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Tuija Kirkinen, Krista Vajanto & Stina Björklund

Animal hair evidence in an 11th century female grave in Luistari, Finland

Abstract
Luistari cemetery in southwestern Finland, is one of the most significant Iron Age and Early Medieval period (seventh to 15th centuries CE) sites with nearly 1,300 excavated inhumation burials. The cemetery has been of great importance for textile research because of the cloth fragments preserved in contact with metal items. The first scientific reconstruction of dress in Finland, the ancient dress of Eura, was based on finds from the 11th century female Grave 56. This paper presents the rich fur and hair finds preserved in Grave 56. The hair and fibre material was identified by their morphological features, using polarised light and scanning electron microscopy (SEM). It is suggested that fur was used for furnishing the grave and for accessories such as a knife sheath and a pouch. The possible remains of fur garments which enhance the current understanding of the outfit of the woman in Grave 56 are also discussed.

Key words: animal hair, hair identification, furs, microscopy, Viking Age, Finland

Introduction

Animal pelts and fur were long assumed to have decayed in archaeological contexts in Finland due to the acidity of the soils. Contrary to this deeply rooted belief, fur remains have proved to be a relatively common find material in the Late Iron Age (800 CE to 1100/1300 CE) and Early Medieval period inhumation burials (Kirkinen 2015; 2019). The Medieval period started in western Finland in 1150/1200 CE and ended in the 1520s CE. The Early Medieval period, also referred to as the Crusades period, prevailed during the period 1025/1075 CE to 1150/1200 CE. In eastern Finland, the dates are some decades later (Haggrén et al. 2015).

Large animal pelts were used for wrapping or covering the deceased, and furs were used for garments and accessories such as sheaths, scabbards and pouches. Instead of sheep or cattle pelt garments, which have been found in Danish bogs (Mannering et al. 2010; 2012; Brandt et al. 2014) and even in Bronze Age Danish oak coffin burials (Brandt et al. 2014; Harris 2014, 122–124; Frei et al. 2015), the most commonly exploited species in Finland were wild animals such as European elk (*Alces alces*) and reindeer (*Rangifer tarandus* sp.), various fur animals (Mustelidae, *Vulpes vulpes, Castor fiber, Sciurus vulgaris*), brown bear (*Ursus arctos*), seals (Phocidae), and mountain hare (*Lepus timidus*) (Schwindt 1893; Tallgren 1931, 170; Tomanterä 1978; Riikonen 1990; Asplund & Riikonen 2007; Kirkinen 2015; 2019).

Despite the number of finds, knowledge about the use of fur garments is relatively limited. The reason for this is that fur has been most often preserved in contact with metal items, where toxic (copper) alloys have prevented the growth of bacteria and fungi (Edwards 1989; Solazzo et al. 2014). In these cases, sometimes only a couple of hairs were found attached to a brooch, which makes the interpretation of findings difficult. The material presented here indicates that in Finland there have been at least two fur clothing traditions: the one here termed Eurasian, in which seal pelts were exploited for trousers or gaiters and reindeer skins for coats; the second is here termed Scandinavian or north European, which applied fur animal skins as collars

Fig. 1: The ancient dress of Eura reconstructed from the evidence of the textiles found from Grave 56 (Image: U. Moilanen - *Peek into the past* project)

and linings while favouring cattle, goat and sheep skins for garments (Kirkinen 2019).

In this paper, the find material from the 11th century Grave 56 in the Luistari cemetery in Eura, southwestern Finland, was analysed for fur and hair remains. This burial is of particular interest because it is the richest grave in Luistari for metal finds and offered good preservation conditions for animal fibres. This can be seen in the quantity of relatively well-preserved textile fragments, which have been a source for a dress reconstruction (fig. 1) (Lehtosalo-Hilander 1978; Tomanterä 1978; Lehtosalo-Hilander et al. 1982). The aim here is to complement the dress with its fur garments for the first time in Finland.

Luistari inhumation cemetery

Luistari cemetery is located in Eura, southwestern Finland, about 80 km north of the city of Turku (fig. 2). With its nearly 1,300 excavated inhumation burials, Luistari is one of the most significant Iron Age and Early Medieval period sites in Finland. The cemetery was discovered in 1969 on a construction site, which opened the way for a full-scale excavation during the period 1969 to 1992 by Pirkko-Liisa Lehtosalo-Hilander (Lehtosalo-Hilander 1982a; 1982b; 1982c; 2000). During recent years, the abundant and well-published find material has provided an ideal basis for the study of osteological remains (Salo 2005), aDNA by the work group Päivi Onkamo (Översti et al. 2019), stable isotopes by the work group Laura Arppe (*Elämänhistoriat hampaissa, 2015-2017*), and microfossils (Juhola et al. 2019).

Evidence for the change from cremation burials to inhumations in Finland first appears in the Eura-Köyliö region during the sixth century CE. In Luistari, the first inhumation burials have been dated to about 600 CE (Lehtosalo-Hilander 2000, 227). From then on, Luistari was in use for several hundred years. In the richest burials, women were clothed in peplos-type dresses, which were fastened by brooches, and supplemented with bronze spiral ornamented aprons, undergarments, and shawls. They also wore ornaments such as necklaces, bracelets, pendants and finger rings made of bronze and silver (Lehtosalo-Hilander 2000, 208–220). In male graves, weaponry and the remains of cloaks, fastened by penannular brooches, have been detected (Lehtosalo-Hilander 2000, 207). In children's burials, bell pendants and sleigh bells, as well as small-sized ornaments, were typical finds (Lehtosalo-Hilander 2000, 221–226). The find material from the graves also included tools such as axes, grinding stones, sickles, and vessels, to name but a few. However, about 70% of the burials were unfurnished, representing the final phase of the cemetery during the 13th to 15th centuries CE (Lehtosalo-Hilander 1997; Salonen 2014, 6, 67).

Luistari has been interpreted as a prosperous peasant community, which acquired wealth through trade as a transit thoroughfare (Lehtosalo-Hilander 1982c, 55, 67–68, 74–76). The role of hunting has been estimated to have been of minor importance in Luistari because no wild animal bones were found in the graves (Lehtosalo-Hilander 1982c, 68). However, analysis of animal hairs and fur from burials provide evidence that wild animal products were supplied either through trade or by hunting (Kirkinen 2015; 2019).

On the basis of the number of burials and the differences in burial customs, Lehtosalo-Hilander (1982c, 57) has interpreted Luistari originally as a graveyard for two families. In the middle of the

11th century, contemporary with the subject of this research, female Grave 56, the estimated population of the nearby Kauttua village was about 30 persons (Lehtosalo-Hilander 1982c, 55).

