and archaeological journals and series.[5] If an article was done in multidisciplinary cooperation, it was included in the data only if the first author had a formal education in archaeology. Furthermore, in these publications, not only researchers affiliated with institutions in Finland publish their research but also researchers affiliated in institutions in other countries. I limited the data to research done by researchers affiliated with institutions in Finland, Norway, and Sweden.

From these journals and publication series, I went through scientific articles, review articles, discussion articles, articles based on scientific presentations, essays, and monographs to look for Saami terms. I did not include the following types of texts: book or exhibition reviews, travel reports, conference reports, columns, editorials, texts based on *lectio praecursoria*. Of PhD dissertations that

Table 1. Journals and publication series published in Finland that were included in the data. The first row presents academic archaeological PhD dissertations that were done at the Universities of Helsinki, Oulu, and Turku in Finland. Some were published by the universities, while other monographs were published in archaeological publication series, such as Monographs of the Archaeological Society of Finland. *The last column of the table indicates whether a publication forum uses peer review. A question mark in this column indicates that I have not been able to find information about the peer review process or the lack of it.*

Name of the journal/series	**Archaeological/ Multidisciplinary**	**Publication year of the first volume**	**Peer review**
Academic PhD dissertations	Archaeological		Yes
Bidrag till kännedom av Finlands natur och folk	Multidisciplinary	1858	?
Faravid	Multidisciplinary	1977	Yes
Fennoscandia Archaeologica	Archaeological	1984	Yes
Iskos	Archaeological	1976	Yes
Monographs of the Archaeological Society of Finland	Archaeological	2011	Yes
Muinaistutkija	Archaeological	1984	Not before 2019; only some articles were reviewed
Publications of Giellagas Institute	Multidisciplinary	2002	?
SKAS	Archaeological	1993	Not before 2017; only some articles were reviewed
Suomalais-Ugrilaisen Seuran Toimituksia	Multidisciplinary	1890	Yes
Suomen Museo – Finskt Museum	Multidisciplinary	1894	Yes
Tietolipas	Multidisciplinary	1945	Yes

consisted of both an introductory part and articles, the introduction was handled separately from the articles, and articles were not included in the data if they had been published on a forum that was not in the data (e.g., articles published in a country other than Finland).

In the data, I only included publications in which Saami (or Lapp, as the Saami were previously called) culture played a central role or were situated in Lapland in Finland; the area north of Idre in Dalarna, Sweden; and the area north of Femund in Hedmark, Norway (see Zachrisson 1988: 115; Hamari & Halinen 2000: 155; Bergstøl 2008: 2–3). Of the research situated in these areas, I included all research about the Iron Age, the Middle Ages, and newer times, even if the Saami were not mentioned.[6]

Studies of the Stone and Bronze Ages in Lapland were not included if the Saami were not mentioned. Studies in Saami linguistics have shown that the Saami languages were not present in Lapland before c. 200–300 CE (e.g., Aikio 2012: 87; Heikkilä 2011: 76; Häkkinen 2010b: 59). Thus, we cannot speak of Saami-speaking existence in Sápmi (the land of the Saami) before this time (Aikio 2012: 66). However, studies of Stone and Bronze Ages in which the Saami played a central role were included in the data, as it is historically interesting to examine how the understanding of the Saami past and its dating has changed among archaeologists. These studies may also be connected to the use (or non-use) of Saami terms. In addition, it has an impact on how the majority and the Saami themselves see the Saami culture. If a study on an area south of the mentioned areas focused on the Saami (or the Lapps), it was included in the data.

Many of these limitations are artificial and constrained. The Stone and Bronze Age archaeological heritage in Lapland does connect to the Saami even if the makers and users of the Stone Age sites did not speak a Saami language. Even so, they are *cultural ancestors* of the Saami. In turn, based on linguistic research results, Saami speakers inhabited most of the area of Finland in the Iron Age (e.g., Aikio 2007; 2012: 88–92). Thus, Saami archaeological cultural heritage should be looked for in the whole area of Finland. This sort of research has not, however, been done in the southern parts of Finland in any significant amounts, and it is not known which archaeological cultural heritage connects to which linguistic (or ethnic) group.[7] The limitations have been implemented only to control the amount of the data. As the research is qualitative in nature, and I had to read every single article in the data, it was not possible to include everything (see Schreier 2014: 175).

I have limited the period of research to the 50 years between 1970 and 2019. Before the 1970s, Saami archaeology was not entirely an area of research in archaeology but in ethnology (e.g., Hansen & Olsen 2006: 9–11; Fossum & Norberg 2012: 25), although there were also archaeologists who discussed Saami questions before the 1970s. However, as seen in Table 1, most of the journals and series are far younger than 50 years. Only three of the journals and series (*Bidrag till kännedom av Finlands natur och folk, Suomalais-Ugrilaisen Seuran Toimituksia, Suomen museo – Finskt museum*) existed before the 1970s, and none of these are purely archaeological.

Methods

Content analysis

From the publications mentioned in the previous chapter, I collected all the Saami terms—words in Saami languages that denote Saami archaeological cultural heritage. The method of content analysis was used to collect and analyze these terms. Here, content analysis as a method is defined shortly. I then explain how I have used content analysis while collecting Saami terms from archaeological publications.

Content analysis is a flexible and suitable method for many kinds of material, from visual to written material (Schreier 2014: 180). It is a form of text analysis—although *text* should be understood broadly, with any document put into written form being accepted as a text. The purpose of content analysis is to find and examine meanings found in texts (Tuomi & Sarajärvi 2018: 117).

The aim is to link the results of content analysis to their context to make it possible to describe a specific phenomenon (Bengtsson 2016: 9; see also Schreier 2014: 181). The content analysis in this research is material based, which means that the aim of the analysis is to create a verbal and explicit description (Tuomi & Sarajärvi 2018: 122, 127) of the data, i.e., the use and non-use of the Saami terms. Material-based content analysis aids in organizing incoherent and fragmentary data in a compact but articulate way (Tuomi & Sarajärvi 2018: 122). In this study, it helps to examine which terms are used, as well as when and how often they are used. Content analysis is based on interpretation and deduction, which progresses from empirical data toward a conceptualized understanding of the phenomenon in question (Tuomi & Sarajärvi 2018: 127; see also Bengtsson 2016: 10).

In the analysis, the data is first fractioned then conceptualized and combined into a logical entity (Tuomi & Sarajärvi 2018: 122). According to Miles and Huberman (1994; see also Bengtsson 2016), material-based content analysis is a three-phase process: first, the data is reduced; second, the data is classified; and third, theoretical concepts are created from the classified data (about classification, see also Schreier 2014: 174–179). It is also important to create a meaning unit, the smallest unit that contains insights that researchers need in their analysis (Bengtsson 2016: 11; Tuomi & Sarajärvi 2018: 122). In this research, meaning units are words in Saami languages that refer to Saami archaeological cultural heritage, i.e., Saami terms.

I began the analysis by downloading all the Saami archaeological publications on NVivo software and creating two main categories: publications with Saami terms and publications without Saami terms. In this paper, I concentrate mostly on the former, which I reduced to meaning units. I collected all the Saami terms from the publications then analyzed the meaning units based on 1) what kind of archaeological cultural heritage they referred to and 2) when and how much they had been used from 1970 to 2019. Finally, I made conclusions about what types of remains are most often referred to using Saami terms and the changes in this phenomenon over time. The analysis aims to give answers to questions about the beginning of Saami term use, changes in this term use over time, the frequency of term use, and the archaeological cultural heritage that most often gets called by Saami terms.

Notes on collecting the Saami terms

To collect all the Saami terms from the data, I went through every volume of every journal, series, and dissertation. I began by looking for the words *saame-/lappa-* (Finnish), *same/lapp* (Swedish, Norwegian), and *Saami/Sami//Lapp* (English) to see if there were articles that explicitly handled Saami archaeology. I carefully read those articles that often mentioned one or both of these words, and almost all of them have been included in the data. Many articles only mentioned the words once, and skimming through these articles revealed that they often did not handle matters in Saami archaeology. Some, for example, used Saami culture as an ethnological analogy. I also read the abstracts of all articles whenever they were available. With these methods, I found the texts that connect significantly to the Saami past. I also wrote some details of the publications in the data (such as a short synopsis of the publication and my own observations and comments on the data) in an Access database.

I collected Saami terms from body texts, captions, and attachments. If there were direct quotations from other research publications, I did not include the Saami terms from them because the quoted articles themselves might have been in the data.

Some Saami words have been borrowed and adapted to Finnish, Swedish, and Norwegian. If they have been borrowed to refer to objects in Saami archaeology, they were counted as Saami terms. One good example of this are the Finnish word *seita*, the Swedish *sejte* or *seite*, and the Norwegian *seide*, which are all loanwords from Saami words, e.g., the North Saami *sieidi*, and refer to, for example, sacred rocks and trees in the Saami culture. Saami terms can also be part of compound words in which another part (or other parts) is in the language of the article, e.g., Finnish *seitakivi* '*sieidi* stone'.

All the publications in my data are public, i.e., possible for anyone to read. A big part of the data is found on the web, and rest are available in public libraries. I do not aim to point fingers at any one person on how they have used or not used Saami terms. That is why, even though the publications in the data are public, I will, in this and future articles, refer to them using 'P' (for publication) and the tag that the Access database automatically gives to each entry, e.g., P1, P2, P3.

ANALYSIS

In this chapter, I analyze the data. First, I present the Saami terms that were used in the publications. This presentation includes perspectives on how many publications the terms were used in and how many times in total the terms appeared in the data. Such perspectives provide information about which terms were used more and which terms were used less. This will, in turn, aid the analysis of which types or categories of ancient remains get called by Saami terms. With the help of the article contexts of the terms and Saami language dictionaries, I also analyze in which Saami languages terms are given and why the language in question was chosen.

Second, I examine the changes that have occurred in term use from 1970 to 2019. It is of interest to see which terms were used, as well as when the term use began and how it progressed. I study more closely the use of the five most frequently used terms.

Used Saami terms

The data contains 138 publications that can be considered to handle the Saami past and/or the Saami archaeological cultural heritage in significant amounts or are situated in the traditional Saami area. Saami terms were used in 63 (45.65 %) publications, i.e., in less than half of all the publications in the data. In 75 (54.35 %) publications, not one Saami term appears.

All the Saami terms with meanings and appearances are listed in Appendix 1 of this paper. I went through all the terms and have provided the meanings that are found in Saami dictionaries, etymological dictionaries, or dictionaries for Finnish, Norwegian, and Swedish. It seems that many of the terms were given meanings in archaeological research that are not found in dictionaries. In such cases, I provide the archaeological meaning as well, but in some cases, this archaeological meaning might be wrong. Comments on the terms and their meanings are found in Appendix 1.

In this chapter, I first explore the problems in Saami term use that arise from the data. Then, I move on to describe the frequency and characteristics of Saami terms and the languages used in the articles. Lastly, a brief look at publications in the data that do not acknowledge the Saami past at all is presented.

Problems in the use of Saami terms

The problem in the publications is that most often, no reference was given to the source of the Saami term. In many cases, the terms were not written in any Saami language, occasionally even in articles in which the used Saami language was named. These types of problems are commented on and analyzed in the endnotes of Appendix 1.

Another problem is that in most articles, it is entirely unclear to the reader which Saami language was used, as the used Saami language was not named. Newer articles had notes on the language, but they quite often commented only the used orthography (how the word is written), not the language. In different Saami languages, word forms (sounds in the words) and meanings of words differ, as well as their orthography. For example, the North Saami word *sieidi* "sacred stone, rock, cliff or other" and the Lule Saami word *siejdde* "id" do not only have different orthography, but they also have different sounds—they are not pronounced the same way. For example, the North Saami *sáiva* "sacred lake" has a different meaning from the South Saami *saajve* "mythological beings living inside mountains," and the two have different sounds in the word.[8]

The third problem is that in the articles, it is not described why a specific Saami language is used. There is, for example, an article in the data that handles the Pite Saami area—the area where the Pite Saami language is (traditionally) spoken—but Lule Saami language is used to describe the archaeological cultural heritage without any explanation on the choice of the language (P52). There might be a natural reason for this; for example, Pite Saami is such a small language nowadays that it is not easy to find Pite Saami terms for the phenomenon studied. However, such reasons are not explained in this or other articles.

Saami terms: amounts, semantic fields, and the Saami languages used

The 63 publications with Saami terms contain a total of 65 terms (Appx 1). However, 39 of these terms (60%) were used only in one publication, eight terms were used in two publications, and two terms were used in three publications. The rest of the terms are presented in Table 2. These are the 16 most frequently used terms by their

Table 2. The 16 most frequently used terms in articles, given in one of the Saami languages in which the term is found in the data, often the one that has the most frequent use in publications.

Term	Meaning in English	No. of publications
sieidi (SaN)	sacred stone, rock, tree, cliff, etc.	33
siida (SaN)	(Lapp) village; reindeer village; home	25
goahti (SaN)	hut; house; home	18
stállo (SaL)	scary and strong mythological being; troll type of a dwelling site in the fell area often with a circular or oval floor surface and centered hearth surrounded by a low bank	19
boassjo (SaL)	the back of a Saami *goahti*, often considered sacred	12
noaidi (SaN)	Saami religious expert; shaman	9
árran (SaN)	hearth	7
sáiva (SaN)	fresh water; small lake; lake without an outlet or a river that brings water to the lake; sacred lake, often believed to be double bottomed	6
purnu (SaN)	storage that is dug in the ground and supported by a log structure	6
uksa (SaN, SaL)	door	6
bearpmet (SaN)	a row of stones or logs that lead to the *árran*	5
vuobme (SaL)	forest; wide valley with forest; inland area with a lot of forest	4
vuomen (Fi)	a funnel-shaped fence for catching deer	4
buvri (SaN)	storage shed	4
lávvu (SaN)	tent; light-structured *goahti* made of canvas	4
loaidu (SaN)	sitting and sleeping areas on either side of an *árran* in a *goahti*	4

appearance in publications. These cover the rest of the terms in the data: those appearing in four publications or more.

As Table 2 shows, eleven of the terms appeared in less than ten publications, and it is not clear if they can be called as systematically or widely used terms. It can be considered that even though Saami archaeology has progressed vastly and quickly in recent decades, many Saami archaeological phenomena are relatively understudied. Some of the terms in the data may concern phenomena that are studied only in a few research projects and thus may not appear in many publications. This means that the infrequent use of some terms does not (always) denote archaeologists' lack of knowledge about the Saami term; rather, it highlights the amount of research done on the archaeological phenomenon to which the term is connected.

However, in this study, I decided to classify terms that appear in ten or more publications as systematically used. This leaves five Saami terms that are used very frequently in the publications published in Finland. They are (given in one of the Saami languages found most often in the data) *boassjo* (SaL), *goahti* (SaN), *stállo* (SaL), *siida* (SaN), and *sieidi* (SaN). These are widely used, and the use of each of these terms became systematic at some point within the research period (1970–2019) (see the next chapter).

Four of the frequently used terms are connected to religious phenomena: *boassjo* 'the sacred back part of a Saami hut (*goahti*)', *noaidi* 'Saami religious expert', *sáiva* 'sacred lake', and *sieidi* 'sacred stone, rock, cliff, or other.' The word *stállo* 'scary and strong mythological being' is a part of the mythological world, but in archaeology, it widely refers to a type of dwelling site in the fell area of Norway and Sweden (about *stállo* sites, see Hedman 2003: 27–28 and the references there). The number of religious words among the Saami terms indicates that Saami indigenous religion is one of the most studied fields within Saami archaeology, which is not surprising because Saami indigenous religion has been a topic of deep interest since the colonization of the Saami began along with the Christianization of the Saami in the 17th century (see e.g., Pentikäinen & Pulkkinen 2018: 77–91; Hansen & Olsen 2022: 300–312).

The other terms listed in Table 2 connect to the social organization of traditional Saami society: dwellings, hunting, and storing goods. The rest of the terms (Appx 1) concern all sorts of matters, such as reindeer, sacred sites and sacred phenomena, dwellings and dwelling places, travelling, storing, tools and other artifacts, and hunting and fishing. In Appendix 1, I present my analysis of the semantic field of every term.

As seen in Appendix 1 and Table 2, the three Saami languages used in archaeological research were Lule, North, and South Saami. North Saami was, expectedly, the most frequently used language with respect to Saami terms. North Saami has the most speakers of all the Saami languages (Arctic Council), and thus, it is quite understandable that words related to Saami archaeological cultural heritage are known and easy to find in this language. South and Lule Saami were used in some publications published in 2009 or later. In addition, Saami loanwords in Finnish, Norwegian, and Swedish were used in the data, as explained earlier in this article.

It is interesting that in the research published in Finland, terms are found in South and Lule Saami, which are spoken in Scandinavia, but not in Inari and Skolt Saami, which are spoken in Finland. The South and Lule Saami terms are mostly used by Swedish and Norwegian researchers who do research in South and Lule Saami areas in Scandinavia; researchers in Finland working with the Inari and Skolt Saami areas do not use the respective languages—they use North Saami or Saami loanwords in Finnish. In the future, it would be fruitful to study what kind of discourses within archaeology or Saami politics have caused researchers in Finland to not use Saami languages other than North Saami.

The non-use of Skolt and Inari Saami cannot be attributed to poorer opportunities to find terms. The situations of these four small Saami languages (Skolt, Inari, Lule and South Saami) are quite similar: they are seriously endangered, but in recent years, there have been successful attempts to revitalize these languages. All these languages are becoming academic languages with possibilities to study the languages at the university level.[9] Additionally, dictionaries have been developed for all these Saami languages in the recent decades, and Giellatekno, the research group for Saami language technology, was established in 2005 at the Arctic University in Tromsø (Giellatekno 2005). The online dictionaries for Saami languages have gradually increased in size as well.

However, it is not entirely clear if researchers themselves know which Saami language they are using. As noted earlier, the used Saami languages were often not mentioned, and this also concerns the publications that I interpreted (based on the word forms and search in dictionaries) to use South or Lule Saami. According to my interpretation of the languages, these two Saami languages were used in 14 publications, and out of these, nine did not define the used Saami language. In two publications (P80 and P81), both North and Lule Saami were used, according to my interpretation of the word forms (e.g., *goahti* and *lávvu* in North Saami and *boassjo* in Lule Saami). In one of the publications that defined the language (P119), the language was given as South Saami, but the word used was, in fact, a Lule Saami word.

In addition to the mentioned Saami languages, there are four other Saami languages spoken nowadays: Ume and Pite Saami in central and northern Scandinavia and Kildin and Ter Saami in the Kola Peninsula in Russia. These languages are extremely endangered; for example, Pite Saami has approximately 50 speakers remaining (Arctic Council). None of these languages were visible in the data of this research. However, some of them should, perhaps, be. For example, P52 defined the Pite Saami area as their research area, but they used Lule Saami terms in their research. P81 researched the Inari Saami area but used North and Lule Saami terms (without mentioning which language was used, however). As noted earlier, no motivation for the use of these exact Saami languages was given.

Publications without acknowledgement of Saami archaeological cultural heritage

Publications without Saami terms may acknowledge the Saami in ways other than by using Saami terms (see Discussion). Some of these publications might also be theoretical contributions to Saami archaeology, and

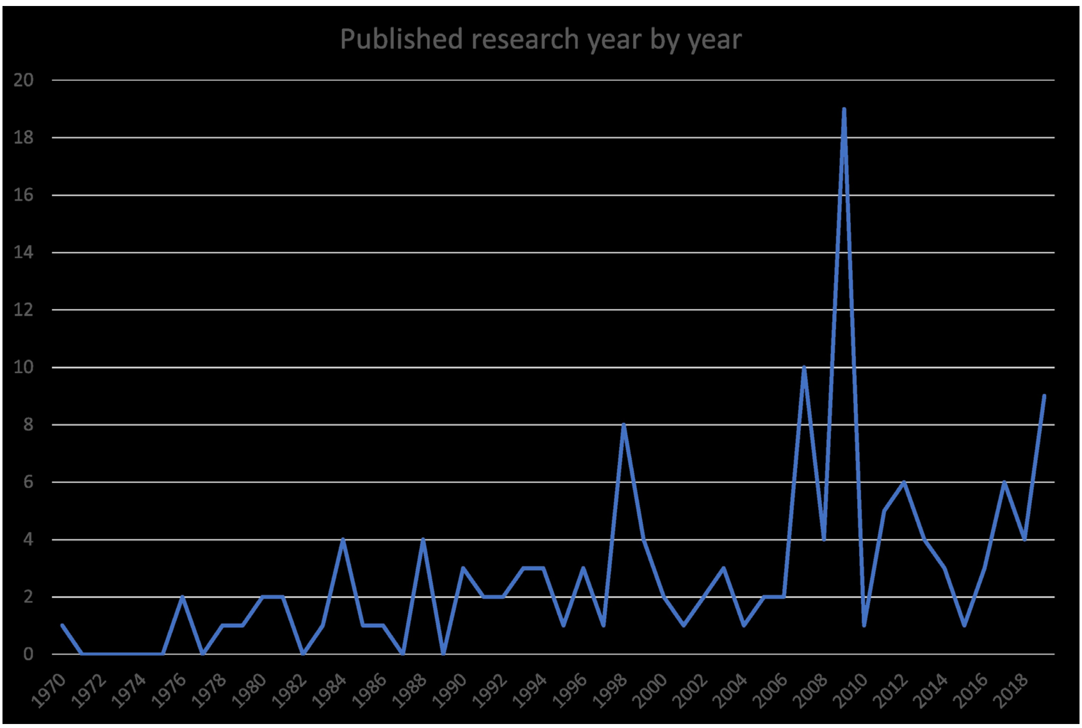

Figure 1. Published research 1970–2019. Figure: M. Piha

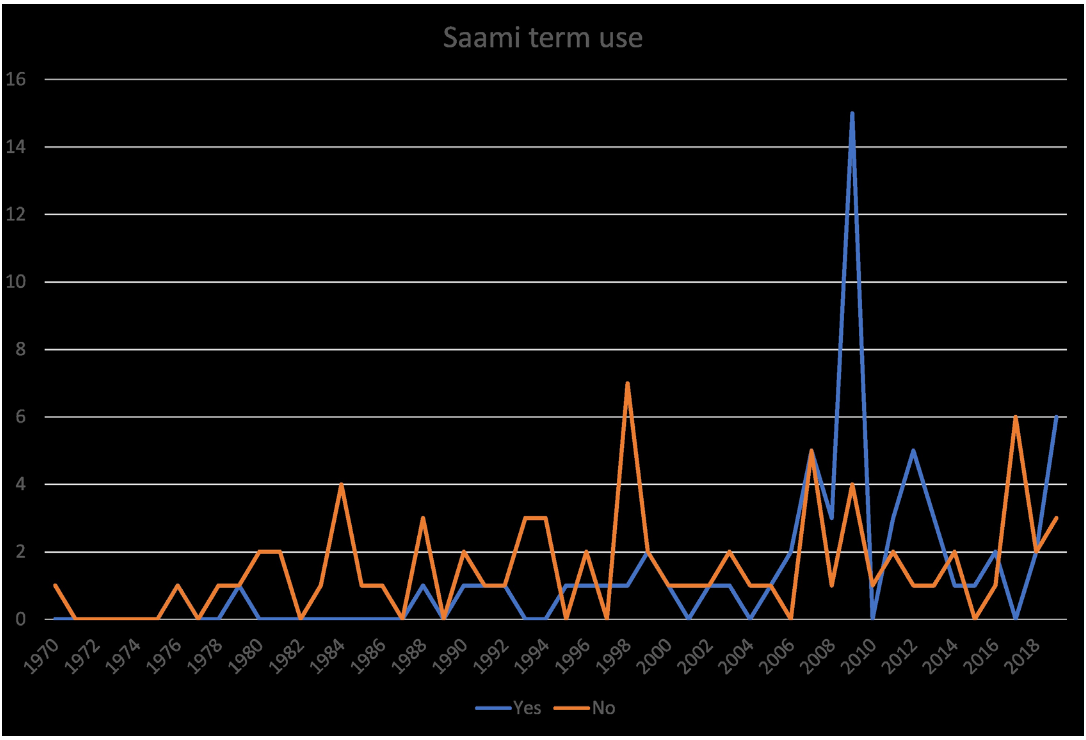

Figure 2. Saami term use in publications per year. The blue line depicts the publications in the data that used Saami terms. The orange line depicts the publications in the data that did not use Saami terms. Figure: M. Piha

they do not handle any Saami archaeological cultural heritage but instead, for example, colonialism in Sápmi.

However, some publications may have handled archaeological cultural heritage that might very well be Saami but do not use Saami terms or acknowledge the Saami past in any way. A few publications even denied the possibility of connecting archaeological cultural heritage to any ethnic or linguistic groups. In a recent publication (P109), it was noted that the connection between archaeological material and ethnic groups is unfounded. It was stated that it was a bold conclusion to claim that the Saami lived in northern Fennoscandia already during the Iron Age.

It is true that ethnicity is not easy to point out in archaeological material. However, at the time of the publication linguists argued the same but pointed out that linguistics can prove the existence of *Saami languages* in northern Finland during the Iron Age and criticized the way archaeologists had connected material culture, ethnicity, and language as one and the same (e.g., Aikio & Aikio 2001: 13; Häkkinen 2010a: 21–28). It is possible to connect some archaeological material with people who spoke Saami. However, P109 fails to consider the research history on Saami ethnicity, language, and culture. It is a fact that the Saami have often had their history denied. From a decolonizing perspective, such publications may be interpreted as implicitly endorsing narratives that support Saami colonialism.

Changes in term use from 1970 to 2019

Figure 1 shows that while interest toward Saami archaeology has visibly increased closer to the 2000s, there has been constant interest in the Saami past since the 1980s. This interest, however, did not, in many cases, include the use of Saami terms.

Figure 2 highlights that the use of Saami terms has somewhat increased over decades. In the 1970s and 1980s, only one publication used Saami terms. The use of Saami terms increased in the 1990s and particularly after the turn of the millennium. The year 2009 was significant to the use of Saami terms, with 15 out of 19 publications published that year using Saami terms. During the year, two publications concentrating solely on Saami questions were published: *Recent perspectives on Sámi archaeology in Fennoscandia and North-West Russia* (Halinen et al. 2009) and *Máttut – Máddagat. The Roots of Saami Ethnicities, Societies and Spaces/Places* (Äikäs 2009). Most writers in these anthologies adopted the use of Saami terms. However, there were no Saami terms used in publications in the following year.

Similar peaks – although not as high – can be seen in the years 1998, 2007, and 2019 (Fig. 1). In the last issue of *Muinaistutkija* in the year 1998, papers from a seminar concentrating on archaeological perspectives of the roots of populations of Finland were published (Halinen 1998: 1). Not all of the papers dealt with Saami archaeology, but many did, resulting in the peak. However, the difference with the peak eleven years later in 2009 is that Saami terms were used in only one article (Fig. 2).

The peak in 2007 (Fig. 1) was mainly the result of another anthology concentrating on archaeology in *Sápmi, Peurakuopista kirkkokenttiin. Saamelaisalueen 10 000 vuotta arkeologin näkökulmasta. Arkeologiseminaari Inarissa 29.9.-2.10.2005* (Harlin & Lehtola 2007). Figure 2 shows an interesting phenomenon this year: out of the ten publications in the data, five contained Saami terms, and five did not. Between the peak of 1998 without Saami terms and the peak in 2009 with Saami terms, this seems to be halfway in terms of the use of Saami terms, but these terms were not yet used by majority of researchers.

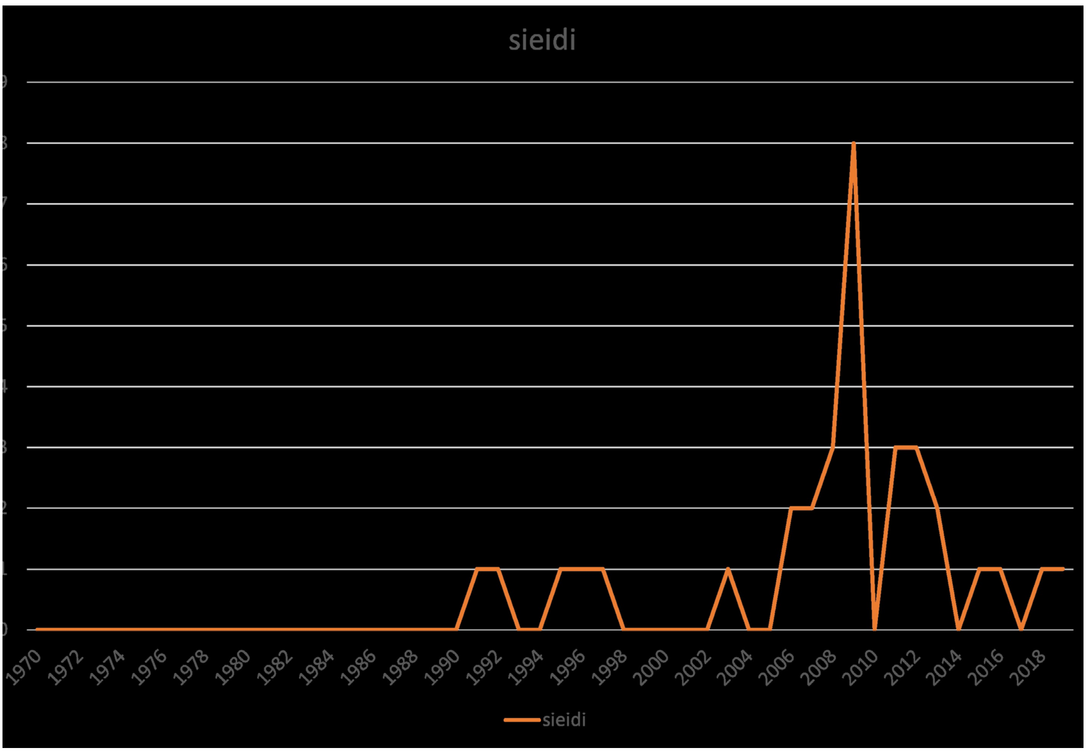

Figure 3a. Number of publications with and without the Saami term sieidi. *Figure: M. Piha*

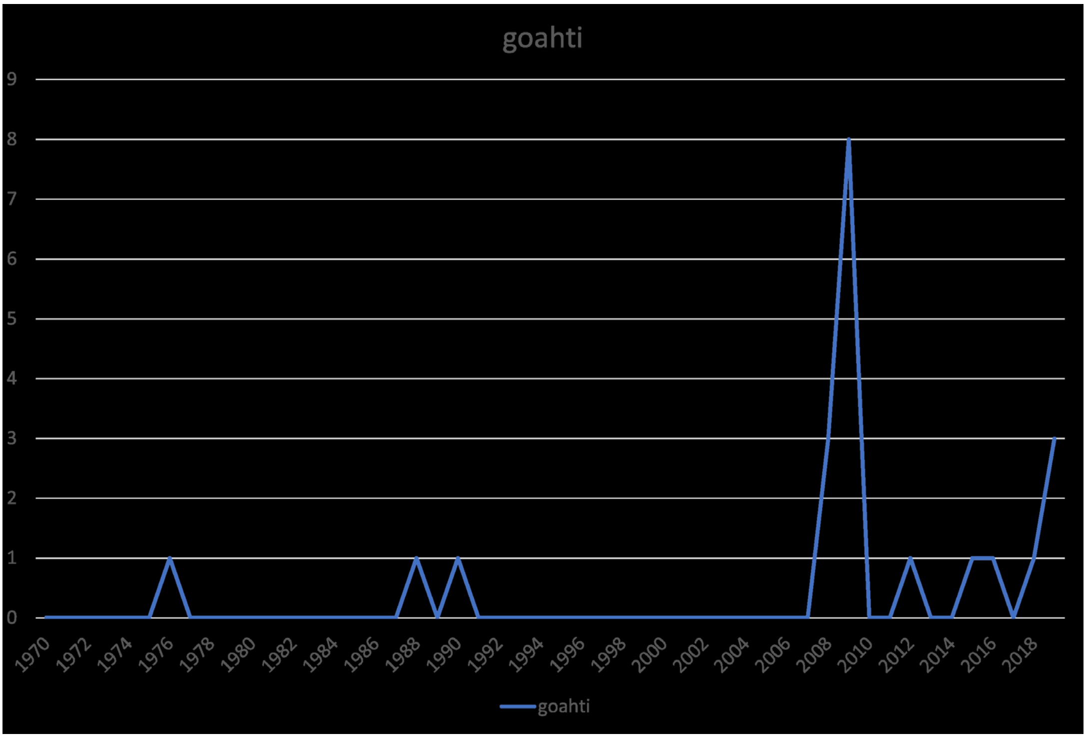

Figure 3b. Number of publications with and without the Saami term goahti. *Figure: M. Piha*

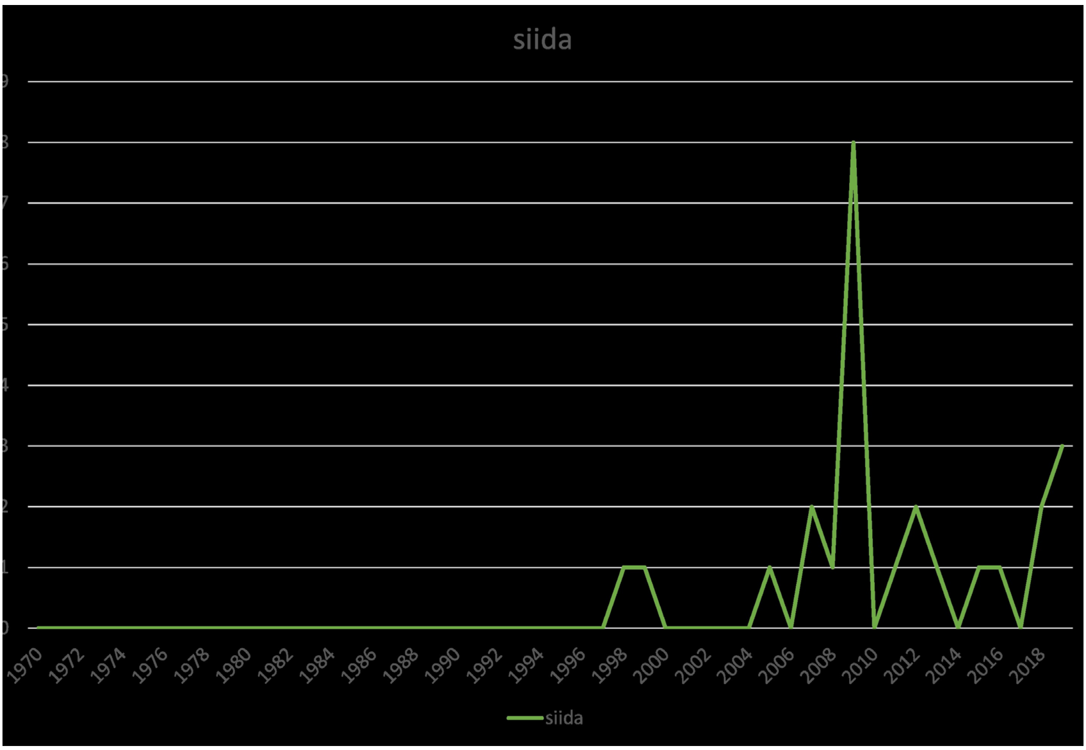

Figure 3c. Number of publications with and without the Saami term siida. *Figure: M. Piha*

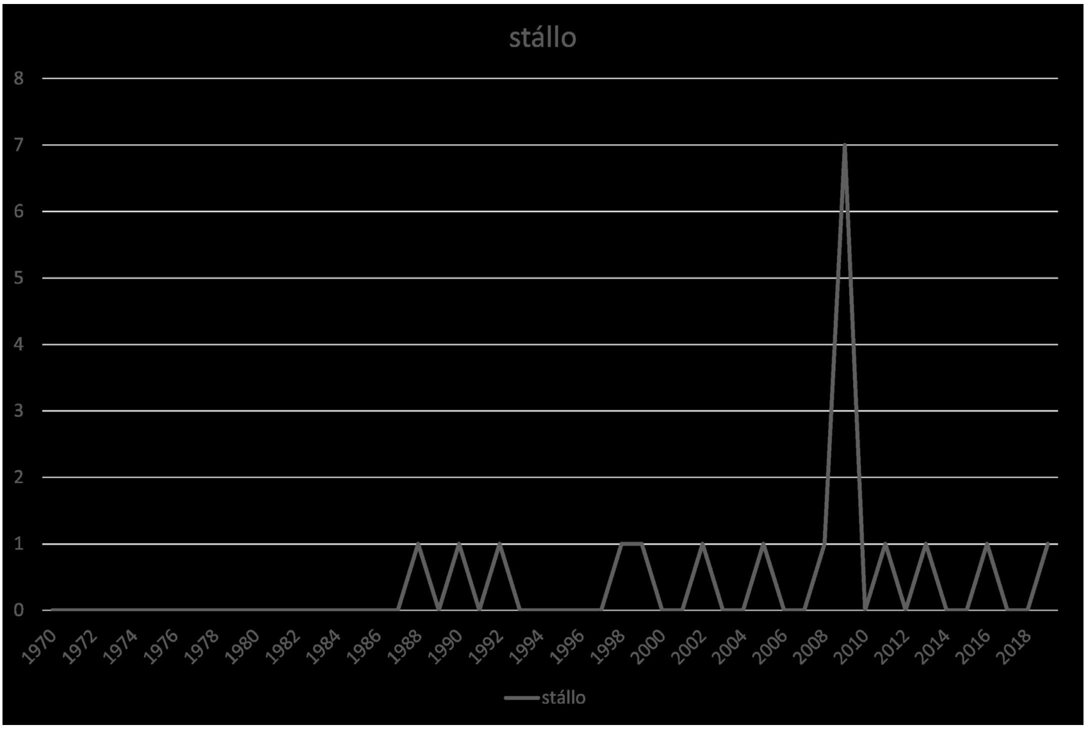

Figure 3d. Number of publications with and without the Saami term stállo. *Figure: M. Piha*

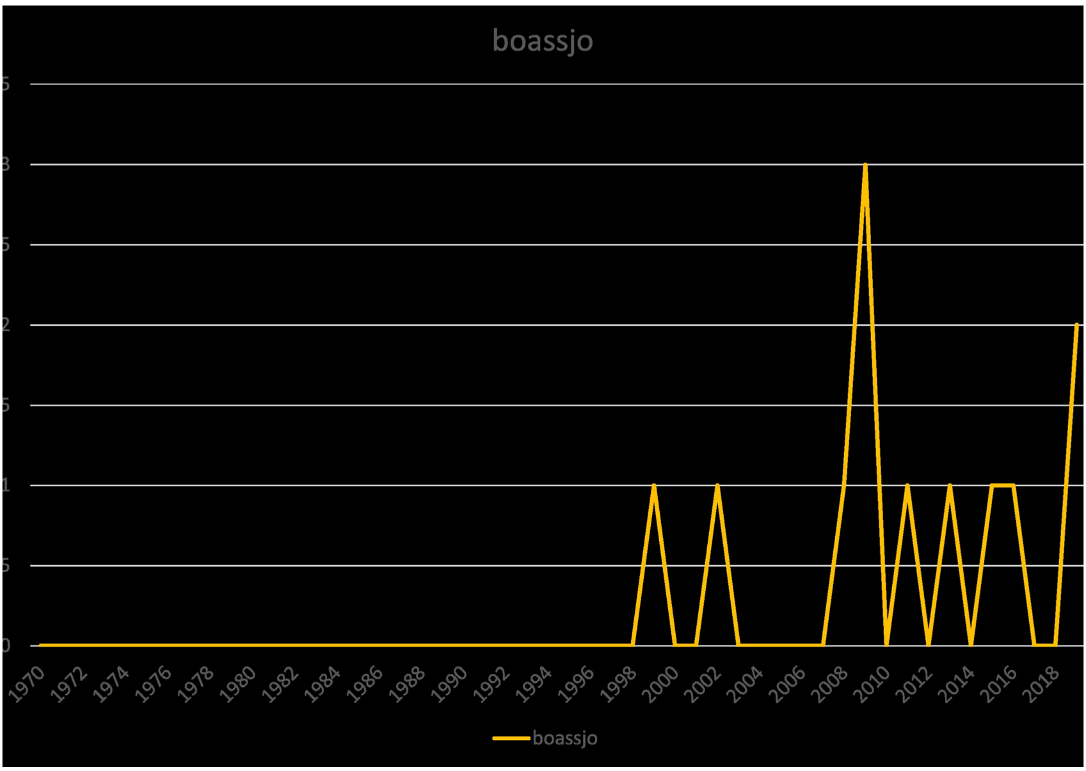

Figure 3e. Number of publications with and without the Saami term boassjo. *Figure: M. Piha*

However, a similar tendency was revealed even after the great peak of Saami term use in 2009: in 2017, six Saami archaeological publications were published (Fig. 1), but no Saami terms were used at all (Fig. 2). Two years later, a similar number of publications were published with terms, with three additional publications without terms. In the last peak seen in the data, in 2019, the number of publications using Saami terms surpassed those that did not use Saami terms (Fig. 2).

Changes in term use over time in the five most frequently used terms

I chose to analyze changes in the use of the five most frequent terms (see Table 2) to determine when the use had become systematic. The most frequently used terms are depicted in Figure 3a–e, and they are SaN *sieidi, siida, goahti* and SaL *stállo* and *boassjo*, as well as their cognates in other Saami languages and borrowed items in Finnish and the Scandinavian languages.

As depicted in Figures 3a–e, all the most frequently used terms had their first use before the turn of the millennium. The term *goahti*, which was used for the first time in 1976, is a somewhat special case. It was the first time a Saami term was used in the history of Saami archaeology in a publication that was included in the data. However, it was not used in Saami but in its Swedish form *kåta* (P89). *Stállo* was first used at the end of the 1980s, also in its Swedish form *stalo* (P88). The other three terms were used in the 1990s for the first time: *sieidi* in its Finnish form *seita* in 1991 (P104), *siida* in its North Saami form in 1998 (P15), and *boassjo* in its Finnish form *posio* in 1999 (P20). Thus, it seems that the first uses of Saami terms were not actual uses of Saami languages but rather the use of Saami loanwords in Finnish and Swedish.

The use of these terms in Saami languages began later, mostly after the turn of the millennium. The North Saami *sieidi* was used for the first time in 2006 (P45), and Lule Saami *siejdde* was used in 2009 (P123). The North Saami *goahti* was first used in 2009 (P73; P76; P122; P125). As for the Lule Saami word for "hut", it is not entirely clear if any of the forms meaning "hut; house; home" are actual Lule Saami, but it is possible that the form *goathe* (pro *goahte*) is Lule Saami, but written systematically wrong (P120; see Appx 1, endnote 19). It had its first use in 2009 as well. As mentioned, *siida* was used in its North Saami form the very first time the term was used. *Stállo* was first used in Lule Saami in 2009 (P120; P123), and this term did not appear in any other Saami languages in the data. *Boassjo* was used in the Lule Saami language for the first time in 2008 (P62) and North Saami in 2009 (P115).

The developments and changes seen in the use of the five most frequent Saami terms show that these terms were first used as loanwords from Saami to Finnish and Swedish; it was only in the 2000s that language changed in favor of the Saami languages. The Saami loanwords in publications written in Finnish and Scandinavian (and occasionally English) were still used in the 2000s and 2010s, but it seems that the Saami languages have become more popular for Saami terms. The year that had the strongest contribution to this was 2009, which can be seen as a peak in Figures 1–3. It can be stated that the two previously mentioned anthologies in Saami archaeology (Halinen et al. 2009; Äikäs 2009) were the most influential publications in the systematization of the use of Saami terms in Saami languages in research published in Finland. However, the 1990s could be seen as the birth period of the use of Saami terms.

DISCUSSION

In this chapter, I first answer the question that I set on to solve: What does the use and non-use of Saami archaeological terms reveal about language policies in Saami archaeological research? It seems that there are no systematic policies in Saami term use, and here I discuss what kind of challenges in the Saami term use the data reveal and why Saami terms should be used in archaeological research. At the end, I explain some of the next steps toward decolonized term use within Saami archaeology.

Policies on Saami language use in archaeology

The analysis of term use and changes in it do show that there is a growing understanding of the importance of Saami term use in archaeological research published in Finland. This understanding began mainly in the 1990s with the use of terms borrowed from Saami languages to the Scandinavian languages and Finnish. In the 2000s, the use has progressed toward using the terms in original Saami languages, although the Scandinavian and Finnish versions are also in use. Such a development toward term use is contemporaneous with the development of the perspectives of Indigenous archaeologies, as hypothesized in the introduction of this paper. However, this contemporaneous development with Indigenous archaeologies requires further analysis, which will be conducted later in the same project 'Saami terms in archaeological research' that this paper is a part of.

The decision to use Saami loanwords in Finnish and Scandinavian might be caused, for example, by the fact that it is easier to use words that have been adapted to the morphophonology of the language of the research. This concerns Finnish in particular, as it is an agglutinative language, meaning that inflective and conjugative elements are added to words as suffixes. Yet, no mention of such a reason is given in the publications. Additionally, Saami terms in Finnish and Scandinavian are sometimes used in publications written in English (e.g., P71, P75).

However, there are several shortcomings of Saami term use, and it is questionable whether there are policies of term use in Saami archaeology. The shortcomings connect with used Saami languages, used Saami terms, and the origins of the terms used.

Saami archaeological fieldwork is done in all the geographical areas of Sápmi (and outside of it), but in the data, only three different Saami languages were used: North Saami, Lule Saami, and South Saami. These languages are occasionally used to refer to areas in which they are not spoken. South Saami terms might be used in Lule or North Saami areas, while Lule Saami terms might be used in Pite Saami areas (e.g., P52; P124; see also Piha 2020a: 122). Another problem is that languages get mixed. For example, one researcher mistakenly called a Lule Saami word a South Saami word (P119). A third challenge related to this is that the language used is seldom specified; there might be notes on orthography, but talking only about orthography indicates that perhaps it is not quite clear to all that Saami languages have more differences (e.g., in phonology, semantics) than orthography alone. Or, perhaps, the meaning of *orthography* is not quite clear to researchers in archaeology, and they use it in the meaning of "language."

The use of Saami terms, though increasing, is not systematic. The analysis shows that only five terms were used in more than ten publications, and 60% of the terms were found in only one publication. In 55% of the publications, no Saami terms were used at all.

In some cases, the non-use of Saami terms does not mean that the Saami past or Saami archaeology is not acknowledged at all. In these articles, Saami toponyms might have been used or, simply, the acknowledgement was in the form of the word *Saami/Sami/Sámi* (or *Lapp* in the earlier research) or its counterparts in the Nordic languages. The word *Saami* is, naturally, used in publications with Saami terms as well as in, for example, theoretical contributions to Saami archaeology that do not concentrate on some or any Saami archaeological remain types (e.g., P56; P58; P63; P78).

In addition, even until the 2010s, there were publications that handled possible or likely Saami archaeological heritage or were situated in the geographical area of Sápmi, but Saami terms were not used in these publications to name different types of remains. Even a mention that the heritage handled in the research might belong to the Saami past was lacking in some publications (e.g., P54; P109; P111; P114).

The origin of Saami terms, i.e., where the writer found or adopted the used terms from, is mainly not given in the publications included in the data. In some cases, there were mentions of using the terms found in historical documents or rare references to adopting a term from previous research (P43). However, it was often impossible to trace the origin of the used terms. Knowing the origins of the terms is important for the reader to be able to judge and understand the correct use(s) of a term. Different publications used terms in different ways, and the different Saami languages have different meanings for cognate terms, so definitions are needed.

The need of Saami language policies in archaeological research

According to the analysis of the data, it seems that there are no language policies regarding

Saami term use in Saami archaeology. It is a positive development that the Saami terms have an increasing use in the research of the Saami past, but the systematic use of terms and instructions on how to use them is missing. This causes a lot of confusion and mistakes in Saami terms, as can be seen in the endnotes of Appendix 1 of this paper.

It is possible that there are some invisible and silent policies around Saami term use as a preferable tendency, but they are not binding or formal. Rather, researchers themselves may opt whether to use them or not, and there is no obligation to motivate the use or non-use of the terms, or the choice of the language used.

Another perspective on Saami language policies regarding term use is the question of whether it is at all clear why Saami terms should be used. To use archaeological terms and define them is a normal procedure in archaeology, just as it is in any science. Archaeological terms describe characteristics and functions of archaeological concepts and serve as understandable and commensurate terminology that can be used in national and international research. This makes it easier to compare archaeological material in different geographical areas.

