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A comparative osteological and intra-site spatial analysis of *tarand*-graves

MA dissertation

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1 Introduction

Intensive comparative osteological analysis accompanied with spatial analysis is an approach that has not yet been undertaken in Estonia. All of the studies that have been made so far tackle only some of the aspects of data that well excavated osteological material have to offer. Unfortunately, a brief look on the material does not explain much, more likely creates questions. Why did people have two separate ways of burial in the same grave? What did the way of burial depend on? How did the human remains become fragmented and commingled? What were the different grave areas meant for?

Wanting to find answers to the previous questions is one of the reasons I have chosen to analyse ancient human remains. In order to be informed of the latest osteological techniques and to gain practical knowledge supervised by the best in Europe, I completed MSc course on Human Osteology and Funerary Archaeology in the University of Sheffield.

This project will be focusing on Early Iron Age (500 BC – AD 450) structurally distinctive monumental stone graves in Northern Estonia. The work is centred on Viimsi I *tarand*-grave, its intra-site spatial and osteological analysis. The *tarand*-grave of Võhma Tandemäe is also comprised as most of the grave contents was analysed to acquire comparative data for Viimsi I. Altogether 524 different contexts of various sizes of cremated and inhumed human remains from Viimsi I and Võhma Tandemäe graves were analysed, so that the study grasps a great number of individuals and many different burial activities.

I started this project hoping to broaden knowledge about burial customs in Early Iron Age Estonia and to see whether the handling and placement of the bones inside the Viimsi and Võhma Tandemäe *tarand*-graves was arbitrary or the buriers had followed certain rituals that have left their mark on the material. Based on the previous studies of Viimsi I grave, the prospect of finding traces of bone-related rituals looked promising and identifying the reasons behind the actions seemed challenging.

Of course, any of the found trends need to be rechecked on more burial places as an analysis of two graves cannot be fundamental. Nevertheless, the following should cover at least one small chapter of the future deep knowledge on that topic.

This dissertation benefited greatly from the knowledge, input, feedback and guidance of my supervisors, Marge Konsa and Pia Nystrom, who I thank sincerely. I am also grateful to everyone else who has given me feedback on the work and allowing me to use their collections of articles and books. Also I would like to thank the people from Tallinn Universtiy Institute of History who have helped me to find the way in their endless corridors.

1.1 Background

To start with, I will give the reader a brief insight to the archaeological background of Early Iron Age Northern Estonia, grave contents and location in relation to other archaeological assemblages.

1.1.1 Archaeological assemblages

The society of Early Iron Age Estonia is reflected in many, mostly monumental archaeological sites. First, hill-top and unenclosed settlements can be observed (Lang 2007b: 89). Hill-top settlement sites have been dated to 1^{st}-2^{nd} centuries AD and are located in the vicinity of open settlements and stone graves (*ibid.*:90–91). That indicates that the archaeological sites once formed a fully functioning habitation complex that served a possibly hierarchical society (*ibid.*: 92). Several fossilized field systems have been radiocarbon dated to Pre-Roman Iron Age illustrating the agricultural life (*ibid.:* 117).

The building of monumental stone cist graves continued through Pre-Roman Iron Age (500 BC – AD 50), but the grave form started slowly changing (Lang 2007b: 98). First, the building of Bronze Age stone cist graves was gradually replaced by building cairn graves[1], *tarand*-graves and probably some other ways of burial that have not left marks on the ground (*ibid.*: 100–101).

During Roman Iron Age (AD 50–450), the archaeological knowledge largely comes from burial places as they have been excavated the most (compared to other assemblages from the same period) (Lang 2007b: 125). Some new archaeological landmarks: iron smelting sites, offering sites appear on the landscape (*ibid.*: 159, 163). The social organisation was probably similar to the one during Pre-Roman Iron Age (*ibid.*: 167).

It seems that during the Early Iron Age the society was not very unsettled, but some social stratification had occurred. Valter Lang (2007a: 167) has observed that during that era the society was probably led by one more dominant farmstead while the settlement units shrunk in size during Roman Iron Age. Even graves showed some social stratification as one richer (*tarand*-)grave was usually accompanied by a few burial sites with fewer and poorer items (*ibid.)*.

1.1.2 *Tarand*-graves

The graves chosen for this study - *tarand*-graves - are collective burial places with rectangular closed above-ground stone wall constructions that are called *tarand*s (Lang 2006a: 83). When these graves first appeared on the landscape in Northern Estonia in 8^{th} – 5^{th} centuries BC, they contained more commonly inhumation burials and one rectangular grave was assigned for one or a few bodies (Lang 2007a: 179). Over time, cremation became a more frequently recorded way of disposing the dead and cremated bones were scattered in the *tarand*-area inside the walls (*ibid.:* 179, 192*)* However, during late Roman Iron Age in North Estonia inhumation became once again a popular trend (Lang 2007a: 194ff). Therefore both inhumed and cremated bones are found in rectangular *tarand*s and as there have been numerous burial events, most of the bones are severely fragmented and commingled.