Female Grave 56

Female Grave 56, known as the "Eura Matron" (*Euran emäntä* in Finnish), was excavated in 1969 by Pirkko-Liisa Lehtosalo (later Lehtosalo-Hilander). The burial has been radiocarbon dated to between 940 CE and 1021 CE (Poz-101914, Juhola et al. 2019), the final phase of the Viking Age (from 800Ce to 1050/1100 CE). Since its discovery, it has been the best known grave in Luistari as a result of the dress reconstruction based on its textile finds (fig. 1).

The rectangular grave pit was WSW-ENE oriented, and the deceased was placed on the back, with arms crossed over the waist. The bone material is relatively scarce because of the acidic soils in Finland, and also because the grave was partly destroyed by a later burial. Wood and birch bark remains provide evidence of a simple wooden structure and that the grave was covered with birch bark (Lehtosalo-Hilander 1982a, 89–94).

The grave goods and dress details (National Museum of Finland NM 18000:1624–1792) consist of a necklace made of 34 glass beads, 11 silver coins, two silver pendants – threaded on a wool string (NM 18000: 1624, 1625). Her peplos-type dress was fastened with convex round brooches, joined together by chains made of bronze. The chains were fastened by two pendants and an equal-armed brooch. On her arms, she wore spiral bracelets, she had two finger rings on each of her hands. At her waist she carried a wide bronze-plated knife sheath. Additionally, there were bronze spiral ornaments sewn into her apron. Some stray spirals suggest that she also had a square shawl and or a headdress. On her left side, there was a broken clay vessel, a shear and a sickle. As a whole, Grave 56 has been estimated to be the richest one in the cemetery (Lehtosalo-Hilander 1982a, 89–94; 1982c, 44).

Owing to the number of bronze and silver items, which prevent the decay of organic material in archaeological contexts, a reasonable quantity of wool textile remains were preserved for research. Inside the spiral bracelets, the remains of sleeves had survived (NM 18000:1683, 1689). This woven fabric was dark blue (rich indigotin) tabby of sz/z-spun yarns with a thread count of 13/9 to 10 yarns per cm. The sleeves were interpreted as the remains of a long-sleeved dress according to ethnographic evidence, although the same fabric did not exist elsewhere in the burial (Lehtosalo-Hilander 2001, 54, 87).

Fig. 2: The location of Luistari cemetery in Eura together with other sites included in the survey (Image: Krista Vajanto)

Fragments from a peplos dress (NM 18000:1648, 1652–1676) contained less indigotin and had a greenish hue. Remains of this dress were found especially around the brooches, chains and pendants, and it was possible to define that the upper edge of the dress had been folded. This garment was made in 2/2 twill of sz/z twisted yarns using 9/8 yarns per cm. The warp ran horizontally in the garment, but the starting and finishing borders had not survived – which made it impossible to define whether or not the dress had been tubular or open at the sides. Tubular selvedges were found, bordered with tablet-woven bands in three colours (NM 18000:1691, 1754), which were situated in the hem and at the rim of the fold. The visible colours of the tablet-woven bands are reddish, light coloured and blue, forming some kind of meander pattern. These were woven using 17 tablets with four yarns in each (Lehtosalo-Hilander et al. 1982; Lehtosalo-Hilander 1982a, 89–94; 2001, 51–52, 57, 87). Light greenish fragments with indigotin originated from a

bronze spiral decorated apron (NM 18000:1730–1763). The spiral decoration was made of drawn bronze thread which formed spiral tubes bordering all the fabric edges and forming rosettes decorating the apron's hem. These fragments were 2/2 twill with tubular selvedges, woven of sz/z-yarns, 9/8 yarns per cm. The warp of this fabric ran vertically and the yarns were finer than those in the peplos dress. The apron had starting and finishing borders, woven with nine tablets in a brick wall pattern. The apron was held at the waist with a strongly reddish tablet-woven band (NM 18000:1690, 1707–1710, 1713, 1715), which had been made with sz-yarns in the warp and zs-yarns in the weft and using 12 tablets with four yarns in each (Lehtosalo-Hilander et al. 1982; Lehtosalo-Hilander 1982a, 89–94; 2001, 53, 87).

Attached to the bronze-plated knife sheath, finger rings and birch bark pieces, there were three coloured fragments made in the needlebinding technique (NM 18000:1680, 1696, 1698, 1700, 1701, 1702). The red and light-coloured yarns have an sz twist, but the blue is s-spun. The red colourant was from madder (*Rubia tinctorum*) or local bedstraws (*Galium* species), the blue was indigoids, while the light-coloured yarn contained very low amounts of red and blue colourants – most likely contamination from surrounding yarns (Vajanto 2014). These fragments might have belonged to striped mittens (Lehtosalo-Hilander 2001, 53, 88). Alternatively, these fragments could be the remains of a pouch, since a detailed examination of the striped structure reveals that there are no remains of a mitten thumb (Vajanto 2014), which was suggested in an earlier interpretation (Vajanto 2003). Birch bark has been explained as the grave's covering (Lehtosalo-Hilander 1982a, 89–94). However, it is worth considering that there was a birch bark lining in the pouch. It has been suggested that this kind of lining material was used in Finnish women's Iron Age conical headdresses (Riikonen 2006, 32).

Some bronze spirals and textile fragments (NM 18000:1765, 1766, 1769, 1789) might be the remains of a square shawl or cloak (Lehtosalo-Hilander et al. 1982, 30). This type of twill shawl, often decorated with bronze spirals, is a common garment in Finnish Iron Age female burials in other inhumation cemeteries (Hirviluoto 1973). Conical wool headdresses are also common (Vahter 1952; Tomanterä 1984; Lehtosalo-Hilander 2001, 68; Riikonen 2006, 26–27), and usually made of a blue textile woven in broken twill. The fragments (NM 18000:1785, 1788) might indicate the same kind of veil or headdress was found in the Luistari Grave 56 too (Lehtosalo-Hilander 2001, 63).

Material and methods

Collection and preparation of samples

The Luistari Grave 56 find material is divided into two groups with the most spectacular finds on display at the National Museum of Finland. This collection was examined visually and the observations documented photographically. Owing to the fragility of the finds, they were not moved from the exhibition for testing such as SEM analysis. The rest of the material, the fragmented metal artefacts, small textiles, pieces of fur, organic dirt and soil samples, are archived in the Archaeological Collection at the Finnish Heritage Agency. The fur and hair finds, which were large enough to be detected by the naked eye, were documented, together with minuscule animal hairs other than wool which were examined with a microscope.