In the case of Indigenous studies and, in this case, Indigenous archaeologies, it is not just a question of making international comparisons between areas easier but first and foremost to write about the past of an Indigenous people. As noted in the introduction of this article, Saami terms, when used systematically and critically, describe the functions of objects in the archaeological material in a more detailed and precise way than foreign terms; using non-Saami terms might cause something essential about the function and nature of the archaeological cultural heritage to be missed (see Kaikkonen 2020: 2–3). In addition, foreign terms might make the Saami past unfamiliar and strange to the Saami people, who would fail to recognize their heritage from the usage of foreign terms.

The use of Saami terms in Saami archaeology does not exclude the usage of more internationalized archaeological terminology. These two different types of terminology can be used in parallel. In fact, such a policy in which both these terminologies are used is beneficial to different audiences: on one hand, researchers and other professionals, and on the other hand, the people whose past is studied. The use of international and Saami terminology will also help researchers describe their research to diverse audiences in different language registers—the academic community is not responsible for communicating their research only to other researchers but to the public as well.

In addition, the use of Saami terms can be a significant part in the decolonization of mental patterns of researchers and the non-Saami public. Specialists have a strong influence on what kind of language, e.g., terminology, is used in the popularization of science (Kaikkonen 2020: 6–7). Any changes in practices are gradually transferred into the popular presentations of the topic. When knowledge on the cultural heritage of the Saami is shared using Saami terms, the conceptions of the audience are reformed. The Saami terms highlight the fact that the Saami have as diverse and interesting a past as any other people. However, to make the decolonization process efficient and meaningful, the term use should be made systematic, and in the following chapter, I discuss some ways to conduct such systematization.

Steps toward decolonized term use

This article is the beginning of a project that aims to develop Saami archaeological terminology further and make Saami term use systematic. In this article, I concentrated on the data of research published in Finland. Similar research will be conducted in Norway and Sweden to determine how Saami term use differs between archaeological publications in these three Nordic countries. In addition, a study on term use in publications published by large international academic publishers will be conducted to see if there are differences in how term use is handled in Nordic and international publication forums. After that, at least three steps should be taken to make term use visible, systematic, and sensible: the identification and deconstruction of colonized mental patterns, the collection of terms referring to Saami archaeological heritage, and the creation of a database of Saami terms for the academic and public community to use. Before pondering these steps in more detail, I will present some general remarks of what an individual researcher or institution can do to be part of the systematization of Saami terms before any open access database for Saami terms is available.

Individual input for systematic term use

All the challenges and unsystematic uses of Saami terms described above are understandable. It is not possible to expect a researcher to know every single Saami language or be able to distinguish words in different Saami languages that look very similar. However, some skills in the Saami language of the area that is the researcher's particular interest might be profitable. In addition, significant help could come from cooperation with the Saami-speaking community of the area of interest.

Nowadays, there are several online dictionaries for all the Saami languages (e.g., Giellatekno online dictionaries), and training to use these would be beneficial for Saami term use in archaeology. It is probable that some researchers used the dictionaries, given that the use of Saami terms in Saami languages has increased simultaneously with open access online dictionaries of the Saami languages. However, there is no way to know if dictionaries were used because the source of the terms were not given in the research.[10]

Stating the sources of used Saami terms would be useful for the readers of research. Indicating whether the terms were obtained from historical documents, previous (archaeological) research, dictionaries, Saami informants, or other sources would make it easier to critically examine the used terms and develop their use further.

Furthermore, a section for self-reflection in research would make term use more visible and conscious. I will consider this aspect a little further in light of the data of this paper in the following subchapter.

Self-reflection: Identification and deconstruction of colonized mental patterns

One of the aims of this project is to examine the motivations for using or not using Saami terms in archaeological research. It is of interest why researchers working with Saami archaeology or archaeology of the traditional Sápmi area (or outside of it) use or do not use the terms. What makes researchers use or not use the Saami terms, and what do they want to communicate with this use or non-use?

Motivating the use or non-use of Saami terms should be a part of the self-reflection of the research in which the researcher justifies the research and the perspectives in it. Why is it me doing research on Saami past? How does this research benefit the Saami people? How does the language I use in my research affect the Saami past and the Saami people? Such a self-reflective part is missing from most of the studies in the data. Only a few publications include such a section, and no comment on the use or non-use of Saami terms are given in any of them.

Implicit motivations might be possible to find with the help of discourse analysis, but it is outside of the cope of this study. A quick note on them should, nonetheless, be given. There may be silent practices and conventions for the use and non-use of Saami terms that are not visible in publications, and it is important to ask the researchers' views on these. Additionally, the questions of temporal and spatial dimensions of the Saami languages might make it difficult to know which Saami terms to use and how they should be used. For example, if archaeological research concerns the area of the extinct Kemi Saami language in the southern and central parts of Finnish Lapland, which Saami language should be used to name archaeological cultural heritage? Kemi Saami is not documented well enough to use this language. Answers to these questions are not visible in the data of this paper, but in the future, I plan to conduct a questionnaire for archaeologists working with Saami archaeological cultural heritage to ask about their views on the use and non-use of Saami terms. The data will be analyzed using discourse analysis. Such research will most likely raise challenges like the ones described above. Making these matters visible will help archaeologists see and analyze their own (non-) use of Saami terms and find ways to tackle the challenges that the diversity of Saami languages and cultures create for Saami archaeological research.

Collection of and an open access database for Saami terms

A side benefit of the current project is that all the Saami terms used in archaeological material will be collected. The list of Saami terms used in research published in Finland is attached to this paper as Appendix 1, and the plan is to do the same for the terms used in publications published in Norway and Sweden and by international publishers. However, as the analysis of the data has shown, there are many uncertainties regarding the use of the Saami terms. First, many terms do not represent any of the Saami languages. Second, a Saami language might have been attributed to an area in which that language was not in use. Third, some of the meanings used in archaeological research are not found in Saami dictionaries. Last, some terms have been used very sporadically.

To be able to systematize Saami term use, terminological work must be done. This should be done in cooperation with the institutional community working with the Saami past and the Saami community whose past is being researched. With the Saami(-speaking) communities' help, it would be possible to, for example, uncover which terms are (or were) in real use in the languages and determine whether there are more terms that should be added to the list. With archaeologists' input, the needs of the research community regarding term use can be solved.

A good example of such work has already been done in the South Saami region: Ellen Bull Jonassen and her team (2011) gathered a list of terms referring to South Saami cultural heritage. As Bull Jonassen and the team (2011: 80) stressed, their list of terms is not ready to be used as a formal terminology in cultural heritage registration and research. However, it is, as they point out, a good pre-work for further and systematic terminological developments. Similar work should be done with other Saami languages, to broaden the work toward a terminological database to be used as a reference for Saami archaeological cultural heritage. The finding of Saami terms within the current project is meant to serve as the beginnings of such a terminological database for all cultural heritage workers and Saami communities to use. This database will enhance the systematic use of Saami terms, instruct term use and the choice of the right Saami language, and detail how to motivate term use.

ABBREVIATIONS

Fi	Finnish
Nw	Norwegian
SaL	Lule Saami
SaN	North Saami
SaS	South Saami
Sw	Swedish

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APPENDIX 1

Saami terms in archaeological research published in Finland

Notes on the table

The table lists all the word forms used in the publications included in the data. I list the language of the term in brackets. It is quite rare that the language of the terms is defined in the research; thus, I have looked for the words in Saami dictionaries. If the term is not found in any of the (modern) languages, and there is no definition of the language in the publications, I marked the term with a question mark.

The English meaning of the word is translated from the definitions found in Saami dictionaries, and if the word has a special meaning in archeology, that is also given. If a word is not found in Saami dictionaries, I used the meaning given in the article(s) in which the term appears. Such meanings are marked with "(ARC)" for 'archaeology', and it must be considered that they might be incorrect. Sometimes, I give two different meanings: the one in dictionaries and the one used by archaeologists. In the latter case, the one used by archaeologists is not found in dictionaries.

Sometimes, the English translation of the meaning of the word requires Saami words, such as *bearpmet* 'a row of stones or logs that lead to the *árran*' in which the word *árran* in bold font is a North Saami word that is needed to define the North Saami word *bearpmet* in English. These are given in the same Saami language as the term in question. All the Saami words used in English translations can be found in the table as Saami terms. Saami words in English translations are preferred because Saami terms are often difficult to translate into English in a concise way without using other Saami words.

The last column names the semantic field of the term. In some cases, the semantic field I have listed is marked with a question mark. In those cases, the semantic field is often connected to the concept that archaeologists use but is uncertain from the perspective of definitions given in dictionaries.

In the endnotes of the paper, I comment the use of the terms, as there are many confusions in word use, spelling, and the meanings of the terms.

Saami term	**Meaning in English**	**No. of publications**	**Total no. of mentions in publications**	**Semantic field**
aevsie (SaS)	crown of horns	1	3	reindeer
áiligas (SaN)	sacred	1	1	sacred sites & phenomena
árran (SaN)	hearth hearth-row (ARC)	7	42	dwellings
baeljek (?)	framework of paired curved poles that give the floor of a hut a larger and more oval outline (ARC)	1	1	dwellings?
bálges (SaL)	trail	1	1	travelling
bassi (SaN), *basse* (?)[11]	sacred	2	4	sacred sites & phenomena
bearpmet (SaN), *permikkä* (Fi), *permukka* (Fi)	a row of stones or logs that lead to the *árran*[12]	5	11	dwellings
bearpmetárran (SaN)	a central fireplace with two rows of stone; a type of open hearth with a stone border (ARC)	1	1	dwellings

Saami term	Meaning in English	No. of publications	Total no. of mentions in publications	Semantic field
boaššu (SaN), *boassjo* (SaL), *posio* (Fi), *boassju* (?), *boassu* (?)	the back of a Saami *goahti*, often considered sacred the sacred back part of a Saami *goahti* (ARC)	12	63	sacred sites & phenomena, dwellings
borra (SaN)	meat storage pit	1	2	storage
buvri (SaN), *puura* (Fi)	storage shed	4	6	storage
čearpmat (SaN)[13]	last year's calf	1	1	reindeer
daektiesijjie (SaS)	bone cache (ARC)[14]	1	1	sacred sites & phenomena
dálvvadis (SaN)	winter dwelling place; winter land; winter market place	1	1	dwelling place
Duorpun (SaL?)[15], *Tuorpon* (?)	a fishing method that involves the use of a pole to scare the fish into a net or fish trap (ARC)	2	6	hunting & fishing
geinnodat (SaN)	migration road; passageway	1	3	travelling
gieddi (SaN)[16]	field; meadow; milking grounds (ARC)	2	3	topography, reindeer?
giedtieh (SaS)[17]	reindeer corrals	1	1	reindeer
gieres (SaL?)[18]	boat-shaped Saami sledge pulled by reindeer (ARC)	1	7	travelling, reindeer
goahti (SaN), *goahtte* (SaL?), *goathe* (?)[19], *gåahti* (?), *koahte* (?), *kåta* (Sw)	hut; house; home	18	203	dwellings
godderoggi (SaN)	hunting pit for deer	1	1	hunting & fishing
jiekiö (Fi)	a tool for shaping skin	1	3	tools & artifacts
jutata (Fi)	to move with the reindeer	2	3	travelling, reindeer
jåartasijjie (SaS)	bone cache (ARC)[20]	1	1	sacred sites & phenomena
jårtesie (SaS)[21]	bone deposit, bone cache	1	1	sacred sites & phenomena
kannus (Fi)[22]	*noaidi* drum	3	8	sacred sites & phenomena
kitta (Fi?)	working area for women (ARC)	1	1	dwellings
kurtta (Fi)	reindeer milk; dried reindeer milk (ARC)	1	2	reindeer
launi (Fi)[23]	wooden fish hook	2	5	hunting & fish-ing

Saami term	**Meaning in English**	**No. of publications**	**Total no. of mentions in publications**	**Semantic field**
lávggastat (SaN)	small decorative leaflet in a piece of jewelry	1	1	tools & artifacts
lávvu (SaN), *lavvo* (Nw)[24], *lavvu* (SaN?)[25], *laavu* (Fi)	tent; light-structured *goahti* made of canvas	4	6	dwellings
loaidu (SaN)[26], *loido* (?), *loito* (Fi), *luoito* (?)[27]	sitting and sleeping areas on either side of an *árran* in a *goahti* the left side of a *goahti* (ARC)	4	12	dwellings
luojddo (SaL)[28]	floor in a tent or *goahte* the areas alongside a hearth (ARC)	1	1	dwellings
loude (Fi)[29]	hut cover; hut fabric	3	11	dwellings
luopsi (?)[30]	the back part of the *goahti*	1	1	dwellings
luovve (?)[31]	sacrificial platform (ARC)	1	1	sacred sites & phenomena?
luovvi (SaN)	storage place	1	1	storage
nammaláhpat (SaN)	A male reindeer over eight years old A male reindeer over six years old (ARC)	1	1	reindeer
nili (Fi)	a small storage hut that stands on one pole	1	1	storage
noaidi (SaN), *noajdde* (SaL), *nåjd* (Sw), *noid* (?)	Saami religious expert; shaman witch; Lapp shaman (ARC)	9	35	sacred sites & phenomena
orda (SaN)	tree line the upper forest zone (ARC)	1	1	topography
orohat (SaN)	reindeer grazing area; area with Saami residence	2	5	dwelling place, reindeer
peski (Fi)	reindeer fur coat Lapp coat (ARC)	1	3	clothing & textiles, reindeer
purnu (Fi)	storage that is dug in the ground and supported by a log structure a storage that is dug in a field of rocks; fish cellar (ARC)	6	35	storage
raanu (Fi)	wool blanket with the base fabric made of cotton or linen and pattern fabric made of wool	1	4	clothing & textiles
sáiva (SaN)[32], *saivo* (Fi)[33], *sájva* (?)[34]	fresh water; small lake; lake without an outlet or a river that brings water to the lake; sacred lake, often believed to be double bottomed	6	152	sacred sites & phenomena
sarva (SaS)	reindeer bull	1	1	reindeer
sarve (SaS)	elk	1	1	animal

Saami term	Meaning in English	No. of publications	Total no. of mentions in publications	Semantic field
sieidi (SaN), *siejdde* (SaL), *seita* (Fi), *sejte* (Sw), *seite* (Sw?), *seid* (?)	sacred stone, rock, tree, cliff, etc. sacred site (ARC)	33	1307	sacred sites & phenomena
šiella (SaN)	present given to the newborn; reward for finder metal artefact made of pewter or silver for offering; gift; reward (ARC)	1	2	sacred sites & phenomena
sieppuri (Fi)	a short cape; round cape made of bear skin with neckline in the middle neck wrapping (ARC)	1	2	clothing & textiles
siida (SaN), *sijdda* (SaL)[35], *siita* (Fi), *sijda* (Sw?)[36]	(Saami) village; reindeer village; home Saami village; traditional administration unit; notion used for people, the political organization, and the resource area/territory used by each group in Saami society; territorially autonomous social unit consisting of a collection of households; Saami community functioning as an independent social and economic unit (ARC)	25	144	social organization
šillju (SaN)	yard site area (ARC)	1	1	dwelling place
sjïele (SaS), *sjiele* (SaS?)[37]	wedding gift; sacrificial gift; amulet; (metal) artefact used as an offering	2	10	sacred sites & phenomena
sjïelegierkie (SaS), *sjielegierkie* (SaS?)[38]	sacrificial stone	2	2	sacred sites & phenomena
slahpa (SaL)	a room under a stone where it is possible to take shelter during storms or for overnight stays	1	1	dwelling, topography
stállo (SaL), *stallo* (?)[39], *staalo* (Fi), *stalo* (Sw)	scary and strong mythological being; troll type of a dwelling site in the fell area often with a circular or oval floor surface and centered hearth surrounded by a low bank (ARC)[40]	19	119	sacred sites & phenomena, dwellings
suohpáš (SaN)	crossing point bottleneck of a passageway (ARC)	1	1	travelling
suopunki (Fi)	lasso	1	3	reindeer
Talv-sijd (?)[41]	winter village (ARC)	1	1	dwelling place

Saami term	Meaning in English	No. of publications	Total no. of mentions in publications	Semantic field
tseegkuve (SaS)	sacrifice; reindeer sacrifice	1	13	sacred sites & phenomena
uksa (SaN, SaL)	door front area of a *goahti* (ARC)	6	14	dwellings
ushta (?)[42]	spoon bait	1	1	hunting & fishing
vuobme (SaL), *vuome* (SaL?)[43], *vuoma* (?)	forest; wide valley with forest; inland area with a lot of forest Saami community; regional network of related families (ARC)	4	7	topography, social organization?
vuobman (SaN?)[44], *vuomen* (Fi), *vuobma* (?)	a funnel-shaped wire fence for catching deer	4	32	hunting & fishing

NOTES

[1] I use the form *Saami* for naming the different Saami languages or referring to the languages as a group. I have chosen this form after consulting Sámi Giellagáldu, the joint organization of the Saami in Nordic countries that is responsible for matters on Saami languages. Giellagáldu recommends this long vowel form that does not favor the North Saami form *Sámi* above word forms in other Saami languages (such as Skolt Saami *sää'mm* and South Saami *saemie*) but shows the important long vowel of the word (Sven-Erik Duolljá e-mail to Piha 16.12.2019; see also Piha 2020b: 25–26).

[2] The Saami live also in Russia, but Saami archaeology in Russia has been excluded from this article due to a language barrier and the present geopolitical situation.

[3] The role of Indigenous studies and Indigenous archaeologies within Saami archaeology and in relation to the use of Saami terms will be discussed in more length and detail in a future paper of this ongoing project 'Saami terms in archaeological research'.

[4] However, Saami terms can be turned into international terms (Kaikkonen 2020: 9–10). An example of a minority-language term that has become an international scientific term is 'shamanism' (see e.g., Tieteen termipankki 28 February 2024: *Uskontotiede: shamanismi*. Exact address: https://tieteentermipankki.fi/wiki/Uskontotiede:shamanismi), which originates in the Evenki word *shaman* "the one who knows/sees" (SESK s.v. *samaani*).

[5] Archaeological journals do publish research from other disciplines, such as anthropology and linguistics, if they are relevant to archaeology.

[6] The only exceptions to these are studies that are clearly not connected with Saami archaeological cultural heritage, e.g., dissertation by Tiina Väre (2017) that studies a body of one deceased person, Vicar Nikolaus Rungius, who lived in Lapland. Even if Rungius had connections with the Saami, the study is not about certain or possible Saami archaeological cultural heritage. The urban archaeological studies of Lapland towns are not included either if they do not have a Saami perspective or if they do not see the towns specifically as places for major population (Finnish, Norwegian, Swedish) in which there was no place for the Saami.

[7] One such archaeological remain type that connects to Saami speakers might be Lapp cairns, and I have included research about these in my data whenever they are published on forums that are in my data. The traditional name of the remain type indicates a connection to the Saami, as the name *Lapp* is convincingly argued to point to the Saami people (Aikio 2012: 95).

[8] Nowadays e.g., *Fennoscandia archaeologica* (https://journal.fi/fennoscandiaarchaeologica/about/submissions, read 28 February 2024) gives instructions on how to deal with Saami terms: 'Saami languages/terms: The used Saami language in which the Saami terms are given should be indicated and used coherently.'

[9] South and Lule Saami is taught and researched at Nord University in Norway and Umeå University in Sweden; South Saami can, to some extent, be studied also at Uppsala University in Sweden. Inari and Skolt Saami are taught and researched in the University of Oulu in Finland.

[10] Training on the use of dictionaries could be a part of academic education in Saami archaeology, and a course in Saami archaeology should be compulsory in studies in archaeology in Scandinavia and Finland. This is, however, a note for institutions, not to individual researchers who do not have much power to decide what is studied in universities.

[11] The form *basse* was only used in one publication (P64) in a context in which historical documents about Saami religion are described. It is not entirely clear if this form is cited from these old documents. The language of the word is not mentioned, but in the publication, it is described that North Saami orthography is used unless otherwise stated. *Basse* is 'sacred' in Lule Saami, but presumably, Lule Saami is not used in this case. In addition, it is acknowledged in the publication that the root *basse-* is found in North Saami toponyms when the word is the attributive first part of a compound, e.g., *Bassečielgi*.

[12] In one of the publications (P51), the meaning 'a central fireplace with two rows of stone' is given in reference to this term, but it is the meaning of the term *bearpmetárran*.

[13] This term is found only in one publication (P115), and a wrong meaning is given to this term. It is written that the meaning is that of *bearpmet* 'a row of stones or logs that lead to the *árran*'.

[14] The word *daektiesijjie* is not found in dictionaries, but it is a compound word with parts *daektie* 'bone' and *sijjie* 'place'. The word is not found in the '*Åarjelsaemien baakoe kultuvremojhtesidie*' 'The South Saami word list of cultural heritage' (Bull Jonassen et al. 2011).

[15] In P120, the word *Duorpun* (with a capital letter in the beginning of the word) is used and defined as a Lule Saami word. Most likely, this word is meant to refer to the meaning of the word *duorbun* 'white-painted piece of wood (shaped like a fish) with a lead sinker at one end, which is sent toward a school of herring to chase it in a certain direction'.

[16] This is a cognate word with SaS *giedtieh* that has a different meaning.
[17] This is a cognate word with SaN *gieddi* that has a different meaning. The SaS word is in nominative plural form.
[18] In P55, the word *gieris* 'open sledge that is built like a boat' is probably meant; the meaning of *gieres* in Lule Saami is 'darling, beloved; loving'.
[19] In P120, the Lule Saami form *goahte* is probably intended, but it is systematically written wrong.
[20] The word *jåartasijjie* is not found in any dictionaries. It is a compound word with parts *jåarhta* 'soil' and *sijjie* 'place'. It is probable that in P124, it is meant as *jårtesie* 'bone deposit, bone cache', which is found in the *Åarjelsaemien baakoe kultuvremojhtesidie* 'The South Saami word list of cultural heritage' (Bull Jonassen et al. 2011). According to the list (id. 85, endnote 20), *jårtesie* is not written by the modern orthography because the word is not found in modern dictionaries. The form is taken from Bäckman & Kjellström (1979: 60).
[21] This word is obtained from Bäckman & Kjellström (1979: 60) and does not conform to modern South Saami orthography.
[22] It is not quite certain whether this Finnish word is a loanword from Saami to Finnish. The only meaning is 'Saami *noaidi* drum', and it is found specifically in northern Finnish dialects (SKES s.v. *kannus*). Thus, it could be a word of Saami origin, e.g., SaN *goavddis* and SaL *goabdes*. However, the sound substitutions might not be regular.
[23] It is not entirely clear if this is a loanword from Saami. The Saami and Finnish words might be cognates that originate in the same protolanguage (SKES s.v. *launi*).
[24] In P51, *lavvo* is presumably given as a term in a Saami language even though it is not explicitly specified. It is, however, a Norwegian word that is borrowed from Saami.
[25] In P49, it was stated that North Saami designations are used unless otherwise indicated. However, *lavvu* is not a North Saami word, and no other language is stated for the word. The North Saami word *lávvu* was probably intended.
[26] This is a cognate word with SaL *luojddo* that has a different meaning.
[27] In P117, this word is inflected in nominative plural *luoidot* according to the Finnish inflection system. Additionally, the Finnish word for the concept is given (*loito*) in the same publication. However, it is not entirely clear which language *luoidot* is in. The Finnish nominative singular of *luoidot* would be *luoito*.
[28] This is a cognate word with SaN *loaidu* that has a different meaning.
[29] In the publications, this word is used as the attributive part of a compound *loudekota* 'hut covered with fabric'.
[30] This word in P20 might refer to the Inari Saami word *luopsâ* 'the place for dish in the back part of the *kuáti* (hut)', but it has been misunderstood to refer generally to the back part of the hut.
[31] It is not clear which Saami word this is, and the language is not specified in the publication (P69). In Lule Saami, *luovve* means 'storage place that stands on four poles and is used for storing food, clothes and equipment'; In North Saami, *luovvi* has a similar meaning. The meaning 'sacrificial platform' given to the word in archaeological research is not found in any of the dictionaries.
[32] In P64, the different meanings of the word *sáiva* (or its cognates in different Saami languages) are noted and described. According to the descriptions, in the west, *sáiva* lakes were associated with fells and mountains, while specifically in the areas of Finland and Sweden, a *sáiva* lake meant a lake with a double bottom (about the *sáiva* as a concept, see Pelttari 2012: 40–42).
[33] In P49, the terms *sáiva* and *saivo* are written with a capital letter at the beginning of the words, but it is not explained why.
[34] The form *sájva* in P49 might refer to the Lule Saami word *sájvva* 'sacred lake or mountain'. The Lule Saami word takes part in consonant gradation and is inflected as *sájva* in weak grade. This form is used in the context of 'Southern Sámi areas' in P49. However, the word is *saajve* in South(ern) Saami. Lule Saami is a Saami language that is undeniably spoken south of North Saami but not traditionally in the Southern Saami areas.
[35] In P119, it is written that *sijdda* is the South Saami form of the word. However, it is a Lule Saami word; South Saami word would be *sïjte*.
[36] This word is used in P62 as the Swedish translation of the Saami word. However, it is not found in dictionaries or in SAOB.
[37] In P82, *sjiele* is claimed to be a South Saami word, but the correct form is *sjïele*.
[38] Also in this compound word, the correct form for the first part is *sjïele*; however, in P72, it is written as *sjiele*.
[39] This form seems to appear in publications in which the used Saami language is North Saami (e.g., P76; P81; P125), and in one of the publications it is explicitly noted that the used Saami language is North Saami (P125). However, the North Saami form for this word would be *stállu*.
[40] This word has a well-established meaning in Saami and Nordic archeology that many archaeologists use to discuss this particular type of dwelling site.
[41] The capital letter at the beginning of the word is originally from P84.

[42] In P21, it is stated that this is a word in ‘Norwegian Lapp language’; it is probably the North Saami word *ušta* ‘spoon bait’.

[43] This is probably the form of *vuobme* in weak grade that is used when the noun is inflected in certain cases and numbers.

[44] The correct form of North Saami would be *vuopman*. *Vuobman* is a word in Lule Saami that means ‘volume; space’.

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Marie Ødegaard & Kristoffer Hillesland

SOCIAL AND SEASONAL ORGANIZATION OF RED DEER HUNTING FROM THE NEOLITHIC TO THE LATE IRON AGE (C. 2000 BC TO AD 1000): STONE-SET HUNTING BLINDS FROM WESTERN NORWAY

Abstract

This is the first paper to examine social and seasonal organization of red deer hunting using stone-set hunting blinds in Norway. The paper examines seven hunting blinds discovered in Gjesdal, western Norway. Four of the hunting blinds are unique; it was possible to date them directly with radiocarbon dating. The sites exhibit multiple construction phases, with a usage period ranging from the Neolithic to the Mid Iron Age, and we would suggest, extending into the Late Iron Age and Middle Ages. The datings and multiple phases make it possible to discuss temporal change in the construction of the hunting blinds, which is unprecedented in a Fennoscandian context. Hunting appears to align with social trends, becoming more prominent during periods of settlement decline and increased use of outfield resources for surplus production. While hunting in the lowlands of western Norway, particularly between 0 and 900 metres above sea level, appears to have been smaller in scale compared to mass-scale hunting in Norway's high-altitude zones and eastern regions, the high population of red deer until about 500 years ago indicates profitable hunting opportunities during specific seasons. The cluster of hunting blinds suggests organized cooperation among neighbours and families, with surplus products potentially sold and exported to local and regional markets.

Keywords: Hunting blinds, outfield resources, red deer, lowlands, Neolithic, Iron Age.

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INTRODUCTION

Big game hunting has been practised in all periods of prehistory around the world as a basis of life, income source, and for use in cult activities and myths (e.g., Kelly 1995; Mansrud 2006; Indrelid & Hufthammer 2011; Fletcher 2013: 83–144; Henkelmann 2013; Weber 2013; O'Shea 2014; Hennius 2020; Pasda et al. 2020). Different trapping systems for large animals are well known throughout the world (e.g., Reagan 1919: 443; Spiess 1979; Indrelid et al. 2007, Reimer 2009; Stormyr 2011; Lemke 2015; 2021). In Norway, mass-harvesting of reindeer in large trapping systems is well known from the alpine, high-altitude zones (Bang-Andersen 2008; Indrelid & Hufthammer 2011), with methods which could also include stone-set hunting blinds, guiding fences and pitfalls (Pilø et al. 2018; Solli 2018a). Pitfalls for elk are well known from eastern Norway and northern Sweden and can be singular or in systems with up to tens or even hundreds of pits, stretching for several kilometres (Jordhøy et al. 2012; Hennius 2020; Post-Melby & Bergstøl 2020a; 2020b). In total, almost 5000 hunting facilities are known in Norway, with a majority from high altitude zones above 900 m.a.s.l. (e.g., Indrelid Hufthammer & Røed 2007; Indrelid & Hufthammer 2011; Solli 2018b), and new artefacts from reindeer hunting are continuously being found from melting icecaps (Wammer 2007; Finstad & Pilø 2010; Callahan 2013; Høyer 2015; Bjørgo et al. 2016; Martinsen 2016).

While prehistoric hunting of elk from eastern Norway and reindeer from the high-altitude zones is well known, hunting of red deer in the Norwegian lowland areas below 900 m.a.s.l. has only been investigated to a small degree and, as far as we know, none of the structures have previously been dated. This study, however, presents a unique case in which several hunting blinds could be radiocarbon dated, and multiple phases of construction were investigated. While hunting architecture has been well studied across the globe, it is rarely carried out in relation to prehistoric red deer hunting. To remedy that is the aim of this paper.

Several finds from high altitude zones in Norway have shown that large-scale hunting was taking place already from 2500–2280 BC – that is, the Middle Neolithic (Åstveit 2007: 15–16; Finstad & Vedeler 2008: 68; Callahan 2013: 729–740). Hunting of elk intensified during the Neolithic (c. 4000–1700 BC) and further increased in the Bronze Age (c. 1700–500 BC). (Post-Melby & Bergstøl 2020: 319). There is evidence for extensive and systematic hunting in mountain areas from the Roman Iron Age (c. AD 1–400) up to the Middle Ages (c. AD 1050–1536) (Pilø et al. 2018; Solli 2018a). However, when it comes to prehistoric hunting in the lowlands, it has been argued that it was of minor importance because it was only possible to kill one or a few animals at a time (Indrelid & Hufthammer 2011: 8). This seems to indicate that the hunting must have been organized on an individual level, in contrast to the communal organization of mass hunting of reindeer in the mountains, controlled by the king or by elites. This is still an open question, and here we will study how hunting in the lowlands was organized.

Our starting point is a group of seven hunting blinds and one possible guiding fence from the lowlands in Gjesdal municipality, Rogaland County, in western Norway. They are located at two different historical farms, *Haraland* and *Bollestad*, approximately three kilometres apart. The sites were excavated by the Museum of Archaeology, University of Stavanger in 2020. The use of these blinds has been dated from the Neolithic up until the Mid Iron Age (c. 2000 BC to AD 300). We will investigate the chronology of these sites, and spatial and temporal patterns. Our aim is to throw light on the social context and the organization of the red deer hunt in the Scandinavian lowlands during prehistory.

DISTRIBUTION OF ANIMALS AND HUNTING FACILITIES IN NORWAY

There are four large wild ungulates in Norway; elk (*Alces alces*), reindeer (*Rangifer tarandus*), red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*). Reindeer exist in the higher mountain areas of Gjesdal today, but not below 500 m.a.s.l. (Stegarud 2018). The sites at Haraland and Bollestad are located at around 200 m.a.s.l. Historically, the respective distribution of red deer and elk in Norway varies from region to region. Elk has been associated with the more continental eastern inland or boreal bioregion, while red deer were found along the milder Atlantic west coast, separated by the Scandes mountain range (Collett 1912). However, bone material shows that both elk and red deer were present in western Norway in the first part of the Holocene (Rosvold 2013 with refs.). Farming and domestic animal husbandry in western Norway was firmly established in the Late Neolithic, c. 4500–4000 cal. BP (Høgestøl & Prøsch-Danielsen 2006). The landscape then changed, with pollen diagrams showing deforestation and an opening of the landscape following both the beginning of agriculture and the colder climate of the late Holocene (Kaland 1986; Bjune 2005; Hjelle et al. 2006; Hjelle et al. 2010; Høgestøl & Prøsch-Danielsen 2006). Red deer coped with these changes better than elk, and in the following periods red deer have become the most common big game animal in western Norway (Rosvold 2013). The population of roe deer in Norway has been relatively low through prehistory and up to the 20th century (Hufthammer 1992). Thus, red deer became the predominant ungulate in western Norway during the mid-Holocene warm period, c. 8000–4000 cal. BP. (Rosvold et al. 2013), and it is reasonable to assume that the hunting structures from Gjesdal must have been for red deer.

As mentioned above, c. 5000 hunting facilities are known from Norway. If we disregard those from the high-altitude zones, we are left with c. 600 hunting facilities from lowland areas: the Atlantic region along the coast and the boreal region of eastern Norway (Fig. 1). In the southwestern region, red deer have been the predominant ungulate, while in the northern parts of Norway reindeer and to a lesser extent elk have been predominant. Boreal eastern Norway, on the other hand, is dominated by elk. The Atlantic areas of southwestern Norway and up to mid-Norway (that is, from Rogaland to the Trondheim fjord) have been the most important habitats of red deer both in Norway's prehistory and up to our time (Langvatn 2020a). In all, c. 370 hunting structures are known from these areas. Of these, 230 are from the lowland areas, below 900 m.a.s.l., and the Atlantic bioregion. To our knowledge, none of these sites are dated. All in all, the few sites from the lowlands suggests a more individually organized hunt than the mass hunting of reindeer in the mountain areas and mass trapping sites for elk in eastern Norway.

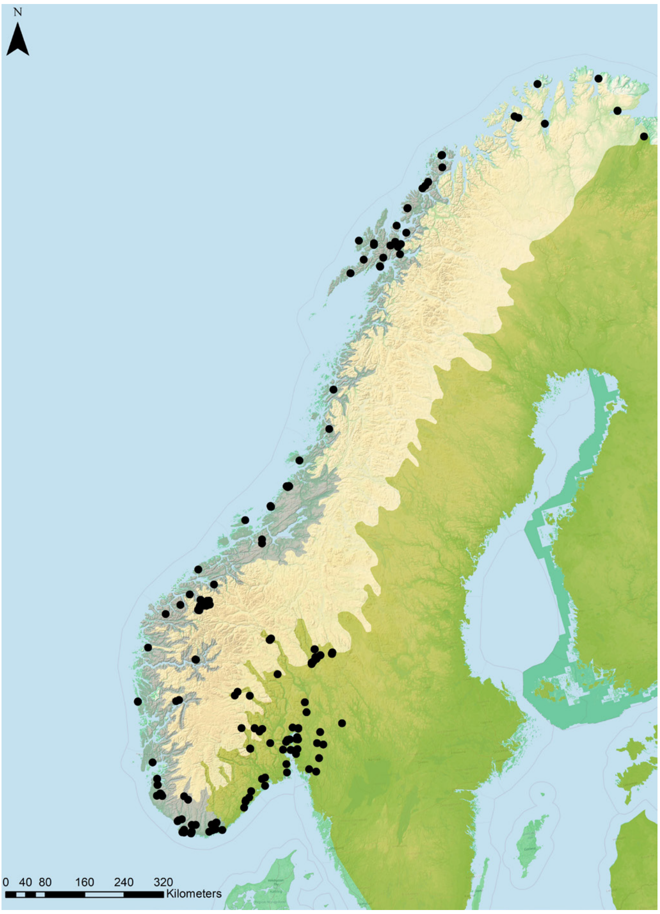


Figure 1. Distribution of hunting sites from the lowland areas of Norway: The Atlantic region along the coast (grey), the mountain regions in inland Norway (yellow) and the boreal region of eastern Norway (green). Map: K. Hillesland (OpenStreetMap and contributors, CC-BY-SA; HERE, Garmin, INCREMENT P, USGS).

HUNTING BLINDS FROM GJESDAL

In the summer of 2020, the Museum of Archaeology, University of Stavanger excavated seven stone-set hunting blinds: three at the farm of Haraland, and four at the farm of Bollestad, both being sites in Gjesdal county (Fig. 2). Hunting blinds are facilities consisting of straight or halfmoon shaped stone walls, usually stacked with naturally occurring stones. To expose details in the construction, all the hunting blinds were excavated by deconstruction in several phases. Gjesdal belongs to the inner parts of the Jæren region in western Norway and is more densely populated than the agricultural regions of the coast. The western part of Gjesdal has a hilly landscape of many small regions separated by lakes, wetlands, and light forest but connected by rivers (Rosvold 2013). Further east, the landscape consists of mountains and valleys, with steep hillsides and rough terrain. There are also flatter

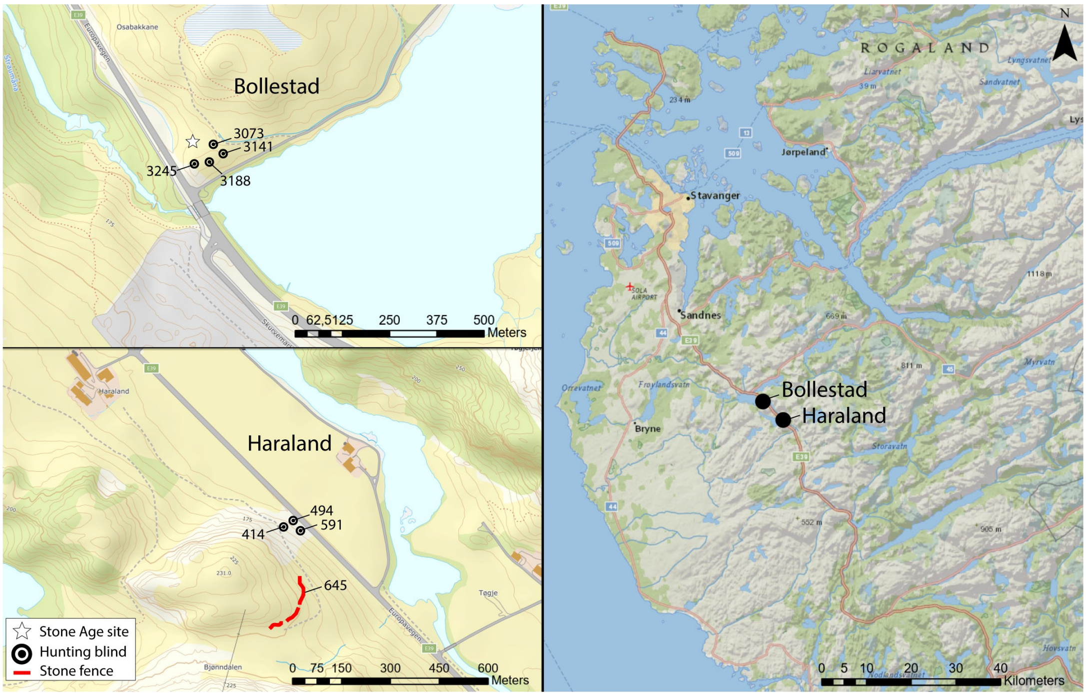


Figure 2. Map of the seven hunting blinds and the guiding fence from Gjesdal county, Rogaland. Map by K. Hillesland (OpenStreetMap [and] contributors, CC-BY-SA; HERE, Garmin, INCREMENT P, USGS).

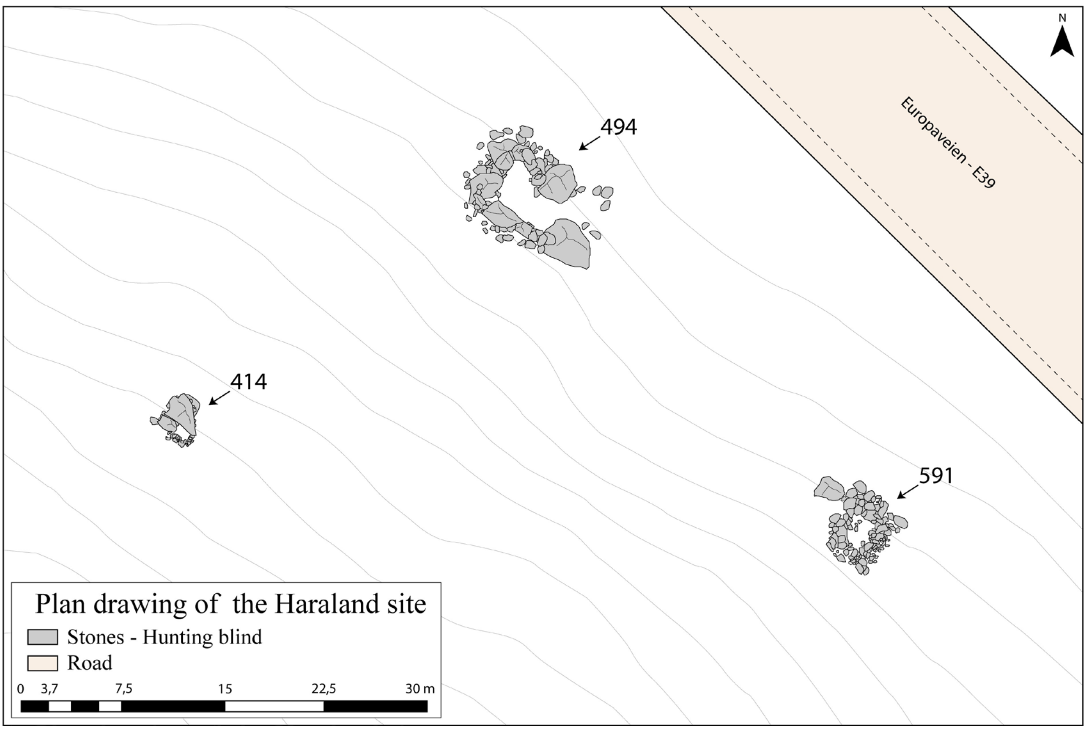


Figure 3. Plan drawing of the Haraland site, showing the three hunting blinds and how they are situated in the landscape. Drawing: K. Hillesland.

areas where agriculture is the dominant land use, and both lightly and heavily forested areas. Both Haraland and Bollestad are located along existing wandering routes for red deer, where the lowlands adjoin more mountainous areas (Forvaltningsplan 2021). This explains the hunting blinds' location: they take advantage of the terrain and of the seasonal wanderings of red deer.

Haraland

The farm of Haraland has three hunting blinds, located in a narrow part of Gjesdal valley along the modern E39 road (Hillesland et al. 2020). They are at the bottom of a rocky hillside consisting of large boulders and glacial deposits, where the sloping terrain merges into the infield areas at the bottom of the valley. The hunting blinds are at an intersection, where a valley from the southwest enters the main valley below. From here, further passage between the lowlands and mountain areas is possible. Thus, the red deer would have passed the hunting blinds when travelling northwards or southwards, or by the narrow valley towards the southwest (Fig. 2).

The hunting blinds at Haraland were situated in a cluster, c. 20 metres apart, and strategically placed in the landscape (Fig. 3). They were built to "fit" the terrain and consisted of naturally occurring rocks laid out in rectangles, all above ground. Id 494 was the largest of the three structures, measuring approximately 4 x 3 metres with a height of about 1.5 metres (Fig. 4). It had an almost rectangular shape, constructed around several large boulders with smaller stones placed between them. Inside the structure, a stone floor was constructed.

To the southeast, we find id 591, with rectangular shape and dimensions of 2.3 x 1.5 metres. Most of the structure was built around several large stones with smaller stones placed between them, ranging in size from 10–40 cm. Id 591 appeared less distinct than the other two blinds at Haraland, with the southern side forming a clear wall, while the northern side was mostly eroded and unclear. The third hunting blind at Haraland, id 414, measured approximately 1.6 x 2.0 metres and 0.8 metres high at its highest point. The structure was partially built

Figure 4: The hunting blind (id 494) at Haraland, looking towards the south. Photo: K. Hillesland and M. Ødegaard. Museum of Archaeology, University of Stavanger. CC-BY-SA 4.0.

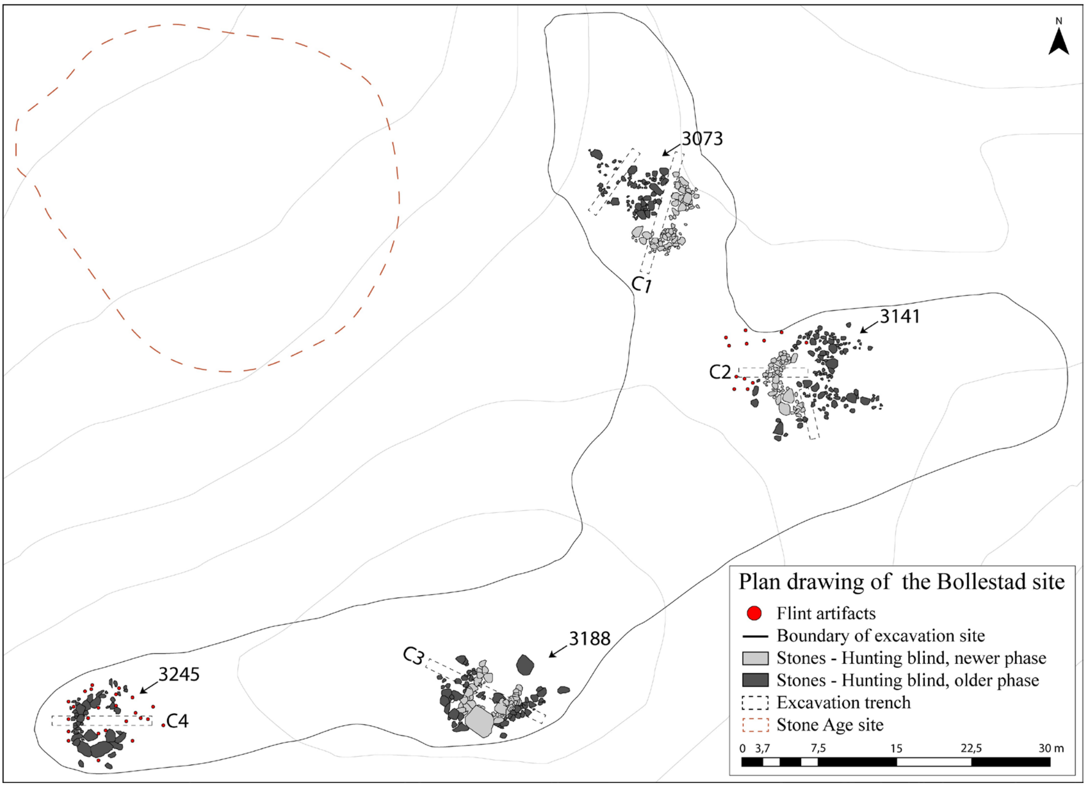


Figure 5. Plan drawing of the Bollestad site, showing the four excavated hunting blinds. Drawing: K. Hillesland.

into the slope towards the southwest of id 494, with 3–4 layers of stones. Id 414 differs from the other two hunting blinds in its smaller construction. No soil or charcoal was found in them, and thus no material for radiocarbon dating, presenting a classic problem with this type of feature.

On the hillside above the site, there are several stone fences running downward from the mountain. Some of these fences could be guiding fences for leading the prey down from the mountain towards the hunting blinds. One stone fence was investigated as part of the excavation (id 645; cf. Fig. 2). It curves in towards the hunting blinds, but is then cut off by a modern road, making it impossible to establish for certain what the original relationship between them was.

Bollestad

Northwest from Haraland we find the site of Bollestad (Fig. 2). The site is located on a hilltop, overlooking lake Klugsvatnet to the south and the lowlands of the valley northwards. The location can be described as a "bottleneck" for travelling up and down the valley, making the location ideal for the placement of a hunting facility, as the animals would have passed through this area between summer and winter habitats. In total, there are four hunting blinds, located 7–17 meters apart (Fig. 5). They all consist of rocks, mostly 10–50 cm^2 in size, built in a dry wall construction in a semi-circular to circular shape with an opening to one side. The two northernmost blinds (id 3073 and 3141) were the largest.

Before the excavation began, id 3073 appeared as a depression in the landscape. Below the turf, a stone wall was revealed, forming a circular structure approximately 4.5 metres in length and 4 metres in width, with a depth of about 80 cm (Fig. 6). The highest part was oriented to the southeast. The opposite side, the northwest, was slightly lower with a discernible entrance leading into to the centre. At the lowest point in the northwest, a less robust stone wall was visible, likely part of an earlier phase of the structure. The stones of the hunting blind were possibly stacked directly on an underlying peat layer. Additionally, a darker layer, potentially a cultural layer, containing charcoal, was observed below this peat. This cultural layer (Layer 3) at the structure's base was undisturbed by the overlying stone packing.