A number of the archived archaeological finds were selected for sampling. The sampling material can be characterised as comparatively fragile and fragmented, especially with regard to the condition of the organic remains, as were the inorganic metal finds, primarily bronze ornaments or fragments of such artefacts. The condition of the sampling material was fairly stable although some of it appeared more degraded than others.

Sampling was prepared and performed on the premises of the Finnish Heritage Agency by a researcher and a conservator. All finds chosen for sampling were photographed with a digital camera before removal. Next, individual finds were placed onto the stage of a stereo microscope (a LEICA S6D StereoZoom microscope with magnification range of 6.3x to 40x with a digital camera, a Leica DMC2900) for sampling.

Before removing the samples, the finds were examined, and their degree of deterioration estimated. The areas for potential sampling were determined by visual inspection under the microscopic. The effects of sampling were considered carefully. The method is invasive, so it is important to perform the sampling in locations where it is considered possible without causing prominent damage to the find.

Each area for sampling was captured in a digital microscopic image including a scale (fig. 3). Image processing allowed for the recording of the sampling location as well as indicating a single sample depicted in each image. Viewed through the microscope, single fibres were separated from the finds with dental instruments and samples were collected with fine metal tweezers or, if necessary, cut with a scalpel. The samples were each put into individual Eppendorf tubes which were labelled appropriately for the sample and the find.

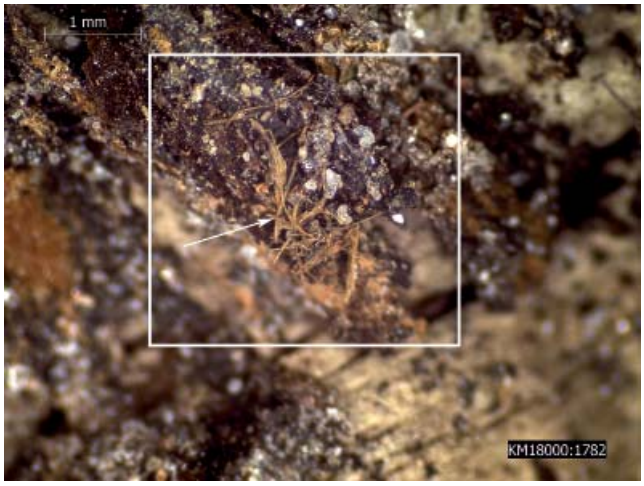

Fig. 3: Microscopic image showing a bundle of hair on the surface of birch bark and other organic matter (NM 18000:1782) from Grave 56. The arrow indicates the location of the sampling (Image: Stina Björklund, National Museum of Finland)

The quantity of sampling material was limited. The fragility and fragmentary nature and degree of deterioration of the material determined the quantity as well as the quality of samples. Considering the characteristics and condition of each find, samples with varying features such as colour, shape, size and texture were removed. The aim was to obtain only the quantity needed to address the research questions.

The sampling was further documented in find specific conservation reports with all the essential information. All the documentation and the sample slides for analysis were organised and archived according to the practice of the organisation responsible for the maintenance of the finds. The samples were prepared for transmitted light microscopy examination by mounting them in transparent nail polish on objective glasses. The material was studied with visible and polarised light microscopy, using a Leica DM 2000 LED microscope with 100x to 400x magnification. The material was documented with Leica ICC50 W. The same fibre materials were also prepared for scanning electron microscopy imaging by soaking the objective glasses in acetone to remove the nail polish. Revealed fibres were plucked with sharp tweezers and placed on double-sided carbon tape that had been fixed on aluminium stubs. The SEM samples were coated with Leica ACE 600 sputter coater with a 12 nm layer of carbon, to diminish the charging effect and drifting while imaging. SEM imaging was performed with Zeiss Sigma VP, with a secondary electron detector and using an acceleration voltage of 3 kV.

Fibre identification

The morphological identification of animal hairs was based on the diameter of the hair and the structures of medulla and cuticular scales (Goodway 1987; Chernova 2002; Tridico 2005). For the identification, the keys on Teerink (2003), Rast-Eicher (2016) and Tóth (2017) were applied. The terminology mainly follows Tóth (2017). Next, the samples were compared with a reference collection of Fennoscandian species, collected at the Natural History Museum, University of Helsinki. For the identification of domestic animals, the material was referenced with samples collected from north European domestic breeds. Proteomics, MSPS or other scientific methods were not considered for species identification because of the minuscule size of the samples and limited number of hairs.

Results

Animal hair and fur

The evidence for the use of fur and pelts in the furnishing of the grave, clothing the corpse, and manufacturing grave goods consisted of three kinds of source material (fig. 4 and table 1). First, relatively large pieces of fur and clumps of loose hair were already recorded during the excavation and listed in the find catalogue. Second, minuscule hair fragments were detected when viewing the finds microscopically. Finally, hair impressions on the surfaces of metal items such as brooches were recorded. A soil sample (NM 18000:1779) taken from a dark structure on the leg area of the grave was analysed by Juhola et al. (2019). No remains of animal hairs were found in that sample.

Pieces of Furred Skin and Clumps of Loose Hair: Three pieces of furred skin (NM 18000:1742) measuring 10.9 mm x 7.4 mm, 13.5 mm x 2.3 mm and 19.3 mm x 4.6 mm were excavated near the deceased's waist. Furry skin remains were also detected inside a wide bronze-plated knife sheath (NM 18000:1703; Lehtosalo-Hilander 1982b, 48). Finally, clumps of loose hair (NM 18000:1706, 1721, 1743, 1749, 1750; Lehtosalo-Hilander 1982c, 68) were preserved in contact with the bronze-plated knife sheath and the apron's bronze spiral decorations, as well as on the bottom layer of the grave. Lehtosalo-Hilander (1982c, 68) interpreted the hairs as the remains of a deer pelt.

Minor Hair Fragments: Long hair fragments measuring 0.6 mm to 4 mm, with some even 15 mm to 30 mm, were detected from 30 contexts through the microscopic examination of the textiles, metal items and organic dirt. From three contexts, tiny pieces

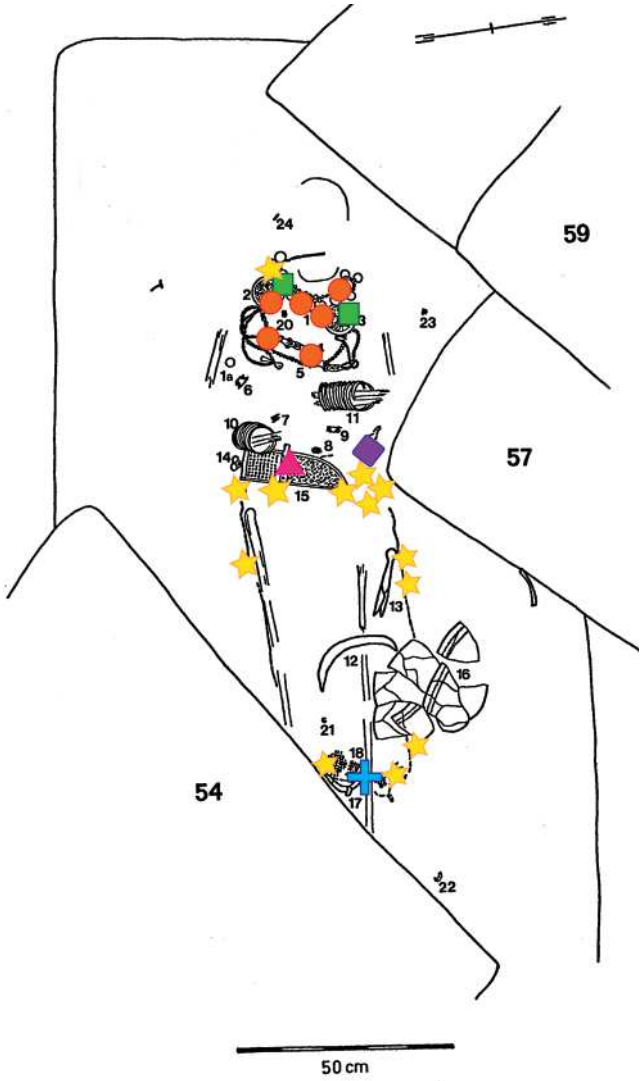

Fig. 4: The distribution of hair and fur in Grave 56 in Luistari, Eura: Star = reindeer; triangle = *Felidae*; rhomboid = otter; circle = brown bear; cross = *Canidae*, square = *Mustelidae* (Image: Tuija Kirkinen; map after Lehtosalo-Hilander 1975, 65)

of furred skin were found (fig. 4). In addition, some loose hairs were detected in the material that was on display at the National Museum of Finland. Hairs were present especially on the hem of the apron, close to its bronze spiral decorations.

Hair Impressions: Hair impressions were detected on the underside surfaces of round convex brooches (NM 18000:1652, 1660), and on the upper surfaces of a finger ring (NM 18000:1681) and spiral bracelets (NM 18000:1682, 1685). The impressions look like loose, relatively long hairs (1 cm to 2 cm). No further analyses were made because of the fragile nature of these items.

Identification of hairs

Wild Forest Reindeer Hair: The most numerous and best preserved loose hairs and hair clumps were identified as (wild forest) reindeer (*Rangifer tarandus*). The guard hairs were identified as *Cervidae* by the bottleneck shaped base and filled multiserial, spongoid type medulla with round cells (fig. 5a). The medullary index is almost 1. Scales are mosaic-like and scale margins smooth. *Rangifer tarandus* sp. was differentiated from *Alces alces* (Tóth 2017, 220–221) by the width of the hairs (maximum 390 µm) and by the number of rows of medullar cells (≤ 10). In addition, the average value of the width of scales is lower in reindeer (in the reference samples the mean is 14 µm) compared to European elk (25 µm), so the measurements (12 µm to 14 µm) of Grave 56 material support the hypothesis that this is a reindeer pelt. Because reindeer and European elk were the only *Cervida*e species present in Finnish fauna during the Viking Age (Ukkonen & Mannermaa 2017; pers. com. Kristiina Mannermaa 2019), comparisons to other *Cervidae* species were not made. However, there is still room for consideration of whether the pelt was of a wild forest reindeer (*Rangifer tarandus fennicus*) which was still living in the southern Finland area during the 17th century, or a semi-domesticated reindeer (*Rangifer tarandus*) living in the northern parts of Fennoscandia.

Reindeer hairs were found on the top of the apron's bronze spiral decoration, beside the body and under the knife sheath in a total of 21 different places in the grave (fig. 4). This suggests that the lower body of the deceased was covered with a reindeer pelt. It seems that the impressive knife sheath was not covered by the pelt; instead, it was placed above it in order to be seen. Single *Cervidae* hairs were also found in the neck area of the deceased but not in contact with the metal items in the chest area. Therefore, these are likely to be loose hairs from the pelt.

Felidae Fur-Lined Knife Sheath: A wide bronze-plated knife sheath (NM 18000:1703) was placed on the right side of the body's waist. According to Lehtosalo-Hilander (1982a, 92; 1982b, 48), inside the sheath, there were two layers of furred skin, the lower one of which was placed with the furry side inside, while the upper one had the skin side inside, with the hairs against the bronze plate.

The fur was identified as *Felidae*, which is lynx (*Lynx lynx*) or domestic cat (*Felis catus*), which are the two possible species in Finland. The identification of guard hairs was based on the fine grained structured multicellular medulla with large air sacs (fig. 5e). The