Id 3141 was about ten metres southeast of 3070 (Fig. 5). It measures approximately 6 x 5 metres. The circular structure had a noticeable depression in the centre, devoid of stones. The stone wall around it was clearly added in several phases, with larger stones (20–60 cm in diameter) forming the upper layer with relatively "loose" stacked stones. This part was oriented to the west. Beneath this, a more compact stone wall with smaller stones was found (5–20 cm in diameter), suggesting an older use-phase, like in id 3141. The wall's construction seemed to be integrated with existing, natural stones and had a slightly more northwest orientation. Thirty-one Stone Age artifacts were found between this stone layer, and slightly north of the structure (Fig. 5 & 7). These artifacts are presumed to be contemporary with the construction, or older than the structure itself. A linear stone layer with smaller stones extended eastward from the structure, both in the northeast and southeast. These might be remnants of an older and now disturbed wall construction, or possibly a guiding barrier for leading animals towards the blinds.

Approximately 20 metres to the southwest were two smaller hunting blinds, id 3245 and id 3188 (Fig. 5). Id 3188 was positioned on the highest point of the ridge, offering a strategic vantage point overlooking lake Klungsvatnet and the southern valley. The blind measured approximately 4 metres in length and 3 metres in width. The dry-stone wall construction featured stones ranging from approximately 20 to 60 cm in diameter. After excavation, an older phase became apparent, marked by a more compact

Figure 6. Hunting blind (id 3073) at Bollestad in Gjesdalen valley, looking towards the south. Photo: M. Ødegaard. Museum of Archaeology, University of Stavanger. CC-BY-SA 4.0.

construction with stones ranging from 15 to 50 cm in length, below the upper layer and traced on the outer edge of the structure. A slight elevation of soil, 10–20 cm high, with stones measuring 15–40 cm, was discovered on the structure's west-northwest side during the survey. However, this feature could not be clearly identified in the profile sections. It suggested the possibility of a third usage phase for the blind.

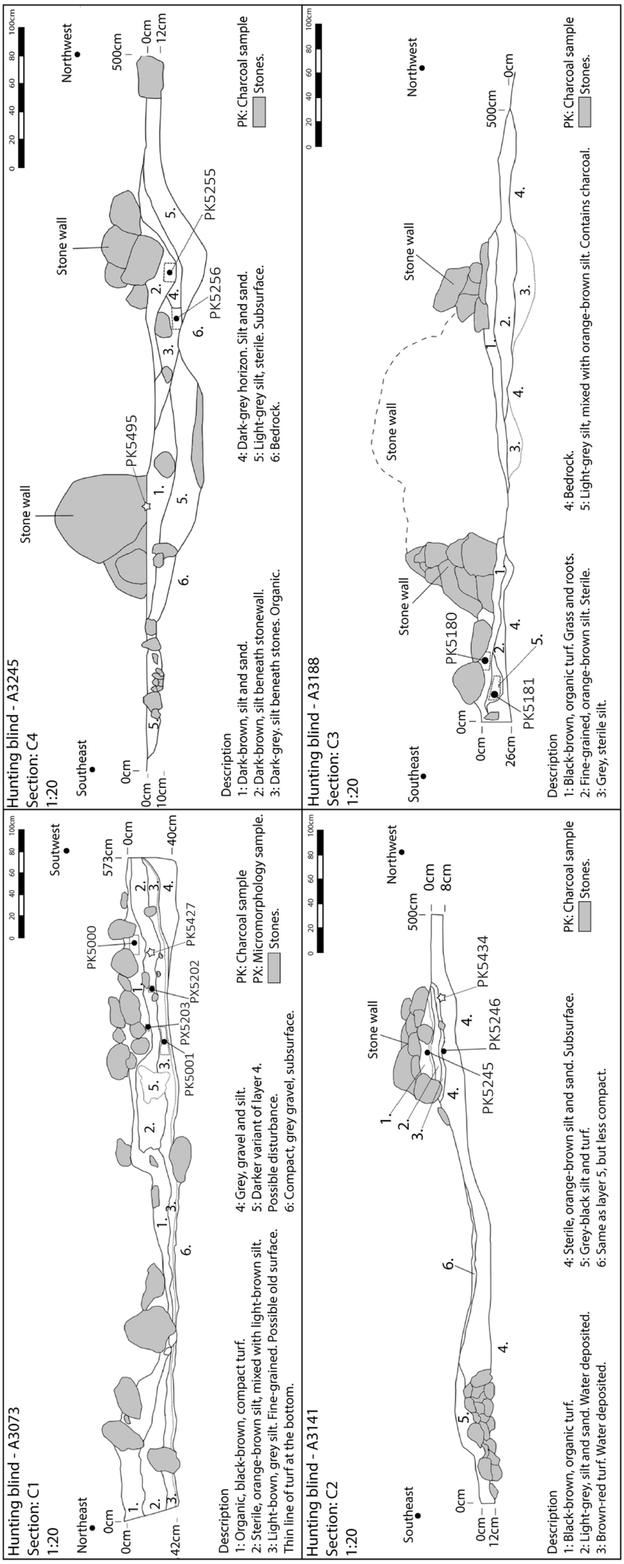
The south-westernmost hunting blind (id 3245) was on the same ridge and about 15 metres west of id 3188. This blind was the smallest on the site, measuring about 2.4 metres in length and 2 metres in width. Constructed with dry-stone walls, the structure featured a large boulder at its base, surrounded and incorporated by other stones. The wall was highest to the southwest, which was likely the route of approaching animals. This part of the construction had clearly been modified in recent times. There was an opening into the centre of the structure from the northwest. After excavation, a larger portion of the structure became visible beneath the peat, with the wall appearing more compact and mixed with soil/peat at the base. This section was interpreted as belonging to the oldest phase of the structure. An exposed profile through the structure revealed natural soil layers, but no distinct cultural layers were visible. Flint artifacts were, however, found here. Some finds were beneath the walls of the blind and may belong to an older activity phase. In total, 71 stone artifacts were found in association with this hunting blind. Their distribution pattern around the structure suggests that they all relate to the structure (Fig. 7).

Figure 7. Collection of flint artifacts found in hunting blinds id 3245 and id 3141. Here, platform core, parts of one blade and two micro-blades. Photo: A. G. Øvrelid. Museum of Archaeology, University of Stavanger. CC-BY-SA 4.0.

DATING AND CHRONOLOGY OF THE SITES

In total, nine samples for ^{14}C-dating were taken from soil layers in different profiles during the 2020 excavation at Bollestad (Table 1; Fig. 8 & 9). In addition, three samples (Beta 546911; 546910 and 546909) were taken during the pre-excavation registration by Rogaland County Council (Tegby & Samuelsen 2020). The ^{14}C-data was calibrated using Ox.cal. 4.4.4. (Bronk Ramsey 2021) and the Intcal20 calibration curve (Reimer et al. 2021). All dates are presented as calibrated dates BC/AD, 1. sigma. The samples were taken in distinct cultural layers below the stone constructions, and in some cases from between the rocks in the walls.

Four samples were dated from hunting blind id 3073 (for all samples see Table 1; Fig. 8 & 9). One sample from an intact cultural layer below



the construction was dated to the Late Nordic Bronze Age, 800–595±30 calBC (Beta-586355; Fig. 9 & 8. Layer 3, sample 5001). A sample from higher up in the same profile shows activity in the same period of the Bronze Age, 760–545±30 calBC (Beta-586360; Fig. 8. layer 2, sample 5427). A sample from in between the rocks of the stone wall, further west in the hunting blind, was dated to the Pre-Roman Iron Age, 360–200±30 calBC (Beta-586358; not in Fig. 8). This sample was taken in the structure where the stones are smaller and where they lay more compactly in the subsoil. The last sample (Beta 546911) was taken from higher up in the stratigraphy, and dated to the Late Roman Iron Age, calAD 220–325±30 (Fig. 8. Layer 1, sample 5000). The dating indicates that the hunting blind may have been built in the Bronze Age, and that there was some activity here in the pre-Roman Iron Age, while the youngest phase, which corresponds with the expanding construction phase with larger stones, dates to the Late Roman Iron Age.

The hunting blind id 3141 has the oldest date from the site (see Table 1; Fig. 8 & 9). Two samples in the northern profile indicate activity in the Late Neolithic (2020–1900±30 calBC; Beta 586362; Table 1; Fig. 8. Layer 4, sample 5434), and the Early Nordic Bronze Age (1620–1540±30 calBC; Beta 586357; Table 1; Fig. 8. Layer 1, sample 5245). The samples were taken just below the stone construction. In the same layers flint artefacts, such as a cylindrical blade core and a microblade, dating to the

Figure 8. Profile drawing showing four sections from the hunting blinds at Bollestad. The drawings show where the ^{14}C samples were taken, and the different layers within the structures (Samples 5427, 5434 and 5495 were added to the drawings post excavation). Drawing: K. Hillesland.

Id	AM lab no.	Beta no.	Wood Species	BP	±	Cal. BC/AD, from	Cal. BC/AD, to	Z1	Cal. BC/AD, from	Cal. BC/AD, to	Z2	Askeladden id
3073	2020/76-2	586355	Unknown	2560	30	-800	-595	68.2	-805	-560	95.4	265650
3073	2020/76-14	586360	Betula sp.	2490	30	-760	-545	68.2	-775	-485	95.4	265650
3073	2020/76-9	586358	Betula sp.	2210	30	-360	-200	68.2	-380	-175	95.4	265650
3073		546911	Unknown	1800	30	220	325	68.2	165	350	95.4	265650
3188	2020/76-4	586356	Pinus sp.	3280	30	-1610	-1505	68.2	-1620	-1460	95.4	265645
3141	2020/76-6	586357	Pinus sp.	3320	30	-1620	-1540	68.2	-1680	-1505	95.4	265648
3141	2020/76-15	586361	Pinus sp.	2460	30	-750	-480	68.2	-760	-415	95.4	265648
3141	2020/76-17	586362	Deciduous tree	3600	30	-2020	-1900	68.2	-2115	-1880	95.4	265648
3141		546910	Unknown	2450	30	-750	-420	68.2	-755	-410	95.4	265648
3245	2020/76-10	586359	Pinus sp.	2440	30	-735	-415	68.2	-755	-405	95.4	265646
3245	2020/76-20	586363	Deciduous tree	2890	30	-1120	-1015	68.2	-1205	-940	95.4	265646
3245		546909	Unknown	1890	30	120	205	68.2	75	235	95.4	265646

Table 1. The table shows the hunting blinds' id number, the internal Museum of Archaeology (AM) lab. number, the wood species, the date in BP, and calibrated dates in 1. and 2. sigma as well as the Askeladden id (Askeladden is the Norwegian Cultural Heritage database). Table: M. Ødegaard.

Early and Middle Neolithic, were found. Two other samples from another profile further south were dated to the Late Nordic Bronze Age with a transition to the Pre–Roman Iron Age (750–420±30 calBC, Beta-586361; 750–420±30 calBC, Beta 546910). These samples are from the southern profile and were not marked in the profile drawing. The samples were taken from below the stone construction, thus the same layer as the previously mentioned sample (ID Beta 586357). This indicates activities at the site and changes in the construction at that time.

From the westernmost hunting blind, id 3245, two radiocarbon (^{14}C) samples were taken (Fig. 8). One sample from below the stone wall was dated to the Late Nordic Bronze Age with transition to the Pre-Roman Iron Age, 735–415 calBC±30 (Beta-586359; Fig. 8. layer 2, sample 5255). Another sample was taken below a large boulder that was part of the wall construction, located directly over the bedrock and assumed to be from the oldest part of the construction. The sample was dated to 1610–1505±30 calBC (Beta-586356; Fig. 8: below stonewall, sample 5495), corresponding to the transition between the Early and Late Nordic Bronze Age. From this hunting blind, and id 3141, several flint artefacts dating from the Late Neolithic to the early Pre-Roman Iron Age were found, including a single platform-core, ten micro-blades and various debitage from tool production (Fig. 7). The two ^{14}C samples and the flints are from the same period, suggesting their use may be contemporaneous. The last sample was taken from underneath the stones in the middle part of the structure and was dated to calAD 120–205±30 (Beta 546909; Fig. 9), indicating activity also in the Early Roman Iron Age. The southwestern hunting blind, id 3188, was placed on top of the bedrock. It was only possible to get one sample from within its walls, and according to this single sample the structure is dated to the Early Nordic Bronze Age; 1610–1505±30 calBC (Beta-586356; Table 1; Fig. 8. Layer 5, sample 5181).

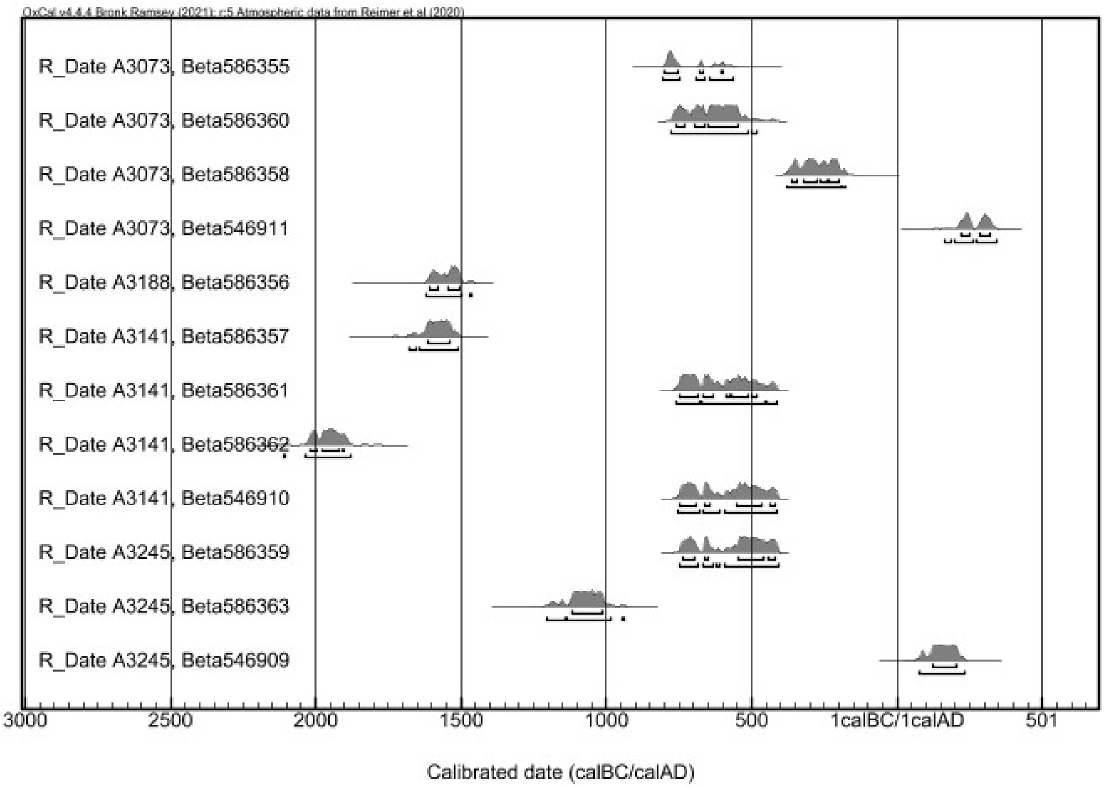


Figure 9. The dates from the farm of Bollestad in Gjesdal, Rogaland County, western Norway (Ox.cal. 4.4.4: Bronk Ramsey 2021. Intcal20 calibration curve: Reimer et al. 2021).

Altogether, the samples indicate activities in several phases. The oldest dates are from the Late Neolithic and Bronze Age, and the youngest from the Roman Iron Age (Fig. 9). The oldest dates coincide with the dates of some of the flint objects. The flint indicates tool production for hunting activities in and around the hunting blinds, and this could be seen in relation to a neighbouring Stone Age site, excavated the same year. This site is slightly lower in the terrain, about 30–50 m north of the hunting blinds. A total of 8992 processed stone materials were found, of which 35% are various forms of blades, with a particularly high number of microlites, in addition to scrapers, arrowheads, and various other flint-tools and debitage (Viken & Lagemaat 2022: 38-40). This implies that the activities taking place on the site were specialized, and connected to hunting, further emphasized by the presence of the blinds nearby. Although most of the finds date to the Mesolithic, some of them also show activity in the late Neolithic and the early Bronze age. A few finds, one Neolithic leaf-shaped arrowhead, and two possible neolithic flint-scrapers, correspond with the earliest ^{14}C-datings from the hunting blinds, possibly linking the two localities. It has been suggested that the leaf-shaped arrowhead may be an arrow shot from one of the hunting blinds, as no other secure finds were made from that period on the Stone Age site (Viken & Lagemaat 2022: 35).

The indications are that hunting in the area took place here from Mesolithic times. The hunting blinds, at least id 3141 and id 3245, were constructed somewhat later, in the Neolithic. It is unclear if the Bollestad Stone Age site was still in use at that time. The presence of the Neolithic leaf-shaped arrowhead and the two possible flint-scrapers do indicate a possible usage of the site in this period, possibly related to activity at the hunting blinds. However, as most artifacts from the site are Mesolithic, it is likely that the site was no longer used as an active dwelling site. The dates from the hunting blinds also show activity in the Late Bronze Age and Pre-Roman Iron Age, as indicated by id 3073. Most dates are from the Pre-Roman Iron Age; however, as some of the samples (e.g., Beta- 586355 and 586360) are from the same layer, it does not necessarily indicate more activity at that time. Signs of activity are also found at the hunting blinds in the Roman Iron Age, and the extension of the stone walls seems to have been carried out in this period. Although the hunting blinds at Haraland could not be dated, it is likely that they were in use at the same time as those at Bollestad, as it is only approximately 3 km between the sites.

To our knowledge, all other prehistoric hunting blinds in Norway have been dated based on various archaeological artifacts and organic material found on or near the hunting blinds and from melting ice caps (e.g., Åstveit 2007; Finstad & Vedeler 2008; Callahan 2013; Hole 2017; Pilø et al. 2018; Solli 2018a) or assumedly related archaeological features (Ramstad 2015). The dated localities are all from the mountain high altitude zones. In these cases, the hunting blinds are constructed above ground with little overlaying soil masses, thus making them very difficult to date. Hunting blinds, constructed with non-organic materials or subject to decay and disturbances, may lack suitable samples. Moreover, the potential re-use, reconstruction, and movement of blinds by later activity may further complicate dating efforts. Since the Bollestad hunting blinds have been dug down into the ground, it was possible to extract ^{14}C samples from soil and cultural layers, making the site unique in terms of dating prehistoric hunting blinds. However, if we look at other types of hunting facilities, such as pitfalls for elk, which were also dug down into the ground, many of these have been dated (e.g., Post-Melby & Bergstøl 2020; Hennius 2020). Nevertheless, several source-critical issues relating to the origin of the dating material from dug down hunting facilities should be discussed. Such dates are based on samples from old ground surface, consisting of humus and remnants of, for example, burnt grass or trees that were on-site when the hunting facilities were constructed. This means that the dating sample of charcoal in the soil in most instances may be older than the construction phase and does not have a direct connection to the construction itself. It will however show the earliest possible construction phase of the structure. The dates, therefore, do not necessarily reflect the date of hunting activity, but they do indicate activity in the area. However, the fact that we could discern different layers and unique construction phases at Bollestad suggests important phases of usage of the sites at these times.

TEMPORAL PATTERNS

The temporal patterns derived from the ^{14}C datings of Bollestad align well with the general patterns in Norway from this period. Several other sites in Norway have indications of hunting this early, such as of elk and reindeer from the Late Stone age (3000–2000 BC) and reindeer from the Middle Neolithic (2500–2280 BC) in the high-altitude zones of Norway (Åstveit 2007: 15–16; Finstad & Vedeler 2008: 68; Callahan 2013: 729–740; Post-Melby & Bergstøl 2020: 315). The finds from Bollestad suggest that this was also the case in the lowlands. This could also explain the presence of the Stone Age site next to the hunting blinds at Bollestad. In this context it is also important to point out that there are several other Stone Age sites in the Gjesdal valley, the closest one being on the other side of lake Klugsvatnet (Lagemaat 2021; Mansrud 2022), around 500 m southeast of Bollestad. This could indicate that the Bollestad site was important for hunting ungulates early in the Stone Age.

Hunting intensified in the Neolithic (from 2800 BC) and further increased in the Bronze Age (c. 1800 BC) in Scandinavia (Post-Melby & Bergstøl 2020: 319; Hennius 2020; Prescott 2012). The forests in western Norway (Høg-Jæren) were burned around 2500–2200 BC, giving room for grassland for grazing (Prøsch-Danielsen et al. 2020). This process of domesticating the landscape is likely reflected in the samples from Bollestad. Similar anthropogenic fires to improve pastures are attested around hunting architecture at many sites around the world (e.g., Oetelaarr 2014; Svizzero 2016). This may have been part of a seasonal utilization of the open field areas, as animals moved between grazing areas in the spring and autumn seasons (Odden et al. 1996; Lovari et al. 2019).

The Early Iron Age was a period of greater use of outfield resources and scorching in western Norway, creating the historical heathlands used for winter fodder (Hjelle 2015; Prøsch-Danielsen et al. 2020). In this period, there was an increase in the number of farms in the valleys of western Norway, with a subsequent need to use outfield areas for fodder for husbandry. This is also seen in Gjesdal with several settlements and increased agricultural traces from this period, the nearest one being the farm of *Heio*, only c. 400 m southwest of Bollestad, containing an Early Iron Age farmstead with two grave mounds, several fences and 44 clearance cairns (id 64633). These changes in the human use of the landscape are likely reflected in the usage of the hunting blinds in Gjesdal. The last datable phase at Bollestad was in the Roman Iron Age. The hunting blinds' stone walls also seem to have been extended in this period, suggesting an increase in hunting activity, and a connection between the temporal and spatial patterns of the hunting blinds.

Surplus production from hunting, trapping and iron production in Norway was already an important part of the economy from the centuries after the beginning of the Common Era onwards. Evidence for extensive and systematic hunting in the high-altitude zones of Norway testifies to a significant level of hunting activity from the Roman Iron Age up to the Middle Ages (Pilø et al. 2018; Solli 2018a). Dates from hunting and trapping in eastern Norway and Sweden show an increase in hunting and trapping during the third and fourth centuries and onwards, with suggested activity peaks in the fifth to sixth and seventh to eighth centuries (Gundersen 2021: 293; Hennius 2020). There is also growing evidence in the use of outfield resources in Scandinavia in these periods. These include extensive bear hunting (Lindholm & Ljungkvist 2016), as well as exploitation and distribution of gaming pieces and reindeer antler (Hennius 2020), and use of resources, such as iron (Stenvik 2015), coinciding with a significant settlement and agricultural expansion (Myhre 2002: 127–159; Pilø et al. 2018; Pilø & Barrett et al. 2020). The increased use of outfield resources, including hunting and trapping, may have been a result of land-use pressure from farming communities (Bergstøl 2008: 195–198). The structural changes of the blinds at Bollestad during the Roman Iron Age must reflect these societal and land use changes.

Although there were no ^{14}C datings from the Haraland site, their close location in the same valley makes it probable that the sites had a similar temporal development and substantiates the use of the valleys as primary hunting areas. In the Early Iron Age, it is plausible that the sites were used by people living on the nearby Early Iron Age farmstead at Heio.

SPATIAL PATTERNS

Several spatial patterns can be observed from the two excavated sites in Gjesdal. At Bollestad, three of the hunting blinds are oriented to the west-southwest, overlooking a river and a flat terrace area with good grazing. The animals could thus be spotted far from the blinds. This way, their natural behaviour was exploited, placing the blinds in natural bottlenecks along migration routes and on elevated ridges (cf. Bar-Oz & Nadel 2013; Smith 2013; Lemke 2015: 76; Lemke 2021). Using hunting blinds, such as those at Bollestad and Haraland, was a form of active hunting, in which hunters would wait behind stone-set hunting blinds, strategically placed in the terrain at a post located along a known animal route (Lemke 2021). Behind them hunters with bows and arrows would wait for the animals to appear within shooting range, and then shoot arrows at their targets, usually at a range of around 20 metres (Ramstad 2015). After hunting rifles, with a range of several hundred metres, were introduced hunters still found it expedient to lie hidden until the prey was up close. One therefore finds hunting blinds dating from relatively recent times (Ramstad 2015). This was also evidenced at Bollestad, where hunting in the blinds still took place in 2019, the year before the excavation (Hillesland & Ødegaard 2021). Interestingly, it thus seems that even if the projectile technology differs, developing from bow and arrow, to thrown spear, and then to rifle (see Friesen 2013), the hunting architecture is the same (e.g., Lemke 2021).

The west-southwest orientation at Bollestad indicates hunting of animals coming either from the direction of the small lake Skurvetjørna, c. 800 meters to the southwest of the site, from the western side of Klugsvatnet, or through the small valley northwest of the site, where the E39 road is situated today. This may, given the dates from the site, indicate a possible shift in the hunting pattern through time, since there is a strong possibility that the nearby Iron Age farm at Heio changed the movement of red deer by disturbing their wandering routes. Further back in time, the exploitation of the red deer wandering routes also explains the presence of the Stone Age site at Bollestad, as well as a small cluster of Stone Age sites at the northwestern end of Klungvatnet.

The undated Haraland site, situated in the same valley, was, we would argue, used at the same time, exploiting the movement of the red deer throughout the landscape. However, the Haraland hunting blinds do not have a half-moon/horseshoe form but are more closed enclosures with only minor openings. This might indicate that their intended use is not hunting from one direction only, but possibly from two, three or even four directions. This could indicate a local adaptation of the blinds to fit the animal routes in the area without having to change the structure of the blinds. It might also be explained by the topography as they are at the intersection between two valleys.

The spatial patterns of the two sites can be interpreted in several ways. At Bollestad, we see that all the hunting blinds have a different orientation in the landscape; three of them are oriented to the south-southwest, and one to the east. This indicates that their individual orientation shifted over time, likely to adapt to red deer approaching from a given direction, and the structures were likely changed to adhere to changes in the movement of deer through the landscape. Hunting techniques and strategy always consider the movement patterns of the hunted animals. While some red deer are sedentary throughout the year, others have wandering routes of varying lengths between summer and winter habitats. A common pattern is that, over winter, the animals stay near the coast or in the lowlands, where there is little snow and mild weather, and at springtime, when the snow withdraws and new vegetation sprouts, they move further inland to higher areas. During these spring migrations, large packs of deer can often be seen moving together (Odden et al. 1996; Lovari et al. 2019).

It could also mean that there were multiple animal routes in the area, or that their routes changed over time. Both id 3141 and id 3245 at Bollestad, with ^{14}C datings from the Bronze Age, give evidence for this, as they have similar datings, but a different orientation. Alternatively, it could suggest that the animals were chased to the blinds from a set direction (e.g., Lie 2004). There are several stone fences near the sites that might indicate this. There are several stone fences outside of the excavated area as well, and while hard to prove, some of them might have originated as guiding fences. Built structures to aid hunting activities, such as fences, have been documented on every continent except Antarctica, and the sites show similarities across time, space, environments, and cultures (Lemke 2015; 2021).

It is possible that the changes in the spatial pattern at Bollestad relate to nearby changes in the landscape during prehistoric times. The already mentioned Heio farm, situated c. 400 metres southeast of Bollestad, was established during the Iron Age. At Bollestad, the hunting blind id 3073, with ^{14}C dates to the Bronze and Iron Age, has an eastward orientation, in contrast to the other three blinds. Maybe the establishment of the farm in the area changed the wandering routes of the deer, causing the change in orientation. This is, however, hard to prove, as id 3245, with southwestern orientation, has ^{14}C dates from the same period. In addition, no evidence of any other prehistoric changes has been found in the landscape in direct proximity to the site. However, there are several other prehistoric settlements in Gjesdal that could have triggered changes in animal routes, and consequently changed the spatial arrangements for the hunting blinds at Bollestad. For the Haraland site, all the blinds face the same direction, and there is no evidence of changes in orientation over time.

Regarding hunting strategy, the two sites likely represent local hunting. Nevertheless, it is possible that the two sites were part of a larger cooperated hunt. In the adjoining eastern valley c. 1700 m to the south of Haraland, an additional hunting blind is seen. This might suggest that the hunting blinds were part of a larger system with coordinated exploitation of red deer movement in the landscape along the valleys. This is a singular blind, possibly an outlier post, where they could have directed the animal movements into the possible guiding fences going into the main hunting site at Haraland, and again further north in the valley towards Bollestad. The placement of the hunting blinds in the landscape in Gjesdal shows detailed familiarity with animal behaviour, seasonal migration routes, local environment, and topography.

ORGANIZATION OF THE RED DEER HUNT

The red deer was a major source of meat in prehistoric societies, especially for hunter-gatherers, in large parts of Europe, as evidenced by the archaeological bone record (Bergsvik 2001; Fletcher 2014: 84). Even so, we have not found any comparative studies of red deer hunting in Norway, and thus the hunting blinds from Gjesdal offer valuable insights into how red deer hunting was organized during prehistoric times.

After the Neolithization, when people became sedentary, the hunting of red deer became less of an economic necessity, but the animals' ritual value grew. Rock art, myths and archaeological finds tell of the red deer's place in prehistory (Fletcher 2014). Hunting, trapping and fishing, in combination, were vital for settlement along the coast and in inland and higher-lying areas of Norway. Hunting rights were an important resource. Meat, fat, skin and hides of animals were key products. Bone and antlers were indispensable raw materials for tools and ornaments. Their importance grew over time, especially from the seventh century onwards when trade and craft production became increasingly significant in the emerging trading ports and emporiums of northern Europe (e.g., Røed & Hansen 2015; Skre 2017; Baug et al. 2018; Sindbæk & Ashby 2020: 8). As discussed above, hunting seems to have followed social trends in general and become more important in periods where the general use of the outfield resources increased, creating surplus production for barter and trade.

Ungulates formed an important economic basis for many chiefs and powerful men in prehistory. It has been argued that individual hunting, before rifles replaced spears, bows, and arrows, gave a poor outcome, so it was expedient to hunt on a larger scale (Ramstad 2015). Large-scale hunts can be seen in many societies dependent on ungulates as a resource, where people have secured the animals by some sort of driving or enticement with varying types of fences and "scare sticks", luring them into containment facilities, waterbodies, or even, as is known from the high-altitude zones of Norway, the edges of steep cliffs (e.g., Bang-Andersen 2008; Indrelid & Hufthammer 2011; Solli 2018a; Lemke 2021).

In Greenland, the North American Arctic, and in some parts of Norway, stone-set hunting blinds for reindeer hunting were also used for large-scale hunting. Many of the previously investigated trapping systems for elk and reindeer in Scandinavia also indicate large-scale organization (Indrelid et al. 2007; Bang-Andersen 2008; Ramstad 2015; Bergstøl 2016). At Sumtangen on Hardangervidda, in southern Norway, it was calculated (based on minimum number of individuals [MNI]) that the extent of the hunt of reindeer could have yielded an annual average of 3.85 tons over a 50-year period, and 7.7 tons for 25 years (Indrelid & Hufthammer 2011). As mentioned earlier, it has been suggested that this mass hunting in the high-altitude zones in the Viking Age and early Middle Ages was so extensive that local communities and individual farmers could not have organized it themselves, and that the organization must have been the work of the king or the church (Mikkelsen 1994: 178; Indrelid & Hufthammer 2011), or of a local elite (Solli 2018a: 22; see also Hansen & Olsen 2004: 186). This is more unclear when it comes to hunting in the lowlands and in western Norway, where deer hunting must have been close to dominant. As our study indicates, the limited extent of hunting blinds from the lowland zone, and the fact that most of these blinds are located alone or in small clusters, suggest that the hunt was on a much smaller scale than that known from the alpine bioregion. Our investigations at Haraland and Gjesdal support this theory.

Nevertheless, the building and manning of clusters of hunting blinds must have demanded a certain degree of organization. The hunting blinds at Haraland and Bollestad were set in groups, and at Haraland there might have been a drive line, suggesting this was an organized hunt carried out by several people. On the other hand, it can be argued that an absence of drive lines could indicate that there were plenty of animals within reach of the hunting blinds, requiring less organization (Morrison 1981: 175). How many animals could have passed the site in one season, and what type of hunting was practised in the lowland-zone sites? Red deer follow, almost without exception, the same routes, even the same paths, each year, and at the same time. The population of red deer is larger today than in prehistory; today game cameras have documented that over 160 deer can pass through an area in two weeks. On some nights as many as 30 animals pass (Jegeravisen 2020). In 1889 only 150–200 red deer were reported hunted in Norway each year – however, that was after red deer had almost become extinct due to heavy exploitation and the increased numbers of predators in the eighteenth century (Lunden 2002: 263). This was likely the culmination of a lengthy process, starting at the end of the Iron Age (i.e., before AD 1000) (Rosvold et al. 2012). Before AD 1500, the numbers were, as has been mentioned, relatively high (Rosvold et al. 2012) and the hunt may have been relatively large-scale, dependent on the season. The three to four hunting blinds at each site in Gjesdal suggest that at least three to four people were needed to man them at each site. This suggests that this was done in cooperation by several people, perhaps by cooperating neighbours, probably including several families of men, women and children (e.g., Spiess 1979; Hockett et al. 2013).

A comparison may be made with another important resource and export industry from the Late Iron Age, namely iron. Iron production from southern Norway consisted of small-scale production sites, initiated and organized by skilled farmers (Loftsgarden 2021). The relatively low number of animals to be shared between many people suggests that the meat and other products from hunting activities in these lowland sites most likely were consumed and/or used by the hunters and their families on nearby farms, and that leftovers of meat, and surplus products, may have been bartered or traded in exchange for other goods at local and regional markets.

CONCLUSION

In this paper we have discussed two sites in Gjesdal, Rogaland County, in western Norway, with a total of seven hunting blinds used for red deer hunting. Two to three different construction phases of the hunting blinds at Bollestad could be discerned, meaning that the hunting blinds were modified over time. This indicates the importance of the hunt and points to transmission of cultural traditions and knowledge of animal behaviour to new generations. The orientation of the blinds also varies, meaning that they were adapted to several animal routes or changes in the wandering patterns of the deer, further implying good knowledge of the animals' behaviour. The use of hunting blinds dates from the Neolithic up until the Mid Iron Age (c. 2000 BC to AD 300), but it is likely that the sites were also in use later in the Iron Age and Middle Ages. The site at Bollestad was actively in use by local hunters as late as in 2019, bearing witness to the long-lasting tradition in using such sites and the stability in the animal's behaviour and migration patterns. The long timespan suggests that the assets and resources acquired from red deer hunting were highly sought after in both prehistoric and historical periods, and highlights the importance of these hunting activities.

Hunting, trapping, and fishing were important economic activities in past societies, providing meat, fat, skins, hides, bone, and antlers for various purposes. The red deer was an important contributor in this context, providing food, and raw materials for tools and ornaments. The red deer was relatively abundant until 500 years ago, suggesting the potential for profitable hunting during seasonal periods. We have shown that the hunting in the lowland zones below 900 m.a.s.l. (Atlantic and boreal bioregion) was small-scale compared to the mass hunting of elk and reindeer known from the high-altitude zones and from eastern Norway. Nevertheless, the number of animals killed in the lowlands may have been large enough to provide a surplus production at certain times of the year, or surplus production in certain seasons. Hunting in the lowlands was likely done by hunters and their families on nearby farms, with surplus products sold and exported to local and regional markets.

Anthropogenic fires to improve pastures is an attested activity in the Neolithic and Bronze Age, at the time when traditional hunter-gatherer societies started to orientate towards agriculture and a more sedentary way of life. Dates from Bollestad from the Early Iron Age coincide with periods of greater use of outfield resources and scorching in western Norway, creating the historical heathlands used for winter fodder. Interpreting the spatial and temporal patterns, hunting thus seems to follow social trends in general and become more important in periods where settlement declined and the use of the outfield resources increased, creating surplus production for trade and barter. The spatial patterns at Bollestad could also indicate that the social changes in the landscape impacted the wandering routes of the deer, leading to structural changes and changes in the orientation of the hunting blinds.

Overall, the study highlights the importance of red deer hunting in the lowlands as a valuable resource in prehistoric and historic societies, both for subsistence and other usage. The findings suggest a complex relationship between hunting, settlement patterns, social trends, and the exploitation of natural resources in prehistoric western Norway.

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Nikolai Paukkonen

TEN YEARS OF PHOTOGRAMMETRY AND LIDAR: DIGITAL 3D DOCUMENTATION IN FINNISH ARCHAEOLOGY BETWEEN 2013–2022

Abstract

The realities of archaeological fieldwork have been revolutionized by new digital documentation methods. Among these are various new ways to produce photorealistic and/or accurate 3D measurements, namely photogrammetry and laser scanning. They have become well known technologies but the actual frequency of their use in day-to-day fieldwork has not been studied before. The 'Quality instructions on archaeological fieldwork' (*Arkeologisten kenttätöiden laatuohjeet*) document, published by the Finnish Heritage Agency in 2013, states that all archaeological reports have to mention the technologies and methods used. Using a collection of some 3600 digitized reports from between 2013 and 2022 I show how widespread the use of these novel methods has actually been during the decade in Finland, and what are the implications of their use. What kind of actors are the most prevalent users? Have the methods been widely adopted, or are some more traditional methods still more popular?

Keywords: fieldwork methods, digital archaeology, LiDAR, laser scanning, photogrammetry, digital humanities, Finnish archaeology

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INTRODUCTION

During the 2010s 2020s, digital 3D documentation and measurement methods, especially Structure from Motion (SfM) photogrammetry and LiDAR (Light Detection and Ranging, colloquially also known as laser scanning), have become generally accepted tools in archaeological fieldwork in Finnish projects. At least that is how it might seem, when reading publications written by enthusiastic users and developers about computer applications, digital tools, and novel devices. It is significantly more difficult to reach the actual situation on the field: have LiDAR and photogrammetry actually become the mainstay of archaeological measurements, or are their users still a minority? Another question pertains to the details of their use: what equipment and software are the most popular, and why?

These questions are difficult to grasp, especially in a country where the majority of archaeological fieldwork is performed by private companies. With new innovations and expensive investments in equipment, training and software, it is reasonable to expect that many private actors do not wish to open the details of their workflows or setups. However, the final fieldwork reports are required to be submitted to the Finnish Heritage Agency (FHA) – and are required by law to be public documents – which means that they offer an opportunity to study the proliferation of new technologies and methods.

In this paper I present an overview of the development and increase of the use of SfM photogrammetry and LiDAR documentation in Finnish archaeology, with a focus on the years after 2013. This year was chosen as a starting point, since in 2013 the 'Quality instructions on archaeological fieldwork' (Arkeologisten kenttätöiden laatuohjeet) document was published (Finnish Heritage Agency 2020a). It states that all archaeological reports must mention the technologies and methods that have been used in the field work and reporting stages, therefore giving a reason to expect that this information would be available in the reports from that year onwards. The instructions have been updated a few times since 2013 – the newest version being from 2020 – but as far as I was able to find out, the need for explicating the used documentation and measuring methodology has been included since its first version. In the oldest document available through The Wayback Machine, it is stated that in the excavation report at least the following data must be included (Finnish Heritage Agency 2016: 37):

- Description of the work process
- Used methods and principles of documentation
- Used devices and software (brand, model)
- Used coordinate and vertical coordinate reference systems
- Ground control points

The instructions are not legally binding and instead work just as guiding principles. Consequently, strict adherence to these directives has not been consistently observed.

The main source material for this study is formed by data gathered from publicized fieldwork reports of archaeological actors working in Finland. Additionally, I present a summary of earlier publications and other work in Finland related to this theme. Ultimately, the result will be a realistic assessment of the level of archaeological measurement technology in Finnish fieldwork.

The fieldwork reports submitted to FHA from 2017 to 2023 were available at the FHA *Asiat* ('Documents' or 'Cases'; literally 'Things') portal (https://asiat.museovirasto.fi), whereas the earlier ones were accessed through the *Kyppi* cultural heritage service portal (https://www.kyppi.fi/palveluikkuna/). Since neither of the browser-based portals offer a possibility for mass downloading reports per annum, I used a custom web crawler script to collect the data. The analysis of these reports – which are some 3600 in total – could be partially automated, but a lot of it had to be done manually. This meant opening each report individually, skimming the contents for possible sections about methodology, and inspecting the figures and appendices for possible SfM or LiDAR generated images. However, images of point clouds, 3D meshes or other similar data without any indications of what technology had been used were not considered hits. Additionally, some individual reports were not machine-readable and had to be studied more carefully, usually by trying to find any paragraphs describing methodology and technology.

Pioneering work in photogrammetry and LiDAR use has been done in Finnish archaeology already during the 1990s, but many of these reports and papers have been published only in Finnish (or seldom in Swedish), making international comparative study difficult. Thus, this paper will also act as a way for non-Finnish speaking scholarly audience to acquire an overview of the history of archaeological 3D documentation methodology in Finland during the 21st century.

In this paper, 'photogrammetry' or '3D photogrammetry' are used to refer to the modern software-based technology that uses 2D digital photographs to generate textured mesh models or point clouds in 3D coordinate system. All kinds of LiDAR are often called 'laser scanning'. This includes aerial laser scanning (ALS) and terrestrial laser scanning (TLS), often done with tripod-mounted systems. Recently, lightweight mobile LiDAR systems have complicated the division between ALS and TLS, since similar sensors can be deployed on small drones, cars, backpacks or even mobile phones. Here 'LiDAR' is used to denote traditional TLS devices, but also other smaller laser scanning devices used in excavation context, whereas ALS is used only in the context of large-scale airplane mounted devices.

Earlier studies

Both LiDAR and photogrammetry were experimented in Finnish archaeology already in the late 1990s and early 2000s. First adopters were working in cooperation with non-archaeologist professionals, such as researchers from Helsinki University of Technology during the Finnish Jabal Hārūn project in Jordan, where rudimentary photogrammetric images were used in coordination with total station measurements in making a 3D model of the site (Frösén et al. 2001: 359–360; Koistinen 2000). However, actual day-to-day documenting of the excavation process was not made using these methods, and for accurate 3D data only total stations were relied upon (Haggrén et al. 2005: 4). Similarly, in another Finnish international project in Pompeii, photogrammetric measurements were used to support other methods to record the architectural features (e.g., Heiska 2008b).

Laser scanning had its early adopters in the 2000s as well. Due to its significant costs, the technology was not widely adopted, however. In 2007 a Callidus CPW8000 terrestrial laser scanner was tested at the medieval site of Aboa Vetus in Turku, with promising results (Uotila 2007: 15–17; Heiska 2009: 91–92). Later, a Faro Focus 3D was used in the same location (Uotila & Korhonen 2011: 12). A Mensi GS200 scanner was used in the Finnish Pompeii project for documenting the house of Marcus Lucretius (Heiska 2009: 89). Typically, these cases were isolated and did not lead to continuous workflows or habitual adoption of the method.

Generally, only some earlier work has been published as peer-reviewed articles or otherwise in relevant publications. Starting from the early adopters in the early 2000s, some single case studies from Finnish or international teams with a Finnish component have been made available (e.g., Heiska 2008b; Junnilainen et al. 2008). Single case studies have showed the possibilities of the methods (e.g., Haggrén 2007; Heiska 2008a: 41; Seitsonen & Holappa 2011; Debenjak 2015; Lehto & Uotila 2017; Seitsonen 2018), but no publication has considered how widespread the use of these methods has actually been during the years.

To my knowledge, systematic overviews and quantitative studies of documentation technologies and techniques in Finnish archaeology have not been done earlier. Usability and quality of these methods in single sites has been studied only recently as well (e.g., Paukkonen 2023; Hakonen et al. 2015). The only exception to this void is the subfield of Finnish maritime archaeology, where an overview of its history has been published including some notes on the used documentation and measurement methodologies – however, no actual statistics are included there, either (Marila & Ilves 2021).

Internationally, widespread studies attempting to extract numerical data about the prevalence of technology adoption in archaeology has been understandably difficult as well. Firstly, the field reports are typically difficult to access *en masse*, either on national or international level. Secondly, even if they are available, there is typically no sufficiently accurate metadata or standardised formats to find out the details of the technologies used for fieldwork. General discussion about the possibilities and the pros and cons of photogrammetry and laser scanning have been ubiquitous (e.g., Magnani et al. 2020; Roosevelt et al. 2015; Dallas 2015), but there is very little data about the actual spread of their usage.

A survey of peer-reviewed publications about archaeological photogrammetry was published in 2021 (Marin-Buzón et al. 2021), but scientific publications might not give a realistic picture of the realities of the majority of conducted fieldwork. An attempt to make a comparable survey of Finnish peer-reviewed articles, theses, and other scholarly works was performed using Google Scholar for the purposes of this article, but the results were inconclusive, with many years yielding no results at all. Regardless, archaeological fieldwork in Finland includes a lot of supervision work and smaller projects, for which the fieldwork report submitted to the local authorities is often the only extant document. It could be that, despite all the proof-of-concept papers and case studies, there is still room for advocacy of integrating these technologies in research and fieldwork in general (Magnani et al. 2020).

Studies examining the problems of using public Finnish archaeological databases have been published before. Roiha and Holopainen, while researching a different kind of problem, wrote about the issues related to the reusability and failure to produce the FAIR principles in the FHA Antiquities record. The record is accessible through the *Kyppi* portal, and often contains also links to the field reports (Roiha & Holopainen 2023). Beginning in 2023, the national '*Arkeologia 2.0*' project is aiming to renew the Finnish archaeological knowledge, research infrastructure and development, but its ultimate effects are still impossible to evaluate at its current planning stage (Finnish Heritage Agency 2023).

Research about field reports and various forms of data available in them has been studied in the Nordic countries, but not by quantifying documentation and measurement methodology. Knowledge-creating processes in archaeological field reports on a larger and more qualitative scale have been studied in Sweden, but on significantly smaller datasets (Huvila et al. 2021: 1114; cf. Huvila et al. 2022: 3–4). There are, however, some notions about tools and methods used, but with discouraging results – quite often the reports just mention 'usual documentation' having been used for the project in question (Huvila et al. 2021: 1116–1117, 1121).

In the category of knowledge and information creation studies, this research also belongs to the topic of archaeological 'paradata', data about the process of gathering archaeological knowledge. In that theoretical framework, one terminological classification for the work done in this article would be the study of KMP, 'knowledge-making paradata' (Börjesson et al. 2022: 2).

METHODS AND MATERIAL

Extraction of the data

Neither of the FHA services, Kyppi or Asiat, provide any options for mass downloading of documents; they need to be downloaded individually in PDF format. Additionally, the metadata provided is lacking, so discerning different categories of documents is challenging, as the *Asiat* portal contains also other files, such as excavation permits. With the later reports uploaded to the *Asiat* portal, some complications were caused by the fact that the reports were categorized based on the year they were added to the database, instead of the year of their submission or completion. Using two custom Python scripts the downloading from both portals could be automated, so that all the PDF files containing the keyword '*Tutkimusraportti*' (i.e., 'Research report', including both excavation and survey reports) could be extracted. In the *Asiat* portal the information regarding the search results could be found as a JSON file on the server, from which the user can get a formatted list of the document identification numbers and use them to download the actual PDF files *en masse*. For the *Kyppi* portal the HTML file had to be parsed directly to extract the links to the PDF files.

It is worth noting that in Kyppi the reports are stored under two distinct registers: *Kulttuuriympäristön tutkimusraportit* and *Arkeologiset hankkeet* (i.e., Cultural Envinronment Research Reports and Archaeological Projects). They have a significant overlap, but some reports may be visible only in one or the other. The initial query was performed on the *Kulttuuriympäristön tutkimusraportit* register, the results from which were then compared with the results from the *Arkeologiset hankkeet* register. This should ensure that the set of reports studied here is as complete as possible, but some individual documents may be missing. Additionally, a small number of reports have been use-restricted (for instance, due to some personal information contained in the files) and are not available online. These have not been included.

The downloading was performed during the weekend nights to minimize the effect on other users due to the possible strain on the servers. Regardless, all the downloaded files were manually opened and checked to ensure that they indeed were reports from actual field work projects. Field work permits and reports of analyses (such as osteological or radiocarbon dating reports) were removed from the material at this stage.

Figuring out the final coverage of this extraction process was done by comparing the results with the annual FHA financial reports, which contain some vague data regarding the number of submitted reports, often contained within the sections detailing yearly performance. The FHA does not keep accurate statistics about the number of reports themselves, and the data I was provided by email was clearly missing even hundreds of projects for some years (Pers. com. FHA archives record keeper E. Kykkänen, e-mail to the author 23 November 2023).