Catalogue sub number (NM)	Sample	Species identification	Diagnostic features of hair	Identification references
1644 (a)	Organic material under a silver coin pendant on the neck.	*Carnivora/ Ursus arctos*	Guard hair, dark brown in colour. No medulla. Scale pattern irregular waved, scale margins rippled. Width 59 µm, length 2.2 mm.	Tóth 2017; Rast-Eicher 2016
1644 (b)	Organic material under a silver coin pendant on the neck.	*Mustelidae* sp.	Underhair. Medulla structure is unicellular ladder. Scale pattern in the proximal part is rhomboidal (diamond) petal and in the distal part broad petals and coronal. Width 13.1 µm, length 13 mm.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1646 (a)	Organic material on the top of a silver coin pendant on the neck.	*Carnivora/ Ursus arctos*	Guard hair, dark brown in colour. Medulla not visible, scales badly preserved. Width 51.1 µm, length 3 mm. Fine hair, light yellow in colour. No medulla, broad petal and rhomboidal scales. Width 21.1 µm, length 3 mm.	Tóth 2017; Rast-Eicher 2016
1646 (b)	Organic material on the top of a silver coin pendant on the neck.	*Cervidae* sp./ *Rangifer tarandus*	Guard hairs. Medulla is multiserial, spongoid type with round or polygon shaped cells, medullary index is almost 1. Scales mosaic-like, scale margins smooth. Width 155 µm, length 0.7 mm.	Tóth 2017
1646 (c)	Organic material on the top of a silver coin pendant on the neck.	Unidentified/ *Ursus* ?	Guard hair, dark brown in colour. Medulla not visible, scales badly preserved. Width 61.3 µm, length 1.7 mm. Fine hair, yellowish in colour. No medulla, scales badly preserved, some broad petal-like scales. Width 19.4 µm, length 1.7 mm.	Tóth 2017; Rast-Eicher 2016
1652	Hair sampled from the organic material excavated under a round convex brooch on the shoulder.	*Mustelidae* sp /*Mustela erminae*	Guard / intermediate hair, dark in colour. Medulla structure in the central shaft is chambered multicellular (crescented), medulla margins scalloped. Scale pattern in the shaft is rhomboidal petal, in the shield irregular waved with rippled margins. Width 37.9 µm, length of a complete hair is 15 mm.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1654 (a)	Organic material from the top of a round convex brooch on the shoulder.	Unidentified	Guard hair, root section, light brown in colour. Root bulb knobby-like, medulla amorphous continuous, medullary index 0.3. Scales irregular mosaic. Width 44.8 µm, length 0.6 mm.	
1654 (b)	Organic material from the top of a round convex brooch on the shoulder.	*Carnivora/ Ursus arctos*	Guard hair, dark brown in colour. Medulla estimated as relatively thin, hollowed out. Scale structure diagonal waved. Width 46.7 µm, length 1.4 mm.	Tóth 2017; Rast-Eicher 2016
1670	Organic material under the iron pendant on the chest.	Unidentified/ *Ursus arctos?*	Guard hair, brown in colour and underhair, light yellow in colour. Guard hair medulla hollowed out, no scales preserved. Underhair are non-medullated, scales rhomboidal and broad petal. Width 50.9 µm (guard hair) and 23.7 µm (underhair), length max 0.9 mm.	Tóth 2017; Rast-Eicher 2016
1674	Organic material from the top of a bronze chain on the chest.	*Carnivora/ Ursus arctos*	Guard hair, dark brown in colour. Medulla badly preserved and hollowed out. Scale structure rhomboidal petal and irregular waved/chevron-like. Width max 54 µm. Underhair, light yellow in colour. Medulla thin, continuous/interrupted, scale pattern broad petal. Width max 27.8 µm. Several pieces, lengths 1-2 mm.	Tóth 2017; Rast-Eicher 2016

Table 1: Description and identification of hair and fur excavated from the Luistari cemetery in Eura, Finland in 1969 now in the Archaeological Collection at the Finnish Heritage Agency

Catalogue sub number (NM)	Sample	Species identification	Diagnostic features of hair	Identification references
1703	A small piece of fur inside the bronze-plated knife sheath.	*Felidae* sp.	Guard hair, yellowish in colour. Medulla is fine-grained structured, chambered multicellular, medullary index 0.7, medulla margins fringed. Scale pattern is broad petal and irregular waved mosaic. Width max 61.1 µm, length max. 4 mm.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1706	Hairs on the top of textile near the bronze-plated knife sheath on the waist. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1711	A small amount of hair was preserved under the bronze-plated knife sheath. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1712	Organic material and textile remains preserved under the bronze-plated knife sheath.	*Cervidae* sp./*Rangifer tarandus*	Guard and underhairs. Medulla is a multiserial, spongoid type with round or polygon shaped cells, medullary index is 0.9-1. Scales mosaic-like, scale margins smooth. Width max 162 µm (guard hair), length max 1.2 mm.	Tóth 2017
1714	Organic material and some hairs near the tip of the bronze-plated knife sheath near the waist. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1721	Hair below the bronze-plated knife sheath near the waist.	*Cervidae* sp./*Rangifer tarandus*	Guard hairs. Medulla is multiserial, spongoid type with round shaped cells, medullary index is almost 1. Scales mosaic-like, scale margins smooth. Width 300 µm, length 15 mm.	Tóth 2017
1724	Organic material beside a finger-ring on the right hand. Fibres were too small for sampling.	Unidentified	No sample.	
1726	Organic material in contact with bronze-plated knife sheath near the waist.	Unidentified	Guard and underhairs. The medulla of the guard hair is hollowed out. In underhairs, the medulla is thin continuous. Width 81 µm (guard hairs) and 29.9 µm (underhairs).	
1732	Fibres in contact with apron's bronze spiral ornament.	Unidentified	A possible piece of skin tissue with guard and underhairs. Width (guard hairs) 32.3 µm, and (underhairs) < 10 µm.	
1736 (a)	Hair in contact with apron's bronze spiral ornament near the waist.	*Cervidae* sp./*Rangifer tarandus*	Guard hairs. Medulla is multiserial, spongoid type with round shaped cells, medullary index is almost 1. Scales mosaic-like, scale margins smooth. Width 182 µm, length 18 mm.	Tóth 2017
1736 (b)	Piece of fur in contact with apron's bronze spiral ornament near the waist.	Unidentified	Badly preserved black guard and underhairs.	

Table 1 (cont.): Description and identification of hair and fur excavated from the Luistari cemetery in Eura, Finland in 1969 now in the Archaeological Collection at the Finnish Heritage Agency

Catalogue sub number (NM)	Sample	Species identification	Diagnostic features of hair	Identification references
1741	Organic material under apron's bronze spiral ornaments near the waist. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1742 (a)	A hair from the surface of a piece of fur from the left side of the body, near the waist (see below).	*Lutra lutra?*	A long guard hair, dark brown pigmented in colour. Medulla is chambered multiserial by structure, the width of the medulla varies, medullary index max 0.6. Medulla margins strongly scalloped. Scale pattern irregular waved mosaic, scale margins rippled. Width 52.3 µm, length 13 mm.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1742 (b)	A small piece of fur from the left side of the body, near the waist (see above).	Unidentified/*Lutra lutra* ?	A tiny sample of fur, underhair 25 µm in width, no medulla, scales not preserved. The width and the lack of medulla match with otter (see above).	Rast-Eicher 2016
1743	Hair under apron's bronze spiral ornaments on the top of the hip bone.	*Cervidae* sp./*Rangifer tarandus*	Guard hair. Medulla is multiserial, spongoid type with round shaped cells, medullary index is almost 1. Scales mosaic-like, scale margins smooth. Width 370 µm, length 12 mm.	Tóth 2017
1745	Hair in contact with apron's left side bronze spiral ornaments.		Badly preserved guard and underhairs, length max 3.3 mm. In guard hairs, medulla is multiserial, spongoid type with round shaped cells, medullary index is almost 1.	Tóth 2017
1746	A small amount of hair in contact with apron's left side bronze spiral ornaments. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1748	Organic material in contact with apron's bronze spirals. The material consists mostly of (coffin) wood.	Unidentified	Guard hair. Thin medulla partly destoyed. Width 56.6 µm, length 6 mm.	
1749	Fur remains from the left side of the body were listed in the find catalogue. The NM sub-number was not found from the archaeological collections.			
1750	Hair in contact with apron's left-side bronze spiral ornament.	*Cervidae* sp./*Rangifer tarandus*	Guard hair. Medulla is multiserial, spongoid type with round shaped cells, medullary index is almost 1. Scales mosaic-like, scale margins smooth. Width 390 µm, length 11 mm.	Tóth 2017
1751	Hair and organic material under the bronze spiral ornament. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017

Table 1 (cont.): Description and identification of hair and fur excavated from the Luistari cemetery in Eura, Finland in 1969 now in the Archaeological Collection at the Finnish Heritage Agency

Catalogue sub number (NM)	Sample	Species identification	Diagnostic features of hair	Identification references
1759 (a)	A hair from apron's hem in contact with bronze spiral ornaments.	*Canidae* sp.	Guard / intermediate hair, dark brown pigmented in colour, bicolorate or banded. Medulla uniserial regular to uniserial chromosomal in the shaft, and chambered multiserial in the shield. medullary index in the shield is 0.7. Scales rhomboidal petal and diagonal mosaic in the proximal shaft, petal-like and irregular waved in the shield, scale margins rippled. Width 34.5 µm, length 30 mm.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1759 (b)	A small amount of hair from the apron's hem in contact with bronze spiral ornaments. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1762	Organic material and hair on the top of apron's hem. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1764 (a)	Hair in between the coffin wood and the apron.	Unidentified	Guard hair, brown in colour. No medulla. Width 41.4 µm, length 0.56 mm.	
1764 (b)	A small amount of hair under the apron. No sample was taken.	*Cervidae* sp.	Badly preserved flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1780	Organic remains from the grave, no information about their precise location, probably on the top of the head / chest area.	Unidentified/ *Carnivora*	A piece of skin with guard and underhairs. Guard hair dark brown in colour. Medulla continuous amorphous, medullary index 0.3. Scale structure mosaic transversal regular with smooth edges and waved regular with rippled edges. Width max 42.7 µm, length 0.76-1.9 mm. Underhair possibly same as 1736.	Teerink 2003; Tóth 2017; Rast-Eicher 2016
1782 (a)	Hair from the surface of birch bark in the upper part of the grave.	Unidentified	Badly preserved hairs, light yellow in colour. Widths 21.2 and 27.3 µm, lengths 0.8-1.9 mm.	
1782 (b)	Hair from the surface of birch bark from the upper part of the grave.	*Cervidae* sp.	Badly preserved flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1784	A small amount of hair and organic material on the right hip of the deceased. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017
1787	A small amount of hair and organic material on the back side of the deceased. No sample was taken.	*Cervidae* sp.	Flattened light brown hairs were microscopically identified as *Cervidae* hairs.	Tóth 2017

Table 1: Description and identification of hair and fur excavated from the Luistari cemetery in Eura, Finland in 1969 now in the Archaeological Collection at the Finnish Heritage Agency

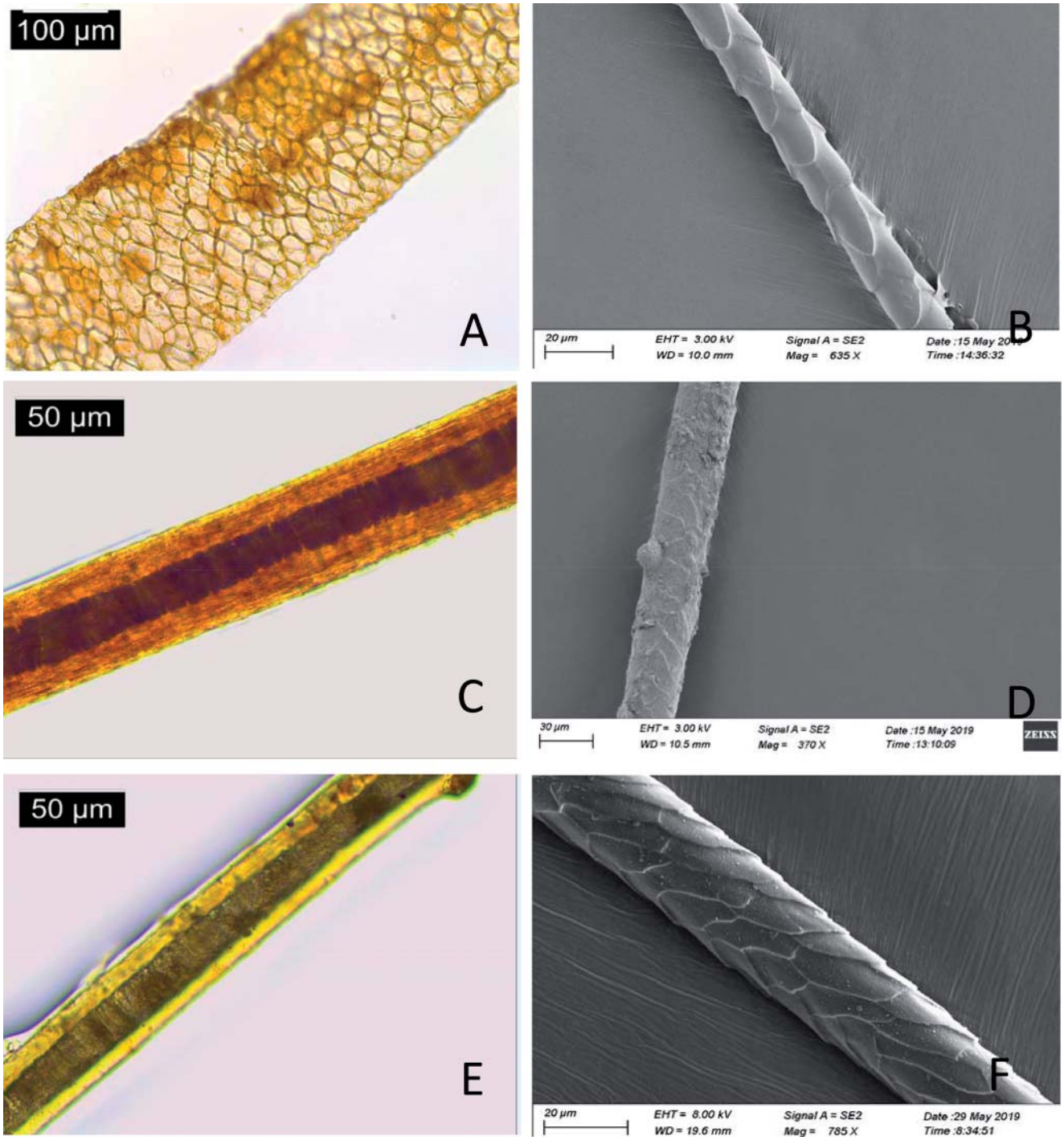

Fig. 5: a) Reindeer, sample NM 18000:1721; b) *Mustelidae*, sample NM 18000:1652; c) Otter, sample NM 18000:1703; d) Predator/brown bear, sample NM 18000:1674; e) *Felidae*, sample NM 18000:1703; and f) *Canidae*, sample NM 18000:1759 (Images: Tuija Kirkinen and Krista Vajanto)

medullary index is 0.7 with fringed medulla margins. The scale pattern is broad petal and mosaic in type.