The numbers deduced from the financial reports vary greatly, from 200 to 344 annual reports in the years 2018–2020, whereas the number of reports from the years 2013–2017 vary between 822 to 13061. This, however, is most likely caused either by alternating ways of choosing which reports were included in the count, or the retroactive digitization of older reports (Finnish Heritage Agency 2020b: 38; 2017: 29; 2015:27). The yearly average of the reports extracted by me was 317 reports. It is not clear what reports are included in the financial data, and whether it includes reports that were processed after the year was completed. Thus, at least based on the scale of this comparison and assuming the financial data from years 2018–2020 represents the actual reports submitted during the year, it seems that the coverage of the data gathered for this research is rather good.

Processing and analysis

The reports were categorized into two groups according to their type: Group 1, contains various kinds of invasive fieldwork or other work that typically requires extensive and/or accurate documentation, such as excavations, supervisions, test trenches and architectural documentation. Group 2 contains field surveys and other surveys, which are mostly non-invasive and use only limited measurement equipment, such as GPS antennae. The focus of this study is on Group 1 due to the suitability of these methods for that kind of fieldwork. Site inspections or evaluations, which were generally not a uniform group, were left outside both Group 1 and Group 2, although some individual ones do mention using some of the methods under study here. The reports were grouped by the year during which the fieldwork was performed, which allows for year-by-year comparison. In case of multi-year projects, the last year of the project was chosen to represent the whole project.

Initially, the analysis of the reports was planned to be fully automated, but due to unpredicted variation in the quality of the reports they had to be inspected manually as well, at least on a superficial level. Many reports did not include a separate section for the methods, equipment and software used. The usage of terminology was also often inaccurate. Especially in the earlier reports the methods and technologies were not clearly named, but instead would just be presented as '3D-modelling', '3D photographing' or 'scanning'. Similarly, the sporadic use of laser rangefinders or telemeters was noted during the inspection of the results of automated querying (e.g., Tiainen & Koskinen 2018: 5).

Additional complications were related to the nature of simple word-based querying. For instance, searching for the word 'LiDAR' would also show hits for reports that mention that there was no aerial LiDAR (ALS) data available for the area, or that some earlier report had used some LiDAR technology, but that it was not used in the current project, and so forth. This led to the need to also do a superficial manual investigation of the reports. A quick visual examination would show if the file contained images of point clouds, 3D-meshes or orthophotos generated by photogrammetry pipelines or LiDAR equipment. The hits given by the automated queries were always checked and investigated further, especially to find out the software and hardware that had been used. Despite the quality instructions of FHA, the actual standards for accepted excavation and survey reports are often rather ambiguous. Only some actors include systematically a 'methods and technologies used' section in their reports. Thus, sometimes the information regarding the technologies had to be gathered from appendices or captions. Often it was not available at all.

As a secondary processing stage, usage of total stations and ALS data were also recorded, although they were not the focus of this study. These have been included because the prevalence of these technologies has not been studied before either. They also allow for a comparison on how other relatively new technologies that require investments in hardware and material have been adopted in Finnish archaeology. As will be explained below, ALS data for the whole country has been made available free of charge by the National Land Survey of Finland, which has made its usage convenient.

Due to the limited size of the dataset – N=3652, Group 1=1279, Group 2=1430, excluding site inspections – an Excel spreadsheet was deemed sufficient for gathering the results. This spreadsheet has also been made available in an independent online repository for reviewers and other researchers.

RESULTS

The results of Group 1 are shown in Table 1. As mentioned above, Group 1 includes excavations, test trenches, supervision work and documentations. These projects have clear use cases for SfM photogrammetry, laser scanning and total stations. Conversely, survey and inspection reports (Group 2) do not include almost any mentions of the aforementioned methods, but instead do feature ALS use.

The overall results have been visualised in Figure 1. The number of ALS mentions in Group 1 reports is mostly due to the use of publicly

Table 1. Results from Group 1, containing excavations, supervisions, test trenches and documentation projects.

Year	Total	Photogrammetry	%	LiDAR	%	Total station	%	Aerial LiDAR	%
2013	131	2	1.53	4	3.05	37	28.24	8	6.11
2014	108	7	6.48	4	3.70	40	37.04	7	6.48
2015	140	10	7.14	7	5.00	36	25.71	18	12.86
2016	135	11	8.15	3	2.22	36	26.67	15	11.11
2017	112	4	3.57	2	1.79	23	20.54	13	11.61
2018	157	11	7.01	9	5.73	41	26.11	12	7.64
2019	114	12	10.53	6	5.26	34	29.82	9	7.89
2020	141	11	7.80	19	13.48	30	21.28	6	4.26
2021	153	28	18.30	19	12.42	52	33.99	5	3.27
2022	88	14	15.91	21	23.86	15	17.05	3	3.41

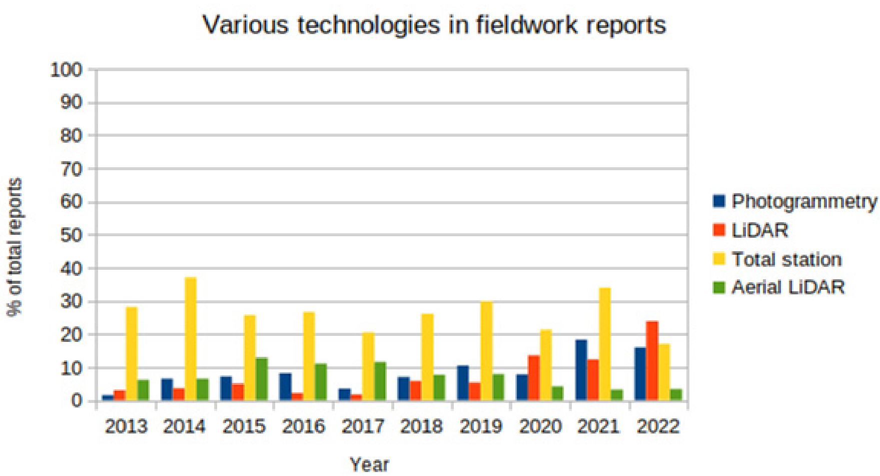

Figure 1. Different technologies used in fieldwork reports as percentage from the total.

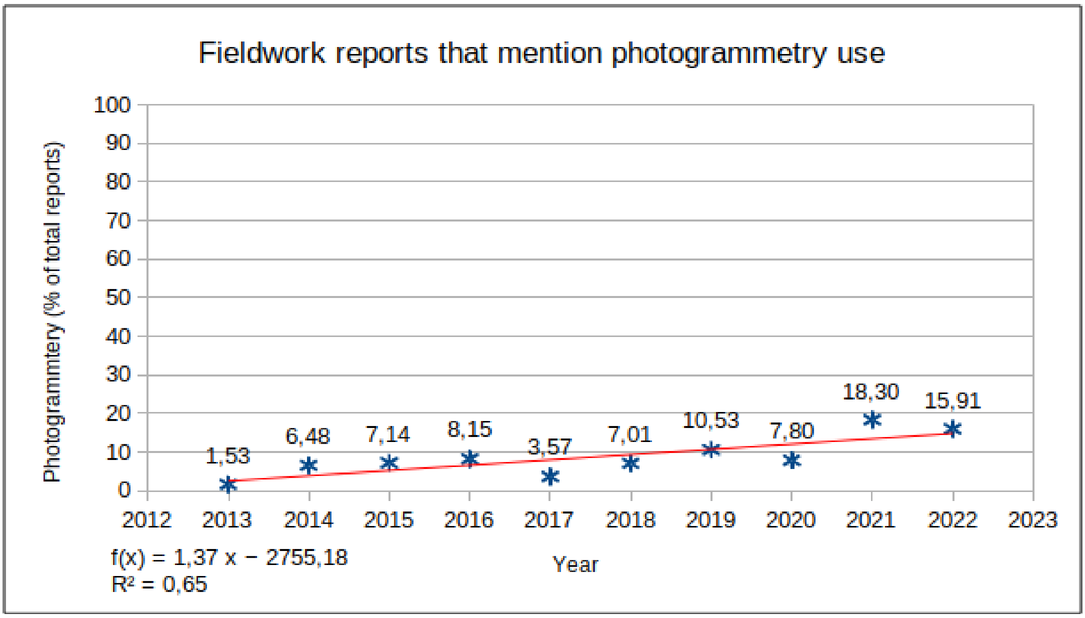

Figure 2. Yearly percentage of Group 1 reports mentioning photogrammetry use and its linear regression depicted as a red trend line.

available data as a background for plotting maps about other measurements done during the fieldwork – the ALS data was never generated by the projects themselves.

Photogrammetry

Many applications of photogrammetry in archaeological fieldwork had already been experimented with and published in the early 2000s, as was shown earlier. Some pioneering work had been done even earlier than that. However, photogrammetry-based methods were not in wide use in 2013, based on the published fieldwork reports. All in all, only two reports singled out any kind of photogrammetry as a documentation method during that year. This means only c. 1.50% of the total of Group 1, or c. 0.45% of the whole total in 2013.

When observing the yearly variation, there seems to be a general increase in the relative number of reporting about photogrammetry. The mean of the yearly data is 8.6% and the median 7.5%, and just by observing these results one can see that all results since 2018 have been equal or above the median. This increase seems to fit with the data gathered by Marin-Buzón from the years 2010–2019, which was based on scientific publications about photogrammetry in archaeology, where a systematic hike in prevalence is also visible (Marin-Buzón et al. 2021, Fig. 5).

After plotting the data, a trend line was calculated using linear regression (Fig. 2). It further confirms that there has been a systematic increase in the relative reported use of this technology in archaeological fieldwork projects during the period.

Regardless of the statistical analyses, an increase is visible. Since 2018, the number has been always equal to or over the median, with 2021 seeing a clear surge. Due to the nature of the reports, significant increases can be caused by single actors choosing to publish large area projects as separate reports: in 2021, Maanala Oy and Heilu Oy reported altogether 13 separate excavations in Hartola area in eastern Häme, with each report mentioning the use of photogrammetry. Similarly, in 2019 FHA Field Services reported four separate excavations in Savukoski area (in eastern Lapland), all of which report photogrammetry as a measurement method.

In addition to the equipment used to take the photographs, which was very seldom explicated, another important detail was the software used. This, however, was also not typically specified in the report. When the software was specified, Agisoft Metashape (and its earlier iteration Photoscan) was without a doubt the most common choice all the way from 2013 to 2022. Interestingly, the Russo-Ukrainian war, which begun in 2014 and then escalated in early 2022, has not seemingly had any visible effect on the use of the Russian Agisoft Metashape, which retained its dominating position through all the years. This is probably due to its easy graphical user interface and actors getting accustomed to it. No report specified the type of license used, which is not surprising, considering the generally frugal level of detail in the reports. It might also be possible that Agisoft's free 30-day trial periods have persuaded many coincidental users to give photogrammetry a try.

Other choices reported were RealityCapture and DroneDeploy, which were each used only by single actors, and both coming into use only after 2019. PhotoModeler was reported of having been used once in 2014 (Haggrén et al. 2014: 22). For some reason, possibly related to the popularity of Agisoft, no free and open-source software (FOSS) has been reported at all, even though open-source projects such as VisualSFM or Alicevision Meshroom have been easily accessible for almost a decade now and are well documented.

The photographic equipment used was only seldom described. Some reports mention the use of digital single-lens reflex (DSLR) cameras for other photography, and it can be assumed that the same tools were used for the photogrammetric documentation. Unmanned aerial vehicle (UAV) or drone-based photographs have been used only in few cases and by few actors, such as Ark-byroo Oy (e.g., Ynnilä 2019: 15), Muuritutkimus Oy (e.g., Uotila et al. 2020: 5) and the FHA Field Services (e.g., Seppä & Laulumaa 2020: 28–29).

TLS and other laser scanners

The situation in 2013 was quite similar for laser scanning as it was for photogrammetry (Fig. 3). Only four instances of their use were reported, 3.05% of the total (Table 1). Three of them were by Muuritutkimus Oy and one by University of Oulu. The used scanner is specified only in one of Muuritutkimus Oy's projects, where it was Riegl VZ-1000, but it can be assumed that rest of the projects

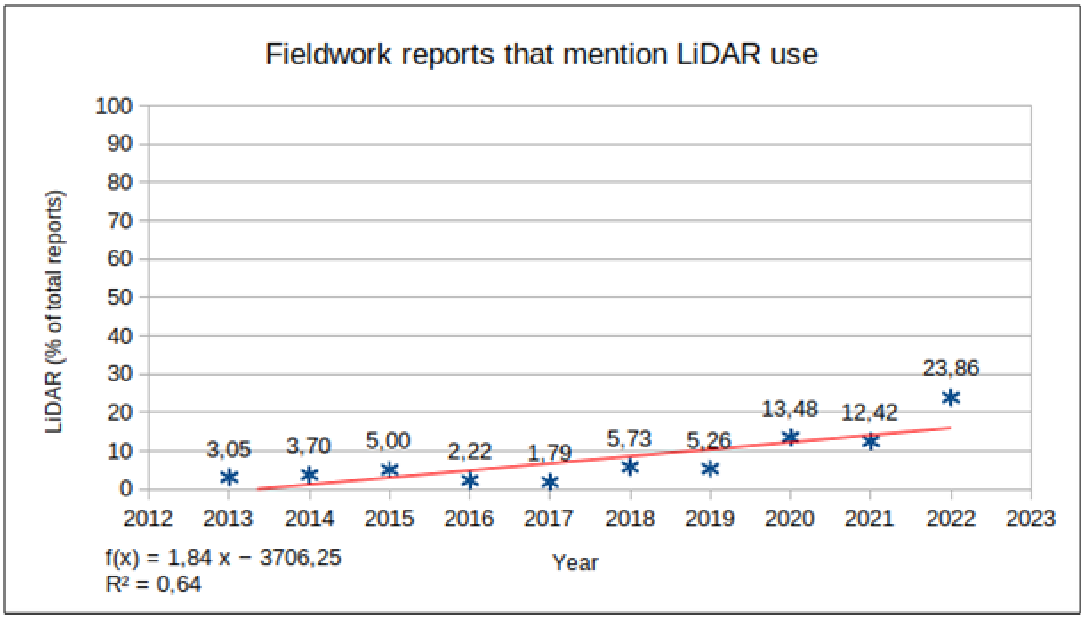

Figure 3. Yearly percentage of Group 1 reports mentioning LiDAR use (not including ALS) and its linear regression depicted with a red trend line.

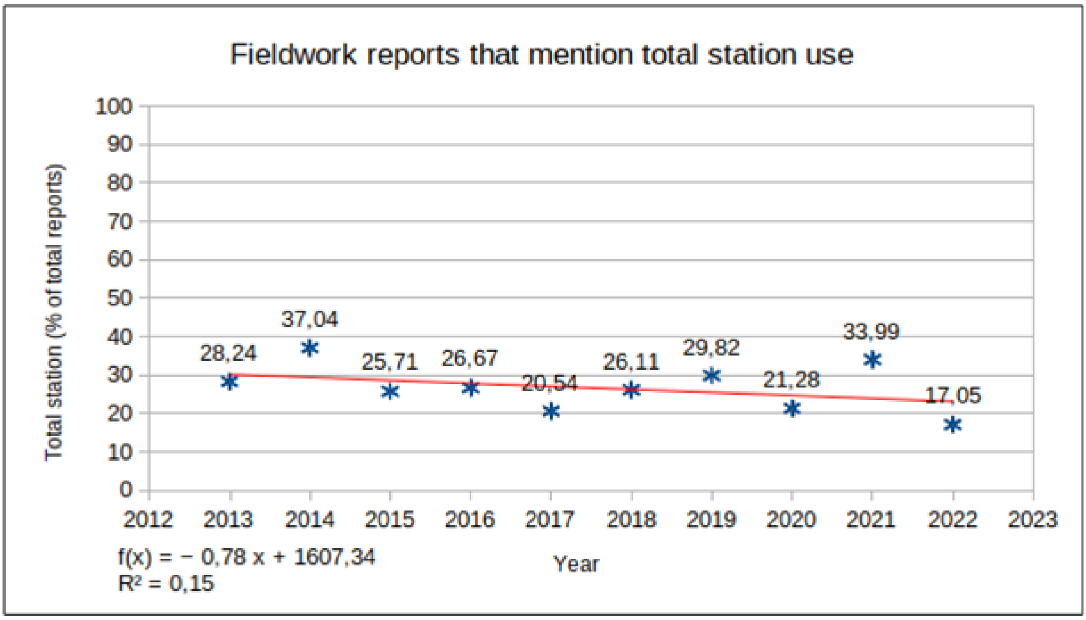

Figure 4. Yearly percentage of Group 1 reports mentioning total station use and its linear regression depicted with a red trend line.

used the same device, since it also appears in reports from later years.

However, whereas photogrammetry saw a steady rise in usage during the years studied, laser scanning increased greatly only in the last three years, beginning from 2020. With photogrammetric methods one could see that they were at least experimented with by many different actors. LiDAR use is clearly a different matter: only a few companies or other actors use them at all, and only for one of them – Muuritutkimus Oy – they are in common day-to-day use during the later years of the period studied. This is most likely caused by the price of the investment and the relative difficulty of their use: when an archaeological actor has invested in a TLS device and the relevant training of their employees, they obviously want to get a return from it. In turn, SfM photogrammetry can be experimented with inexpensively or even for free, which is probably the main cause for its relatively widespread experimental use.

The devices most often reported were Riegl VZ-400i and Riegl VZ-1000 TLS devices, operated by Muuritutkimus Oy. The only other repeatedly used TLS scanner was Leica ScanStation 2, operated by the University of Oulu. Trimble S10, a hybrid of a scanner and a total station, was used by FHA Field Services in few cases. Some mobile devices were also visible in the later reports: iPhone 12 Pro (which includes a LiDAR sensor) and a Faro Freestyle 2 handheld scanner were reported a few times, both used in fieldwork projects of Muuritutkimus Oy. Regardless, disappointingly many reports did not include information about the equipment used for scanning. Even fewer actors mentioned what software was used to further process the point cloud data.

None of the actors reported using drone-mounted LiDAR equipment during this period. Laser scanning could also be performed by renting the device elsewhere, or alternatively, by employing specialist outsider companies. This has been done a few times according to the material, but it has not been commonplace (e.g., Laulumaa 2015).

Comparable technologies

Use of total station has varied between one fifth and one third of the total (Fig. 4). No clear increase can be seen in the usage, which is understandable, considering that the technology has not had similar democratizing price and efficiency developments as photogrammetry (with powerful GPU computing becoming available for consumers) and LiDAR (with ever more affordable hardware available). Total stations have been present in Finnish archaeology at least since 1990s (e.g., Pesonen 1996) and are commonly taught in archaeology programs at universities – indeed, total station use is often considered a basic skill for a field archaeologist in Finland. The slight decrease that might be inferred from the data is possibly a result of total stations becoming, while not ubiquitous, still a commonplace technology, meaning that some report writers deem them self-evident and not requiring separate mentioning. Alternatively, the change may be due to the increased availability of GNSS-devices, which may be replacing total stations especially on smaller projects.

As mentioned earlier, querying for the key-word ‘laser’ gave a plenty of hits for mentions of ALS. It was widely used in various projects, especially in large scale archaeological surveys performed by companies such as Mikroliitti Oy, Keski-Pohjanmaan Arkeologiapalvelu Oy and the archaeological field service department of FHA. This does not come as a surprise, since the National Land Survey of Finland has been providing good quality point clouds of the whole country free of charge starting from 2008 (Koivisto & Laulumaa 2013: 52), which are of immense help when planning a survey.

Reported ALS usage has seen a slight increase during the years 2013–2022 (Fig. 5). Typically, they are mentioned as having been inspected in hillshade visualisation to find new archaeological sites, such as tar pits and military installations. However, as the data has become more easily accessible as various pre-processed visualisations (such as the National Land Survey of Finland MapSite online geoportal), it is very likely that ALS is used even more commonly, but it has just not been reported. Two reports included a mention of using computer vision technologies for automated site recognition, which shows a promise in the technology, but also that it is still far from being commonly adapted into Finnish archaeological fieldwork (Kuusela 2022a; 2022b; also, Anttiroiko et al. 2023).

It is worth noting, that of all the inspected reports between 2013–2022, 64.9% mention none of these technologies. For some, they have perhaps become so self-evident that they have

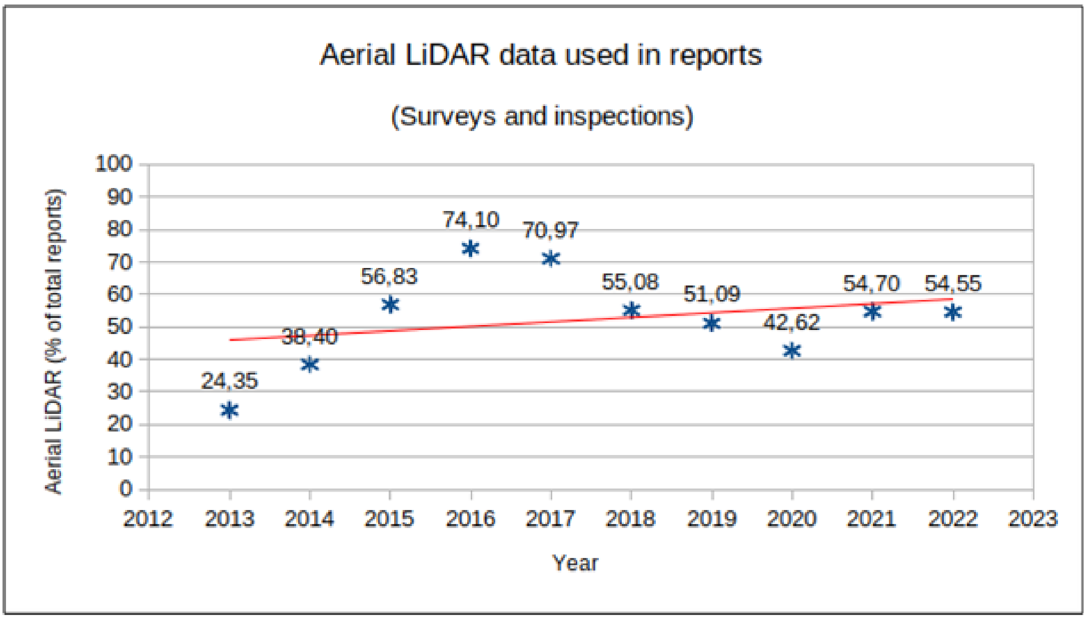

Figure 5. ALS data used in survey and inspection reports and its linear regression depicted as a red trend line.

not been mentioned in concise and quick projects (as per Huvila et al. 2021: 1113; Collis 2013). Others use GNSS RTK antennae or similar devices, especially in supervision projects or quick test trenches. Still, a significant number of projects rely on optical levels or drawing by hand with tape measures or folding rulers. Certainly, they can be accurate and quick enough for some projects, such as supervisions with sparse or no finds. The subjective reasons for depending in older technologies are beyond the scope of this study, but it is likely that the costs of investing into new equipment and training, in addition to accessibility and habit, are decisive motivations.

DISCUSSION AND CONCLUSIONS

The results of querying the fieldwork reports between 2013 and 2022 seem to indicate clearly that SfM photogrammetry and LiDAR scanning have not been widely adopted in Finnish archaeology. Pioneering work with both methods have been done already in the late 90s, but their widespread use is still in a progressing stage. The use of both methods has seen a steady increase, but often it is only due to few actors doing fieldwork. This is especially true when concerning LiDAR use in the field.

The lack of FOSS product use – especially in SfM photogrammetry and point cloud processing – is a surprising observation. One might surmise that archaeological fieldwork actors would be welcoming for software that is free of charge, modifiable and fully open about what actually happens in its processing stages. However, commercial actors might be sceptical about possible risks and liabilities, but the most important reason for this avoidance is probably the unwillingness to spend time tinkering with tools that 'come without a warrant'. FOSS is often seen as difficult and inaccessible, which is sometimes true, but decreasingly so. Some action advocating general FOSS use in Finnish archaeology might be in place.

It is still unclear what kind of changes the national '*Arkeologia 2.0*' project will bring. The project was launched during the 2023 and is still in its early stages during the writing of this article. Apparently, the aim is to overhaul the databases and the data infrastructure related to Finnish archaeology, with some intention to also include spatial data and perhaps even point clouds and other resulting datasets from photogrammetry and LiDAR (Finnish Heritage Agency 2023).

In the context of FHA and regulations pertaining Finnish archaeology it is also worth pointing out that according to this study, the 'Quality instructions on archaeological field work' have not been adhered to very strictly. This may be due to the document's unclear status – are they just instructions, or should they be seen as regulatory? Regardless, this should be considered when planning further research based on excavation reports. Even though the instructions state that some information should always be included, it may not be there in most of the reports.

The questions asked by Heli Lehto and Kari Uotila in their paper in 2017 are relevant: should archaeological fieldwork aim to surpass the minimum set by the FHA Quality instructions, why use 3D documentation methods when 2D raster maps are sufficient for reporting, and who, ultimately, should oversee developing new fieldwork methods and standards (Lehto & Uotila 2017: 9). The current FHA Quality instructions do not encourage innovation and experimentation with new fieldwork methodologies, yet many actors have begun implementing these measurement tools in recent years. The motivations behind this trend are beyond the scope of this article; however, it is worth considering some of the associated problems. If FHA does not actively support the adoption of these new methods or provide platforms for storing new types of data, the archaeological community may miss out on innovative methodologies and workflows. In particular, private actors may be reluctant to share their research and methods publicly, perceiving them as competitive advantages.

Photogrammetry and LiDAR are not silver bullets that could solve all problems regarding archaeological documentation and measurements. Moreover, they are not suitable for all kinds of sites and projects. They do, however, speed up some processes of excavation tremendously, while also giving accurate and reliable data, at least when performed properly. They show potential for financial savings, while also opening new kinds of research possibilities that could not have been done with more traditional documentation methods. However, the possibility of savings and other economic effects are difficult to assess and require further study.

One aspect that was not examined here was the subjective experiences of the different relevant actors. A well-prepared questionnaire or a set of interviews with relevant personnel, such as active field archaeologists and researchers, could provide deeper insights into the causal background of the prevailing status, i.e., the 'why-questions' telling the reasons behind some software or hardware being chosen over others (similar kind of interviews have been done by e.g., Huvila 2014). Other interesting area of study could be the situation in the Finnish archaeological education: what technologies are being taught to new students and with what equipment and software?

Regardless, the results given in this article form a steady and quantified basis for future discussion about development and adoption of field documentation methods, both in Finland and internationally.

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A.M. TALLGREN AND ETHNIC INTERPRETATION IN ARCHAEOLOGY

Abstract

The Finnish archaeologist Aarne Michaël Tallgren is remembered for his article on archaeological theory, which he published in Finnish in 1934 and in French for the international readership in 1936. There he denied the possibility of making ethnic conclusions on the basis of archaeological material. However, Tallgren's relationship to ethnic questions has never before been analysed as a whole. This article examines how Tallgren's conception of ethnicity developed. He inherited the ethnic paradigm of archaeology from his teachers but was initially rather cautious in his conclusions. Up to 1920, Tallgren's own approach to ethnic questions gradually consolidated. In contrast to the view prevailing today, it is shown that ethnic conclusions were a central part of his reasoning in the 1920s but only in relation to the question of the roots of the Finnish people. Criticism against the ethnic paradigm of archaeology was voiced both in Finland and elsewhere in Europe in the 1910s and 1920s, and in the early 1930s, Tallgren also began to doubt this approach. Becoming acquainted with the new Soviet archaeology in the late 1920s sparked Tallgren's interest in archaeology as social history, and the political use of the ethnic view of prehistory first in Germany and soon thereafter in the Soviet Union probably eventually led him to deny any ethnic conclusions.

Keywords: history of archaeology, A.M. Tallgren, ethnic archaeology, 1920s, 1930s

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INTRODUCTION AND RESEARCH QUESTIONS

The Finnish archaeologist Aarne Michaël Tallgren (1885–1945) is remembered for his articles published in the 1930s, in which he denied the possibility of identifying archaeological cultures with ethnic groups or peoples. However, there is very little discussion of Tallgren's earlier thinking concerning the possibility of drawing ethnic conclusions from archaeological finds. This article examines how Tallgren's thinking evolved and whether his thoughts show any influence of earlier or contemporary research or discussion.

More specifically, the questions dealt with here can be formulated as follows: 1. To what extent did Tallgren make ethnic conclusions in his works? 2. How was his conception of ethnicity in archaeological material formulated and how did it possibly change? 3. How and in what contexts did Tallgren identify ethnicities in his material? 4. How and why did he end up denying the possibility of ethnic conclusions in archaeology and did he apply his theoretical considerations in practice?

ETHNICITY IN TALLGREN'S EARLY WORKS

Tallgren touched upon the question of ethnicity for the first time in his review of Alfred Hackman's (1864–1942) work *Die ältere Eisenzeit in Finnland* (Hackman 1905) in the newspaper *Helsingin Sanomat* in 1906. He accepted Hackman's conception of an immigration of Finnish tribes from the Baltic region to Finland as individual smaller groups but not Hackman's assumption that the Balts had perhaps pushed them towards Finland due to increasing population pressure caused by the Slavic expansion. In Tallgren's opinion, in line with Hackman, the new Germanic settlement of the Baltic after the Gothic wanderings in the 3rd century could have caused the Finnish immigration to Finland. On the other hand, he believed that Finnish tribes could have migrated to Finland already before the East Germanic wandering (cf. Hackman 1905: 356–358). In any case, Finnish, Tavastian, and Karelian immigrants would have lived in Finland together with an earlier Germanic population for some centuries before assimilation. In spite of his suggestion of smaller groups, Tallgren's view is based on the idea of whole tribes as such moving from one place to another (Tallgren 1906).

After this, Tallgren did not write about ethnic questions in public before his review of some of Gustaf Kossinna's (1858–1931) works in the magazine Päivä in 1909. Kossinna established the ethnic reading of prehistoric material, drawing parallels between archaeological cultures and ethnicities. He called his approach *Siedlungsarchäologie*, 'settlement archaeology'. One part of it was the idea of Germanic superiority compared with other peoples. Kossinna's method was later declared an official dogma in Nazi Germany (Grünert 2002: 71–76). Tallgren's reception of Kossinna's assumption of the Finno-Ugric movement from France to the Baltic Sea region during the Early Neolithic is ironic, but he does not deny the basic concept of whole peoples moving from one place to another or the existence of Finno-Ugrians at such an early point in time (Tallgren 1909). In his entry on Gustaf Kossinna in the encyclopaedia *Tietosanakirja*, Tallgren stated that Kossinna had also dealt with the past of the Finno-Ugric peoples but that his views had not gained general acceptance (Tallgren 1914a: 1413).

The first time Tallgren himself attempted to answer a question with ethnic content was in his dissertation in 1911, which dealt with the eastern and northern Russian Chalcolithic and Bronze Age. He left the question of the ethnicity of the people(s) without a definitive answer but stated that there could have been Finno-Ugric tribes in the area. Thus, it can be understood that he assumed Finno-Ugric peoples to have existed at that time. He also considered it probable that the finds of the Anan'ino Period would belong to Finno-Ugrians because, in his opinion, the Iron Age from the beginning of the Common Era was certainly Finno-Ugric (Tallgren 1911a: 217–218).

In his article in honour of Johan Reinhold Aspelin's (1842–1915) 70th birthday in the journal *Valvoja* in 1912, Tallgren wrote that Aspelin had worked on the prehistory of the "blood relatives" of the Finns, whom Matthias Alexander Castrén (1813–1852) (Fig.1) had found in the east. Seemingly also Tallgren himself was committed to the idea that a linguistic relationship also meant a biological one (Tallgren 1912: 654). In his biography of

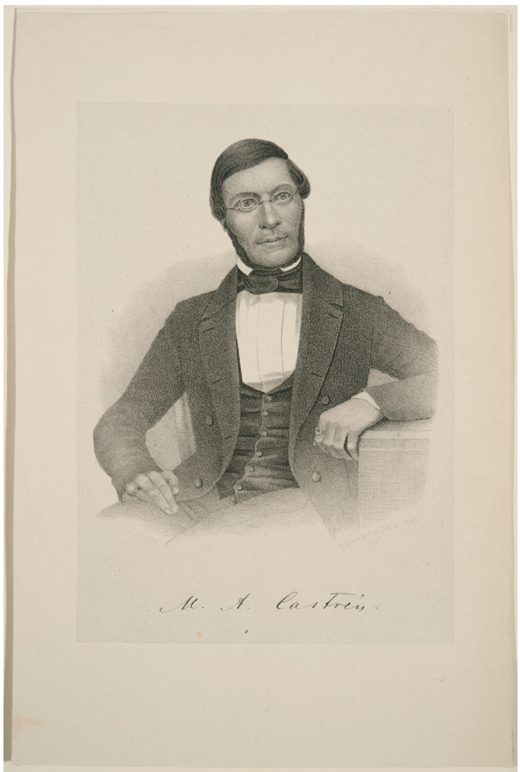

Figure 1. Matthias Alexander Castrén's views, formulated in the 1840s, influenced Finnish archaeologists' ideas of ethnicity still in the 20th century. Portrait E.J. Löfgren. Finnish Heritage Agency (CC by 4.0).

Castrén a year later, Tallgren does not identify a linguistic relationship with a genetic one, although he does not explicitly deny it either (Tallgren 1913a: 128–131).

In his article on the eastern European Bronze Age culture in Finland, Tallgren follows the already established way of thinking. He assumes that the cultural boundary between the coast (western) and inland (eastern) cultures in the Bronze Age in Finland would also have been an ethnic barrier. There would have been immigration from Scandinavia to the coastal areas of Finland, and the tribes of eastern Finland would have had a genetic relationship with the inhabitants of northern Russia (Tallgren 1914b: 21–22; cf. Aspelin 1885: 39; Hackman 1905: 312). It is especially interesting that three years earlier he had not automatically regarded the cultural similarity between the Finnish Comb Ceramic culture and the central Swedish "sub-megalithic" culture as evidence of an ethnic relationship, and he had also not suggested any ethnic connection between the eastern Finnish Bronze Age and its cultural equivalent in Russia (Tallgren 1911b: 27–30).

Tallgren's semi-popular overview of the eastern Russian Bronze Age, published in 1913, is based on the question of whether we can see that culture as the original metal civilization of the Finno-Ugric peoples. Because he supported this view, he must have assumed that ethnic entities in the area had stayed more or less unchanged and continued from the Bronze Age to the Late Iron Age and historical times, which was supported by later linguistic research. Here, he also labels archaeological cultures more generally with ethnic terms, which is seen in the identification of the Fat'yanovo Culture as belonging to the Lithuanian-Latvian peoples (Tallgren 1913b: 676, 678–679, 682).

In his monograph on the Anan'ino Culture, Tallgren again expresses more cautious views on the ethnic identity of the Anan'ino people. The only thing he considers certain is that they were not Scyths, but he is willing to see a continuation from the preceding Bronze Age bearers to the Anan'ino Culture, further to the P'yanobor Culture, and still further to the Magyars. However, he states this very briefly (Tallgren 1919: 184).

CONSOLIDATING A VIEW OF PEOPLES AS ACTING ENTITIES

Tallgren continues his reasoning on the original home and wanderings of the Finno-Ugric peoples in the early 1920s, now based on the linguist Eemil Nestor Setälä's (1864–1935) new overview. In general, in this period Tallgren becomes more and more interested in ethnic questions. It is noteworthy that in his article, Setälä explicitly denies the automatic identification of a linguistic relationship with a genetic one (Setälä 1914: 39–40, 43). Tallgren considers the south-western Stone Age Culture in Finland (i.e. the Battle Axe Culture) as Indo-European because of its wide distribution in Europe and the eastern cultural area as Finno-Ugric. He had never previously expressed this opinion as clearly as here. He also labels the Bronze Age cultural provinces of northern Eurasia with ethnic names, calling the easternmost region Ugrian, the western one Finnish-Permian, and the northern one Lappish. In principle, he follows the interpretation expressed already in the 1840s by M.A. Castrén (Castrén 2017: 120–124). He identifies cultural continuity as both linguistic and ethnic despite Setälä's cautiousness towards or even denial of such a relationship (Tallgren 1921a: 67–71). At the end of the decade, Tallgren has again assumed Finno-Ugrians to be the original inhabitants of northern Russia (Tallgren 1929a: 66, 68, 70). In central Russia during the Late Iron Age, he distinguishes two different cultural areas with their own grave forms and artefact assemblages and interprets them from an ethnic viewpoint as belonging to Finns and Slavs (Tallgren 1929a: 68–69).

Tallgren's view on peoples as acting entities who can move and wander from one place to another is consolidated in his article on the immigration of the Estonians to Estonia. He identifies the Comb Ceramic culture and Bronze Age of eastern Russia with Finno-Ugrians. The Bronze Age people would have divided into smaller groups, one of which would have moved to Estonia during the Pre-Roman Iron Age. The so-called gorodishche (hillfort) civilization of north-western Russia he assumes to be Finno-Ugrian. Tallgren now also uses the concept of the "Finno-Ugric race". The actual aim of the article was to show that the Roman Iron Age of the Baltic, earlier identified by Baltic German researchers as Gothic (Tvauri 2003), is actually ethnically Estonian, although Tallgren admits that there were probably smaller groups of Goths in the Baltic at that time, thus not rejecting the older view altogether (Tallgren 1921b: 188–189, 191–194).

Again, we see a contrary example in Tallgren's article on Swedish influences in Estonian prehistory, which does not contain a single word about any ethnic Swedishness in the Baltic countries but concentrates strictly on similarities in the material culture (Tallgren 1921c).

In the 1920s, Tallgren published two articles about the central Russian Fat'yanovo Culture (Fig. 2), one in French in 1920 and another in Swedish in 1924. The role of ethnic interpretation in the earlier article is marginal except for Tallgren's assumption that the roots of the Fat'yanovo Culture were in the west and that it suggests that the European branch of Indo-Europeans spread to the east (Tallgren 1920: 19, 21–22). In the later article, Tallgren assumes that cultural differences between the

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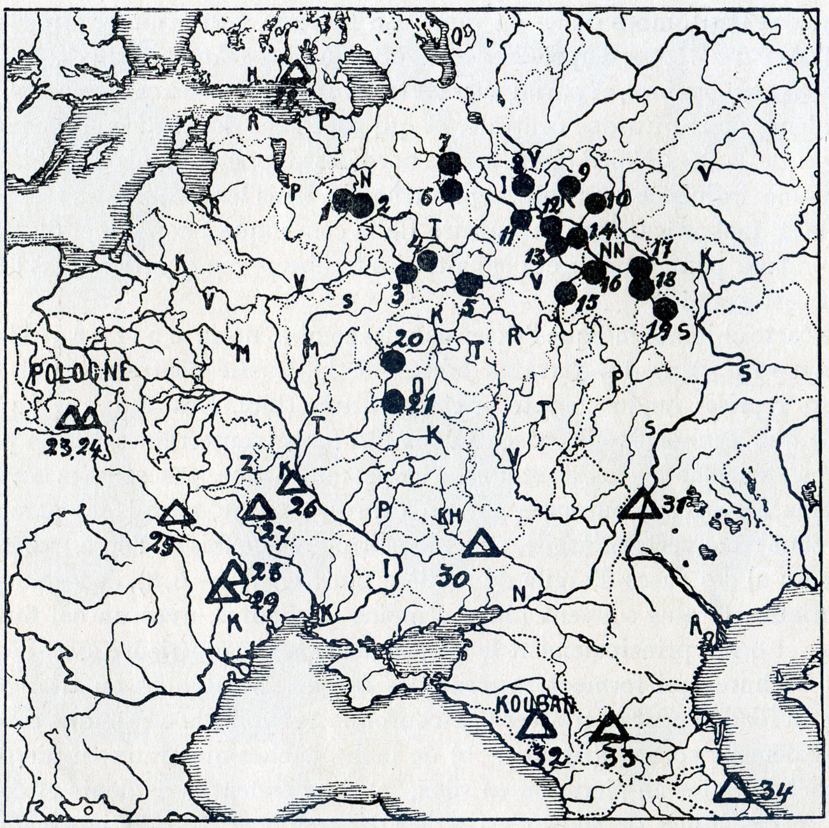

Fig. 59. ● Trouvailles dites de Fatianovo, △ Analogies. 8 Fatianovo, 11 Velikoé, 12 Goviadinovo, 16 Seïma, 21 Brasovo, 25 Schipénitz, 26 Tripolié, 27 Iackowica, 32 Maïkop, Tsarevskaïa, 33 Piatigorsk, 34 Kaïa-Kent.

Figure 2. Distribution map of Fat'yanovo Culture finds, and their analogies as known to Tallgren. Tallgren 1926b: 88 (Fig. 59).

two Chalcolithic cultures in central Russia are probably also a sign of ethnic differences. He also states that the Fat'yanovo Culture emerged from western impulses, but the article contains no actual ethnic identifications (Tallgren 1924a: 1, 15–16). Russian researchers like Aleksandr Andreyevich Spitsyn (1858–1931) and Vasiliy Alekseyevich Gorodtsov (1860–1945) did not accept the western origins of the Fat'yanovo Culture but instead assumed its roots to be in the south, emphasizing the independence of the Russian Chalcolithic from the west (Salminen 2014a: 144; 2017).

In his two-volume monograph on the prehistory of Estonia, especially in its first volume, Tallgren repeated his views on the Indo-European ethnic character of the Battle Axe people of the Baltic and Russia (the latter meaning the Fat'yanovo Culture). They would have arrived as immigrants and conquerors from the Wisla region. He also cited anthropological (craniological) materials but without any definite identifications, although he assumed that there were two separate ethnic groups living in Estonia in the Stone Age (Tallgren 1922: 52, 62, 71). Comb Ceramics are presented without an ethnic definition (Tallgren 1922: 68). According to Tallgren, the Stone Age population had moved further south from Estonia before the beginning of the Bronze Age, and he considered it impossible to say anything about the nationality of the Bronze Age inhabitants of the country, especially because practically no finds from the Late Bronze Age and Pre-Roman Iron Age were known (Tallgren 1922: 73, 77).

In Tallgren's book, Iron Age material is divided into four groups: a Gothic group, which was prevalent until the end of the 5th century, and Late Iron Age Estonian, Latvian, and Liv groups from the 9th to the 13th centuries (Tallgren 1922: 79). The Middle Iron Age between these two phases was very little known in Estonia at that time (Tallgren 1925a: 3–32). Although the Early Iron Age artefact types were Gothic, Tallgren was "inclined to assume" that the population was ethnically Estonian. Thus, his expression contains less certainty here than in some of his earlier texts published in Finland (see above). In any case, he does not seem to consider the cultural character of the artefacts as an ethnic indicator in this context. In his view, the most important evidence for an ethnically Finnic population in Estonia were the grave forms known from Finland at the same time, which had seemingly arrived with a new population from Estonia to Finland; this conclusion was largely based on linguistic interpretations. Like Hackman and the Estonian amateur archaeologist Adolf Friedenthal (1874–1941) before him, Tallgren interpreted the difference between grave forms in Estonia and Latvia as meaning also an ethnic boundary between these areas (Tallgren 1922: 123–126). He considered it probable that there were Germanic colonies in northern Estonia (Tallgren 1922: 127–129). In the second volume of Tallgren's book, ethnic terms are used in connection with the Late Iron Age (Tallgren 1925a: 171–173).

In the middle of the process of writing about the prehistory of Estonia, Tallgren attended an international congress of historians in Brussels in 1923 and delivered a presentation on the "prehistoric ethnography" of the Baltic countries. He must have assigned a special significance to this paper because he published it as a scholarly article in the Estonian, Finnish, French, and Swedish languages, as well as a popular newspaper article in Finnish (Tallgren 1923a; 1923b; 1923c; 1923d; 1923e). According to this study, the Comb Ceramic Culture was Finno-Ugrian, the Battle Axe Culture was Indo-European, and the West Baltic Bronze Age as well as the East Prussian Bronze Age were Germanic. The ethnicity of the Early Iron Age in East Prussia was assumed to be either Germanic or Baltic. The cultural continuity in western Finland from 100 to 600 CE was seen as evidence of the Finno-Ugric ethnicity of the inhabitants of this area. Consequently, Tallgren viewed it as certain that by then, also the population in Estonia and partly in Livonia had been Finno-Ugric and the population in Latvia had been Baltic (Tallgren 1923b: 335, 339–346). Thus, although Tallgren had earlier made ethnic conclusions about the inhabitants of Finland on the basis of the probable ethnicity of the population in Estonia, his reasoning now was the opposite. He viewed archaeological cultural areas as ethnic areas from the Bronze Age onwards.

SYNTHESES OF THE ETHNIC READING OF FINNO-UGRIC PREHISTORY

In his installation lecture as Professor of Finnish and Nordic Archaeology at the University of Helsinki in the beginning of 1924, Tallgren presented a broad overview of western and eastern elements in the Finno-Ugric Iron Age until the year 800 CE (Tallgren 1924b; 1925b). Here, his reading of prehistory is completely based on the ethnic paradigm with peoples as acting elements. However, even in this lecture, cultural similarity did not, in his view, always imply ethnic similarity, as in the case of the Gothic culture in central Russia from the 5th century onwards. Even though the population was replaced by another, the culture developed further along the lines it had adopted during the Gothic occupation. Another area with a similar development, as Tallgren had stated also in his earlier works, was the Baltic. There the overall character of the material culture was Gothic because of the strong and expansive Prussian industry spreading its products to the area, not because of any Gothic population (Tallgren 1925b: 136–141). In a popular context, Tallgren gave cultural spheres ethnic names from the Roman Iron Age on, and also here, he assumed Estonian immigration at that time (Tallgren 1926a: 244–245).

Tallgren continued his analysis of the Finno-Ugric Iron Age with an account of Late Iron Age cultural spheres in 1927. In this article, he analysed the period from ca 900 to 1200. Also, this article was published in both Finnish and French (Tallgren 1927a; 1928). Undoubtedly because of the growing number of historical sources, the ethnic approach is emphasized here more than in the study of the earlier period, and artefacts are characterized with ethnic names. Tallgren has been seeking the "national character" of the material culture in each region, just as J.R. Aspelin had done in the 1870s. On the other hand, when "cultural hegemony" had been in the hands of an exterior element like the Varyags in Karelia, Tallgren could not distinguish any national groups even in areas where there must have been distinct tribes like the Karelians and Veps (Chuds) (Tallgren 1927a: 122).

Tallgren published a synthesis of his view of the prehistory of Finland in 1931 (Tallgren 1931a). The book must be seen in connection to the articles published at the same time or a couple of years earlier (Tallgren 1929b; 1929c; 1929d; 1931b; 1931c). In his article on the prehistoric settlement of Tavastia in 1929, Tallgren explicitly says that continuity in material culture also means ethnic continuity in Tavastia from the year 500 to 1100 (Tallgren 1929b: 149), but he says nothing else concerning ethnicity. Another article on the settlement of Finland Proper again proposes Finnish settlement continuity from around 100 CE and immigration from Estonia but, notably enough, also states that we cannot say anything about the race and nationality of the Stone Age inhabitants of the province. According to Tallgren, Finnish immigration had taken place little by little in small groups (Tallgren 1929c: 21–26). He may have meant this also in his earlier works, but here he formulated the statement explicitly.

Tallgren also wrote a special article in order to answer the question of when the ancestors of present-day Finns had arrived in Finland. The article does not contain anything new compared to his earlier statements; also here, the explanation is based on the idea of migrating tribes (Tallgren 1929d).

The ethnic explanations in *Suomen muinaisuus* (Tallgren 1931a) can be summarized as described here. The arrival of the Battle Axe Culture is for Tallgren an immigration of new, probably Indo-European inhabitants, because there are no earlier artefact forms known from which the culture could have developed in Finland. Although uncertainly, he assumes also ethnic differences between western and eastern Finland (Tallgren 1931a: 66, 70–71). The western Bronze Age is a sign of immigration from the west, while the eastern Bronze Age is, in his opinion, a continuation of the local Stone Age culture. He does not express any views on whether there have been only small immigrant groups or a larger movement of new people coming to western Finland (Tallgren 1931a: 91). In the Pre-Roman Iron Age, the western parts of the country were not completely deserted, but they were very sparsely inhabited (Tallgren 1931a: 96). Actual Iron Age settlement begun around 100 CE, and here Tallgren repeats what he had written in his articles of 1929 – in places the text is identical to the article Tallgren 1929d. The Finnish migration would have taken place gradually between 100 and 600 CE (Tallgren 1931a: 101, 135–136, 141–151).

In the book *Suomen kulttuurihistoria* (Cultural History of Finland), Tallgren formulated the same idea as settlers coming to Finland across the Gulf of Finland during the first three centuries of the Common Era. The chapter has been titled "East Baltic culture and the move of Finns to Finland", but in the text itself, Tallgren leaves it open whether the settlers were already "Finns" when leaving Estonia or whether they became Finns only after crossing the sea (Tallgren & Toivonen 1933: 46).

PREHISTORY OF UKRAINE, THE CAUCASUS, AND EUROPE

In the second half of the 1920s, Tallgren mainly turned his attention to other topics, such as Ukraine and the Caucasus. Ethnic questions had very little significance for him in that context. In his monograph on the Bronze Age of the Pontic Steppes or Ukraine before the Scyths Tallgren mentions migrating peoples and writes about Scyths, Thracians, and Cimmerians supported by Herodotos's descriptions, assuming that the rise of the Bronze Culture in Ukraine was probably caused by the immigration of Cimmerians to the steppes, but he often sets "ethnic" terms like Hungarians or Cimmerians in quotation marks, indicating that his usage of these terms is of a regional rather than an ethnic character (Tallgren 1926b: 217, 220, 223–224; 1927b: 22; Salminen 2023). Otherwise, there are practically no attempts at ethnic explanation in any of his work on these parts of Eurasia.

The same attitude is reflected in the Estonian-language prehistory of Europe that Tallgren published in 1927. Ethnic labels are used in connection to Scyths, Sarmates, and Germanic peoples, especially Goths. There are speculations about the ethnicity of the Minusinsk Bronze Age in western Siberia. The Roman Iron Age in Finland is interpreted as the period of Finnish immigration into Finland, and the Late Iron Age in northern Russia is divided into ethnic cultural spheres according to the different Finno-Ugric peoples known there from historical sources. Ethnic conclusions are retrospective and based on information from later, historical times. In other contexts than these, ethnicity does not play any role in the book (Tallgren 1927c: 94–95, 103, 107, 114, 117–118, 120–121, 141–143, 157–176).

INGREDIENTS OF TALLGREN'S ETHNIC CONCLUSIONS

Were Tallgren's ethnic conclusions based on typology, cultural similarity on a more general level, or some other factors? For this closer comparison, we will use the works Tallgren 1911a; 1920; 1921b; 1922; 1923a; 1923b; 1923c; 1927b; 1929d; 1931a.

In his dissertation, Tallgren based his still very cautious ethnic conclusion on a retrospective from the Late Iron Age, discovering probable cultural continuity extending from the Bronze Age through Anan'ino to the Iron Age (Tallgren 1911a: 217–218). There is no actual comparison of finds on which the assumption would be based. Tallgren uses the concepts of Kulturkreis and Kulturgruppe, consisting of a uniform complex of finds, to distinguish, for example, the Fat'yanovo Culture (Tallgren 1911a: 10–11, 49).

Ten years later Tallgren was more convinced of the ethnic identity of at least some archaeological cultures connecting the Battle Axe and Fat'yanovo Cultures to the Indo-Germans or the Aryan branch of the Indo-European people wandering from Scandinavia to Persia and India (Tallgren 1921b: 187; more details in Tallgren 1920: 16–22). He considered the Comb Ceramic Culture as Finno-Ugric, because "we don't know anything about the existence of a foreign culture in northern Russia" (Tallgren 1921b: 188). Thus, the retrospective view was extended to the Stone Age now and the result was supported by an *ex silentio* argument. According to Tallgren, the disappearance of the Fat'yanovo Culture meant the wandering of those people and the replacement of the population by Balts, Slavs, and Finns (Tallgren 1921b: 189). He also views the Gorodishche Culture from 500 BCE to 800 CE as belonging to the "West Finnish" peoples (Tallgren 1921b: 190–191). His arguments for the presence of Estonians in Estonia in the Early

Iron Age were based on cultural continuity, a Finnish migration to Finland from 100 CE on, and linguistic results. Here, it is especially noteworthy that Tallgren does not infer ethnicity directly from material culture: a Gothic artefact assemblage does not imply Gothic ethnicity (Tallgren 1921b: 194–196).

Thus, we can see that Tallgren made his ethnic conclusions on the basis of cultural continuity and the presence or absence of cultural phenomena. In his view, cultural areas were equivalent to ethnic areas, changes in culture were mostly explained by immigration or emigration of peoples, and when internal development occurs in a culture, the impulses for it come from other peoples with a higher cultural level (see also Tallgren 1922: 124–129). The articles Tallgren 1923a–c do not add anything new to the reasoning presented two years previously, and it seems that Tallgren had formulated the principles along which he makes ethnic conclusions already around 1920.

In the mid-1920s, the same basic idea still prevails: cultural areas are ethnic areas and significant changes in the material are also signs of an ethnic change (Tallgren 1926b: 217; 1927b: 22). At the end of the decade, the basic idea is still unchanged and Tallgren's image of prehistory is based on migrating tribes, which he follows retrospectively, at least as far as the prehistory of Finland and the Finns is concerned (Tallgren 1929d; 1931a). Tallgren's reasoning does not differ in any significant way from that of Gustaf Kossinna and other adherents of the ethnic paradigm of archaeology.

ATTENTION TO THEORETICAL QUESTIONS

The first time that Tallgren paid attention to the question of the conditions on which ethnic conclusions can be drawn from archaeological material was while explaining the archaeological research method in the introductory chapter to the prehistory of Finland in 1931. At least he had not published any such considerations before. He describes here how cultural provinces are distinguished from each other. After the borders between cultural areas are identified, the next task is to find out whether a geographically distinct area is also a national one or whether the differences can be explained by different economic or societal factors. If a sudden change in material is found, the question to ask is whether it is associated with wanderings of peoples or economic upheavals (Tallgren 1931a: 8–11). These reflections are the embryo or first phase of the reasoning Tallgren took further some years later. At this point, Tallgren had said everything he had to say concerning ethnic questions in his research areas without going deeper into the theoretical foundations of his results.

Tallgren's theoretical thoughts resulted in an article that was published in three slightly different versions in 1934 (in Finnish), 1936 (in French), and 1937 (in English). In addition to these, also translations into Polish (1936, from the French version) and Spanish (1941, from the English version) appeared. According to Tallgren himself, the main reason that had led him to think critically about the research methods used in archaeology was the political use of prehistory in Germany and the Soviet Union. In his article, Tallgren especially criticizes the identification of archaeological cultures with ethnoses as such. He points out that two different ethnic groups may have very similar material cultures, and on the other hand, the material culture within one people does not need to be uniform. He shows examples from both the Finno-Ugric peoples of Siberia and 18th-century Europe to illustrate the difficulty of drawing ethnic conclusions from archaeological finds. Despite these reservations, Tallgren still considered it possible to indisputably identify the nationality of the Finnish Iron Age population. Wanderings of peoples have occurred, not to such an extent that a certain people would have completely replaced the former inhabitants of a certain region but rather in the form of smaller groups of immigrants arriving and settling among the existing population. Tallgren also sets the study of social and economic history and the function of artefacts instead of form as archaeology's foremost tasks. For him, archaeology is a historical discipline (Tallgren 1934: 204–210; 1936a: 19–23; 1937a: 156–159).

In 1939, Tallgren took his reasoning on the emergence process of different peoples still further. Now he denied the whole existence of homogeneous primeval peoples that would as such form the basis of each present-day people. There were never any "original homes" from which peoples would have wandered and spread. All peoples and especially the so-called cultural peoples are conglomerates of heterogeneous elements coming from different directions, and it is questionable whether even any uniform original form of language has existed. Again, in Tallgren's view, the western Finnish people formed an exception, because in the more remote regions the emergence process would have been simpler, and the existing population would have assimilated newcomers more easily (Tallgren 1939: 40–45).

THE FEW PRACTICAL ADAPTATIONS OF THE NEW APPROACH

Tallgren's productivity was already declining in the second half of the 1930s, and he did not have many opportunities to adapt his new approach into practice. In his short essay on the settlement history of the region extending from the Gulf of Bothnia, he still seemed to support the idea of wanderings of peoples, as he states that northern Russia is not an original land for any Finno-Ugric peoples but only their former usufruct area and that it is not the starting point for any wanderings of peoples either (Tallgren 1935: 232).

In a short overview of prehistoric settlement and population in 1936, Tallgren says that the Finno-Ugric peoples and Arctic peoples "probably originate" from the hunters and fishers of the Comb Ceramic cultural area, and he indicates the Indo-European background of the Battle Axe Culture with the word "perhaps" and a question mark. The "Indo-Germanic" population would soon have assimilated with the original inhabitants of the country and the heritage of the Stone Age hunter-gatherer culture is continued as Lappishness or the Lappish ethnos ("lappalaisuus") (Tallgren 1936b: 417). For the Bronze Age, Tallgren considers it possible that Scandinavian immigrants would have lived on the coasts of Finland and the actual settlement of the country would have happened in the Early Iron Age with the migration of the Finns to Finland, arriving in small groups (Tallgren 1936b: 419–420). In these latter contexts, Tallgren again identifies an archaeologically observable change in settlement with a certain ethnicity, as he had done before.

In 1937 at the Finnish Society for Sciences, Tallgren delivered a presentation about the Scandinavian Bronze Age in Finland. It is one of the relatively few syntheses of any prehistoric period that he published after the theory article of 1934/1936. In this analysis, the Bronze Age of Finland is viewed through a social and economic approach more consistently than before and the signs of the Scandinavian Bronze Age in Finland are considered as indications of entrepreneurs, merchants, and immigrants coming from the west to Finland at that time. On the other hand, this conclusion includes an ethnic dimension as such, an assumption that they were foreign in Finland and that, therefore, the whole Scandinavian Bronze Age is actually an ethnic phenomenon in Finland (Tallgren 1937b: 11–12, 16). The term 'lappalaisuus', Lappishness, which he uses to describe the inland or eastern Bronze Age in Finland, is now set in quotation marks (Tallgren 1937b: 17). His two articles on the prehistory of Russian Karelia contain very few ethnic conclusions, even the latter, which was published in both Finnish and Swedish just after Finland had started its occupation of the area, which was to last three years (Tallgren 1938: 15–19; 1941a; 1941b).

THE ROOTS OF TALLGREN'S THINKING

A.M. Tallgren became an archaeologist in the first years of the 20th century, completing his MA degree in 1905 (Kivikoski 1954: 80–82; Salminen 2001). The leading Finnish archaeologists at the time were Johan Reinhold Aspelin, Hjalmar Appelgren (from 1906, Appelgren-Kivalo, 1853–1937), and Alfred Hackman. The somewhat younger generation was represented by Kaarle Soikkeli (1871–1932), Julius Ailio (1872–1933), and the medievalist Juhani Rinne (1872–1950). There were no other young students of archaeology than Tallgren until 1907, when Aarne Europaeus (from 1930, Äyräpää, 1887–1971) began his studies, and he did not turn to archaeology in earnest until some years later (Fig. 3).

The main goal set for Finnish archaeology by J.R. Aspelin in the 1870s was to search for the roots of the Finnish people and traces of their wandering from their original home to Finland, which meant that ethnic problems formed the

Figure 3. A.M. Tallgren and Alfred Hackman on the excursion of the Second Baltic Archaeology Congress, held in Riga in 1930. Photo Karin Hilden. Finnish Heritage Agency (CC by 4.0).

core of the discipline. Aspelin thought that the national character of each people was reflected especially in their ornaments. Thus, also areas inhabited by these nationally identified peoples could be distinguished and the roots of a present people could be traced at least to the Bronze Age (Aspelin 1875 passim; Nordman 1968: 32–38; Salminen 2003: 43–46, 60–63, 169–172). Hjalmar Appelgren-Kivalo continued along similar lines but with an emphasis on more specific details, such as bronze spirals as ethnic indicators (esp. Appelgren-Kivalo 1915; 1926). Despite methodological differences, both believed that ethnic conclusions could be drawn from archaeological finds. Also, in their view, peoples were recognizable units that had wandered from their original homes to their present locations. Aspelin was also familiar with the idea of archaeological cultures from earlier and contemporary Scandinavian researchers and called them ’civilizations’ in a French text (Meinander 1981: 106–107; Salminen 2003: 152–153). The approach of both scholars was closely related to the way of thinking usually connected with the German linguist-archaeologist Gustaf Kossinna. Appelgren was formally Tallgren’s supervisor during the latter’s studies of archaeology, but Tallgren never developed into a real typologist like Appelgren (Nordman 1968: 39–41). Instead Tallgren followed Aspelin, who based his conclusions on more general comparisons of forms and cultural similarities (Salminen 2003: 173).

Alfred Hackman knew Kossinna personally, and among the Finnish archaeologists, he was the one with the closest ties to Germany. He also largely followed the main concept of Kossinna’s *Siedlungsarchäologie* but was more cautious in his ethnic conclusions (see esp. Hackman 1905: 331–337; Nordman 1968: 45–47; Salminen 2014a: 27). Julius Ailio was both archaeologist and geologist as well as a Social Democrat politician. Such a background meant that ethnic questions in the nationalist sense were of secondary importance for him, although he did not reject them altogether and was highly interested in questions of race and physical anthropology. Ailio’s work and interpretations have never been analysed (Autio 1999/2017; Nordman 1968: 50–52; Salminen 2014a: 27).

During his visit to Sweden in 1905, Tallgren studied under Oscar Montelius (1843–1921) and Oscar Almgren (1869–1945) (Kivikoski 1954: 86). Montelius had been inclined to study ethnic questions and especially the roots of the Germanic peoples since the 1870s. He also had a significant influence on Kossinna when the latter formulated his research methods and identification of archaeological cultures with ethnoses. Almgren, on the other hand, criticized the identification of today's "linguistic tribes" with earlier human races (Baudou 2004: 182–186; 2012: 346, 352–353).

There were, however, also other Finnish archaeologists who discussed the question of parallelism between archaeological cultures and ethnoses in the 1910s and 1920s. Carl Axel Nordman (1892–1972) denied a direct equivalence between these two for the first time in a presentation in 1914, and he repeated his views in 1915, 1928, and, for a German audience, in 1937 (Nordman 1914: 25; 1915: 6–9; 1928: 132–133; 1937: 480; Meinander 1991: 31–32; Salminen 2011: 284–285; 2014a: 223–226).[1] Despite his rejection of a self-evident ethnic reading of finds, Nordman accepted Oscar Montelius's conception of a Germanic cultural continuity in Sweden from the Stone Age to the present and called the Battle Axe people arriving in Finland "Swedes, or more correctly proto-Germans". On the other hand, he regarded it as uncertain whether the Comb Ceramic people were Finno-Ugrians or not (Nordman 1914: 27–29). Fourteen years later, he said more cautiously that the Battle Axe Culture "could be Indo-European" and the mixed culture following thereafter in western Finland "could possibly be called Germanic" (Nordman 1928: 145).

The most striking difference occurs in Nordman's interpretations of the Early Iron Age ethnic circumstances in Estonia. In 1914, he stated that the Baltic German scholars' view of culturally weak Finno-Ugrians subdued by a superior Gothic culture and people has been declared false "by excellent experts", but in 1928 he had again adopted the view of cultural domination by ethnic Goths in the Baltic countries (Nordman 1914: 36; 1928: 135; also 1937: 485–486; Tvauri 2003). Thus, Nordman had returned to a direct ethnic reading of material culture, which he had previously rejected. Nordman's conclusions about the past of the Swedish population of Finland are expressed with more certainty than his ideas about the Finnish inhabitants, while e.g., Tallgren was more convinced of the roots of Finnish-speaking Finns than those of the Swedish-speaking population. As Nordman published all analyses of ethnicity in contexts discussing the age of the Swedish settlement in Finland and its relationship to the Finnish-speaking population, language political background influences cannot be excluded. Nordman was most consistent in his application of the idea of distinguishing between archaeological cultures and ethnic groups in his article in *The Journal of the Royal Anthropological Institute* in 1922, where he kept most of his ethnic interpretations to a hypothetic level (Nordman 1922: 35–36, 38, 40–43).

Aarne Äyräpää did not explicitly write anything about ethnic questions in his most important work of the early 1930s, but his conclusion that the Battle Axe Culture can have spread only from central Europe to central Russia (Fat'yanovo) implies its Indo-European ethnicity, as Tallgren had also written some years earlier (Äyräpää 1933: 154; note also the title of his study).

Elsewhere Gordon Childe (1892–1957) expressed his critical attitude towards the possibility of tracing ethnicities in archaeological material in the 1920s but was nevertheless bound by old ethnic stereotypes (Trigger 1980: 49–52; 2006: 243–246). Both Tallgren and Nordman corresponded with Childe and met him personally, and Tallgren also influenced his archaeological views (Salminen 2014a: 152–153, 220–222, 229–230, 376). Thus, a reverse influence is also possible.

Tallgren's Estonian pupil Harri Moora (1900–1968) was not convinced in 1932 that the Finns' forefathers would have arrived in a completely empty country. He also questioned the Estonian origins of the Early Roman Iron Age graves of Finland but did not deny the immigration itself. In 1925, another Estonian pupil, Marta Schmiedehelm (1896–1981), asked under what conditions a culture can change without a change of population. Tallgren replied that such a change is possible (Salminen 2014a: 115, 158). Tallgren also closely followed the debate that Aarne

Europaeus had with his Swedish colleagues about the origins of the Battle Axe Culture in Finland, which also touched upon ethnic questions (Salminen 2014a: 132–142; 2014b).

WHY DID TALLGREN REASSESS HIS VIEWS ON ETHNICITY IN ARCHAEOLOGY?

As we have seen above, Tallgren's thoughts about how archaeology could be used to trace past ethnicities experienced two changes, firstly the consolidation of the ethnic interpretation in the 1910s and secondly its rejection during the first years of the 1930s. Tallgren has not left us any explicit material to clarify what led him to abandon his earlier approach and, with some exceptions, exclude ethnicity from the tasks of archaeology. Nevertheless, because this topic had been discussed even in Finland since the 1910s, it is not surprising that also Tallgren chose his side in the question. Most probably the explanation must also be sought in external factors. Two developments are especially crucial here.

In the 1920s, Tallgren made three journeys to the Soviet Union, developed an extensive network of acquaintances among archaeologists there, and founded, together with the ethnologist Uuno Taavi Sirelius (1872–1929), the journal *Eurasia Septentrionalis Antiqua* just to publish studies on Russian and eastern European prehistory (Kivikoski 1954: 105–108; Salminen 2014a: 97–116). This meant familiarizing himself with the new Soviet archaeology, the theoretical basis of which was just created in the late 1920s by applying Marxism to the interpretation of prehistory. Eventually Soviet archaeology ended up adhering to the theory of languages as being socioeconomically determined, developed by Nikolay Marr (1864–1934) – or rather it was gradually commanded to adhere to this theory – but the preceding transition phase at the end of the 1920s provided several ideas that clearly influenced Tallgren, such as a focus on how prehistoric societies had lived and especially the use of a sociological approach (Kivikoski 1954: 110–111; Trigger 2006: 335–339; Sveshnikova 2009: 65–73; Platonova 2010: 122–124, 161–165, 177–180, 196–197; Salminen 2014a: 115; on the influence of Soviet archaeology on Childe and parallelism with Tallgren here, Trigger 1980: 92–95).

However, a counter-reaction to the ideas of the 1920s was soon to follow both in the Soviet Union and elsewhere. The ethnic reading of prehistory was dogmatized first in Nazi Germany and combined there with the search for German superiority in the past. The Soviet Union replied in 1935 with a programme to emphasize Slavic cultural superiority (Shnirelman 1995; Wiwjorra 1996; Grünert 2002: 336–342; Trigger 2006: 251). Several of the scholars who had developed Soviet archaeology in the 1920s were repressed, even executed (Platonova 2010: 124, 184–188). Tallgren's criticism of the political misuse of archaeology in the two totalitarian states resulted in a fierce debate with some German archaeologists and was one of the factors preventing him from entering the Soviet Union again (Salminen 2011: 274–283; 2014a: 241–248). Tallgren's distancing from ethnic interpretation seems to have resulted from the combination of three impulses: domestic discussion since the 1910s on the possibility of drawing ethnic conclusions in archaeology, the sociological emphasis in the Soviet archaeology of the late 1920s, and the rise of new nationalist archaeologies in the 1930s. Tallgren had also expressed his views against the extreme rightist phenomena in Finland in the early 1930s (Kivikoski 1954: 114–115).

CONCLUSIONS

Tallgren's scholarly background was within a paradigm of ethnically coloured archaeology. He learned it from both of his teachers, J.R. Aspelin and Hjalmar Appelgren-Kivalo. Gustaf Kossinna's *Siedlungsarchäologie* was also introduced in Finland in a moderate form by Alfred Hackman in the first years of the 20th century. While studying in Sweden, Tallgren may have been exposed to opposing influences with respect to ethnicity in prehistory. However, Tallgren avoided straightforward ethnic conclusions in his earliest works.

There was at least some discussion of how archaeology could be used to reach ethnic results in the 1910s in Finland, when C. A. Nordman published two papers on the topic. At this point, his critical attitude did not yet influence Tallgren, who instead sought more certainty about the conditions on which he could draw ethnic conclusions, more specifically trace the roots of the Finno-Ugric peoples. At this phase, he viewed peoples as rather static entities that could wander from one place or area to another. Tallgren's ethnic reasoning consolidated in the early 1920s and did not change much for the next ten years.

Tallgren made most of his ethnic conclusions retrospectively from late prehistory or medieval times back to earlier periods. Linguistics provided support for him but remained in the background. Tallgren attempted to combine certain historical phenomena with archaeological remains, such as hillforts. However, he seldom considered any artefact types as ethnic indicators as such, and when other arguments like linguistics pointed in another direction, such as in the case of the so-called Gothic Early Iron Age in Finland, Estonia, and Latvia, artefacts lost their evidential value altogether.

The ethnic question was most important for Tallgren in connection with so-called Finno-Ugric archaeology. Otherwise, he did not pay much or practically any attention to prehistoric ethnicities. It could even be said that for Tallgren, the ethnic approach mostly belonged together with one specific question, that of the history of the Finno-Ugric peoples and especially the Finns' arrival in Finland.

In the beginning of the 1930s, Tallgren questioned most of what he had said or thought about archaeology so far, including the ethnic paradigm. During his journeys to the Soviet Union in the 1920s, Tallgren had become interested in the new possibilities of archaeology as a historical-sociological discipline, and in the 1930s, archaeology and especially ethnic archaeology was applied for political purposes first in Nazi Germany and soon thereafter also in the Soviet Union. Thus, several currents running in parallel led Tallgren to the reassessment of his earlier approach and resulted in the theory article of 1934/1936/1937. Tallgren took his rejection of ethnic conclusions in archaeology even further in 1939, but still with one exception, the roots of the Finns.

Tallgren did not apply his new thoughts much in practice because of the Second World War and his own deteriorating health. Thus, we do not know what kind of archaeology he would have practised if he had followed the path he had pointed.

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NOTES

[1] The Nordman 1937 presentation is mostly a direct translation of Nordman 1928, although complemented with an overview of the Stone and Bronze Ages, rich illustrations, and a reference to the influence of national characteristics on material culture. Salminen 2014a: 225.

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Jenni Sahramaa & Mervi Pasanen

SPIRAL DECORATED SHAWLS IN LATE IRON AGE FINLAND – AN INTERPLAY OF LOST AND RECONSTRUCTED MATERIALITY

Abstract

Spiral decorated shawls in Late Iron Age Finland (c.AD 800–1200) were elaborate and special garments with strong connections to identity. In prior research, richly decorated shawls from female graves have been reconstructed for ancient costumes. In this study, we trace the sensorial properties of shawls using microarchaeological methods, experimental archaeology and reconstructions. Examples from female graves, male graves and a child's grave are included for examining the similarities and differences between spiral decoration techniques. In a broader context, we discuss the use and meanings of shawls in both life and death.

Keywords: textile archaeology, sensory archaeology, ancient clothing, reconstructions

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INTRODUCTION

Clothing is important for the study of identity: it shows to others who we are and what we represent. At the same time, it is intimately connected to our sensing bodies, warming and protecting or sometimes irritating them, being sometimes too tight or too itchy. Clothing was needed for practical reasons, but it was also a display of wealth and skill. Archaeological textile finds do not just tell the story of practical clothing adapted to a cold Northern climate: the remains are of finely made and elaborate garments.

In the area of present-day Finland, Late Iron Age (c. AD 800–1200) cloth culture consisted of several layers of clothing, such as long-sleeved dresses, peplos-type rectangular garments attached with different types of pins and brooches, and aprons tied to the waist with colourful bands (Lehtosalo-Hilander 1984: 54, 58–59). Burial finds suggest that the outermost garment was in several cases a rectangular garment that could be called either a cloak, a mantle or a shawl (Lehtosalo-Hilander 1984: 51–57; Kirjavainen & Riikonen 2007: 135–136; Hirviluoto 1973). The evidence of garments is usually restricted to the textile fragments connected to a metal object or decoration, as metal oxidation and corrosion may preserve the organic materials near them. Therefore, interpretation on the way a rectangular garment was worn can be made based on the placement of brooches and the direction of the fabric's warp: a garment is interpreted as a peplos if it was worn attached from both shoulders, with the warp of the fabric being transverse to the body. Cloaks or shawls are not as clearly definable, as they were sometimes dressed on the deceased but more often used to cover or wrap the body, and the use of brooches probably differed in life and in the grave setting (Appelgren-Kivalo 1907: 29, 44–45; Hirviluoto 1973; Asplund & Riikonen 2007: 26). In this study, we use the term 'spiral decorated shawl' to refer to a rectangular wool outer garment decorated with ornaments made of small spiral tubes drawn with copper alloy wire.

The structures and appearance of Finnish Late Iron Age female clothing are well understood, since, due to the more extensive quantity of copper alloy jewellery , more textile fragments have survived in female than in male graves (Lehtosalo-Hilander 1984: 5). The most elaborate items from Late Iron Age clothing are the spiral decorated shawls found in female graves from the 11th to 13th centuries. The first well-preserved remains of spiral decorated shawls were found in *Perniö Yliskylä* cemetery and published by Hjalmar Appelgren-Kivalo in 1907. Examples of similar decoration styles have been found in female graves from several Late Iron Age cemeteries in South-West Finland, including *Masku Humikkala, Raisio Ihala, Köyliö Köyliönsaari C, Eura Luistari* and *Turku Kirkkomäki* (Pälsi 1928: 76; Hirviluoto 1973; Cleve 1978: 199; Lehtosalo-Hilander 1982: 160; Asplund & Riikonen 2007: 26–27).

The study of clothing from grave finds in Finland has long been entangled with the practice of making ancient costumes and reconstructions (Lehtosalo-Hilander 1984; Riikonen 2003; Lipkin 2023). The beautiful decorative details of the Perniö Yliskylä finds (Fig. 1) were re-materialised in the Ancient Perniö Costume published in 1925 and exhibited in the Finnish National Museum for 90 years (Lehtosalo-Hilander 2001: 35; Sahramaa & Wright 2021: 141). Although the quality of the surviving textiles from male and child graves is generally poor, shawl remains have also been identified in some male burials (Appelgren-Kivalo 1907: 55–56; Lehtosalo-Hilander 1982: 165–172; 2000a: 193–207 ; 2001: 77–81; Riikonen 2006) and child burials (Lehtosalo-Hilander 2000a: 221–226; Asplund & Riikonen 2007: 26; Wright et al. 2024). A strong gender bias is nonetheless evident, as female clothing has been studied down to the most minute detail in ancient costume reconstruction projects. Thus, when discussing shawl finds from male graves, interpretations are based both on findings from female graves as well as other sources commonly used in ancient costume studies, including archaeological finds, like the 5th-century graves from *Evebø/Eide* in Norway and *Högom* in Sweden (Mannering 2017: 156 with references), together with image sources from other areas of Northern Europe, like the Bayeux tapestry (Bayeux Museum 2023).

In this paper, we discuss the possibilities of connecting the recorded technical data on the properties of archaeological textiles, including the weave, thread count, spin angle and dye analysis results, with the sensorial properties characteristic of the original materiality of such textiles, such as the look and the feel of the garment. Susanna Harris (2019: 212) draws attention to ‘a sensory disconnect between the archaeological textile artefact and the sensory materials that existed in the past’. In the archaeological literature, researchers have presented multidimensional, colourful and sensuous garments from the past both in tables listing their properties as well as in black and white photographs (Hurcombe 2007: 533; Harris 2019: 211–212). Within sensory archaeology, new perspectives on the past are created by stressing the bodily interaction of human beings with their surroundings (Day 2013: 5). While senses are not universal but culturally specific, we nevertheless experience the world through our senses just as our ancestors did, and this shared corporeality is the starting point for our interpretations of the material world (Day 2013: 6).

Here, evidence of spiral decorated shawls from female, male and child graves will be presented to demonstrate the similarities and differences in material culture based on gender and age. The technical and dye analyses of textiles make it possible to trace the properties of the garments, but reconstructions are needed to make sense of the tactile characteristics of the textile. The reconstructions will offer glimpses of the rhythmic, haptic and visual (Hurcombe 2007: 539) reality of past textile production. In the making process, the craftsperson's relationship to the materials includes the feel of the wool yarn in their hands, the colour and the surface texture of the fabric building up weft by weft when weaving, how the fabric falls and wraps after removing it from the loom, and even the smell of the dyes and dyeing methods used combined with the wool's own odour. The repetitive and laborious making process creates experience and embodied knowledge that in turn helps researchers understand the materiality and value of the original spiral decorated shawls (Hurcombe 2007: 537).

With reconstructed shawls, it is also possible to study the impact of textiles on bodies, both on living bodies and in a reconstructed grave setting. In our case studies, spiral decorated shawl reconstructions are used to explore the practical constrains and opportunities of different wearing practices. The tests were conducted via historical reenactment events as well as photoshoots to both discuss subjective reflections on the reconstructions and document different wearing practices. With funeral setting reconstructions, the choices concerning the dimensions and placement of decorations on shawls are examined. By providing visual examples of the possible original use of the shawls, the sensorial aspects of spiral decorated shawls and their role in the clothing culture of Late Iron Age Finland can be understood. In previous research, archaeological shawls have not been studied using sensory research. Therefore, this paper will provide fresh approaches to the topic.

Spiral traditions in Finland and the Baltic

The tradition of decorating garments with small copper alloy spirals began in Finland in the 9th century at the latest (Lehtosalo-Hilander 1984: 60–61). Separate spiral tubes have been found in cremation burials, but their connection to clothing can be studied in inhumation graves, where the dead were supposedly buried in their normal or festive clothing (Lehtosalo-Hilander 1984: 2, 62; Riikonen 2005: 37, 45). The placement of decorations and jewellery should therefore also represent the way people dressed during their lifetime, although sometimes, for example, two aprons or shawls have been placed in the same grave (Kirjavainen & Riikonen 2007: 135).

Spiral ornaments were used both in finishing and decorating the textiles. For example, garments woven on a warp-weighted loom were usually started and finished in tablet-woven bands, where the fabric warp yarns served as a weft for the band. The fan-like corner ornaments of aprons were used to hide the warp yarns of the tablet-woven band (Vahter 1928: 68–69; Riikonen 2005: 33). Spirals were used as a decorative element and also as finishing in shawls and female headdresses (Vahter 1928: 66–68; Kirjavainen & Riikonen 2007: 136) as well as in headbands (Riikonen 2023: 81–82; Paschenko 2023) and leg bands (Riikonen 2023: 63).

Besides garment finishes, separately made ornaments appliqued to the fabric were also used. The earliest examples of such ornaments are those found in early 10th-century male graves at Eura Luistari, constructed of woollen yarn and separate spiral tubes (Lehtosalo-Hilander 1982: 170; Riikonen 2005: 39). From the late 10th or 11th century onwards, ornaments constructed by opening up parts of longer spiral tubes and interlacing them with each other to form the base of the ornament were used to decorate female apron hems (Lehtosalo-Hilander 1982: 161–162; Riikonen 2005: 39–40). Variations on this type of technique were also used in round, star-like and cross-shaped ornaments connected to shawls (Tomanterä 1984: 37; 39–40).

Only a few studies have been done on clothing remains from male graves. According to Lehtosalo-Hilander (2000a: 206), the spiral ornaments from male graves at Eura Luistari were most abundant during the first half of the 10th century, and this fashion continued until the middle of the 11th century. A technical shift seemingly occurred in ornaments found in male graves as well, with straightened spiral tube parts later included in the middle of the ornament, like those found in the 11th-century Luistari grave 670 (Lehtosalo-Hilander 1982: 165; 2000a: 206 and plate 22). While such ornaments are most commonly interpreted as having originated from shawls, Lehtosalo-Hilander (1982: 165) points out that some of the ornaments might also have been placed on other garments, like tunics.

Since the earliest preserved copper alloy spiral finds from the Baltic countries (Rammo & Ratas 2019: 125 with references) precede

Finnish finds by several centuries, the craft of using spiral tubes as a textile decoration technique possibly came from the south (Lehtosalo-Hilander 1984: 60). By the 11th to 12th centuries, several technically different ways of decorating shawls were present in Finland and the Baltic countries. In South-West Finland, spiral ornaments were added directly to the warp ends of the fabric, and separate ornaments were sewn together with woollen yarn. In the finds from the Mikkeli area, in eastern Finland, plant-fibre yarn was used in the threading of spiral decorations, while in Ladoga Karelia the spirals were threaded using horsehair (Vahter 1928: 63; Lehtosalo-Hilander 1984: 61). In the eastern areas, however, spiral decorations were only used on aprons and perhaps veils, not shawl fabrics (Schwindt 1893: 118–119; 121). In the northern parts of Finland, a few spiral decorated tablet-woven bands have been found in the Valmarinniemi cemetery in Keminmaa (Puolakka 2023).

Parallel examples of spiral decorated shawls similar to those from South-West Finland have been found at the cemetery of Siksälä, in Estonia (Matsin 2010; Valk & Laul 2014: 90–91) and in Latvia (Žeiere 2005: 77–78; 2017: 119–123). Most shawls were woven in 2/2 twill with tubular selvedges and dyed dark blue, and many similar decorations can be found in both those finds and in the Finnish finds, like tablet-woven bands and threading spirals added directly onto warp yarns (Matsin 2010: 191; Rammo & Matsin 2014: 214; Rammo & Ratas 2019: 136–137). The Latvian shawl finds contain a wide variety of different decoration techniques, including copper alloy decorations woven directly onto the fabric, small yellow glass beads, tin-lead rosettes and colourful fringes and tassels, with the style of decoration varying in different areas and evolving over time (Žeiere 2017).

Shawl decorations in South-West Finland

Different garments found in Late Iron Age graves are recognised by the typical spiral decorations typologically connected to them, in addition to their placement in relation to the remains of the deceased. Archaeologist Anna-Liisa Hirviluoto has proposed a three-staged typology for spiral decorated shawls based on findings from the Ihala cemetery in Raisio (Hirviluoto 1973: 64–65).

- *Type 1*: Rectangular shawl is finished in a manner where the wool warp yarns of the fabric serve first as wefts of the tablet-woven finishing band, then continue to a spiral-decorated cross-work of braids and end up as wefts of another tablet-woven band, leaving the yarn ends as fringes. Separate ornaments have been applied to the fabric, and the longer edges of the fabric are decorated with separately made spiral bands (Fig. 1b).
- *Type 2*: Otherwise resembling type 1, except that the longer edges of the fabric are decorated with separately made, tablet-woven bands (Fig. 1a).
- *Type 3*: Simpler design, where copper alloy spiral decorations are used only as separately made ornaments appliqued to the fabric

Hirviluoto (1973: 66) dates type 1 and 2 shawls to the 11th and 12th centuries and the starting point for type 3 shawls broadly to the Viking Age. Later, the earliest spiral decorated shawl remains from male graves at Luistari site in Eura have been dated to the 10th century (Lehtosalo-Hilander 2000a: 196–197).

The more decorated the shawl, the easier it is to define the finds as a shawl. When only separate ornaments or small pieces of fabric are left, there is always the possibility that the ornaments had been sewn to some other kind of garment (Hirviluoto 1973: 65). This challenge concerns especially the type 3 shawls, with no metal bordering on the edges (Hirviluoto 1973: 66). Types 1 and 2 have only been found in graves gendered as female, while type 3 also covers spiral decoration finds from male graves. In the latter graves, brooch or dress pin finds have also been interpreted as proof of a shawl (Lehtosalo-Hilander 2000a: 205–207).

Recently published shawl finds from *Ravattulan Ristimäki* in Kaarina contain both shawls with spiral decorated cross-work in graves 18/2016 and 20/2016 as well as simpler ones in graves 37/2016, 38/2016 and 41/2016 (Riikonen 2023: 74–75). The latter finds fit the Hirviluoto type 3 shawl, as they have copper alloy spirals only as separate ornaments, but the remains also contain other details: the short edges of the rectangular fabric are hemmed, and a tubular tablet-woven band encircles the whole shawl. According to Jaana Riikonen (2023: 74), the fashion in spiral decorated shawls had possibly shifted from complicated finishes to less time-consuming and skill-demanding practices. In the Häme area, several examples of different shawl decoration traditions have been described by Leena Tomanterä (2003: 37–43). According to her, shawls in Häme were typically decorated by pressing separate copper alloy rings around the tablet-woven edge of a shawl, and separate spiral tube ornaments were placed on the edge so that there was no fabric under them. Tomanterä (2003: 37–38, 41–42) also points out the similarities between the spiral tube ornament finds from Vilunsenharju grave 2 in Tampere and Kirkkailanmäki grave 4 in Hollola and Estonian finds.

Handicraft techniques and ancient costume reconstructions

The first spiral decorated shawl to be reconstructed in Finland was made for the Ancient Perniö costume, based on finds from Perniö Yliskylä grave 6 (Lehtosalo-Hilander 2001: 35). The well-preserved find shows elaborate finishings: the short edges of the fabric are finished with a tablet-woven band, followed by spiral decoration cross-work using braided warp yarns, and again a tablet-woven band locking the cross-work in place, with the rest of the fabric's warp yarns left as fringes. Here, the warp yarns of the tablet-woven band are used in a rigid twofold corner ornament, linked to separately made spiral lace bands sewn onto the long selvedges of the fabric (Fig. 1b.). At Yliskylä grave 1, the pattern of ornaments on the cross-work is different, and the corner ornaments with the warp yarns of the tablet-woven band are just small circles with a cross in the middle (Fig. 1a). Both shawls also have several separately made ornaments appliqued onto the fabric. From the more decorated shawls, it has been possible to obtain measurements of the fabric. At Yliskylä grave 1, the shawl measurements were 150 x 90 cm, while at Yliskylä grave 6 they were 147 x 94 cm (Appelgren-Kivalo 1907: 29, 44).

Several examples of the Ancient Perniö costume were produced for festive costumes (Lehtosalo-Hilander 2001: 36). Without instructions or detailed knowledge of the original techniques, we can only speculate that complicated details of the costume, like the shawl endings, were probably done by copying the techniques according to each person's handicraft knowledge and sharing tips and patterns with others, in the same tradition as many early national costumes were produced (Valkeapää 2023: 84–90). The Ancient Perniö costume has also been

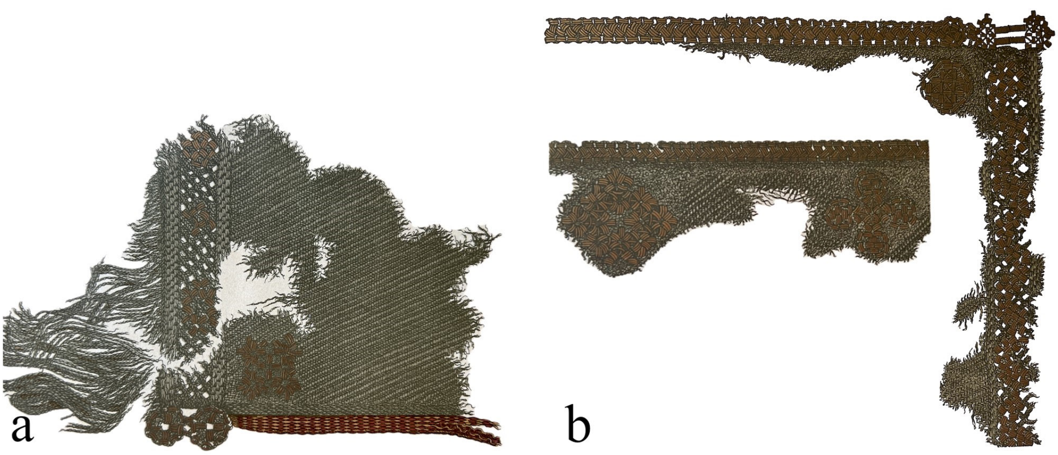

Figure 1. Shawl remains in Perniö Yliskylä a) grave 1 and b) grave 6. Not in scale. Drawings: Jenny Nummelin (Appelgren-Kivalo 1907: Taf. XII:1 and VI:2).

produced at the Helmi Vuorelma workshop, in addition to national costumes. The first set of instructions for making modern reconstructions of the cross-work decoration were included in the description of the Ancient Masku costume, a reconstruction based on the Masku Humikkala grave 32 finds (Tomanterä 1984). The brief set of instructions note that the cross-work part of the decoration should be done as finger-loop braiding with three loops (*kolmipohjukkainen iskunauha* in Finnish). Instructions for making the Ancient Perniö costume were finally published in the year 2000, again suggesting finger-loop braiding for the cross-work decorations (Lehtinen et al. 2000: 20).

Most Finnish ancient costume reconstruction projects have been done for the purpose of wearing the costume on festive occasions. Therefore, their basis has not been so much experimental archaeology or discussing original contexts but creating practical solutions to produce impressive costumes for contemporary use. This practice has developed into a craft tradition in its own right, offering solutions for how to produce details typical of Iron Age weaving, like tubular selvedges, when using modern vertical looms (Pasanen & Sahramaa 2021: 209–219). The same adapted techniques have usually been followed when producing textile reconstructions for museum exhibitions.

Table 1. Sites and graves

Shawl burial	Cemetery data	Excavated	Spiral ornaments	Brooches	Other jewellery	Other findings	Human remains
Lieto Ristinpelto							
Grave 86: H50109:8 Female C14 13th c. (Sahramaa et al. 2024: 40)	12th-13th centuries c. 150 burials, 2 with shawl finds	1905, 1949–1950 Cleve 1952; 1974	12 separate ornaments from shawl	-	Round silver sheet pendant	Apron, spiral decorated headband, several other bands, other textiles, fur	Parts of skeleton
Masku Humikkala							
Grave 31 KM 8656:H31:1-26 Female Typologically 12th–13th c.	11th-13th centuries, 56 burials, 15 with shawl finds	1925 Pälsi 1925; 1928	:2, 6, 13, 14, 17, 19, 21, 22 and 24–26 16 separate ornaments, :8, 17, 22 and 24 pieces of cross-work ending	:7 silver penannular brooch 3.0 cm (no textile), :9–10 copper alloy penannular brooches 3.9 cm (peplos)	Two silver rings, glass beads and possibly imitated coin (late 10th c. dirhem, Talvio 2002: 20, 171) from necklace	Apron, headdress, peplos dress, bands, bronze plate knife sheath	Parts of skull
Hollola Kirkkailanmäki							
Grave 4/1978 KM 20450:10–37 Mature female (Salo 2011: 7), c. 165 cm tall C14 13th c. (Moilanen 2021: 136)	11th-14th centuries, c. 140 graves	1935-6, 1978–9, 1987 Hirviluoto 1979	:12, 16, 19, 26 and 31 5 separate ornaments possibly from shawl	:27 and :28 two convex oval brooches (peplos)	Chain arrangements, earspoon, two bracelets, two glass beads	Spiral ornaments possibly from apron, textiles, knife and bronze sheath	Parts of skeleton

Turku Kirkkomäki								
Grave 11 (D/1984) KM 22631:53-136 Male Based on coins 12th c.	11th–12th centuries, 43 burials, 15 with shawl finds	1950, 1962, 1983–84, 1991–92 Katiskoski 1984; Asplund & Riikonen 2007	:62–65, :69–74 nine separate ornaments	:56 silver penannular brooch (no textile), 3.9 cm	Gold foil bead	Belt, two silver coins (11th–12th c. German), textiles, fur, spearhead, unidentified iron pieces	
Grave 16 KM 27025:16001-16090 Male Typologically 12th c.			:16048, 16054, 16056-58, 16060, 16066-67, 16071-73, 16083-84, 16089-90, 16093 17 separate ornaments	:16045 silver penannular brooch 4.3 cm, :16051-3 copper alloy penannular brooches 3.8 cm, 3.3 cm and 3.1 cm	Silver ring, gold boil bead	Belt, two silver coins (11th–12th c. German), textiles, fur, spearhead, unidentified iron pieces	Teeth
Grave 35: KM 27196:35001-35079 Child 0.5-3 years old Typologically 12th c.			:35032-34, 35042 and 35060-61 11 separate ornaments, :35002-3, 35035 and 35037-39 pieces of cross-work ending	:35005: silver alloy penannular brooch, 3.8 cm :35029 copper alloy penannular brooch, 2.1 cm	Glass beads and silver coin (Byzantium AD 977–989) from necklace, two sleigh bells	Ceramic pots, iron knife, linden mat, birch bark box	Three teeth
Salo Rikala								
Grave 24/Z: KM 12690:356-362 Male Typologically 11th–12th	11th–12th centuries, 40 burials, 16 with shawl finds	1950–53, 1976–78 Leppäaho 1955	:357-359 three separate ornaments	-	-	Iron knife, bronze fittings possibly from belt	

MATERIALS AND METHODS

Materials for this study were selected from Late Iron Age inhumation cemeteries in Southern Finland, including three female graves, three male graves and one child's grave, with spiral ornaments interpreted as shawl decorations. All the graves contained preserved textile fragments and had not been subject to prior detailed analysis. Besides studying objects found in the graves, grave maps and excavation reports were used to understand the structure of the grave and the placement of the different finds. All materials used in this study are part of the Finnish Heritage Agency collections.

Besides spiral decorations, four of the seven graves studied here contained penannular

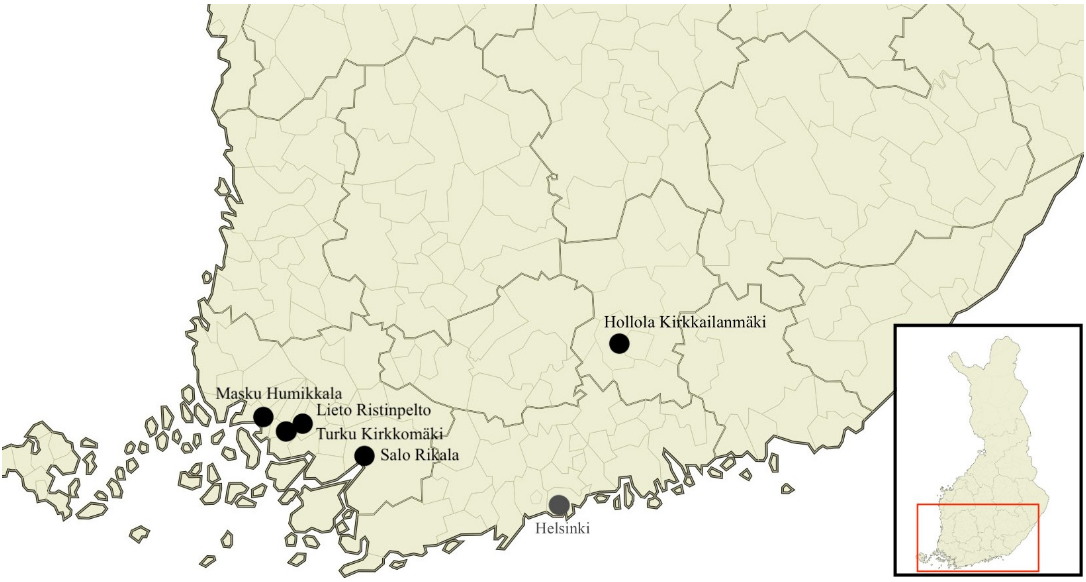

Figure 2. Map of sites. Image: Jenni Sahramaa

brooches, while *Hollola Kirkkailanmäki* grave 4 contained oval convex brooches (KM 20450:27 and 28). Two copper-alloy penannular brooches (KM 8656:H31:9 and :10) placed on the shoulders of the deceased found in Masku Humikkala grave 31 and the Kirkkailanmäki grave 4 brooches can be connected to typical female peplos-type dress. Third, the silver brooch (KM 8656: grave 31:7) found in Humikkala grave 31 contained no textile remains, but it could have been used to attach the shawl from the middle of the breast. Turku Kirkkomäki child grave 35 contained one silver (KM 27196:35005) and one small copper alloy penannular brooch (KM 27196:35029), both placed in the neck area but containing no textile remains. In Turku Kirkkomäki male grave 11, a silver penannular brooch with no textile remains was found at the probable place of the head in the grave. Turku Kirkkomäki grave 16 contained four penannular brooches, with the three copper alloy brooches (KM 27025:16051-16053) having been found at the place of the chest and the silver brooch (KM 27025:16045) found near the left hip of the deceased. All contained small textile remains. No brooches were found in *Lieto Ristinpelto* grave 86 or *Salo* (formerly *Halikko*) *Rikala* grave 24.