Otter Fur: Three pieces of fur (NM 18000:1742), excavated from the corpse's left side waist, were identified tentatively as otter (*Lutra lutra*). The identification of guard hair was based on the chambered multiserial medulla structure with air sacs. The medullary index is a maximum of 0.6, and the medulla margins are strongly scalloped

(fig. 5c). The scale patterning is irregularly waved, where it is preserved. The underhairs are non-medullated.

Brown Bear/*Carnivora* Hair: On the upper half of the body, minuscule guard and underhairs are preserved above the bronze, silver and iron ornaments. The hairs are fragile and poorly preserved. The medulla of the guard hair is hollowed out. The original width of the medulla can be regarded as relatively narrow, with a maximum medullary index of 0.3, which excludes most fur animals. The scale pattern is irregularly waved mosaic. The underhairs are non-medullated, and their scale structure is broadly rhomboidal (fig. 5d). These hairs were identified as *Carnivora*, and tentatively as brown bear (*Ursus arctos*).
Hairs were sampled from five contexts above the silver coin pendants on the neck area (NM 18000:1644, 1646), the convex round brooch on the shoulder (NM 18000:1654), the bronze chain (NM 18000:1674) on the chest, and under an iron pendant (NM 18000:1670) on the chest. This suggests that the upper half of the corpse was either covered with a brown bear pelt, or she was wearing a fur garment.

Mustelidae sp. Hair: Single guard and underhairs were recovered under the necklace (NM 18000:1644) and the round convex brooch (NM 18000:1652). These hairs were long (maximum 15 mm) and relatively well preserved. The guard hair was identified as *Mustelidae* on the basis of a chambered multicellular, crescented (Teerink 2003, 10) medulla structure in the central shaft, with scalloped medulla margins. The scale pattern in the shaft is rhomboidal petal while in the shield it is irregularly waved with rippled margins. In the underhairs, the medulla structure is unicellular ladder. The scale pattern in the proximal part is rhomboidal (diamond) and in the distal part broad rhomboidal coronal (fig. 5b).

Canidae sp. Hair: A single 3 cm long guard or intermediate hair was identified as *Canidae* sp. The hair is dark brown pigmented in colour, bicolorate or banded. The medulla is uniserial regular to uniserial chromosomal in the shaft, and chambered multiserial in the shield. The medullary index in the shield is 0.7. The scales are rhomboidal petal and diagonal mosaic in the proximal shaft, and petal-like and irregularly waved in the shield, with rippled scale margins (fig. 5f). The hair was found at the hem of the apron (NM 18000:1759).

Discussion
The investigation provided evidence that reindeer, brown bear, *Felidae*, *Mustelidae*, otter, and *Canidae* hairs and fur were present in the find material excavated from female Grave 56 in Luistari. Besides the fur and pelt remains noted during previous research, the microscopic examination of the finds revealed numbers of minuscule fibres other than sheep's wool. However, the identification of these hairs is uncertain owing to their length and, as a result, the limited number of diagnostic features available.
In addition to differences in the quantities of preserved fibres, there were also discrepancies in the preservation of the hairs depending on their location and the species in question. For example, *Cervidae* hair preserves relatively well in Finnish acidic soils (Kirkinen 2015, 106), which was the case in the Luistari Grave 56. Accordingly, the hairs which were found under the metal items were in better condition than the ones preserved above the artefacts. The *Canidae* hair (NM 18000:1759), which was found on the hem of the apron, was exceptionally well preserved. As a single hair, it was interpreted as contamination. In the following section, each of the identified species is discussed in detail with interpretations about the original function of the fur and hair.

Reindeer pelt
Most of the hairs were identified as wild forest reindeer or *Cervidae*. The distribution of the hairs indicates that the lower half of the deceased was covered with a reindeer pelt, except the impressive bronze-plated knife sheath which was placed above it.
Furnishing a grave with reindeer and European elk pelts was a relatively common tradition in Finland during the Viking Age and Early Medieval period (Tallgren 1931, 170; Asplund & Riikonen 2007; Kirkinen 2015; 2019). In northern Finland among the Sámi, reindeer pelts were still in use during the 17th century (Leppäaho 1937; Kirkinen et al. 2019). *Cervidae* pelts have also been found in the Luistari cemetery in graves 90, 377, 381 and 404 (Lehtosalo-Hilander 1982c, 68; Kirkinen 2015, Appendix 1). The covering and wrapping of bodies in *Cervidae* skins has been interpreted as a long-standing north Eurasian tradition, which facilitated a transition from the realm of the living to that of the dead (Kirkinen 2015; 2019).

Brown bear pelt or garment
Brown bear hairs, which were detected from the organic material excavated above the metal items, hypothetically indicate the covering of the deceased's

Fig. 6: a) Traditional sieppuri made of bear pelt. Utsjoki, Finnish Lapland (S3168:34) (Image: Tuija Kirkinen); b) Traditional garment made of a whole bear cub pelt. Acquired by JohanTuri in the Russian part of Lapland in 1914. Belongs to the National Museum of Denmark (NM K.264) (Image: Roberto Fortuna, National Museum of Denmark)

upper half with a bear pelt. In Finland, bear pelts are known to have been used in cremation burials especially from the fourth to the 11th centuries CE, where the burnt third phalanges (the remains of claws) indicate the presence of bear skins together with the corpse (Petré 1980; Schönfelder 1994; Mäntylä-Asplund & Storå 2010, 62; Kirkinen 2017). In inhumation burials, bear hairs have been found only occasionally from Luistari, from the Kekomäki cemetery in the Karelian Isthmus, and from Ristimäki cemetery in southwestern Finland (Kirkinen et al. 2020). Bear pelt remains have also been found in the 17th century Mukkala forest Sámi cemetery in eastern Lapland (Kirkinen et al. 2019).