Hollola Kirkkailanmäki (also Kirkailanmäki and Kirkk'ailanmäki) grave 4, from Päijät-Häme, in Central Finland, is included since interpretation of the spiral tube decorations found there as shawl remains serve as an interesting point of comparison to the better-known South-West Finnish shawls. Moreover, the dress remains from this grave were selected as the basis for a costume reconstruction done for the Lahti Historical Museum. The sites (Fig. 2) and graves are summarised in Table 1.

All the finds from a single grave were first studied visually to recognise the various textiles and other organic remains of clothing. This effort included studying and documenting them with an iPhone 13 Pro 12MP camera system as well as a Leica S6D microscope with Las EZ 3.4.0 software. The findings were compared to excavation reports and grave maps, redrawn using colour codes for different materials and mapping the textile finds.

To characterise the textiles, standard textile analysis included the weave, thread count, twist of the yarn and finishing details (see Walton & Eastwood 1988). Small, 2–5 mm samples of the different yarns were collected together with a conservator and used for fibre and dye analyses. Fibres were scattered from a sample onto glass, mounted in Entellan New rapid™

Table 2. Properties of shawl textiles

Shawls	Textile	Thread count warp/ weft yarns/ cm	Colour	Bands	Shawl on grave
Lieto Ristinpelto 86	Sz/z twill	10/9–10	Visually blue, indigoids and unknown compounds	Starting border, separate tubular tablet woven band sewn to the edge	Covering the deceased
Masku Humikkala 31	Sz/z twill	10/8–9	Visually blue	Finishing border, separate tubular tablet woven band	Over shoulders
Hollola Kirkkailanmäki 4	Sz/z twill	8/8	Visually blue	-	Over shoulders
Turku Kirkkomäki 11	Twill?	-	Visually dark	-	Covering the deceased
Turku Kirkkomäki 16	Sz/z twill	9/9	Visually light, ornament sewing yarn visually blue	Separate tubular tablet-woven band	Wrapped around
Turku Kirkkomäki 35	Sz/z twill	10/8	Visually blue, indigoids and unknown compounds from ornament sewing yarn	Possible tablet woven band	Covering the deceased
Salo Rikala 24	Sz/z twill	9-10/8-9	Visually blue, ornament sewing yarn visually red	-	-

and covered with a cover glass to be studied with a Leica 2500 transmitted light microscope with a Leica MC190HD camera and measured with LAS V4.13.0 software.

Selected samples were analysed using high-performance liquid chromatography and a photo diode array detection system (HPLC-DAD). The method has been described and discussed at length by Vanden Berghe et al. (2009). The previously published results for Lieto Ristinpelto grave 86 and Turku (formerly Kaarina) Kirkkomäki grave 35 (Wright et al. 2023; 2024) are included in Table 2. As the analyses of other dye samples have not yet been completed, they are studied only visually here.

Spiral decoration patterns were drawn from the finds if they were still relatively intact, and excavation photos, microscopic images and in some cases also x-ray images were used to trace their original form. Different ways of sewing an ornament together were tested in practice, and the results were compared to microscope images of the original. This process followed the experimental study pattern described by Maikki Karisto for the study of tablet-woven bands (Karisto & Riikonen 2018: 6). Spirals were measured based on the photos taken with a Dino-Lite Edge Digital Microscope using DinoXscope 2.4 software for Macintosh. As the original spirals vary in terms of the width of both the wire and the diameter of the spiral tubes, average measures were used in the craft experiments and reconstructions.

RESULTS OF THE MATERIAL ANALYSIS

All the fabric remains interpreted here as shawl parts shared similar characteristics, regardless of whether they originated from female or, presumably, male graves. Fabrics were woven in

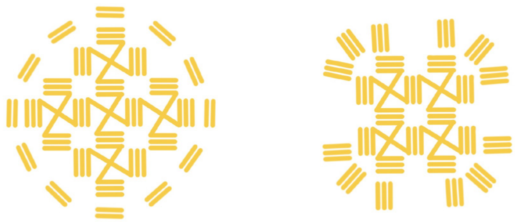

Figure 3. Schematic drawing of two spiral ornament patterns from the Lieto Ristinpelto grave 86 shawl. Image: Jenni Sahramaa

2/2 twill, typical of Finnish Late Iron Age textiles. All warp yarns were first spun with a z-twist, then two-plied in an S-direction for warp, while the weft yarns were of a single-ply z-twist. The most typical thread counts were 8–10 yarns/cm for both warp and weft. The varied construction of soft underwool and more coarse hairs can be observed in the fibre samples. Most samples included some visually blue fibres, while an indigotin-based dye source was confirmed for the Lieto Ristinpelto 86 shawl samples. Results of the textile studies are shown in Table 2.

Two basic techniques had been used for all the separate spiral ornaments analysed in this study, except for Hollola Kirkkailanmäki finds. The body of the ornament was made using long spiral tubes straightened in several parts and placed crosswise so that the straightened parts met (Figure 3). The outer edges were then often finished with a kind of chain made of 2–4 separate round spirals and yarn. The basic patterns consisted of square ornaments, roundels in several sizes, looped squares and different types of crosses (Figure 4). With the Masku Humikkala grave 31 shawl finishing, a technique typical of Late Iron Age spiral decorated shawls can be recognised (Figure 5). Turku Kirkkomäki child grave 35 yielded far fewer shawl remains, but they can be interpreted as evidence of the same pattern (Wright et al. 2024: 87).

RECONSTRUCTIONS

Reconstructions of spiral decorated shawls were used to experiment with different styles of wearing a shawl and dressing the body in the grave. The experiments were done during historical reenactment events as well as separate photoshoot events: four male, five female and one child reenactor (including the authors)

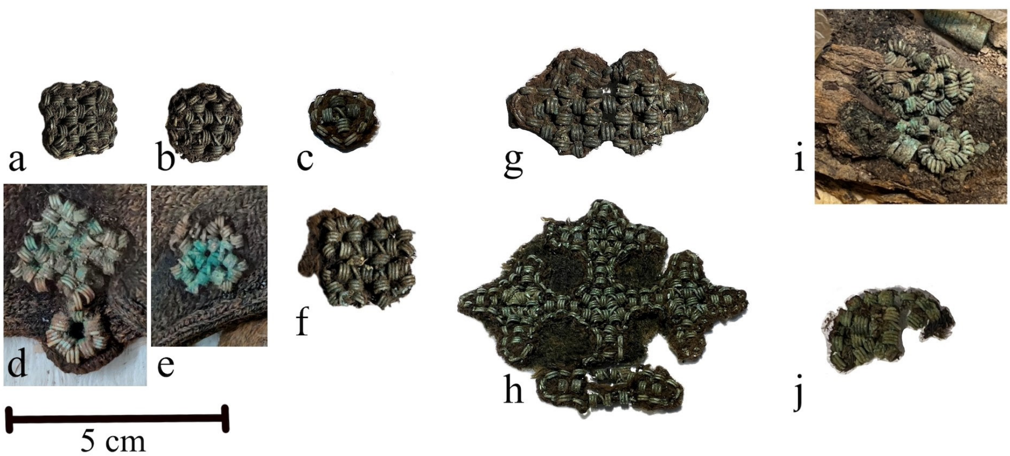

Figure 4. Separately made spiral ornaments a) square ornament and b) roundel from Masku Humikkala grave 31 (KM 8656:H31:25); c) small roundel from Turku Kirkkomäki grave 16 (KM 27025:16090); d) looped square with extra loop and e) looped square from Lieto Ristinpelto grave 86 (H50109:8); f) looped square from Masku Humikkala grave 31 (KM 8656:H31: 22); g) ornament from Turku Kirkkomäki grave 16 (KM 27025:16058); h) cruciform ornament from Salo Rikala grave 24 (KM 12690:357); i) looped square (KM 20450:26) and j) fan-like ornament (KM 20450:16) from Hollola Kirkkailanmäki. Photos: Jenni Sahramaa / Finnish Heritage Agency

took part to the try outs. For the shawls, data concerning reconstruction choices, sensorial properties and wearing practices was gathered in discussions with the participants.

Finds from Lieto Ristinpelto grave 86, Hollola Kirkkailanmäki grave 4 and Turku Kirkkomäki grave 35 were used for the complete shawl reconstructions done by Mervi Pasanen. Commercially available yarns were used, as it would have been far too time consuming to produce sufficient amounts of tight and even hand-spun yarn. All the yarns were wool, specifically spun by Pirtti Spinnery in Finland for weaving ancient costume fabrics.[1] The shawls were woven using modern horizontal looms, but with details typical of Late Iron Age textiles, like tubular selvedges and tablet-woven finishing bands. The spiral decorations were made of commercially available bronze wires. The properties of the reconstructed shawls are summarised in Table 3.

Twelve spiral ornaments were found at different locations in grave 86 in Ristinpelto in Lieto. In the first version, ten of them were reconstructed for the shawl, and a round ornament was made for the right lower corner that matched the one found in the left lower corner. Two ornaments with loops found on the right side of the deceased were left out of the first version – they were possibly placed in the lower long edge of the original shawl. The tablet-woven band finds from Lieto Ristinpelto grave 86 and efforts at reconstructing them have been discussed elsewhere (Sahramaa et al. 2023).

The fan-like spiral decorations found in Hollola Kirkkailanmäki grave 4 (Fig. 4j) were interpreted as belonging to the corners of a shawl in the costume reconstruction made for the Lahti Historical Museum. Despite the fan-like spiral decorations serving as apron markers in South-West Finland, the construction of the Kirkkailanmäki ornaments differed from those finds, and their find places did not suggest that they had been part of an apron. The reconstructed fabric was woven as 2/2 Sz/z twill, similar to the other wool fabrics from the Kirkkailanmäki grave, although few textile remains were found in direct connection with the spiral decorations. The Estonian conservator Jaana Ratas, a specialist in copper alloy spiral reconstructions, made the spiral decorations threaded with horsehair, following their original craft technique.

For a child-sized shawl, a piece of fabric originally woven as part of a large adult apron was used. Since grave 35 in Kirkkomäki in Turku

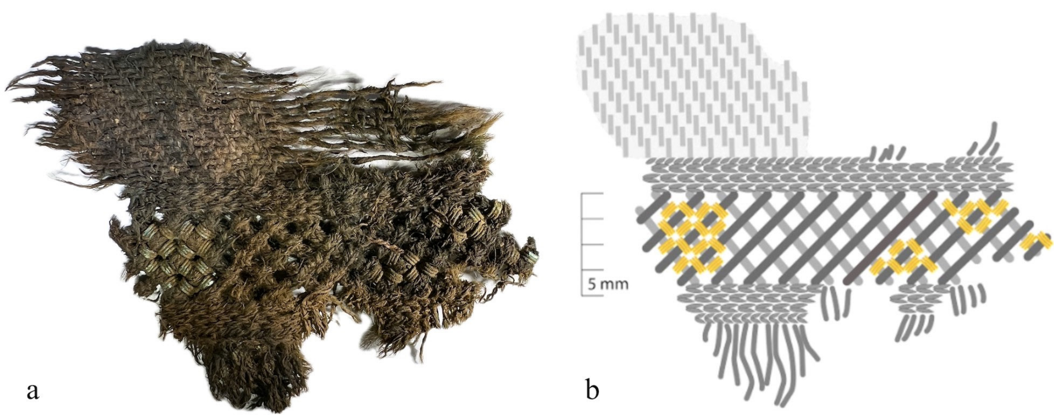

Figure 5. Masku Humikkala 31 shawl finishing: a) Photo: Jenni Sahramaa / Finnish Heritage Agency; b) Drawing: Maikki Karisto.

Table 3. Reconstructions and test shawls.

Shawl	Size	Textile properties	Yarn	Dyes and colour	Spirals	Bands
Lieto Ristinpelto 86	150x90 cm	2/2 twill, 9—10 yarns/cm	Pirtti Sz tex 70x2 for warp, z 140x1 for weft	Woad pigment with natrium dithionite vat, medium blue colour	11 ornaments, 0.7 and 0.8 mm wire, inner diameter 2.5 and 3 mm	Finishing bands, tubular tablet-vowen band
Hollola Kirkkailanmäki 4	155x90 cm	2/2 twill, 7 yarns/cm	Ravattula Sz tex 90x2 for warp, z tex 140x1 from Ålandsheep wool for weft	Indigo pigment with natrium dithionite vat, medium blue	4 corner ornaments, 2 appliqued ornaments	Finishing bands
Turku Kirkkomäki 11	200x130 cm	2/2 twill, 9 yarns/cm	Unknown yarn, Sz for warp and z for weft	Undyed white and grey	0.8 mm wire, inner diameter 2.5 mm	-
Turku Kirkkomäki 16	150x100 cm	2/2 twill, 10 yarns/cm	Ravattula Sz tex 90x2 for warp, z tex 140x1 from Ålandsheep wool for weft	Indigo pigment, dark blue	0.8 mm wire, inner diameter 2.5 mm	-
Turku Kirkkomäki 35 / child size shawl	Fabric 97x51 cm, with cross-work and fringes 131 cm	2/2 twill, 10 yarns/cm	Unknown yarn, Sz for warp and z for weft	Dark blue	12 separate ornaments, eight corner ornaments and cross work 0,5 mm wire, inner diameters 1.5 and 3.5 mm	Finishing bands, colourful tablet-woven band

contained few probable shawl remains (Wright et al. 2023: 87), the shawl details were mostly borrowed from adult-sized shawl finds from the Kirkkomäki cemetery, including the tablet-woven band pattern sewn onto the long edge of the fabric (Karisto & Pasanen 2021: 120–121). In the cross-work at the end, eight warp yarns were always braided together, following Maikki Karisto's interpretation of the Masku Humikkala 31 shawl ending (Pasanen & Sahramaa 2021: 246). This braiding technique had proven both simpler and faster than finger-loop braiding in earlier shawl reconstruction projects, and it produced results similar to the technique observed in the Humikkala 31 find.

Complete reconstructions of shawls from presumably male graves have not yet been possible since the dye analyses are not finished. To experiment with the placements of the shawls and spiral ornaments from Turku Kirkkomäki graves 11 and 16, test fabrics were used. Determining the size of the shawls posed a challenge, as the shawls in male graves are not bordered with spirals. One test shawl was woven using the same warp as some Ravattula Ristimäki shawl reconstructions (Honka-Hallila et al. 2023a:

163), while the same yarns and dimensions were used that are typical of better-preserved female shawls. One test shawl with considerably larger dimensions was made of handwoven wool twill purchased from Tingvatten Museum in Norway. The dimensions of this shawl were chosen based on interpretations that Scandinavian shawls had been quite large during earlier Iron Age periods (Mannering 2017: 156–157).

DISCUSSION

Typology and dimensions

The studied shawls represent two of the typological groups of Hirviluoto. Female grave 31 in Humikkala in Masku and child grave 35 in Kirkkomäki in Turku had type 2 shawls with cross-work decorations at the short edges. Lieto Ristinpelto grave 86 and all the shawl finds from male-gendered graves (Kirkkomäki graves 11 and 16, Rikala grave 24) can be classified as Hirviluoto type 3, only with separately appliqued spiral ornaments. The spiral ornaments found in Hollola Kirkkailanmäki grave 4 differ both from the South-West Finnish spiral tradition and the finds from the Häme area defined as shawls by Tomanterä (2003). Additionally, it is not possible to confirm that the spirals originate from a shawl. However, comparing their find positions to the way in which a shawl could be placed on the shoulders of a person laying on their back confirmed that the ornaments could have been placed at the corners of a shawl.

The grave map for the Masku Humikkala 31 burial suggests that the individual was approximately 160 cm tall. The cross-work finishings were found approximately 60 cm from the head of the person. Assuming that the deceased person was laying on their back, a shawl length of 160 cm would fit this description. The well-preserved shawl remains from Perniö Yliskylä graves 1 and 6 measured 150 x 90 cm and 147 x 94 cm, respectively, while the Masku Humikkala grave 32 shawl measured 160 x 100 cm without fringes (Tomanterä 1984: 32). The length of the fabric found at Salo Rikala grave 11 was 154 cm (Hirviluoto 1985: 13), while the length of the fabric for the two shawls found in Kirkkomäki grave 27 was 160 cm without fringes (Kirjavainen & Riikonen 2007: 136). For the shawl reconstructions used in the dressing experiments of this study, the dimensions of the adult shawls were in the same range, except for the Kirkkomäki 11 test shawl, which was considerably larger (Table 3). Thus, it was possible to test both the dimensions known from female shawls and the assumption that male shawls could have been larger based on the placement of spiral ornaments found in male graves.

Fabric's appearance

The fabric's appearance depends on five aspects: yarn, binding, thread count, weaving and finishing (Hammarlund 2005: 106). All the textiles interpreted here as shawls shared the same basic characteristics (Table 2). The yarns were made of wool, spun as single-ply in the z-direction for weft, and Sz-plied for warp. The thread counts for all the studied fabrics varied from 8 to 10 yarns/cm in both the warp and weft. In most cases, only very small and decayed pieces of fabric were preserved in connection with the spiral ornaments, and it was not possible to do a thread count in more than one place. Most probably, the original shawls were woven using warp-weighted looms with no reed, which means that the thread count could also have varied within the same textile (Lehtosalo-Hilander 1984: 8; Nørgaard 2011: 28). Nonetheless, this thread count is typical of textile finds from South-West Finland (Lehtosalo-Hilander 1984: 8), although, for example, some Masku Humikkala shawls had more threads per warp (Tomanterä 1982). When it was possible to study larger pieces of textile, they gave a visually balanced impression.

Besides the thread count, the thickness of the yarn also affects the fineness and appearance of the fabric (Hammarlund 2005: 115; Nørgaard 2011: 22). The act of measuring single sample yarns unfortunately yielded several sources of inaccuracy, as the archaeological yarns had often dried out and become flattened. Moreover, to avoid destroying fragile textile structures, sampling was performed in places where the textiles had already been damaged. Therefore, ensuring the visual similarities of the thread count and that the appearance of the reconstructions matched the originals took priority over measuring the yarn thicknesses.

The reconstructed shawl fabrics were woven with similar thread counts as the originals but using modern horizontal treadle looms. The visual impression given by the original and the reconstructed fabrics, when comparable, was reasonably similar. In this study, it was not possible to reliably differentiate between intentional finishing practices, such as fulling (Hammarlund 2005: 107), and use-wear and damage that had occurred during the time the textiles had spent underground, although some fabrics, like the one found behind the cruciform ornament in grave 24 in Rikala in Salo KM12690: 357 (Fig. 4h), showed slight signs of felting. Since most textiles did not appear to be teaseled or fulled, reconstructed shawl fabrics were finished only by wetting and stretching them to dry (Pasanen & Sahramaa 2021: 216).

Yarns and wool: Feel of the fabrics

Hand spinning, including the wool preparations, has proven to be the most time-consuming part of fabric production (Vedeler & Hammarlund 2017: 30). Late Iron Age yarns were spun with a hard twist to survive the weaving process (Lehtosalo-Hilander 1984: 48; Andersson Strand & Demant 2023: 11). In most reconstruction projects, however, it has been difficult to find the resources to hire a spinner experienced and skilled enough to produce sufficient amounts of quality yarn (Lehtosalo-Hilander 2001: 6; Vedeler & Hammarlund 2017: 27). Therefore, machine-spun yarn has been used as a compromise; when ordered from smaller wool mills, it has been possible to give the yarns more twist than is generally used in modern yarns (Vedeler & Hammarlund 2017: 27; Kaljus 2019: 152–153; Honka-Hallila et al. 2023b: 95–96). Nevertheless, the yarns bought from Pirtti Spinnery for ancient costume reconstructions still have less twist than the originals.

Moreover, the choice of suitable wool is paramount when imitating the qualities of Late Iron Age yarn (Honka-Hallila et al. 2023b: 93). In previous studies, the closest parallels to the quality of Finnish Iron Age wool have come from Åland sheep (Kirjavainen 2023: 87), or possibly from the very small population of Jaalasheep (Vajanto 2013: 82). Åland sheep, one of three native Finnish breeds of sheep, have double-coated fleece consisting of long, coarser outer hair and shorter, soft underwool. Several primitive traits have survived in the breed, like its small size, multicoloured wool and even eves having horns. In contrast, Finnsheep have been bred so that their wool is soft, short, crimp and most often white in colour (Vajanto 2013: 82).

The type of wool used, and the twist of the yarn, are important factors contributing to the feel of the fabric and its behaviour when worn, like how the shawl falls from the shoulders or wraps around the body during use. The feel, in modern fabrics the *handle*, is especially difficult to study since any evaluations of the feel are quite subjective. All the yarns used for the reconstructions in this study were machine spun and mostly made of soft wool. Only the single-ply Ravattula yarns used as weft in the Turku Kirkkomäki 16 and Hollola Kirkkailanmäki 4 shawls were spun from Åland sheep wool (Honka-Hallila et al. 2023b: 96). The wool used in other yarns is, according to the Pirtti Spinnery, of Finnish origin, and it might have originated from several different modern sheep breeds besides Finnsheep.

When comparing the different reconstructions during the test wearings, the Lieto Ristinpelto 86 shawl reconstruction, woven completely from Pirtti yarn, feels softer against the skin than the reconstructions that contain Åland sheep wool, even though it has only been used in the weft. Generally, Åland sheep yarn usually feels coarse to modern hands, and the fabric woven from it is thought to be itchy. Tolerance for the feel of coarse fabrics against the skin was supposedly greater in earlier cultures (Harris 2019: 224), and great differences in subjective preferences, habits and experiences are normal also among modern people. Longer fibres and more twist also affect the durability of the fabric, as softer fabrics wear out more easily.

Shades of blue

In general, research on spiral decorated shawls in Finland, Estonia and Latvia has revealed a preference for dark blue fabrics (Lehtosalo-Hilander 1984: 7; Kirjavainen & Riikonen 2007: 135–136;

Matsin 2010; Valk & Laul 2014: 90-91; Vajanto 2016: 57; Žeiere 2017: 119–120, 123). Textile colours, or rather the dyes used, can also be studied through optical microscopy and chemical and spectroscopic dye analyses. Unfortunately, the presence of colourants in visually blue fabrics or fibres could only be confirmed in the Lieto Ristinpelto grave 86 samples, as other dye analyses have not been completed yet (Table 2; Wright et al. 2023).

Specific dye plants can be recognised in the various combinations of chemical dye components, but usually this type of analysis does not extend to dye practices, nor does it confirm the original hue of the colour (Harris 2019: 219). The most common chemical compound found in Late Iron Age textiles in Northern Europe is indigotin, often together with isatin and indirubin. All of them are present both in different indigo plants (*Indigofera sp*.) and in woad (*Isatis tinctoria*), but, since the cultivation and use of woad is well documented in Europe since ancient times and the arrival of tropical indigo via trade thoroughly changed dyeing techniques and economics in the Modern Era (Cardon 2007: 364–365, 374–377), the use of woad is commonly presumed for prehistoric textile finds in Europe. Traded woad balls were supposedly used in Late Iron Age Finland (Peets 1998: 294–297; Vajanto 2016: 57–59; Rammo et al. 2023: 156).

In the Finnish practice of making ancient costume reconstructions, natural blue dyeing has most typically been done with indigo pigment using a natrium dithionite vat (Lehtosalo-Hilander 1984: 52; Honka-Hallila et al. 2023b: 97). This method easily and reliably produces very dark colours at first, with the results lightening in shade at every dipping as the amount of dye becomes reduced in the vat. In contrast, experimental studies of ancient dye practices with different woad vat methods have resulted in a wide range of blue shades as well as some green and pink colours (Hannusas & Raitio 1997; Hartl et al. 2015). This finding is in line with the present authors' experiences with blue dyeing, where neither fresh woad leaves nor commercial woad pigment have resulted in very dark shades, but rather in medium to light blue shades (see Pasanen & Sahramaa 2021: 202–205). Naturally, this result might be due to the lack of knowledge and experience of modern dyers, and experts have suggested combining several colouring agents or using darker grey, brown or even black wool as a base to achieve darker results (Rammo & Matsin 2014: 338; Rammo et al. 2023: 153). Nevertheless, as previous research on different woad vats has shown, it might be misleading to assume that the results of modern indigo dyeing methods are representative of the colours of original Late Iron Age textiles.

In this study, the naturally light grey yarns used for the Lieto Ristinpelto 86 shawl reconstruction were dyed with woad pigment and those for the Hollola Kirkkailanmäki 4 reconstruction with indigo pigment, both in a natrium dithionite vat. However, the resulting yarns, blue in colour, differ somewhat in hue (Fig. 6). Besides the yarn, pigment and type of vat used, experienced dyers can also make deliberate choices concerning the amount of pigment and number of dips into the vat when aiming for different results. Obtaining a comparable experience when dyeing with woad balls and more primitive types of vats, like the urine vat (Hannusas & Raitio 1997; Cardon 2007: 345–346, 349–351; Vajanto 2010), would require a significant amount of practice.

Spiral decorations

Significantly more spiral ornaments have been recorded from female graves than male graves. For example, at Masku Humikkala and Raisio Ihala sites, only female graves contained spiral decorations from shawls (Lehtinen 1983: 76; Hirviluoto 1973). At Salo Rikala, however, seven male graves contained 1–3 spiral ornaments each, although a later lost fourth ornament is also marked on the original map for grave 24 (Leppäaho 1955: Map 47). Turku Kirkkomäki differs from the other sites in that five male graves with spiral ornaments were recorded (Asplund & Riikonen 2007: 21), while both graves 11 and 16 contained several separate ornaments. Most of the ornaments from South-West Finnish graves followed typical patterns of roundels, looped squares, stars and crosses (Fig. 4a-h).

The spiral ornaments found at Hollola Kirkkailanmäki 4 were constructed using different techniques, as they are threaded with horsehair and not connected to the warp yarns of the fabric or finishing bands. Even though a looped square ornament was also found at Kirkkailanmäki, it was

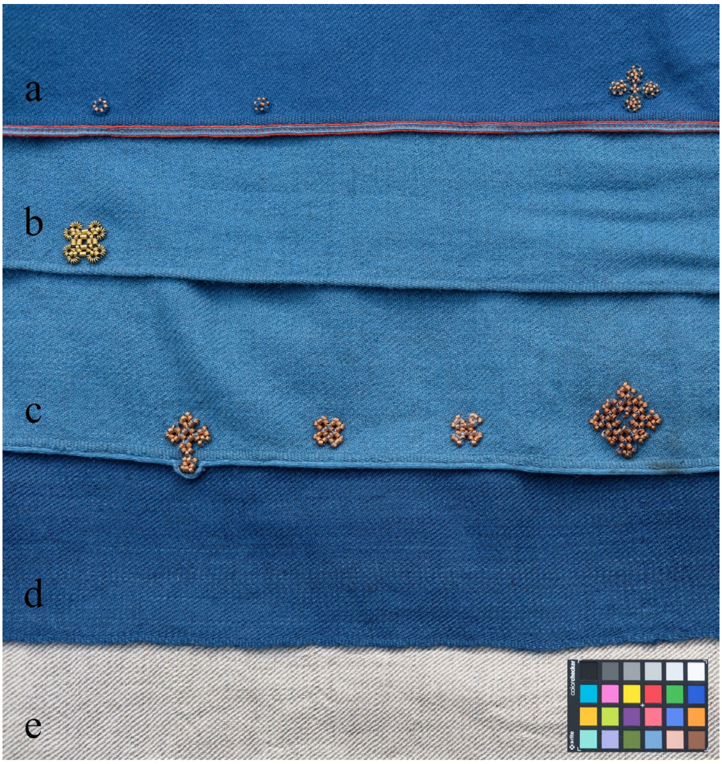

Figure 6. Different shades of blue in shawl reconstructions: a) child size shawl; b) the Hollola Kirkkailanmäki grave 4 shawl dyed with indigo pigment on light grey yarn; c) the Lieto Ristinpelto grave 86 shawl dyed with woad pigment on light grey yarn; d) test shawl woven of Ravattula dress shawl yarns, purchased as predyed with indigo; and e) natural white and gray test shawl. Photo: Riku Pasanen.

constructed without longer spiral tube crossings in the middle, but with longer tubes bent in the corners (KM 20450:26; Fig. 4i). Parallels to the Kirkkailanmäki looped square have been found in Saarenmaa, Estonia (Tomanterä 2003: 42; Mägi 2002: Plate 115 and 99). No direct parallels to the fan-like ornaments with 10–12 spiral beads (KM 20450:12, 16, 19, 31; Fig. 4j) have been found, but a broken ornament (KM 27196:35034) in Turku Kirkkomäki grave 35 had a similar fan-like shape, although it was sewn with wool yarn and not horsehair. In the dress reconstruction, the Kirkkailanmäki fan-like ornaments are placed at the shawl's corners based on the locations where they were found in the grave.

The typical pattern for female shawls is to place separate roundel or small, looped square ornaments next to the corners, a larger ornament in the middle of the upper long edge with possibly smaller ornaments on both sides of it, and a corresponding larger ornament on the lower long edge, again possibly with small ornaments on its sides (Appelgren-Kivalo 1907: taf. V and XI; Hirviluoto 1973: 61–63; Tomanterä 1984: 39–40; see also Riikonen 2023: 74–75). Small roundels might be placed along the edge as well. The Lieto Ristinpelto 86 shawl has a series of seven ornaments on the upper long edge in a symmetrical pattern, with the outermost looped ornaments (Fig. 4d) having been placed 63 cm apart from each other. Under the ornaments, separate loops were sewn onto the tablet-woven band bordering the shawl, most likely for attaching the shawl during use. Curiously, another pair of similar looped ornaments was found in the grave, suggesting other possible ways of wearing and attaching the shawl, which were not explored in this study. Another possibility is that there were two separate shawls in the grave, and the other pair of looped ornaments belonged to a second shawl.

The Masku Humikkala 31 and Turku Kirkkomäki 35 shawls contain both cross-work endings and separate ornaments. For the Humikkala 31 shawl, separate spiral patterns decorate the cross-work between two tablet-woven bands (Fig. 5), but only one possible corner ornament (KM 8656:H31:26), typically placed at the band ends, was found in the storage box where the finds are placed to resemble the grave setting. Regarding the child-sized shawl found at Kirkkomäki 35, several small flower-like roundels could be recognised as originating from the shawl endings, showing traces of having been made at the end of a band (Wright et al. 2024: 87).

Since the spiral ornaments found in male graves are scarce and the textiles connected to them mostly in bad condition, it is quite difficult to reliably assess their placement in a garment. Certain similarities with ornament patterns found in female graves suggest their default use as shawl ornaments, but not much can be said about the dimensions of the fabric. Moreover, the likelihood of spiral decorations having originally been placed on different garments, or their displacement in the grave, are also possibilities.

The spiral decorations are subject to visual change during their time in use. The spirals on the original shawls were made using different copper alloys containing copper, zinc, tin and lead, varying slightly in colour. Moreover, different parts of the wire-drawing process affect the colour of the metal, and even though spirals can be polished, the shine disappears through the oxidation process and decorations already sewn onto fabric cannot easily be repolished (Aspö 2022: 21–22). The original spiral ornaments found on the shawls would probably have undergone several stages of spiral colour change if they had been in use for longer time periods. The commercial wire used in most reconstructions is bronze, with the colour varying from reddish to silverish depending on the amount of tin mixed with copper. Other commercially available copper-alloy wires also have zinc, resulting in more yellow or even a slightly greenish shade of colour. All such ornaments also change to darker and duller shades of colour over time.

Sensory and experience-based process of producing a shawl

Re-examination of old finds has yielded new insights and challenged previous interpretations of the handicraft techniques used in making spiral decorated shawls. Conservator and weaving instructor Maikki Karisto analysed a well-preserved shawl ending from Masku Humikkala grave 31. Based on her vast experience in various braiding techniques and reconstruction experiments, Karisto determined that the cross-work on the shawl ending was not created using finger-loop braiding, as previously believed. Instead, she identified an 8-yarn braiding technique without loop ends as the method used (Pasanen & Sahramaa 2021: 246–247). This technique proved to be more efficient and logical for the cross-work braiding process compared to finger-loop braiding.

Visually, the end results of finger-loop braiding and 8-yarn braiding are nearly indistinguishable, with the primary difference being the process. Such discoveries, although easily overlooked, significantly impact our interpretation of ancient techniques. In experimental archaeology and reconstruction projects, both archaeologists examining the finds and craftsperson(s) doing the actual physical interpretation continually confront questions such as, ‘would they have done it this way?’ and ‘why would they choose this method?’ An impractical or difficult interpretation, such as the use of finger-loop braiding for cross-work end decorations added to a shawl, can lead to either scepticism about the interpretation or an underestimation of the intelligence and capabilities of ancient people.

Despite the 8-yarn braiding technique being simpler and faster, the creation of cross-work decorations still requires considerable time and effort. For instance, producing the tablet-woven finishing bands, braiding the warp yarns, composing the spiral ornaments in the cross-work and tablet-weaving decorative bands onto the long edges of a child-sized shawl (51 cm wide) took even an experienced artisan more than 50 hours. The production of an adult-sized shawl using Late Iron Age methods involves extensive labour: shearing or plucking wool, sorting and preparing it, spinning and plying it with a spindle, setting up a warp, weaving on a warp-weighted loom, acquiring and applying the dye, and finally, tablet-weaving, braiding and sewing (see, e.g. Matsin 2010; Nørgaard 2011; Vedeler & Hammarlund 2017; Pasanen & Sahramaa 2021: 36–41). Additionally, the production of spirals requires drawing copper alloy wire to the appropriate thickness, twisting it into spirals, cutting it to length, and arranging and threading in the ornaments (Leppäaho 1949: 54–66; Matsin 2010: 181; Rammo & Ratas 2019: 127–129). Even with commercially produced yarns and wires, the reconstructions effectively demonstrate the significant resources, time and skills needed to produce spiral decorated shawls.

Shawls in the grave

Most spiral decorated shawls found in South-West Finland were used as a cover or to wrap the deceased in the grave (Appelgren-Kivalo 1907: 29, 44–45; Hirviluoto 1973; Asplund & Riikonen 2007: 26). In this study, the shawls found at Lieto Ristinpelto 86 and possibly in Turku Kirkkomäki graves 11 and 35 were used to cover the deceased (Katiskoski 1992: 81; on descriptions and maps of Turku Kirkkomäki graves 16 and 35 pers. comm. Jaana Riikonen). The shawl found in Masku Humikkala grave 31 was dressed to the body as it might have been worn in life, and the same applies to the interpretation of spiral decorations found in Hollola Kirkkailanmäki grave 4 as corners of a shawl (Fig. 7). With respect to Turku Kirkkomäki grave 16, Jaana Riikonen (pers. comm.) suggests that the shawl was placed at the bottom of the coffin and the long sides wrapped to cover the deceased.

The case involving the shawl found in Salo Rikala grave 24 is more complicated, as there are no remains of the deceased left, and it is not possible to determine how items related to the

Figure 7. Hollola Kirkkailanmäki grave 4/1978 a) map of spiral decorations (KM 20450:12, 16, 19, 26 and 31) connected to the shawl (after Lehtosalo-Hilander 1980: 67); b) testing placement of spiral decorations in a grave setting; c–d) reconstructions of spiral ornaments made by Jaana Ratas. Images: Jenni Sahramaa and Riku Pasanen.

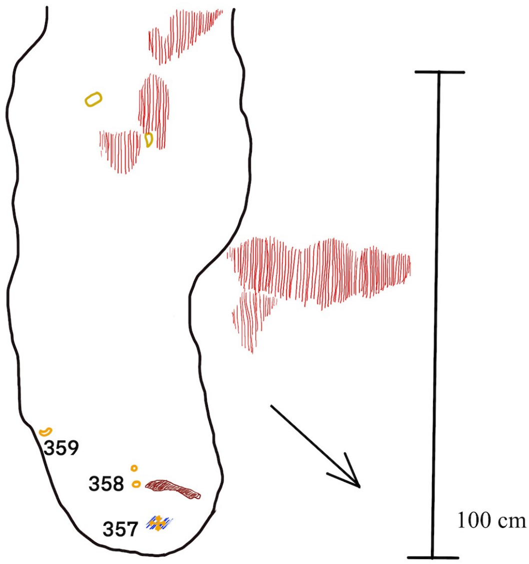

Figure 8. Map of spiral decorations (KM 12690:357–359) in Salo Rikala grave 24. Image: Jenni Sahramaa after Leppäaho 1955 Map 47.

clothing are placed in the grave in relation to the body. At the northeastern end of the grave, a larger cruciform ornament (KM 12690:357; Fig. 4h) and two smaller round ornaments (:358–359) were found together with an iron knife (Fig. 8). After an empty space of approximately 60 cm, copper alloy fittings with some leather remains, possibly from a belt or a sheath, were found; then, the shape of the burial pit was sharply cut, with a total length of approximately 115 cm. Curiously, several patches of red ochre were found at the bottom of the grave. (Leppäaho 1955: 30–31.) Another quite similar cruciform spiral tube decoration (KM 12549:9) was also found at Rikala, but unfortunately the position of this ornament in relation to the deceased could not be observed either (Leppäaho 1955: 5). Both ornaments were nonetheless assumed to have originated from shawl fabrics (Leppäaho 1955: 5; see also Hirviluoto 1992: 96, 102).

To trace the potential placement of spiral ornaments, practical tests with shawl reconstructions were conducted. For Lieto Ristinpelto grave 86 and Hollola Kirkkailanmäki grave 4, the hypotheses regarding the shawl placements and reconstruction dimensions proved plausible. For Turku Kirkkomäki grave 11, most of the small roundel ornaments were found together with the penannular brooch in the presumed place of the head, at the southwestern end of the grave (Fig. 9a). However, one ornament (KM 22631: 74) was found at the other end, approximately 210 cm away. Thus, tests were conducted in which most decorations were placed at one end of the 200 cm-long piece of fabric (Fig. 9b). The fabric was large enough to cover or wrap the test person in several ways.

For Turku Kirkkomäki grave 16, most ornaments were found in a face-down position in the place of the chest of the deceased, together with other objects and several layers of textiles (Fig. 10a–b). The ornament furthest away, the small roundel (KM 27025:16066), was found near the left knee, where a silver penannular brooch (KM 27025:16045) had also been placed. A test was done by placing a 150 x 100 cm shawl at the bottom of the coffin, right side up, and wrapping it around the body so that the short edges of the rectangular fabric ended on top of the chest (Fig. 10b). Even though the grave contained four penannular brooches, in this interpretation they were not used to attach the shawl fabric as it would have been worn in life, because the ornaments were found face down. In the tests, it was discovered that the length of the test shawl, based on the dimensions of female shawls, was

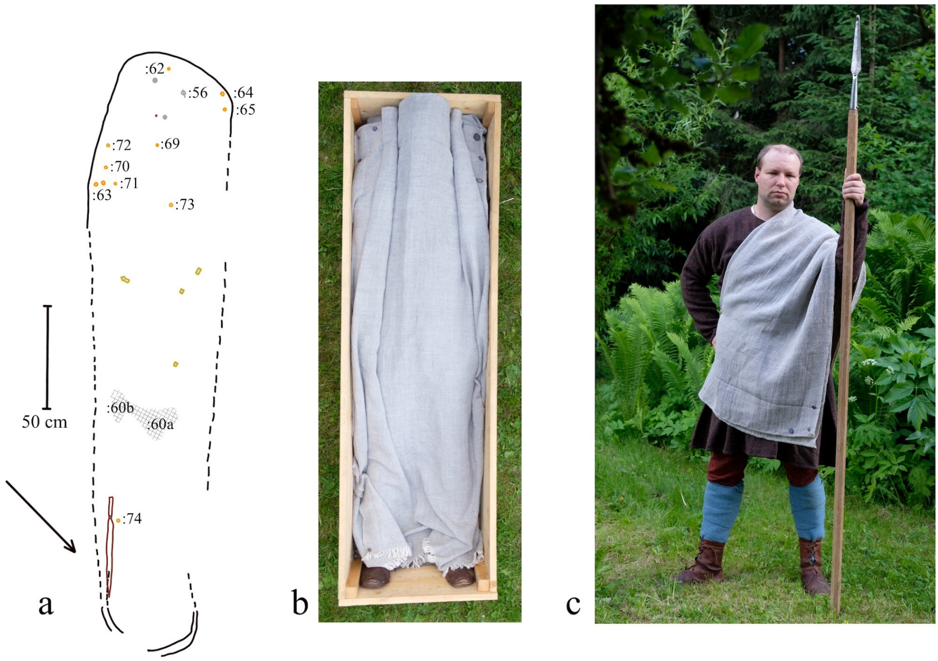

Figure 9. Turku Kirkkomäki grave 11 a) map of spiral decorations (KM 22631:62–65, 69–74; after Katiskoski 1984); b) covering a body with the test shawl; c) wearing the shawl with same placement of spiral decorations. Images: Jenni Sahramaa and Riku Pasanen.

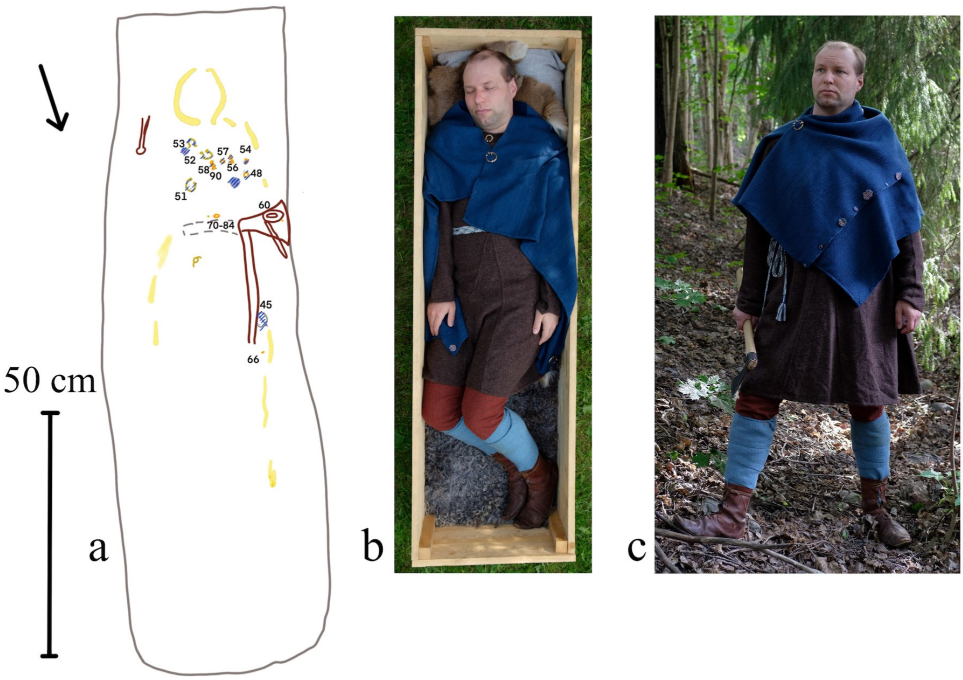

Figure 10. Turku Kirkkomäki grave 16 a) map of spiral decorations (KM 27025:16048, 16054, 16056-58, 16060, 16066-67, 16071-73, 16083-84, 16089-90, 16093; after excavation map provided by J. Riikonen); b) Test shawl placed on the bottom of the coffin and wrapped around the body; c) Wearing the shawl partly folded and placing the brooch on the shoulder. Images: Jenni Sahramaa and Riku Pasanen.

barely long enough to wrap around the test person's broader shoulders. Most probably the male shawls would have been larger than the ones found in female graves.

Shawls in use

In prior studies, models wearing ancient costume reconstructions are mostly displayed in very static postures (see, e.g. Lehtosalo-Hilander 1984: 42–43; Luoma 2003: 48–61). Shawl reconstructions are worn on the shoulders with no brooch to attach them or else carried on one arm with the brooch attached to the fabric. In several pictures, spiral decorated shawls from Perniö and Masku costumes have been dressed on the head (Lehtosalo-Hilander 1984: 63; Luoma 2003: 56). This choice of display is connected to the idea that spiral decorated shawls found in South-West Finnish graves from the 11th to 13th centuries might have their stylistic models in Eastern Orthodox depictions of Saint Mary (Lehtosalo-Hilander 1984: 63; Riikonen 2018). Models for decorating clothing with metal ornaments have also been sought from the east, suggesting that the fashion had Byzantine origins (Hirviluoto 1973: 67; Lehtosalo-Hilander 1984: 63).

In Orthodox icons, three golden stars are generally placed on Mary, one on the forehead and one on each shoulder, symbolising her virginity (Riikonen 2018: 56). The shawls found in Lieto Ristinpelto grave 86, Masku Humikkala grave 32 and Perniö Yliskylä graves 1 and 6 include a large ornament in the middle of the long edge, which would have been placed on the forehead. Both the Ristinpelto 86 and Yliskylä 6 shawls, however, contain several ornaments in a row, while the Humikkala 32 and Yliskylä 1 shawls seem to fit the pattern of three ornaments, resembling Mary's stars.

In practical experiments carried out wearing different spiral decorated shawl reconstructions over the head, the style proved possible but not very practical (Fig. 11a). Compared to the long mafori worn by Mary in Orthodox icons, the shawl reconstructions are rather wide and short and cannot be wrapped around the head and shoulders in the same way as a long scarf. Softer shawls, like the Ristinpelto 86 reconstruction, could have been wrapped around the head and shoulders quite easily, while stiffer fabrics fell

a b

Figure 11. Lieto Ristinpelto grave 86 shawl reconstruction a) worn on the head; b) worn on the shoulders attached with a cord. Photos: Riku Pasanen.

in a straighter manner. Placing the shawl fabric directly over one's hair creates a situation in which the shawl slips backwards off the head with the slightest movement. Wearing a scarf under the shawl helps somewhat, as wool or linen fabric is less slippery than hair. Even so, if spiral decorated shawls had been worn like this in life, the practice was probably restricted to special occasions, where a person would mostly have stood still.

In Masku Humikkala grave 31, a silver brooch suitable for attaching a shawl was found in the middle of the chest of the deceased, although unfortunately with no textile remains. A brooch in this position has commonly been found in Finnish graves, but in most cases with no direct connection to the shawl fabric, so it is unclear if the brooch had been used to attach the shawl to the person or placed on another fabric, as with the peplos dress (Tomanterä 1982: 162; Hirviluoto 1985: 11–12). Not attaching a shawl in one way or another to a person proved, however, quite impractical in the tests, as just placing a garment on one's shoulders again required that the wearer mostly stands still. The only brooch found in Ravattula Ristimäki grave 41/2016 has been deemed too small to support the reconstructed shawl, while the Ravattula shawl reconstruction is attached to the body with a wool braid (Riikonen 2023: 77). This same solution was tried with the Lieto Ristinpelto 86 shawl, which contained loops for attachment, but no brooch was found in the grave (Fig. 11b).

Most of the fabrics seem to have been quite thin, and we have noticed that in winter use, the shawl reconstructions do not provide much warmth against wind or cold. Also, the number of metal decorations and long fringes in the female shawls place them firmly in the category of festive or ritual clothing rather than outer garments preferred for use against the elements. The studied male shawls, while having far fewer spiral ornaments and no cross-work decorations at the ends, did not differ in terms of the textiles' visual characteristics or the densities of the fabrics used compared to female shawls. Their use might still have been different, though.