Bear hairs might also originate from a fur garment, which is familiar from ethnographic sources among the Sámi. Sámi men especially used to wear a traditional *sieppuri*, a short cape made of bear or wolverine pelt. It was a simple garment, which was usually made of the front part of a bear by cutting a V-shaped hole for the neck. The garment was lined with a red wool fabric, which formed a pouch used for carrying hunting equipment (Schwindt 1893, 145; Sirelius 1912, 47-52; Itkonen 1948a, 339). The bear's head skin with its ears, nose and eye holes was placed in the front (fig. 6a). A whole skin might be used for a similar type of a garment (fig. 6b).

Whether as a pelt or a garment, a bear skin must have been a bold statement for the mourners. First, it was by no means a common grave gift. Second, the bear had a central role in Finno-Karelian epic tradition, at the core of which was the idea of the bear's divine origin and its relationship to humans as a forefather and as an ancestor. The special relationship between women and bears has been identified, especially in the case of the ritualistic slaying of a bear, which culminated in the wedding of the bear and a maiden (Tarkka 2005, 272–282; Pentikäinen 2007, 65, 71; Siikala 2012, 389). This was said to be the origin of heroes with human mothers and bear fathers (Pentikäinen 2007, 25; Frog 2014, 402). Therefore, it is reasonable to assume that the bear pelt in Grave 56 had a strong symbolic function.

Mustelidae garment

The well-preserved *Mustelidae* hairs, which were found on the neck (NM 18000:1644) and shoulder (NM 18000:1652) areas, are difficult to interpret. The hairs were found under both the necklace and the round convex brooch, and no fibres were found above these artefacts. Accordingly, on the background of the round convex brooches, 1 cm to 2 cm loose hair impressions, different from textile impressions, were detected (fig. 7). These impressions cannot, however, be separated

Fig. 7: Hair impressions on the background of the round convex brooch (NM 18000:1652) (Image: Tuija Kirkinen)

from sheep hairs without further investigation. Similar kinds of hair impressions were found on the surfaces of spiral bracelets and on one finger ring. It is highly unlikely that the peplos-type dress was fur-lined in its upper part. The *Mustelida*e hairs may originate from an as yet unknown fur or fur-lined garment in the grave. It is also possible that the *Mustelidae* hairs come from a garment which the "Eura Matron" used during her lifetime.

Otter fur pouch

The location of the pieces of otter fur near the deceased's waist may indicate that the fragments were remains of a pouch. These kinds of pouches, made most often of leather or *Mustelidae* fur, have been found in Late Iron Age burials in Finland (Schwindt 1893, 146–147; Lehtosalo-Hilander 1982b, 67; Kirkinen et al. 2019). The pouches were carried at the waist, tied with a tablet-woven belt, and used for carrying silver coins and fire-making supplies, for example. However, in Grave 56, no such finds that might have been kept inside the pouch were found.

Felidae-lined bronze-plated knife sheath

Compared to simpler sheaths, which were manufactured of leather or birch bark, a wide bronze-plated knife sheath undoubtedly represented wealth. Pirkko-Liisa Lehtosalo-Hilander (1982b, 48-49) has noted that the uniform design of this sheath type indicates they were manufactured by only a limited number of workshops. Fur-lined knife sheaths have been excavated from southwestern Finland cemeteries, for example, from Ristimäki, where they were lined with *Canidae* fur (Kirkinen et al., forthcoming) and Kirkkomäki, where they were lined with red squirrel, seal, and *Bovidae* pelts (Riikonen 1990, 25–26; Lehto 1993, 33; Kirkinen 2015).

Conclusion

Harris (2008) has drawn attention to the fact that of the total amount of organic material found in burials, textiles have received much more attention than fur remains. Harris has suggested the reason for this phenomenon by reference to a hierarchy of interest in research which values weaving as a developing technology and sees animal skins as insignificant and unchanging. In Finland, research on Iron Age and medieval clothing cultures have largely concentrated on textiles, whereas fur garments have not been taken into account when, for example, making reconstructions of Iron Age clothing (see Lehtosalo-Hilander 1984; Luoma 2003).

Evidence for fur is nevertheless plentiful in Finnish Late Iron Age and medieval burials, where pelts were used for furnishing the grave, for accessories and furlinings, and for garments such as mittens, coats, trousers, and shoes (Kirkinen 2015; 2019). Compared to Danish bog finds, which provide evidence for the dominance of domestic animal pelts (Mannering et al. 2010; 2012; Brandt et al. 2014), in Finland, most of the identified furred skin remains originate from wild species, especially from *Cervidae*, predators, and small fur animals.

In this paper, fur and hair remains excavated in 1969 from female Grave 56 at the famous Luistari cemetery has been analysed. This research shows that fur and pelts were essential materials in this richly furnished grave. The covering or clothing of the corpse with reindeer and brown bear pelts before the coffin was closed with a layer of birch bark must have been visually impressive. In addition, the use of fur for garments and accessories such as a pouch and a fur-lined knife sheath correlates with the estimated wealth of the burial. This method of using birch bark and reindeer pelts in burials is familiar from Viking Age and Early Medieval graves in southern Finland (Schwindt 1893; Cleve 1978, 82; Lehtosalo-Hilander 1982a, 35; Kirkinen 2019). In the research literature, these materials have been commonly connected to Sámi ethnicity and Sámi burial practices (Itkonen 1948b, 350; Manker 1961; Storå 1971, 87, 95–96, 106; Zachrisson 1997; Svestad 2007; 2011). This is an interesting hypothesis in line with the assumed distribution of southern Sámi groups, based on historical records, place names and recently by aDNA

analysis (Aikio 2012; Taavitsainen 2014, 1074–1075; Lamnidis et al. 2018).

However, the question of whether Grave 56 can be identified as Sámi remains an open one. Thus far, there is no aDNA analysis from the burial. In addition, the way in which the *Cervidae* pelts were used to furnish the graves exceeds the known distribution of early Sámi groups. Therefore, to connect reindeer pelts to any specific ethnic group is highly questionable. Finally, the microscopic examination of the samples collected in the vicinity of the metal items revealed minuscule hair fragments for further analysis. This result demonstrates the need to systematically collect the soil and dirt around metal items during excavation. In order to acquire a more detailed picture of the role of fur garments in burials, these questions could be better answered by a more thorough analysis of the evidence from Luistari.

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Author:
tuija.kirkinen@helsinki.fi