Based on the placement of brooches or pins and the placement of spiral ornaments in some 10th-century graves in Eura Luistari cemetery, Lehtosalo-Hilander (2000a: 206–207; 2000b: 248 and image 260; 2001: 81) suggests that the shawls were designed for use as large rectangular garments, attached from the right shoulder or more often under the armpit at the waist and carried partly folded. Sometimes, the brooch has been found on the left side of the body, possibly indicating a desire to leave the stronger left hand free for left-handed persons (Lehtosalo-Hilander 2000a: 206). Riikonen (2006: 380–381) has sought parallels in contemporary depictions of dress from Central Europe and stresses the importance of symbols of power in clothing. For example, a 10th-century Bavarian manuscript and the Bayeux tapestry show that it was seemingly a common practice to attach a shawl at a person's right shoulder (Riikonen 2006: 381; Bayeux Museum 2023).

Wearing test shawls attached to the right shoulder or at the waist has had interesting consequences for our understanding of the placement of spiral decorations. If the wearer wanted to display the decorations, they then would have needed to place them near the short edge of the garment and at the corners[2] (Fig. 9c and 10c). Questions of practicality were strongly emphasised in discussions during the tests, perhaps because the male test wearers were historical reenactors involved in martial arts. If the shawl was attached at the shoulder, then folding it either partly or totally in half was strongly preferred by the wearers to allow for undisturbed movement of the arms, at least from the elbow downwards. Folding the top part of the shawl while wearing the brooch on the shoulder also made it possible to use the folded part as a head cover. A third way of attaching a shawl onto the body was also proposed during the tests: wrapping the shawl, partly folded, around the body and under the armpit and then attaching the brooch to the shoulder. This use would have made the shawl similar to a peplos-type dress but attached only from one shoulder. Similar use has been proposed by Lehtosalo-Hilander (2001: 75) for the ancient costume shawl from Mikkeli.

Shawls, rituals and meanings

Changes in spiral decoration styles have been discussed from the viewpoints of fashion and pan-European trends of decorating coloured fabrics with metals, like gold and silver (Lehtosalo-Hilander 1984: 62–63). The combination of dark blue fabrics with shimmering metal decorations has been striking, but spiral ornaments may also have had magical and symbolic meanings both for the living and as a protection for the deceased on the journey to the afterlife. Jaana Riikonen (2005) has suggested that the spiral decorations on aprons carried meanings connected to fertility and protection. Common assumptions in the archaeological interpretation of burial rituals are that the treatment of the deceased and objects placed in the grave are the result of deliberate choice and reflect beliefs concerning the afterlife (Ekengren 2013; Koski & Moilanen 2020), and that the deceased were buried in their best clothing (Lehtosalo-Hilander 1984: 2; Riikonen 2005: 32).

Using spiral decorated shawls as burial covers might have carried strong meanings during the ritual preparations of the deceased for the grave. Shawls have covered other parts of the clothing as well, and, for example, in Turku Kirkkomäki graves 11 and 35 probably also the face of the deceased. The large cruciform spiral ornament found in Salo Rikala grave 24 (KM 12690:357, Fig. 4h) might have connected the deceased to the new faith, as Hirviluoto (1992: 102, 104) has proposed. Even though discussing the conversion to Christianity at length is beyond the scope of this article, it is worth noting that cruciform spiral ornaments are common finds from the 11th to the early 13th centuries, and they represent a craft technique produced locally.

CONCLUSIONS

Spiral decorated shawls have been expensive and special garments with strong connections to identity. Making them required resources, time and skill, which is especially true for the most elaborate examples of female shawls. The act of producing handwoven shawl reconstructions with different spiral decorations has yielded much contemporary practical craft knowledge about this clothing tradition and provided insights that may reflect the thoughts and experiences of the producers of the original shawls. Producing a reconstruction requires making several decisions and solving practical problems that the fragmentary textile finds do not answer in themselves. Thus, the reconstruction process helps us to understand the properties of the original garment, not just recording what is left.

Earlier research on spiral decorated shawls has concentrated on shawls found in female graves. The three studied male shawls from Turku Kirkkomäki and Salo Rikala as well as the child-sized shawl from Kirkkomäki examined here were produced within the same craft tradition as the female shawls found in the cemeteries. Similarities in spiral decoration techniques and fabric types confirm that spiral decorated shawls were part of the clothing of both genders in the Late Iron Age. Similarities in shawl finds from different cemeteries in South-West Finland have inspired researchers to think they were produced in close collaboration (Hirviluoto 1973: 66) or by specialised craftswomen (Lehtosalo-Hilander 1984: 24). In the future, a closer analysis of more extensive cemetery data might bring us closer to understanding such individuals and perhaps even the families that used the garments: for example, the richly equipped man and child from Kirkkomäki graves 16 and 35 were buried close to each other as well as to the woman in grave 27, who had two spiral decorated shawls buried with her (Asplund & Riikonen 2007: 20, 27).

Sensory archaeology of textiles is closely interwoven with the making of reconstructions and the understanding of textile crafts gained from experimental archaeology. In an ideal world, all archaeological reconstructions could be carried out in close collaboration with a research team consisting of the archaeologist(s) and handicraft specialist(s), with the possibility of checking interpretations and the results of preliminary experiments against details from the original find (Andersson Strand & Demant 2023: 6). Since such collaboration is rarely the case, the possibilities that the reconstructed object reflects the properties of the original depend on the available resources and all the choices made during the reconstruction process.

In this study, we experimented with the placement of spiral ornaments found in male graves in differently sized shawl fabrics. Testing the placements both in funeral setting reconstructions and with different ways of wearing the shawls in life strengthened the interpretation that male shawls were most probably larger in size than female shawls and carried in a different way. Such experiments are also highly valuable in evaluating evidence for future reconstruction work, and they will be continued before producing more exact reconstructions of spiral decorated shawls found in male graves. Moreover, the reconstructed garments should not only be used as visualisations of archaeological data, but also as a starting point for practical studies of their properties and use. Here, the observations are limited to the subjective perspectives of a few test wearers. Next, a more systematic approach to gathering data from user experiences should be developed, and a broader group of test subjects should be involved in the experiments to evaluate the perspectives discussed in this study.

To conclude, although no reconstruction is ever perfect, the value of a spiral decorated shawl reconstruction project lies in the fact that it can yield important new information about and new perspectives on the original finds. They are whole, tangible objects, and the process of both making and using such garments helps scholars formulate new research questions and connect the detailed handicraft information to larger questions when interpreting Late Iron Age culture. Spiral decorated shawls reflect both local craft culture and personal choices in the making of a garment as well new influences resulting from the large exchange network of raw materials and cultural contacts.

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NOTES

[1] Ravattula yarns are specifically ordered from Pirtti Spinnery by the company Elonvilla, which supplies yarns suitable for the Ravattula costume and other ancient costume projects (Honka-Hallila et al. 2023b: 96–97).

[2] Special thanks to Jouni Tossavainen for first pointing this out.

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Sanna Saunaluoma & Jere Leppänen

VISIBILITY ANALYSIS OF MEDIEVAL AND EARLY MODERN PERIOD FIRE BEACON SITES IN TURKU ARCHIPELAGO, SOUTHWESTERN FINLAND

Abstract

A defense and guarding system consisting of fire beacon networks was commonly used in Scandinavian coastal areas from the Late Iron Age until the Early Modern period. A chain-like system of signal fire stations was established in locations strategically important for defense and activated if the threat of an enemy attack concretized. Historical sources evidence that the same defense system was also utilized in the archipelago and coastline of southern Finland. Also, certain place names are considered to reflect ancient warning fire activities. Using GIS-based analyses, we examine whether these place names in the Turku archipelago can be distinguished from other locations based on their visibility and topography. In addition, we investigate how visible other potential signal fire stations and certain sailing routes are from the sites selected for the analysis, and the possibility of them having an interactive connection based on visual observation.

Keywords: fire beacons, GIS, visibility analysis, place names, Archipelago Sea

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INTRODUCTION

The iconic work "A Description of the Northern Peoples" of the Swedish scholar Olaus Magnus, printed in 1555, has an interesting woodcut in its section about Finland (Fig. 1). It depicts a key element related to the ancient coastal defense system: three high hills with warning fires flaming on their tops can be seen behind armed soldiers manned to repel the landing of an enemy ship approaching from the sea near the coastline. A chain-like system of warning fire stations was established at high points of the terrain in places strategically important for defense, especially along well-known sea routes. Presumably fire beacon sites should have had good visibility to the environment and stood clearly out in the landscape, so that either the fire or smoke signals sent from the other beacon stations of the warning fire network would have been able to be unmistakably noticed. Ancient defensive systems based on fire beacon signalling are widespread around the world (e.g., Hill & Sharp 1997; Baker & Brookes 2015; Iturrizaga 2019), and many authors attest the active use of early signal fire systems and beacon sites in Scandinavia (e.g., Gulowsen 1909; Engqvist 1968; Johnson 1979; Kjellson 1994; Westerdahl 1995). The woodcut in question supports the assumption that a defensive signal fire system based on visual observation actively operated also in the Finnish coastline during the Middle Ages.

However, fire beacon sites are a slightly problematic subject of research for archaeology. Investigating the phenomenon with archaeological methods and techniques is complicated because of the difficulty to detect and identify archaeological remains that would incontestably point to the maintaining of a signal fire station at a certain location in the remote past. For this reason, we examine potential historical fire beacon sites in the Turku archipelago making use of place names and historical sources.

For southwestern Finland the topic of locating historical fire beacon sites by place name has been discussed earlier (Voionmaa 1925; Havia 1981; Sjöstrand 1992), but in this article we also employ spatial and geographical information system (GIS) methods to study the visibility of potential fire beacon stations and observation posts in the archipelago and coastal landscape. GIS-based visibility modelling has been recognized to be a useful tool for investigating and understanding the function and meaning of sites and phenomena that are difficult to discern and measure using conventional archaeological field methods (e.g., Wheatley 1995; Seppälä 2003; Earley-Spadoni 2015; Kantner & Hobgood 2016; Link & Fassbinder 2021; Mauro & Durastante 2022).

We test if the sites selected solely based on place names stand out from the landscape in terms of their location and visibility, and the probability of these sites to have been part of a medieval and Early Modern period defence and warning system in the Turku archipelago. We hypothesize that the sites included in this system differ from other locations in the landscape in terms of their suitability for the observation of incoming enemy ships and the transmission of signals from one site to another. Although some of the Iron Age and medieval hill forts situated at the present mainland and coastline of southwestern Finland may have been part of this same defence and guarding arrangement, we limit our research area to cover only the Turku archipelago, which refers to the western part of the Archipelago Sea between the former municipality of Särkisalo in the southeast and Kustavi municipality in the north (Fig. 2.) Likewise, despite the fact that the coastal defence and signal fire system that was active during the Middle Ages in the Baltic Sea region is a continuation of a system used in the Viking Age (ca. 800 – 1050 CE) in connection with the Scandinavian military levy -organization (e.g., Orrman 1990; Larrea 2021), in this article we restrict the temporal examination of the phenomenon to a period from the Middle Ages to the Early Modern

Figure 1. A woodcut from the Historia de Gentibus Septentrionalibus, chapter X: De ignibus montanis tempore hostile (Olaus Magnus 1555).

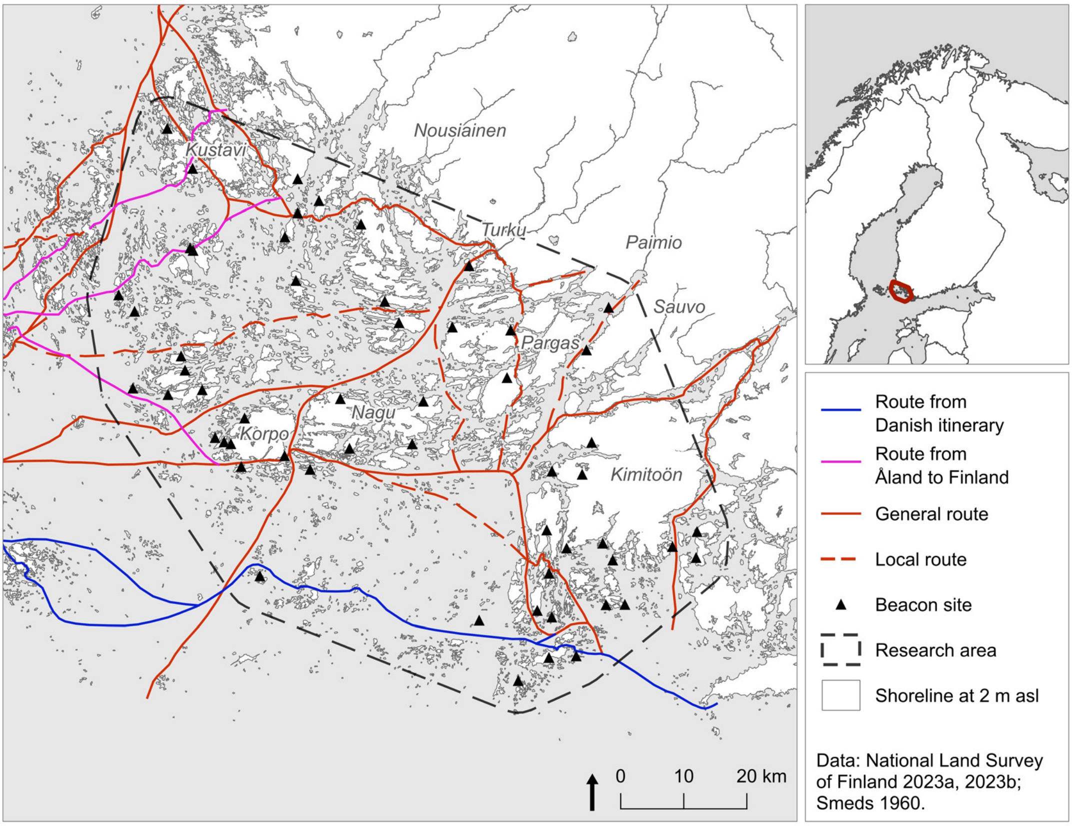

Figure 2. Study area with fire beacon sites selected for the study and the map of archipelago's medieval sailing routes as presented in the Atlas över Skärgårds-Finland (Smeds 1960).

Era since part of our place name dataset is in Swedish. The Swedish speaking population settled permanently in the Turku archipelago only around late 12th or early 13th century (Orrman 1990), hence the sites identified with Swedish place names cannot be undisputedly linked to prehistory.

SCANDINAVIAN ORGANIZATION FOR COASTAL DEFENSE

In the Baltic Sea region, the period from the Viking Age to the 13th century was marked by considerable instability and conflicts in political power relations, which evoked feelings of insecurity among population, especially in coastal areas, and created the need for a guarding system based on a warning fire signalling (Orrman 1990). The turbulent times also contributed to the introduction and operation of the *leiðangr*, the Scandinavian military levy -organization for defending and strengthening the political power of the rulers and securing the vital trading activities in the area. Participation in the *leiðangr* coastal fleet organization was compulsory for all free men. Its guarding and protection mission consisted of three main elements (Skoglund 2003), of which most important was the levy -system based on ships being mustered from various administrative districts in Scandinavian countries to protect coastal settlements from seaborne attacks. The second was the signalling network consisting of several beacon sites, and the third underwater fortifications positioned to prevent the movement of enemy ships in strategically important shipping lanes near the coast and their possible attempts to land. The coastal defence system of the Scandinavian military levy operated under kings' command and was active from the Viking Age until the Middle Ages (e.g., Larrea 2021).

Based on historical sources and references, Voionmaa (1912; 1925) is of the opinion that the *leiðangr* was operative also in southwestern Finland during the Middle Ages, at least in its Swedish-speaking coastal regions. Similarly, Jokipii (2002: 81) states that the *leiðangr* has been proven to have extended into Finland Proper, because the Black Book of the Turku Cathedral in 1380 mentions the Taivassalo fleet or boat company (*Theuesala snäkiolagh*) in the archipelago, and the 'boat company ting' held at Nummenkylä in the parish of Nousiainen in the mainland area inhabited by Finnish-speaking population.

From the beginning of the Middle Ages, when the three Nordic kingdoms were gradually forming within the politically, culturally, and economically hectic Baltic Sea region, detailed regulations on coastal guarding were recorded in Swedish Medieval provincial laws, and a zonal guard service system was stipulated.[1] The system was activated if the threat of enemy attacks in the area concretized. Of the different guard services, the village guard (*byvård*) was local, the coast guard (*strandvård*) was provincial, and the outer guard or signal fire guard (*bötesvård*) was a nationally organized task operating under the command of the king during the Middle Ages (e.g., Modeer 1937). The reactivated signal fire guard system on the Swedish east coast was used in defence against Russia as late as 1719 and 1721 (Dahlström 1944: 89). Since Finland was part of the Sweden at the time, the outer guard system could very well have extended at least to the archipelago and coastal area of southwestern Finland. In any case, according to historical sources (Nagu Sockens Beskrifning 1735: 24) warning fires were lit in Turku archipelago in Nagu parish in 1714, when the Russians had passed Hankoniemi while sailing west. In 1710, the residents of Sauvo parish were obliged to prepare warning fires at three new fire beacon sites to alarm people in case a Russian fleet approached Sauvo bay (Alifrosti 1990: 89). In Åland, signal fires are known to have been used for the last time in 1809 (Drejer 1947).

ANCIENT SAILING ROUTES IN THE TURKU ARCHIPELAGO

Due to the rocky shores and islets of the archipelago and coast of southwestern Finland, sailing and landing in the area is quite challenging. Therefore, marine traffic has always had to travel along certain routes known in advance. The sailing routes in the area probably date back to early prehistoric times, but it wasn't until the end of the Iron Age that the main routes in the Baltic Sea became commonly used as the intensity of trade grew and maritime technology and ships developed further. The so-called Danish itinerary of the 13th century describes, for the first time, an early medieval sailing route from Scania via the east coast of Sweden, the Åland Sea, and the southwestern coast of Finland to Estonia (e.g., Gallen 1993). The manuscript mentions several harbours and landing places along the route, of which Aspø (Aspö), Refholm (Revholm), Malmø (Malmö), Iurima (Jurmo), and Ørsund (Hitis) are in the Turku archipelago. Other important medieval, or even older, shipping lanes in the area include the route from the Åland Sea along the coast of Finland Proper to the Bothnian Sea, the Uusikaupunki route from Lemland in Åland via Enklinge to Kalanti area, and the route from Utö to Turku, which went via Korpoström between Korpo and the main island of Nagu, through Vandrocksund and Omenaistenaukko to Airisto and finally to the Aura River estuary (Fig. 2). In addition to these, there have always been several local sailing routes in Turku archipelago, mostly known and used by people who lived and fished there.

Supposedly, to navigate safely in the labyrinthine archipelago, enemy ships that tried to invade the area would have had to use the same generally known sea routes as the ships that moved peacefully in the area. Consequently, visibility to important sailing routes would have been one of the most important criteria for the placement of the fire beacon sites. Voionmaa (1925), Dreijer (1947), Niitemaa (1964), and Havia (1981) also believe that signal fire stations in the Archipelago Sea area were likely related to ancient sailing routes and natural harbours known to seafarers since primordial times.

Figure 3. View from Nagu Prostvik Kasberget (64 m asl) to the northwest in the direction of the Airisto shipping lane. A potential fire beacon site by the place name (Kasberget, 'beaconfire hill' in English). Photo: S. Saunaluoma 2023.

BEACON SITE AND SIGNAL FIRE CONSTRUCTION

Voiomaa (1925: 7) states that fire beacon sites in southwestern Finland typically locate on top of high hills, from which 'there are extraordinarily ample views toward open sea and the seaways' (Fig. 3). It would be assumed that in the past fire beacon sites had to be reasonably easily accessible, especially when it comes to transporting firewood. In addition to the actual beacon sites, the signal fire network may have also included observation points, from which activities and traffic at sea were merely detected and monitored.

According to the Scandinavian provincial laws, among free men of full age, those 'with good eyesight, good hearing and healthy legs, and who were fit for fight' were obliged to serve as signal fire guards (Skoglund 2003: 61). The law stipulated that warning fires had to be lit when a certain minimum number of approaching enemy ships was detected, so guards also had to be able to identify different types of ships and make the right decisions. Harsh punishments followed if the guard lit the warning fire on the wrong grounds or did not do it when necessary.

Nagu Sockens Beskrifning (1735: 23) mentions that the fire beacons of the Nagu area in the southwestern part of Turku archipelago were built of pine wood and tar casks in the shape of a teepee-like hut, while in Sweden, according to Modin's (1908) ethnographic example, fire beacons were built of tree trunks in a conical shape around a strong pine trunk or equivalent central post (Fig. 4). The walls of beacon construction could have been sealed with smaller branches and sometimes with moss or similar material to make them snow- and watertight. The wood had to be resinous, such as dry pine, so that it would burn intensely, and the flames would rise as high as possible. When a column of smoke was needed, the burning material could for example be moistened. The height of the fire

Figure 4. Reconstruction of a medieval fire beacon structure at Vårdberget, Fituna, Nynäshamn, southeastern Sweden. Photo: Karl Macklin 2017, CC BY-SA 4.0, via Wikimedia Commons.

beacon construction was usually approximately 10–12 meters and the diameter of its lower part was on average 5 meters. An empty space was left inside for kindling material, such as casks of tar. The beacon construction could even have had a small 'doorway' serving also as an overnight accommodation or weather protection for the guard.

PLACE NAMES

Place names are one of the key factors in locating historical fire beacon sites, since potential signal fire stations have today very little, or no physical remains of burned materials or structures left. Many place names still in use in the archipelago and in the coast of southern Finland are considered to be referring to historical guarding or fire signalling places. Such are place names that contain as one part the Swedish words *böte*, *böt* (Voionmaa 1925; Modeer 1937), *vård, var, vål, vakt* (Modin 1908; Modeer 1937), or *kas, kaas, kase, kasa* (Modin 1908; Voionmaa 1925). In the same category belong place names that are formed from the Finnish root word *vartia* (Voionmaa 1925), as in Vartiovuori and Vartsala. Some related words, *pyöt, pyyt,* and *kaasi,* seem to be Finnish versions of the originally Swedish expressions and presumably allude to old warning fire stations.

For this study, place names indicating fire beacon sites were collected from the National Land Survey of Finland's Geographic names dataset (2023a). About 30 000 placenames located in our study area were filtered with the above-mentioned root words associated with old fire signalling stations. This resulted in 446 place names, which were manually inspected and narrowed down to a sample of 56 placenames that could reliably be linked with fire beacon sites (see Supplementary material 1 online). Other place names possibly indicating defence activities, such as words alluding to castles (*linna, slot*), words ambiguous in terms of their meaning (*valkia*) and more general words related to fire (*bränd, kokko, kokon*) were omitted from the analysis, as these names may derive from sources other than signalling fire activity .

Nevertheless, it must be recognized that over the centuries, place names have changed, become distorted in their spelling, or completely fallen out of use, so the etymological information has at least partially been lost. For example, in the 18th-century map (Special Charta över Porkala fjärd 1751) from the Porkkala archipelago in southern Finland, a word '*wårdkase*' and a drawing of a high hill with a cone-like structure on the top is marked on a location in Kirkkonummi where, on the present-day National Land Survey's topographic map is a place called Järsö Kasberget, a potential fire beacon site. However, at two other *wårdkase* locations marked on the same historical map any nominative references to fire signalling no longer exist in the latest versions of topographic maps. Therefore, the dataset collected for this study must be considered a sample of possible fire beacon sites.

ANALYSIS OF TOPOGRAPHY AND VISIBILITY OF POTENTIAL FIRE BEACON SITES

Methods and datasets

The hypothesis of this study is that in selecting locations for fire beacon sites in the coastal defence system, the most important features were visibility to sea and visibility to other beacon sites, and as such the presumed beacon sites should be distinguishable from other locations based on these features. The sites' relationship to areas of settlement is another equally important aspect of the coastal defence system, but was omitted from this study, as our focus is on the attributes of individual beacon sites as well as the internal functionality of the beacon fire system.

To test our hypothesis, a two-part analysis was conducted. First, the characteristics of possible fire beacon sites identified via place names were evaluated through topographical, spatial, and visibility-based variables (Fig. 5). This analysis was executed with statistical tools in reference to several stratified sample datasets, as proposed by Fisher et al. (1997). The objective of this part was to examine whether the fire beacon sites are located on statistically distinct features in the landscape and optimally placed in terms of visibility to the sea and sailing routes. The second part of the analysis focuses on networks of intervisibility formed by the beacon sites. Comparison networks are created from other hilltops of the area to test whether the beacon sites form a more optimal network of visibility.

Datasets were prepared with QGIS v3.34.6 and the GDAL, GRASS and SAGA modules included therein. Operations related to visibility were performed with QGIS Visibility Analysis plugin (v1.9; Čučković 2021). Statistical analyses are performed using R Statistical Software (v4.4.0; R Core Team 2021) and packages rstatix (Kassambara 2020), FactoMineR (Husson et al. 2024) and factoextra (Kassambra & Mundt 2020), effsize (Torciano 2020) and vegan (Oksanen et al. 2024), with some visualizations with package ggplot 2 (Wickham et al. 2024).

Elevation maps

The basis of the topographical and visibility analysis was the National Land Survey's Elevation model 10 m dataset (2023b). This digital elevation map (DEM) was resampled to a spatial resolution of 25 metres, and all subsequent raster datasets derived from the DEM were in this resolution. To account for the change in sea level and shoreline displacement in the archipelago, sea level in the DEM was modified to 2 metres above sea level, which roughly corresponds to sea level in our study area in the 15th to 16th century (Vuorela et. al 2009: 89–95).

Digital elevation models typically represent the bare ground surface. The archipelago area was not, however, devoid of vegetation in the medieval and Early Modern periods, even though the scale of forest cover during that timeframe is not known. To explore the effects of forests on the visibility of the fire beacon sites, an additional elevation map with an estimation of average forest height was created.

A map of forest and non-forested areas was aggregated from 18th 19th century maps digitized in the Landscape history dataset by the

Provincial Museum of Southwestern Finland (2018). Fields, meadows, grasslands, and house plots included in the data were classified as non-forested areas and other features as forest. Areas of missing data were supplemented with CORINE Land Cover (CLC) data (SYKE 2018), where fields and other low-vegetation areas were classified as non-forested and the rest as forest. Forested areas were then divided into 5-metre-tall forests present at rocky areas and 15-metre-tall forests present elsewhere, based on the CLC dataset's level 4 classes. The tree height values for the two general types of forest were estimated based on a present-day dataset of average tree height (Luke 2021).

The vegetation map was then draped over the 25-metre elevation map by summing the two rasters together. During the analysis, forests from areas within 1000 metres of each beacon site were removed, with the assumption that any trees hindering visibility near fire beacon sites would have been cut down.

Relative elevation of beacon sites was approached with a topographical position index (TPI) calculated with the module of the same name in SAGA GIS. TPI is a measure of a point's height in relation to its neighbourhood and is

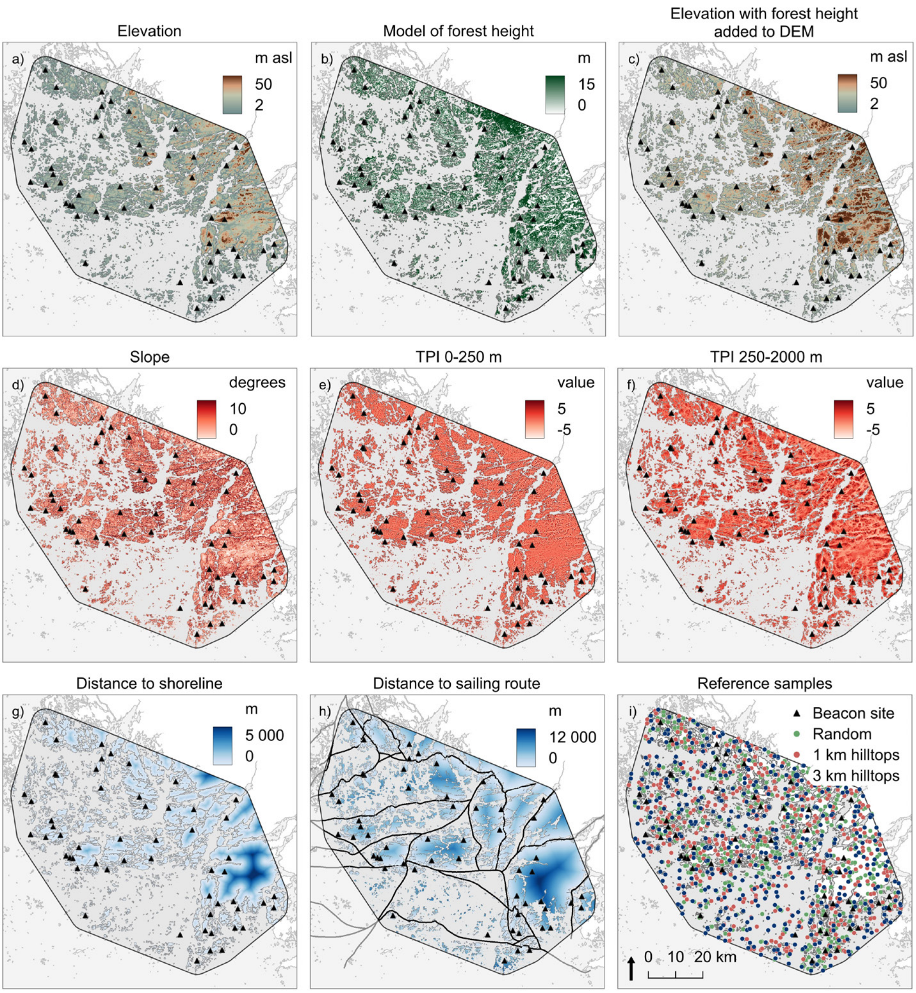

Figure 5.a-f) Elevation and d-e) distance-based variables analysed in the study, and i) reference samples used in the first part of the analysis. Model of forest height (b) is an intermediary dataset used to produce the forest-covered DEM.

widely used to describe and classify landscapes (Tagil & Jenness 2008; Mihu-Pintilie & Nicu 2019; Nicu et al. 2019). TPI is reliant on the size of the neighbourhood to which the height of the cell is compared to. In this study two TPI datasets were created with neighbourhood radii of 0–250 metres and 250–2000 metres, the first representing small topographical features within the landscape, and the latter a wider estimation of the archipelago landscape.

Reference data

The analysis was performed by comparing fire beacon sites to three sets of reference sites. The first dataset was formed from a random sample (n=464) of land area over 2 m asl. The second and third datasets were stratified samples of other hills in the study area, as fire beacon sites are typically situated on elevated landforms (see Fig. 6). Therefore, samples of other elevated landforms in the landscape were established to provide a comparable baseline for the analysis.

The two datasets of reference hills were extracted by classifying topographical variation of the study area with GRASS GIS tool r.geomorphons. The geomorphons approach utilizes image analysis methodology to auto-segment the landscape into 498 patterns that correspond to different landform types (Stepinski & Jasiewicz 2011; Jasiewicz & Stepinski 2013). The r.geomorphons tool simplifies the patterns to the 10 most common geomorphons that can be used to describe the landscape: flat, peak, ridge, shoulder, spur, slope, hollow, footslope, valley and pit (Stepinski & Jasiewicz 2011; Grass Development Team 2023).

A set of five geomorphon maps were generated with search radii of 1000, 2000, 2500, 3000 and 4000 metres. These were evaluated visually, and the search radius of 3000 metres (120 cells) was chosen as the best representation of the local geomorphology. Values representing peaks (2) were extracted from the geomorphon map and turned into polygons. Then a point dataset consisting of the centres of each peak polygon was created (n=27682). Points within 1000 metres of the beacon sites were omitted from the dataset, to ensure that the datasets are distinct populations.

The peaks were sampled to the highest points in a 1-kilometre and 3-kilometre grid pattern, from which more manageable sample sizes were drawn at random (n=428 and n=465). The reference datasets are hence referred to as the random sample, 1 km peak sample and 3 km peak sample. It is to be expected that the 3 km peak sites are more elevated than the 1 km peaks because of the larger sampling radius, and as such the analysis focuses more on differences between the beacon sites and the 3 km peaks.

Data sampling format and location

The Land Survey's place name dataset (2023a) is in a vector point format. These points are likely not situated in the exact location of the landscape feature the place name refers to and are certainly not in optimal locations for fire beacons. Some of the selected place names are situated slightly off from the hilltops, and some refer to a feature next to the hill, a bay, for example. To correct this, the points used for the analyses were selected as the highest elevation on the DEM within 150 metres of the place name point. The distance between the place name and the point selected to represent the site varies between 5 and 148 metres and is on average 69 metres. The same procedure was also executed for the reference datasets.

Sailing routes

Data for medieval sailing routes is based on the map presented in the *Atlas över Skärgårds-Finland* (Smeds 1960). The route map, digitized in Fig. 2, is quite general in resolution, as routes go through numerous small islets in the archipelago. Consequently, the routes were corrected to be as accurate as possible, buffered to be 500 metres wide, and cut with the shoreline at 2 m asl. The resulting sailing route dataset is at most 500 metres wide and narrows down in straits.

Visibility range

The theoretical maximum distance an object is visible to the naked eye is quantifiable from the maximum angular resolution of the human eye, which is 1 arcminute (0.000291 radians) (Yanoff

& Duker 2009: 54) and the size of the object being observed. In the case of observing incoming ships, the critical object size is the width of the ship and its sails. In this study a conservative value of 6 metres is used to represent the average width of a typical ship in the Baltic Sea during the timeframe in question (Litwin 1998: 91–95; Belasus 2019: 178–179; Eriksson 2021; Tanner 2020; Tammet et al. 2023; Tevali 2023). A 6-metre-wide object is visible to the naked eye at a maximum distance of 20.6 kilometres. Height of the target being observed was set to 3 metres, as it was assumed that to detect the incoming ship, some amount of the sail or, in the case of rowed ships, the top portion of hull had to be over the horizon or obstructions in the line of sight, i.e. landmasses or vegetation.

It is recognized that the sizes of ships varied and generally increased with time, but uniform values were chosen for simplicity. The identification of incoming ships as hostile entities was also likely partly based on the number and speed of the vessels (e.g., Skoglund 2003: 61). The range of visibility is also affected by the effects of the atmosphere, weather conditions, time of day, the amount of light, the contrast between the object and its background, as well as the eyesight of the observer (Mauro & Durastante 2022). Effects of the curvature of the Earth and atmospheric refraction with a value of 0.13 are included in the analysis parameters.

Estimations on the maximum distance over which smoke signals could be transmitted from one beacon site to another are varied, and experiments and observations suggest values that range from 15-21 km (Ødegaard 2023: 18) up to 100-200 km (Iturrizaga 2019: 46). One study has found that distances of 5-10 km were most efficient in the system examined (Čučković 2015: 471). It is evident that the distances between sites in a beacon fire system are related to local topography, climate conditions as well as the objectives of the system.

In the 1980s, the functionality of a beacon system was experimentally tested in Finland Proper in the Salo area by burning car tires and cell plastic at a few places identified as historical fire beacon sites (Luoto & Huttunen 1987). It was found that the direct observation of fire was uncertain or impossible during daylight hours, especially when the distance was more than 4 km. The column of smoke, however, could be seen well at distances of 4–8 kilometres, and when the terrain or vegetation did not hinder visibility, even at 17 kilometres. Naturally, the smoke column of the warning fire must rise as high as possible, so that it surmounts the tops of trees and visibility to the next guard post is guaranteed. In addition, the position of the observers, the direction and strength of the wind, as well as the air pressure, humidity, and temperature affect the visibility of the column of smoke. In this study the signalling range of the beacon fire system was explored with values of 10, 20 and 30 km.

Variables

Topographical, spatial, and visibility-based features of potential fire beacon sites were referenced against the random point sample and the samples of other hills in the study area. Topographical variables were sampled from raster datasets as the highest value within a 100-metre radius of the sites. Distance from sites to the shoreline at 2 m asl, and distance to sailing routes were sampled as the average within 100 metres of the sites.

Individual viewsheds were generated for each fire beacon and reference site with the QGIS Visibility Analysis Plugin. Height of the observer is set to 1.6 metres and height of the target to 3 metres in the viewshed analysis, and 5 and 30 metres in the intervisibility analysis. Variables related to visibility were calculated from the viewshed datasets by segmenting them into several classes. The surface area of each class was converted from number of cells to square kilometres.

Statistical tests

The differences between beacon sites and reference datasets were examined with both a univariate and a multivariate test. First a test of normality was performed with Shapiro-Wilk tests for each variable. According to the test, some of the variables are not normally distributed. Based on this observation a non-parametric statistical hypothesis test was chosen for the analysis. The univariate method of choice was the Wilcoxon rank-sum test, which is used to determine whether two independent samples are from populations with the same or similar distributions (Hogg et al. 2015: 381–389).

The Wilcoxon test was performed in pairs, comparing each pair of the four sample groups in the analysis: beacon sites, random sites, and two reference hill sites. The null hypothesis (H0) is that the samples have the same distributions, while the alternative hypothesis (Ha) is that, based on distributions, the samples are from different populations. If the p-value of the test is less than 0.05, the null hypothesis can be rejected.

To evaluate if beacon sites and reference datasets are distinct from each other in a multivariate space, a Permutational Multivariate Analysis of Variance (PerMANOVA) was conducted. PerMANOVA, suitable for non-parametric datasets, first calculates a distance matrix using the distance measure of choice, in this case the Bray-Curtis measure. The test statistic F-ratio is calculated from the distance matrix, and from this the p-value determining the significance of differences between groups (Anderson 2001; 2005). The PerMANOVA analysis was conducted with the Adonis function in the vegan package in R (Oksanen et al. 2024) with 999 permutations for each analysis. Under a true null hypothesis in PerMANOVA, observations are interchangeable, but the results are sensitive to heterogeneity of the data. As such the test and p-values produced should be interpreted with caution (Anderson 2001: 37).

Two separate multivariate analyses were conducted for part 1 and part 2 of the analysis, because the difference in sampling method resulted in noncompatible reference datasets.

RESULTS

Topographical variables

Potential fire beacon sites are located at heights between 4 and 67 metres above sea level, with an average of 35.9 metres (Fig. 6). The 3 km peak dataset is similar with a mean of 36.1 metres. In comparison, the random sample and 1 km peak sample are on average at elevations of 20–25 m asl. Beacon sites and 3 km hills are evidently both situated on similarly elevated places. This is supported by the statistical test, which finds no significant difference between the beacon sites and 3 km peaks (p=0.899, Table 1).

In terms of both small and large topographical features identified with the topographical position index (TPI) datasets, fire beacon sites are higher than their surroundings, with means of 6.33 and 4.19 compared to means of 3.48 and 1.88 of the random sample and 4.45 and 2.59 of the 1 km hill sample, with the difference being significant at p<0.001. However, when compared to the 3 km peaks, the beacon sites tend to have higher TPI values only in terms of the small landscape features (p=0.004).

The average slope angle of sites was calculated to identify if fire beacon sites are located near cliffs, where visibility is less greatly reduced by vegetation compared to more uniform terrain. The data seems to confirm this, as there is a statistically significant difference among each of the group pairs tested (p<0.02). Potential fire beacon sites are slightly more often located near steep gradients than the reference hill datasets, though the effect size (0.11) indicates that the difference is not great.

Variables of distance

The distance to sea from the fire beacon sites varies between 25 metres (the size of the raster cell) and 1890 metres, with an average of 260 metres and a median of 173 metres. The only statistical significance occurs when comparing fire beacon sites to the 1 km peaks (p=0.033).

In relation to sailing routes, beacon sites are located on average at a distance of 2768 metres, whereas with the reference samples the average is over 3000 metres. The difference between beacon sites and the other samples is, however, statistically significant only when compared to the 3 km peaks (p=0.034). Indeed, it would seem that in terms of topography, beacon sites greatly resemble the highest hilltops of the landscape but are crucially situated closer to the routes possibly used by hostile attackers.

It must also be noted that this examination does not consider the variation within the beacon sites dataset; if beacon sites presumably were organized into a chain connecting the outermost sites to settlement areas on larger islands and inland, naturally some sites might be further away from sea routes than others.

Viewshed analysis

Viewsheds generated for each site were developed into three variables: total visibility to sea within 0–20 km, visibility to sailing routes, and an index of visibility range, which is the percentage of the

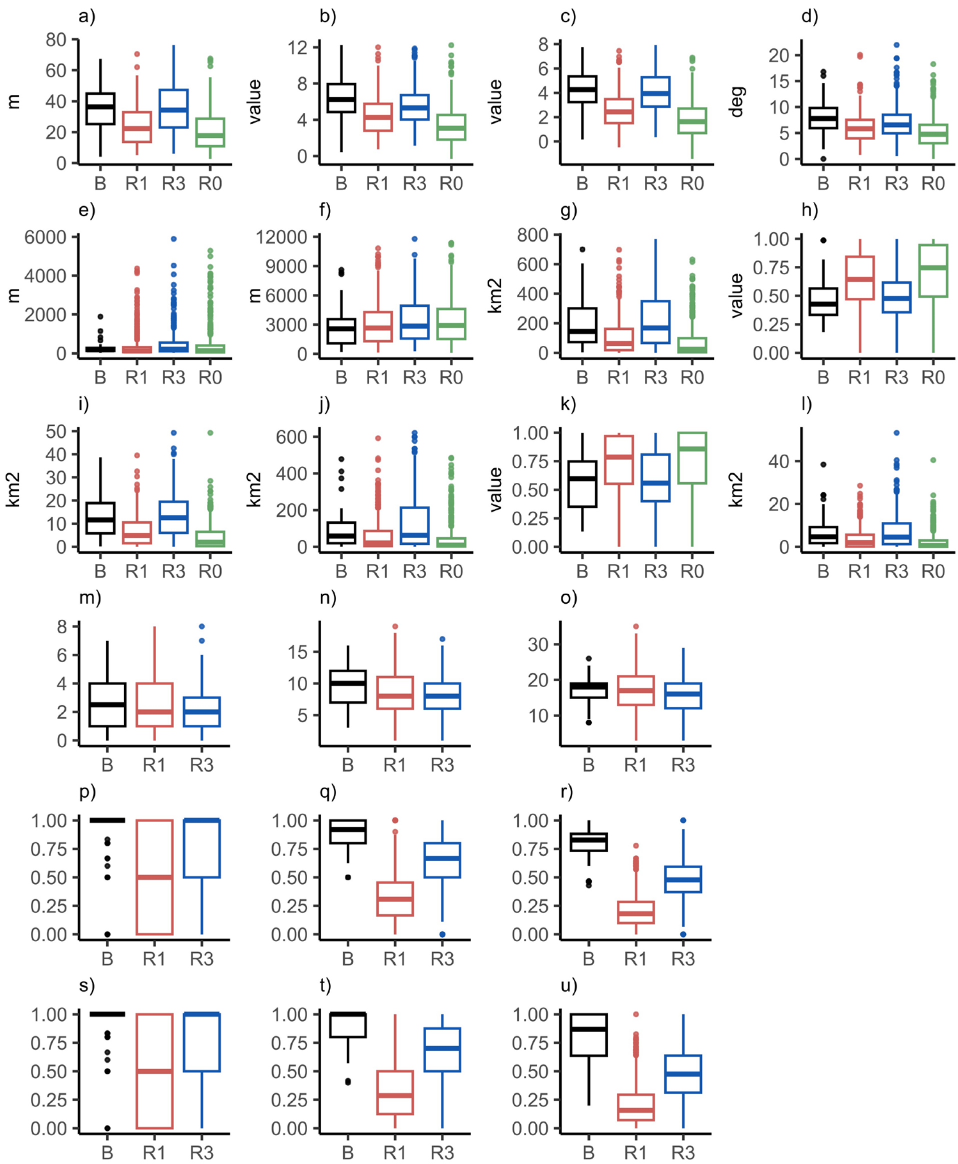

Figure 6. Box plot of variables with bare DEM (a-i) and forest DEM (j-l): a) elevation b) TPI 0-250 m, c) TPI 250-2000 m, d) Slope, e) Distance to sea, f) Distance to route, g) Visible sea, h) Visibility range index, i) Visible route, j) Visible sea, forest DEM, k) Visibility range index, forest DEM l) Visible route, forest DEM. Intervisibility variables with forest DEM and target height of 30 m (m-u): number of other sites at m) 0-10 km, n) 0-20 km, o) 0-30 km, Connection success, incoming at p) 0-10 km, q) 0-20 km, r) 0-30 km, and outgoing at s) 0-10 km, t) 0-20 km, u) 0-30 km. B = beacon sites, R0 = random sample, R1= 1 km peaks sample and R3 = 3 km peaks sample.

Table 1. Pairwise Wilcoxon rank sum test results of variables in a) analysis part 1 and b) part 2. The pair compared is the beacon sites to the 3 km peaks sample. Comparisons between beacon sites and random and 1 km peaks sample summarized as the p-value (p against R0/R1). The test statistic W is the sum of ranks of the smaller sample. The effect size was calculated as $r=Z/\sqrt{N}$, where z is the Z-score and N the number of observations (Fritz et al. 2012: 12). P-values of <0.05 are mildly significant, <0.01 significant and 0.001 highly significant. R values of 0.1 indicate small, 0.3 medium and 0.5 large effects.

a) Variables		**W**	**p**	**Effect size (r)**	**p against R0/R1**
Elevation		13155	0.8994	0.01	< 0.001
TPI 0-250 m		16109	0.0037	0.13	< 0.001
TPI 250-2000 m		13693	0.5275	0.03	< 0.001
Slope mean		15586	0.0159	0.11	< 0.001
Distance to sea		11401	0.1283	0.07	0.11/0.03
Distance to route		10758	0.0336	0.09	0.06/0.31
Visible sea		12475	0.6089	0.02	< 0.001
Range index		11579	0.1759	0.06	< 0.001
Visible route		13212	0.8572	0.01	< 0.001
Visual sea, forest		12397	0.5586	0.03	< 0.001
Range index, forest		12283.5	0.4892	0.03	< 0.001
Visible route, forest		13053.5	0.9753	0	< 0.001
Forest index		12436	0.5835	0.02	0.11/0.45
Forest route index		12868.5	0.8872	0.01	0.11/0.55
b) Variables	**Target height**	**W**	**p**	**Effect size (r)**	**p against R1**
Sites at 0-10 km		38417	0.0035	0.09	0.203
Sites at 0-20 km		41284	< 0.001	0.12	0.0361
Sites at 0-30 km		37326.5	0.0159	0.07	0.776
Index 10 km incoming	5	37268.5	0.0138	0.07	< 0.001
Index 20 km in.	5	38483.5	0.00401	0.08	< 0.001
Index 30 km in.	5	41120	< 0.001	0.11	< 0.001
Index 10 km outgoing	5	37622.5	0.00879	0.08	< 0.001
Index 20 km out.	5	38132	0.00623	0.08	< 0.001
Index 30 km out.	5	40701	< 0.001	0.11	< 0.001
Index 10 km in.	30	37555.5	0.0044	0.08	< 0.001
Index 20 km in.	30	51499	< 0.001	0.24	< 0.001
Index 30 km in.	30	57966	< 0.001	0.31	< 0.001
Index 10 km out.	30	37005.5	0.008	0.08	< 0.001
Index 20 km out.	30	48256.5	< 0.001	0.2	< 0.001
Index 30 km out.	30	53102	< 0.001	0.26	< 0.001

viewshed that is at the 10 km range. Values less than 0.5 indicate more visibility at the 10-20 km range and values over 0.5 mean that most of the visible sea area is concentrated in the close range. Visible land area was not analysed. The classes were calculated separately with the bare DEM and forested DEM. Four indices simulating the effect of vegetation on visibility were calculated by comparing the visible area with and without vegetation cover (Fig. 7).

On average a marine area of 201 km^2 can be seen from fire beacon sites and 223 km^2 from the 3 km peaks. For the random sample dataset, the average is 74.6 km^2. The average area of visible sailing route from both the fire beacon and reference sites is around 13 km^2, while for random points and 1 km peaks it is around 4.5 km^2. The results of the statistical tests reveal that in all visibility categories both fire beacon sites and the 3 km peak points are significantly different from the other reference samples (Table 1), but not from each other, with p-values in the latter comparisons ranging from 0.18 to 0.98.

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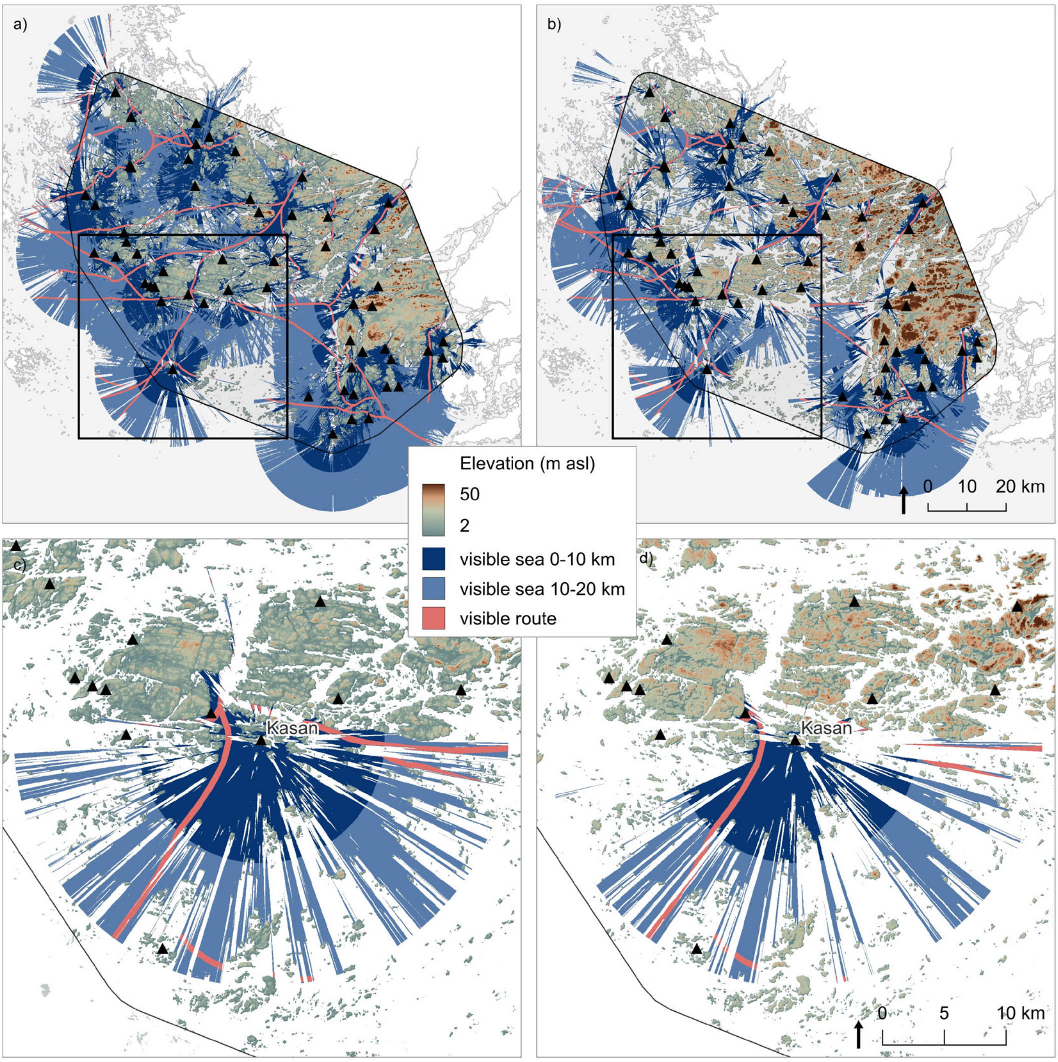

Figure 7. Cumulative viewsheds of beacon sites and example of viewshed sampling in a) bare DEM and b) DEM with forest cover and example of the viewshed of Nauvo Kasan with the c) bare and d) forested DEM.

around 4.5 km^2. The results of the statistical tests reveal that in all visibility categories both fire beacon sites and the 3 km peak points are significantly different from the other reference samples (Table 1), but not from each other, with p-values in the latter comparisons ranging from 0.18 to 0.98.

Beacon sites and 3 km peaks have an average visibility range index value of 0.46–0.49, indicating that the total visibility is split equally between the close and far ranges, whereas for the random and 1 km peaks visibility is concentrated in the long range (Fig. 6).

When using the elevation model modified with vegetation height, the average observable marine area for the fire beacon sites is reduced to 92.5 km^2 and a median of 57.9 km^2, and on average 6.8 km^2 of sailing routes is visible from the beacon sites and 3 km peak points. For beacon sites and all sample groups the viewshed area is reduced to around 30–40 % when vegetation cover is accounted for (Fig. 6). The statistical tests of viewshed size with the forest DEM show no differences between the beacon sites and 3 km peaks, indicating that the presence or absence of vegetation does not separate the beacon sites from the highest hills in the study area. This can be attributed to the naturally barren nature of hilltops in the archipelago area. Compared to the random and 1 km peak samples, the difference in viewshed size remains significant ($p<0.001$).

Based on the statistical tests, it can be concluded that fire beacon sites as well as the 3 km peaks are samples of locations distinct from the general landscape features and not randomly situated. However, when fire beacon sites are compared to the 3 km peaks, a sample of the highest hilltops in the landscape, the only statistically significant differences relate to the small relative elevation differences identified with the topographical position index ($p=0.004$), the steepest slope found near the sites ($p=0.016$) and distance to sailing routes ($p=0.034$). This indicates that the beacon sites in most ways

Table 2. Results of PerMANOVA analysis comparing beacon sites to reference samples. Variation explained by the group factor (beacon or sample datapoint) is indicated by R^2. F is the ratio of external variance between groups to the internal variation inside groups. Df = degrees of freedom.

Topographical, distance- and viewshed-based variables					
Pair	Df	Sums of Squares	R2	Pseudo-F	p (Pr(>F))
beacon / random	1	2.687	0.07295	42.81	0.001
beacon / 1 km peaks	1	1.1393	0.04019	21.48	0.001
beacon / 3 km peaks	1	0.053	0.00201	1.0587	0.354
Intervisibility variables, forest DEM, target height 5 m					
beacon / 1 km peaks	1	5.96	0.04267	52.333	0.001
beacon / 3 km peaks	1	0.586	0.005	5.9052	0.002
Intervisibility variables, forest DEM, target height 30 m					
beacon / 1 km peaks	1	5.812	0.05189	64.248	0.001
beacon / 3 km peaks	1	0.994	0.0195	23.348	0.001

resemble the highest hilltops, and dissimilarities arise only in certain details.

To further investigate this finding, the multivariate PerMANOVA analysis of topographical, distance- and viewshed-based variables comparing the beacon sites and the 3 km peaks dataset was employed. The analysis does not indicate a significant multivariate difference between the two groups (Pseudo-F=1.0587, p=0.354, R^2=0.002), and only 0.2% of total variance in the data is explained with the group factor (Table 2). This result further emphasises the general parallel nature of beacon sites and the most prominent hilltops of the environment. Beacon sites expectedly stand out in multivariate space when referenced against the random or 1 km peak samples.

Intervisibility

The intervisibility of the fire beacon sites was explored by examining positive and negative connections of visibility between the sites at ranges of 10, 20 and 30 kilometres. Connections for each site were calculated as incoming and outgoing signals. We emphasize that there is no guarantee that the fire beacon sites identified by place names and analysed in this study are contemporaneous. Furthermore, the collected fire beacon site dataset likely does not contain all potential fire signal stations in the area. As such, the intervisibility network proposed here is a hypothetical model of possible connections between the sites.

Two reference datasets were used, each of which contained 20 sets of random samples drawn from the dataset of highest peaks identified with the geomorphons tool in a 1-kilometre and 3-kilometre grid. Each sample consists of 56 hilltops, and each reference dataset is an aggregate of all the sample datapoints (n=1120).

The intervisibility analysis was produced with the QGIS Visibility Analysis Plugin. Observer height is 1.6 metres, and target heights of 5 and 30 metres represent direct visibility to the light emitted from the fire and a minimum estimate of the height of the smoke column, respectively. Two separate intervisibility analyses were conducted with the vegetation-free DEM and the DEM modified with vegetation height, but statistical tests were examined only on the latter.

A connection success index was calculated from the number of sites visible at each visibility range. Connection success illustrates the proportion of sites within the selected visibility range that are visible from the observer site (Čučković 2015: 472). The index is a better indicator of a site's significance in the intervisibility network, especially when data is fragmentary, than looking solely at the number of successful connections.

The maximum number of sites with which communication via beacon fires could be executed, was calculated within 10, 20, and 30 kilometres. In both fire beacon and reference datasets one site is on average neighboured by 2.4–2.9 other sites within 10 kilometres, 8.3–9.5 sites within 20 kilometres and 16–17 sites within 30 kilometres. No statistically significant differences were identified with the Wilcoxon rank-sum test in the ranges of 10 and 30 kilometres between the fire beacon site dataset and the randomly generated samples. Within a 20-kilometre radius, fire beacon sites are slightly more clustered together when compared to the reference dataset, and this difference is statistically significant with a p-value less than 0.001 (Table 2).

Intervisibility networks generated at different ranges and target heights are presented in Figure 8. If it is assumed that the maximum range a fire signal could be communicated over is only 10 kilometres, the subsequent intervisibility network is a fragmentary map of isolated clusters of sites, although gaps in the system could easily be explained by missing data in the site dataset. If the maximum range is increased to 20 kilometres, a much more complete network is formed, both with 5 metre and 30 metre target heights, and notably each site has at least one successful connection to another site. With a 30-kilometre range, each site has multiple visual connections not only to sites nearby, but to sites across spans of sea and over islands. The actual maximum range the smoke column could be seen from is not clearly defined, but a distance of at least 20 kilometres seems plausible, if visibility is not hindered by obstructions.

Based on the connection success index, a 30-metre-high smoke column can be seen rising on average from 90 % of the fire beacon

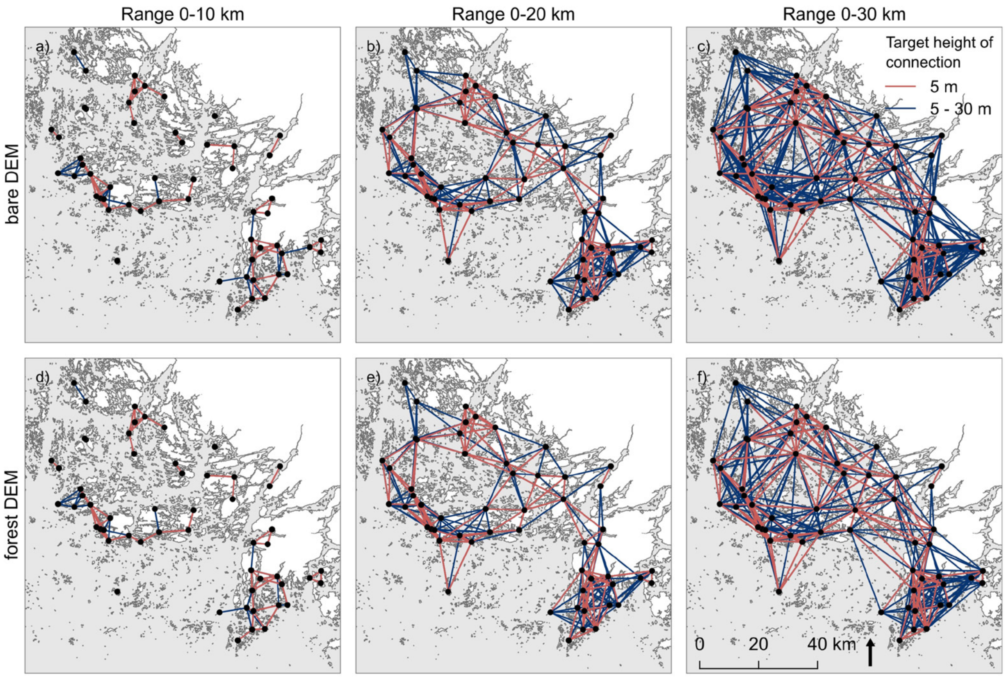

Figure 8. Interconnectedness of beacon sites at ranges 10, 20 and 30 km with a-c) the original DEM, and d-e) the DEM with forest cover. Colour of the connections indicate whether the connection is possible with a 5-metre target, or if it requires a target height of 5-30 metres.

sites within 10- and 20-kilometre ranges and 80 % within a 30-kilometre range of the fire beacon sites (Fig. 6). Vegetation does not seem to have a significant effect on the number of successful connections. For the reference datasets, connection success is much lower, mostly in the range of 30–60 %. Distribution of the connection success index is indeed significantly higher within the fire beacon site dataset compared to reference data in all visibility ranges.

With a 5-metre-high target, successful connections between the fire beacon sites are reduced to an average of 67–69% at the 10- and 20-kilometre ranges and further within the 30-kilometre radius to 54% with the vegetation-free DEM and 29% with the forested DEM. This suggests that, even though fire beacon sites are evidently located on hilltops, the hills are not high enough to rise above all treetops. Reference sites have on average only a 5–25% connection success with a 5-metre target height, depending on the presence of vegetation. The difference in connection success between fire beacon sites and reference sites with a 5-metre target height is statistically significant ($p<0.05$) in all ranges.

The PerMANOVA analysis of intervisibility of the beacon sites and the 3 km peaks dataset, conducted with the forested DEM, reveals a highly significant multivariate difference between the groups with 5- and 30-metre-tall target objects. However, only 0.5–2% of the variation in the data can be explained by sites membership in either the beacon site or sample dataset (Table 2). This indicates that a high amount of variation is explained either by internal differences within the groups, or the cause of the variation is not entirely captured in the analysis. Differences between beacon sites and 1 km peaks are also statistically significant and slightly more pronounced.

When compared to randomly sampled hills in the study area, the fire beacon sites appear to form a more functional network of visibility. This functionality is not a result of random variation of clustered sites, as fire beacon sites are not situated significantly closer to each other when compared to the random samples (Fig. 6: m-o).

CONCLUSIONS

To substantiate the historical sources attesting to the active operation of the defense system based on fire beacon network in Turku archipelago, we conducted GIS-based analyses on a dataset of sites selected by place names alluding to ancient signalling fire activities. The hypothesis was that if the place names are indicators of beacon sites, their locations should positively correlate with high visibility to sea and to other beacon stations, assuming that the main purpose of the system was to identify sea-borne enemy ships and notify these observations to the mainland via a chain of beacon fires.

Our study demonstrates that place names indicating fire beacon sites typically point to steeply sloped hills that are prominent landscape features in comparison to their immediate surroundings and have impressive ranges of visibility. These characteristics clearly distinguish beacon sites from the surrounding landscape and other hills. The fire beacon sites even rival the highest hilltops in the study area in terms of their visibility. However, based on visibility and topography alone, beacon sites do not stand out as a superior dataset when compared to the highest peaks in the archipelago.

More significant differences lie in the connections of visibility between fire beacon sites, which indicate a strong probability that these sites are not randomly situated but rather deliberately placed in predefined positions. The interconnectedness of beacon sites is even greater than that of the most prominent hilltops of the landscape. The analysis suggests that the network of intervisibility contributed significantly to the selection of locations for fire beacon sites. It must be noted, however, that due to the currently lacking data for the fire beacon sites, the intervisibility network presented in this study remains hypothetical.

Since the fire beacon sites identified by place names in this study are not necessarily contemporaneous, further investigations based on the exploration of predictive modelling and geovisualization, as well as multidisciplinary field surveying would be needed. More rigorous modelling is required to fully understand the complexities of the whole fire signalling network. One refinement of the analysis would be the classification of potential beacon sites into groups, corresponding perhaps to their function as either lookout points or as intermediary points in the fire beacon chain. Another important aspect of beacon sites that was left outside the scope of this article and deserves further study is the signalling network's relationship with the settlement sites of the archipelago and coastal mainland.

In any case, our study augments the probability of the existence of various historical fire beacon sites in Turku archipelago as a part of wider defensive system operating in the coastal areas of Scandinavia and Finland during the Middle Ages and the Early Modern period. It also shows the utility of GIS-based analyses and modelling in bringing new perspectives to the research of unrecognized or overlooked archaeological phenomena.

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NOTES

[1] The Hälsingalagen recorded in 1320 applied to Northern Sweden and parts of Finland's western coast (e.g., Tamm 2005).

Tiina Väre

IMPROVING THE TEMPORAL REPRESENTATIVITY OF DENTIN SERIAL SAMPLES IN STABLE ISOTOPE STUDIES

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INTRODUCTION

Dentin micro-sampling techniques and stable isotope analyses have been extensively utilized in studies exploring childhood diets within archaeological populations (e.g., Eerkens et al. 2011; Beaumont et al. 2013; Henderson et al. 2014). This is possible because dentition develops during early life and as the isotopic composition of teeth is inert, it reflects the dietary conditions of this period – apart from that of the later forming secondary and possibly tertiary dentin (Meinl et al. 2007; Smith et al. 2012).

The methodology offers a tool to assess past breastfeeding and weaning schedules. For example, Beaumont and colleagues (2013) analyzed the $\delta^{15}N$ and $\delta^{13}C$ values of transverse, 1 mm dentin segments cut successively from bisected and gelatinized first permanent molars (later M1).[1] I have used this method to tentatively address the breastfeeding customs among a few Finnish archaeological populations (Väre et al. 2022a; 2022b; 2023). The years spent utilizing the methodology have taught me that it only allows very crude estimations of the developmental periods for the transverse dentin segments: similar-sized sections naturally take different times to develop depending on the size of the tooth. But this is far from where the troubles end.

First, permanent molars develop during infancy (see AlQahtani et al. 2010), which is why their dentin isotope composition provides information about diet during infancy – including breastmilk consumption that leads to elevation of particularly the $\delta^{15}N$ value (e.g., Fogel et al. 1989; Fuller et al. 2006). As dentin develops from the crown toward the root, dietary changes can be traced following the changes

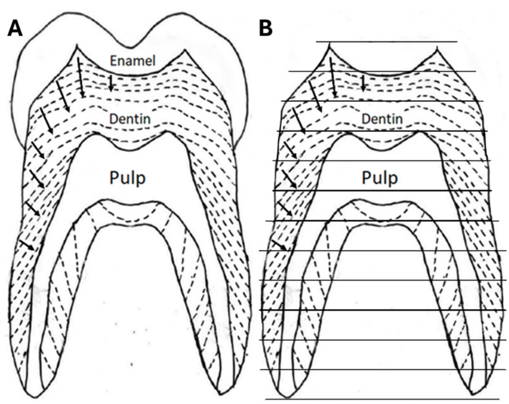

Figure 1.A. The schematical sagittal cross-section of the first permanent molar illustrates the direction and internal pattern of dentin growth increments (image modified by T. Väre after Eerkens et al. 2011, Fig. 2). As a result of the uneven, diagonally oriented growth, dentin does not accumulate evenly following the longitudinal axis of the tooth. B. In many earlier studies, the gelatinized dentin of bisected molars has been cut transversally resulting in parallel dentin segments of equal width. Such a way of cutting does not respect the true direction of dentin development and leads to increased overlapping of growth from different periods in segments toward the root.

in the delta values in the series of subsequent samples. The height of the analyzed segment defines the duration of the period represented by its delta values. It has been estimated that every 1 mm segment takes approximately half a year to develop (or if the various reviewers who have estimated my work are to be trusted, contains dentin grown during 3 to 9 or even 12 months, see also Eerkens et al. 2011; Beaumont et al. 2013; Beaumont & Montgomery 2015; 2016).

THE TROUBLESOME DENTIN SEGMENT DEVELOPMENT PERIOD ESTIMATIONS

The dentin growth rate is not even across the tooth, and the growth direction is not vertical – i.e., dentin does not accumulate in layers perpendicular to the longitudinal axis of the tooth (Fig. 1). Thus, the dentin in the central parts of a transversally cut segment has developed later than the dentin of its outer edge – and this difference is emphasized during the growth of the tooth, as the diagonal pattern becomes steeper towards the lower parts of the root. Consequently, the first couple of segments are the easiest ones to date accurately as the growth of dentin closest to the dentin-enamel junction is primarily directed toward the root, while the development of dentin in the root segments temporally overlaps much more. This causes the values of successive samples to partially reflect the diets of the same periods, time-averaging the values. This produces a rolling average of values that do not accurately represent the diets of limited, subsequent periods. (cf. Eerkens et al. 2011; Henderson et al. 2014; Beaumont et al. 2016.) For example, it is unclear whether the stabilization of values often seen in breastfeeding profiles after the very first segments is a sign of ceased breastfeeding (Fig. 2), or more an effect of the sampling technique causing several samples to contain large amounts of simultaneously developed dentin.

IMPROVEMENTS TO AGE-ESTIMATION ACCURACY

In recent years, new methods have been introduced to improve the accuracy of estimating which periods are reflected by the stable isotope values of dentin samples. These improvements are for a large part an effect of developments in mass spectrometry, enabling the isotope relations of ever smaller samples to be accurately measured. Czermak and colleagues (2018) approached the problem by visualizing the site of the dentin increments using transmission light microscopy on a longitudinal ~70-µm-thinsection cut from the mid-part of the tooth and mounted on a microscopy slide. They used images taken of this sample as a visual reference for the correct location of the lines in a demineralized, 1.5 mm thick longitudinal dentin that was sampled with the aid of a dissecting microscope. Czermak also led another study (2020) in which a 2 mm wide longitudinal central slice was cut from a molar, demineralized, and micro-sampled sequentially from the crown cusp to the root apex with a 1 mm diameter biopsy punch with a plunger. Both these techniques avoid mixing

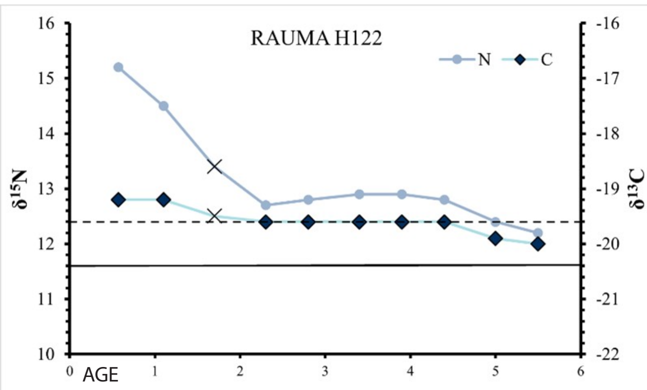

Figure 2. In early childhood dietary profiles, the initial elevation of the δ15N and δ13C values is followed by gradual stabilization near the maternal levels here represented by the population averages (black line δ15N and dashed line δ13C, also note that in the sample marked with X, the collagen quality was insufficient). The declining pattern of values is supposedly caused by first the introduction of weaning foods and then the cessation of breastfeeding. This is when the infant is lowered in the food chain from above the mother to her level (provided they consume isotopically similar diets). This example is from the 19th-century population of Rauma, Southwestern Finland (Väre et al. 2022a). Image: T. Väre.

significant amounts of simultaneously developed dentin between samples and make estimating the developmental periods easier. They have also already been applied to childhood dietary studies (cf. Fernández-Crespo et al. 2018; 2020). Curtis and colleagues (2022) have also introduced a novel way of cutting the incremental samples according to the dentin development lines. They sectioned a tooth-halve into a 1.5 mm thick longitudinal section, which was demineralized and lyophilized before being cut along visible incremental structures using MicroMill software producing as many as dozens of samples from a single tooth.

The new methods compared to the traditionally used 1 mm protocol certainly improve the temporal accuracy and representativity of childhood diet studies (cf. Cheung et al. 2022). The incremental micro-sampling technique by Curtis and colleagues (2022) sounds particularly promising. This method, however, is highly technical requiring specialized tools and software that are not found in every laboratory working with stable isotope samples. During my work, I have noticed that the temporal representativity of the dentin serial samples could be enhanced with much smaller efforts, which I will shortly introduce.

Restricting the sampling to the outer perimeter of the transverse, gelatinized dentin slices cut according to the protocol of Beaumont and colleagues (2013), and thus leaving the internal parts out of the analyses would reduce temporal overlapping between samples. This would make the values measured in subsequent segments align more accurately in chronological order and they would still form a temporally continuous series. Moreover, discarding the dentin surrounding the pulp chamber from analyses would solve the problem caused by the age-bound secondary dentin formation and its time-averaging effects (cf. Smith et al. 2012). As schematically demonstrated in Figure 3, after sectioning the gelatinized dentin of the sagittally bisected tooth halves into subsequent segments, only the outer "rim" of these roughly semicircular dentin slices would be cut out with a scalpel – and subsequently denaturized, lyophilized, weighed, and analyzed.

The $\delta^{15}N$ and $\delta^{13}C$ values are analyzed from dentin collagen. This is why the amount of collagen extracted from these modified

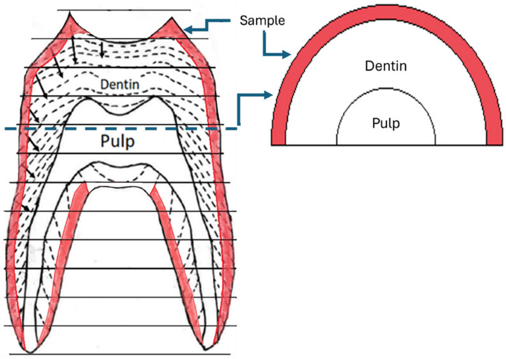

Figure 3. Sagittal cross-section of a molar and its schematic axial illustration presenting the sampling sites in red. The samples are cut from the perimeter of the semicircular, transverse segments of the gelatinized tooth-halves. This way, the periods during which the dentin in each sample has formed overlap much less (see Fig. 1). Image: T. Väre.

samples, comprising only of the outer rim of micro-slices, may be worth considering. In the protocol following Beaumont et al. 2013, the first segment sectioned from the half of M1 consists merely of the cusps, meaning that the amount of dentin is minuscule. Nevertheless, the amount of extracted collagen has almost always been sufficient for packing at least one 0.4–1.0 mg (depending on the laboratory) sample which has yielded reliable results. Unlike in the ultrafiltration method (Brown et al. 1988), the yield of collagen cannot be calculated using this method (whole sample demineralization). However, according to Sealy and colleagues (2014), the weight-% of carbon and nitrogen as well as their atomic ratio but not the yield are the most important determinants of collagen quality in stable isotope analyses. Nevertheless, samples with extremely low collagen yield as well as low carbon and nitrogen concentrations should still be discarded (Guiry & Szpak 2021). Based on my previous experience of visually abundant (albeit not weighed) yields of collagen from even just the cusps, I find it likely that outer-rim samples cut from the segments smaller than the standard 1 mm would contain enough collagen provided the preservation was sufficient.[2] The roots may make an exception to this if they are very narrow near the apex: particularly as it is advisable to only sample one of the roots of bifurcated teeth to avoid mixing dentin grown during different periods. This is difficult to coordinate between the roots.

The suggested improvement does naturally not remove all the problems of the previous method. For example, without following the dentin growth lines, it is not possible to consider the variation in the growth rate of dentin and to accurately estimate the exact age at which the sample was developed. Moreover, even when the analyzed parts of dentin are rather small, the sampling still destroys half of the tooth. Thus far, the discontinued funding of my breastfeeding studies has prevented me from testing the method in practice. It will, however, be interesting to see whether this improvement changes the pattern seen in the early childhood dietary profiles.

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NOTES

[1] According to the protocol of Beaumont and colleagues (2013) the cleansed and bisected teeth are ultrasonicated in ultrapure water and their detachable enamel removed before submerging them in 0.5 M hydrochloric acid (HCl) for approximately 1 to 2 weeks. The demineralized tooth halves are rinsed with ultrapure water and sliced in parallel transverse segments (of 1 mm) beginning from the crown and proceeding to root tip. These segments are denaturalized in 0.001 M HCl solution in separate microcentrifuge tubes at 70°C for 24 hours, the solution is centrifuged, frozen, and lyophilized before weighing the resulting dry collagen samples in to tin cups for IRMS-analysis.

[2] The issue of archaeological samples containing carbon from humic acids of soil should be considered (particularly in Finland). NaOH-treatment removes acid (and lipids) from the sample (Ambrose 1990), but the treatment can reduce the amount of collagen (Chisholm et al. 1983), which may be a problem particularly with poorly preserved samples. The Beaumont et al. 2013 -protocol does not originally include NaOH-treatment.

Sanna Lipkin

PROJECT REVIEW: DAILY AND AFTERLIFE OF CHILDREN (1300–1900) – NEW PERSPECTIVES IN IDENTIFYING CHILDHOOD IN THE PAST

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Lipkin, S. 2024. Project review: Daily and afterlife of children (1300–1900) – New perspectives in identifying childhood in the past. *Fennoscandia Archaeologica* XLI: 140–142. https://doi.org/10.61258/fa.153319

The project 'Daily and afterlife of children (1300–1900): New perspectives in identifying childhood in the past' was funded by the Research Council of Finland. The project received funding through the Academy Project call for younger generation of researchers and ran from September 2019 to August 2023. The total implemented costs amounted to approximately 685,000 euros, of which the Research Council funded around 480,000 euros.

The research was closely tied to PI Sanna Lipkin's Academy Research Fellow project, 'New perspectives on childhood in Finland (1600–1900) – Funerary attire as an indicator of status of children', which ran from September 2017 to August 2022. It was also connected to Tiina Väre's postdoctoral project, 'Breastfeeding, weaning, and nutrition in Post-medieval Finland: Nitrogen and carbon stable isotope analyses of dentin collagen', conducted between March 2020 and February 2023. Both projects were likewise funded by the Research Council of Finland. Altogether, the three projects received approximately 1,224,000 euros in funding from the Research Council of Finland, while the host institution, the University of Oulu, contributed about 525,000 euros in support.

The 'Daily and afterlife of children (1300–1900)' project focused on the emotional bonds children and adolescents formed and how these bonds shaped their lives during the Post-Medieval period. It examined childhood and adolescence in Finland from the 17th to the 19th centuries, aiming to explore the socialization of children and youth from the perspectives of emotion and performance theories. Beyond socialization, the project investigated children's agency as well as parents' care and dedication toward their children. Children's identities were studied through graves and burial clothing, revealing that young people were also responsible for making burial clothing, thereby allowing us to trace their agency (Lipkin et al. 2021; Lipkin et al. 2022). The agency of children and youth was further studied in the context of factory work (Kuokkanen & Hemminki 2023).

The project aimed to better understand the development of emotional bonds between children and their caregivers. The study focused on the applicability of attachment theory in archaeological research, a mostly unexplored topic in archaeology. From archaeological and historical perspectives, studies included emotional bond development between foster parents and foster children in the Clementeoff family of Keminmaa (Tuovinen 2024), the influence of breastfeeding on attachment formation (Väre 2024), and the emotional ties of children who grew up during the Great Wrath (1714–1721) and how they potentially evolved with their parents and later with their own children (Lipkin 2024). We also explored how disruptions in these emotional bonds manifested in an increase in child murders (Kuusisto 2023) and, conversely, how strong emotional ties to natural places emerged (Lipkin 2024). Additionally, the research reflected on how later scholars and contemporary society have viewed those children who died or were enslaved during the Great Wrath through literature, popular culture, and memorials (Lipkin 2023; 2024).

The project also considered the impact of war on children's and youths' emotional development, using the case of a young soldier who died in the Finnish War (1808–1809). We investigated his diet, the effects of military life on his skeleton, and insights into his origin (Northern Ostrobothnia), battlefield conditions based on his clothing (Lipkin et al. manuscript). Overall, our research provided a better understanding of how children and youth in the 18th to early 20th centuries perceived their environment (Lipkin 2022). Emotional bonds were studied from the broadest possible archaeological and historical perspectives.

In addition to historical sources, burials and burial clothing played a significant role in the research. The project used a multidisciplinary approach to examine the burial textiles. Notably, it employed computed tomography (CT) scanning in collaboration with the Research Unit of Health Sciences and Technology at the Faculty of Medicine, University of Oulu. CT technology was applied at clinical, micro, and nano levels. While the application of CT technology in textile archaeology had been explored previously, this project explored its potential more extensively that previous studies (Karjalainen et al. 2023). We addressed the benefits and challenges of this methodology (Lipkin et al. 2023). These findings generated interest, leading to invitations for presentations and a collaborative Horizon consortium project, TEXTaiLES (https://www.echoes-eccch.eu/textailes/).

Understanding childhood in the past allows for broader perspectives on modern childhood. In our research, we addressed sensitive topics, such as children's involvement in war, which resonated with the public, especially after the outbreak of the war in Ukraine. The dissemination of research findings has positively impacted well-being. Discussions of death often arose during the project, involving not only researchers but also priests and the general public. These conversations, facilitated by attachment theory and readings on mentalization, helped us connect and engage with people in a meaningful way (Lipkin et al. 2024). Death is a challenging topic for many, but using historical examples – especially those concerning children – sparked important discussions. I remember vividly the words of Chaplain Outi Pohjola when we were designing the church burial museum in Haukipudas. She expressed the church's role to talk about topics such as death and said that she and others had drawn strength from our research to have these important conversations with the parishioners. The permanent display of the findings in the church burial museum, which opened on September 18, 2022, at Haukipudas Church underscores the significance of outreach.

Besides church burial museum, we have contributed to several temporary exhibitions in museums. These exhibitions curated in collaboration with museum staff, the 'Church, Space and Memory' project (PI Titta Kallio-Seppä), and conservators included the following: Carefully Buried – Archaeological Research from Northern Finland, June 17 – August 30, 2020, 'Changing Church Burial Practices', January 31 – August 30, 2020 at the Northern Ostrobothnia Museum; 'Rungius, Buried in the Church', September 12 – December 1, 2019 at the Kemi City Museum; and 'Anna, Buried in the Church', September 12 – December 1, 2019 at the Torne Valley Museum.

Feedback from visitors highlighted exhibitions' value. One memorable comment came from a mother who appreciated how the exhibition facilitated a conversation about death with her child. Many exhibitions occurred during the pandemic, providing a meaningful experience for visitors when other activities were limited.

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Milton Núñez, Jan Storå & Myriam Llorens-Liboy

ON THE POSSIBLE DENTAL STIGMATA OF THE PUERTO RICO ABORIGINAL CRANIA IN STOCKHOLM – A CORRECTION

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Núñez, M., Storå, J. & Llorens-Liboy, M. 2024. On the possible dental stigmata of the Puerto Rico aboriginal crania in Stockholm – a correction. *Fennoscandia Archaeologica* XLI: 143–145. https://doi.org/10.61258/fa.153328

In Markku Niskanen's Festschrift, we described the presence of stigmata-like features on the crown of a first molar from the Puerto Rico aboriginal collection in Stockholm and its implications for congenital syphilis (Núñez et al. 2023). Since the Festschrift was a limited edition, it is best to enter a brief background for those not acquainted with it.

The crania were found in a cave of northwestern Puerto Rico in the mid-1800s and donated by Justus Hjalmarsson to the Retzius Anatomical Museum collection in 1857. In addition to Gustaf Retzius, the crania were examined by renown anthropologists Rudolph Virchow and Nils-Gustav Gejvall before ending up in our mundane hands (Virchow 1896; Gejvall & Henschen 1971). We studied the crania in 2006-2007 and like Gejvall and Henschen attributed the lesions on the cranial bones to treponemal disease (Núñez et al. 2009).

In 2019, while going through old photos for a presentation at the Anthropos 2020 Congress in Havana, M. Núñez noticed what seemed like an anomaly on the crown of a first molar (Fig. 1a-b). It was reminiscent of the stigmata features characteristic of congenital syphilis (cf. Jacobi et al. 1992: fig.4; Lauc et al. 2015: fig.8; Agarwal et al. 2017: fig.2). It seemed odd that we would have missed them while studying the material 12 years earlier, but we had mainly concentrated in the obvious syphilis-like lesions on the parietal and frontal bones. Unfortunately, we were not able to reexamine the mandible in time for the Anthropos Congress in March 2020 because the crania had been recently moved from the Stockholm University Osteoarchaological Research Laboratory to Karolinska Institute. They were still unpacked and thus inaccessible. There was no congress proceedings publication and the Puerto Rico crania were left in peace during the pandemic.

When we again sought to examine the mandible for our Festschrift article in 2022, we found we could not because Karolinska was in the process redefining their policies about permissions to use its collections. We left in a request to access the mandible and mentioned tentatively the possible presence of dental-stigmata in our article, which we ended with 'To be continued'.

We eventually got access to the mandible last October but, unfortunately, the apparent stigmata lesion turned out to be the result of an optical illusion caused by an excess of

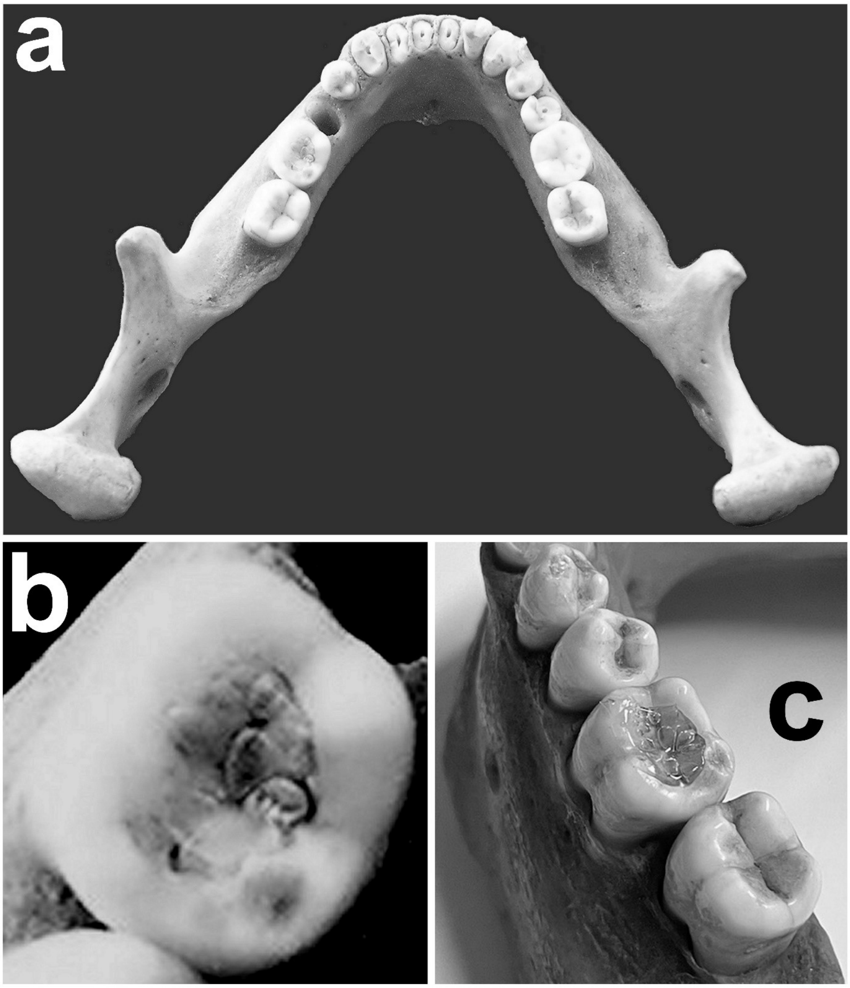

Figure 1. Old and new photographs of the left first molar of one of the Puerto Rico mandibles: (a) The mandible with the odd "formation" on the crown of the left first molar. (b) Fuzzy blown-up view of the molar in the same photograph, showing what appears to be stigmata-like lesions. (c) Recent photograph of the same molar which shows that what seemed to be stigmata lesions were an optical illusion caused by an excess of transparent glue on the crown. Photos: M. Núñez (a) and J. Storå (b).

transparent glue on the molar crown surface (Fig. 1c). The crown of the first molar in question is therefore fully normal.

Nevertheless, we feel that the lesions observed in the Puerto Rico aboriginal crania are consistent with some form of treponemal disease and, consequently, plan on carrying out AMS, stable isotope and aDNA determinations on the Puerto Rico crania to obtain information about their chronology, diet, kin relations, and potential treponemal infection.

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Sanna Lipkin, Taryn Bell, Tiina Väre (eds.) *Archaeologies of Attachment – Emotional Attachments in the Archaeological Record*. **Springer, 2024. ISBN 978-3-031-66569-11. xi, 121 pp.**
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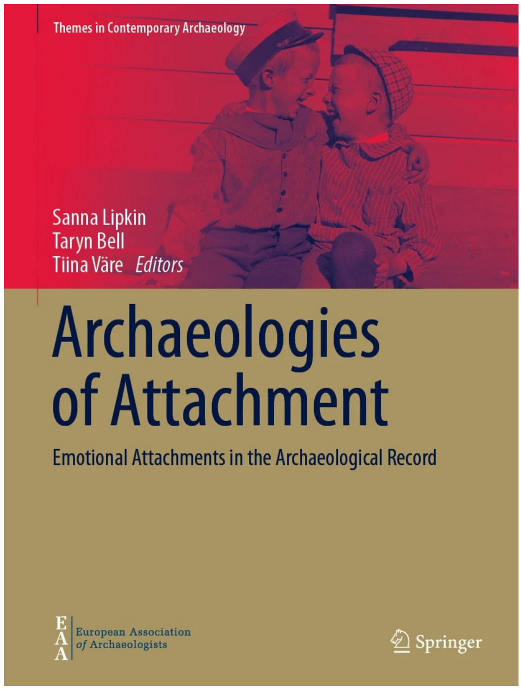

Attachments and emotions. Those mundane yet complex companions that impact our decisions-making, social behaviour and relationships, mood, sleep pattern and appetite. The way we talk and act, the things we lust for and those we try to avoid or fear. Considering that it is often hard to get in terms with and to interpret our own attachments and emotions, let alone those of others, the contributors in the volume 'Archaeologies of Attachment: Emotional Attachments in the Archaeological Record' took a brave leap to the deep end. The book was published in September 2024 as the latest instalment in the European Archaeological Association-backed 'Themes in Contemporary Archaeology' series from Springer.

The volume has its roots in an online session the editors organized in the 27th Annual Meeting of the European Association of Archaeologists hosted by Kiel University in 2021. All three editors have their own niche of interest in emotional and attachment matters: Dr Lipkin (University of Oulu) in emotional attachment, childhood and funeral archaeology. Dr Bell's (University of Leeds) research focuses on object attachments with a time span reaching all the way back to Upper Palaeolithic. Dr Väre's (University of Helsinki) main connection to past emotions is through her research on breastfeeding practices in Finland through stable isotope analyses of archaeological skeletal remains.

There have been some valuable contributions to the study of emotions and affects in archaeology since the beginning of the 21st century (e.g. Tarlow 2000; 2012; Harris 2010; Harris & Sørensen 2010; Creese 2016; Bell & Spikins 2018; Nugent 2019; Bell 2022). Emotions in processes and rituals, such as those connected to burial practices and mourning have also become more prominent in historical research in recent years (see, e.g., McNamara & McIlvenna 2014).

Emotion-centric approaches have not been readily embraced by archaeologists. The main criticism is that emotions are too intangible, individualistic and subjective to study (Nugent 2019, 109). Furthermore, being sensitive about the past or allowing emotions to surface – either past people's or researchers' – are often avoided: archaeology is object- and material-centred, and in this setting the sentient being remains hidden or withdrawn. Archaeology has long avoided speculation on the humane characters, thereby distancing past personhood.

This recent volume under review is a brave and encouraging addendum to the small choir of researchers wrestling with this complex and often overlooked theme. The book is inspired by the psychological theory of attachment and aims to 'improve understanding where and how archaeologists can look for evidence of these attachments' (p. 3). This hands-on orientation is exactly what is needed to make attachment perspectives gain wider foothold in archaeology, and to add new, holistic approaches to the interpretation of material culture, sites and historical sources.

The book is divided into four parts. The first (Chapters 1–2) is introductory. The second part (Chapters 3–6) focuses on social bonds and the third part (Chapters 7–9) on emotional attachments to objects and non-human subjects. The last, fourth part (Chapters 10–11) summarizes the conclusions and presents further applications of attachment theory.

The editors' Introduction represents the reader with the theoretical framework and suggests ways of recognizing attachment and emotional bonds in the archaeological record (Chapter 1). Taryn Bell's article (Chapter 2) sheds light on the versatile uses of attachment theory when interpreting archaeological data in the context of religion, material culture, social relationships and place. Bell's focus is on the Palaeolithic, which shows that emotion-centric approaches should not be overlooked when dealing with prehistoric evidence. Bell gives excellent examples on how, for example, human-animal bond, place attachment and animal depopulation and adaptation in changing circumstances can leave their marks on archaeological material such as burials or art.

In Chapter 3, Tiina Väre digs into the very roots of our mammalian evolution as she explores how breastfeeding and early age attachment have affected psychological resiliency, well-being and infant mortality in eighteenth century Finland. Her approach is based on scientific methods in the research of human remains. Väre brings up interesting aspects regarding early weaning, human behaviour and intergenerational impacts regarding breastfeeding and archaeological remains.

Sanna Lipkin (Chapter 4) approaches attachment and emotions in the context of the Great Wrath (1712–1721), trauma, coping mechanisms and reconciliation. Her research is based on cultural heritage such as historical sources, site-related memorials, folklore and burial evidence. Lipkin's article reminds us that psychological well-being and the effects of stress, trauma as well as positive coping mechanisms can indeed be detected in archaeological material and on archaeological sites. A content warning: Dr Lipkin does not spare the reader from the horrible barbarism of Russians during the Great Wrath.

Saara Tuovinen (Chapter 5) casts light on fictive kinship and its manifestation in archaeological evidence. Fictive kinship is used in the context of family or other affections and attachments that are not based on genetic relations, such as foster parenting. As a case study, she focuses on the nineteenth-century family of the Clementeoffs, a childless couple with two foster daughters. This chapter is a good reminder that, just as in the contemporary world, the family dynamics of past were not always simple or based purely on blood relations.

In Chapter 6, Tibor-Tamás Daróczi ventures into the underworld of prehistoric non-human burials of the Eastern Carpathian Basin. Through Neolithic and Copper Age animal burials, Daróczi builds a picture of emotionally charged, affectuous bond between humans and animals, which includes mainly dogs, but also, for example, sheep, cattle, hare, toad and hedgehog. In terms of archaeological theory, the chapter uses phenomenology to approach burial grounds as meaningful and emotionally loaded sites.

Sometimes object attachment can be complex and problematic. In Chapter 7, Lindsay Büster looks at discard of objects through material assemblages of later prehistory and compares those with contemporary complex object attachments. Her chapter reminds us that objects can have many functions and that just because an artefact survives in the archaeological record, this does not always mean that it was appreciated or valued by its owner. This article (and the third part of the volume with its object-centric approach in general) prompts me to suggest that object biographical approaches (Kopytoff 1986) and the less anthropocentric approach, object itineraries (e.g., Joyce 2012; Hahn & Weiss 2013; Joyce & Gillespie 2015), could in the case of complex object relations emphasize the ontological grounds of attachment theory.

In Chapter 8, we head again to a mortuary as Alessandro Quercia leads us to a first and second century necropolis in Piedmont in northwestern Italy. Quercia's focus is on an artefact assemblage of a five-to-ten-year-old boy's grave. This theme approaches the object attachment from a perspective in memory and identity, value and meaning.

Tuuli Matila (Chapter 9) approaches our times and mundane encounters with objects. The material culture under her inspection are photographs dating back to the years around World War II. Photographs are memories in image form, often emotionally powerful. When we look at a photo, it looks back at us. Through personal, affectuous bond with her own family photos from that era, Matila brings up the position of an observer. The position of the observer and critique of the gaze is crucial in archaeology since politics, trends, opinions and – despite all the requirements for fundamental objectivity – emotions cannot be avoided; they determine where our thinking is focused (Carroll 1993, 245).

In the final commentaries of the volume (Chapter 10 by the editors and chapter 11 by Siân Halcrow), the authors suggest that also the emotions of researchers should be contemplated. I highly recommend this. It is therapeutic and acknowledging one's own emotions and affects as a researcher is an important part of not only the research process, but also of wellbeing. I have recently reflected on my own affects, fears, academic culture shock and emotional bond – lust-love-hate -relationship – to one of my research subjects, a 300-year-old anonymous wreck. In the poetic, biofictive and autobiographical book 'My Darling Wreck – You are a rotting asshole' (2024), I simultaneously felt my own 'wreckness' or vulnerability, and a mindful, existential relationship with those people in the past who had left evidence of themselves as axe strokes on a ship's timber or applied tar, the fragrance still incredibly fresh and intense. Maybe recognizing our own feelings would also help us recognize the feelings of archaeologists and the feelings of archaeology and thus aid us in the study of emotional past. In this reviewed book, Tuuli Matila's chapter on family photographs revealed the researcher's own emotions. The editors do discuss their feelings in Chapter 10 in a very deep and open way. Maybe each chapter could have had their own emotional *post scriptum* or reflection? Or maybe it is the topic for another book?

To sum up, the volume under review prompts the reader to look at objects, places and archaeological evidence in a new, curious way. As the volume puts it, 'attachment theory posits that human behaviour is largely driven by emotions' (p. 38). Archaeology is, to a large extent, about telling tales. Sites and artefacts are interpreted and filtered through stories. And is it not so that any narrative that lacks affects and emotions is a dim and unrealistic abstraction of life, lacking its very essence?

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