The classification of early *tarand*-graves is arbitrary as the different types have been created based on solely the grave construction as the contents remain similar and these categories will not be discussed here. (Lang 2007a: 170). The distinction of early and late (or typical or classically joint) *tarand*-graves is more pronounced and will be briefly explained to introduce the common understanding. The early *tarand*-graves are partially or mostly rectangular stone graves that have sides measuring up to 9m (Lang 2006b: 55; Lang 2007b: 107). The number

[1] Cairn graves are a form of stone graves that have either no distinguishable stone cist or circular stone wall construction (Lang 2007b:101).

of the *tarand*s may vary: there can be one or several dozen, but if there are multiple *tarand*s, they are usually connected with each other (Lang 2006b: 55). The most pronounced difference between early and late *tarand*-graves is that the earlier ones were more irregular and built for one or a few bodies per *tarand*, but each rectangle surrounded by stone walls in the late ones was clearly a collective burial place (Lang 2006b: 55). The classically joined *tarand*-graves resemble the early ones mainly because of their specific rectangular grave areas and contents of mainly commingled human remains (Lang 2007b: 126ff; Jonuks 2009: 171).

There are some *tarand*-graves in mid-eastern Sweden, but early examples are also known from south western Finland (Lang 2006b: 69). Some of these *tarand*-graves have been dated to Late Bronze or Early Pre Roman Iron Age which makes them contemporary to the Estonian ones (*ibid.*). *Tarand*-graves are also present in Northern and Western Latvia, but they spread there slightly later, at the end of Pre Roman Iron Age (Lang 2007b: 112). *Tarand*-graves in Estonia have mainly been dated based on grave goods; few of the graves have been radiocarbon dated and the earliest is known to be Kunda Hiiemäe *tarand*-grave, dated to 730–410 BC (Lang 2007a: 174).

1.2 Objectives

Altogether, more than 50 *tarand*-graves have been excavated since 19th century but the first time cremated bones were thoroughly studied was in 1993 when Ken Kalling analysed the bones of Viimsi *tarand*s (Lang 2007a: 170, 191, Allmäe 2013). The number of *tarand*-grave material osteological analyses published is rather small and has definitely not reached the number of excavated graves (Kalman 2000a, 2000b, 2000c; Allmäe 2013). The amount of studies containing the artefactual data from *tarand*-graves is notably higher (e.g. Schmiedehelm 1955; Vassar 1943; Lang 1996; Lang 2000; Laul 2001; Rohtla 2003; Olli 2013).

In addition to the fewness, in several previous research publications *tarand*-graves have not been osteologically studied in a tenable way: some of the results have not been backed up with any available data; sometimes even methods of analysis have not been recorded or cannot be re-checked. These publications are unfortunately hard to use for further analysis as raw data is not available and the methods used have often been described inadequately to be partially re-checked or complemented. The best example of an osteological report is from stone grave II of Tõugu (Kalman, year unknown). Even the information there is not enough for further osteological analyses, but is definitely good for archaeological purposes.

The disparity in the number of excavation and osteological analyses means that our understanding of *tarand*-graves is mainly based on analysis of grave goods, grave construction and location. I find it important to try to interpret the data while setting focus mainly on the burials and the change in burial practice during time. Recently, several stone-graves of other types have been thoroughly studied and the results published.

It has been noticed before that there could be regularities in differential burying of groups of people into stone graves. The phenomenon has been observed by Jonathan Kalman and Valter Lang when in Rebala and Kaseküla stone-cist graves[2] the majority of the buried were children

[2] Stone-cist graves are a form of stone graves that have above-ground structures, usually a stone cist surrounded by one or more circular walls filled with soil and smaller stones (Lang 2007a: 147)

(Kalman 2000a: 20; Lang 2007a:153). In Võhma Tandemäe grave, children seemed to have had a designated burial area and in Tõugu the cranium of a new-born may have been used as an offering and placed below the *tarand*-wall (Kalman 2000b: 392; Kalman 2000c: 429). In addition to the possible differential treatment of children, cranial bones have been either overrepresented (e.g. in Võhma Tandemäe and Tõnija Tuulingumäe) or underrepresented (e.g. in Tõugu and Rebala) which suggests cranium-related rituals (Allmäe 1996; Lang *et al.* 2001:45; Lang 2007a: 180).

This study first starts with eliminating shortcomings in the osteological study of *tarand*-graves by focusing on one northern Estonian *tarand*-grave, Viimsi I, and using the material from Võhma Tandemäe and Viimsi II to fully understand and complement the noticed phenomena. In addition to the osteological analysis, the location information of the contexts will be used to search for any kinds of systems in placing the dead into the *tarand*s.

The main goal of this dissertation is to analyse the placement of the bones inside the Viimsi *tarand*-graves, compare the results with the findings from Võhma Tandemäe grave, look for patterns and give reasons why the dead were treated the way they were. Based on the previous studies it seems that there should be differences and maybe remnants of ritual actions in the spatial organisation of the bones in *tarand*-graves. Therefore, the working hypothesis is that there was indeed a certain normative way of placing the dead into the grave and its *tarand*s and there are aspects of rituals that can be observed in the material.

1.3 Importance of the study

The importance of the study is definitely that it will be the first full intra-site spatial and statistical osteological analysis of *tarand*-graves. As a result of this work, there will be a proper database of the bone fragments and burials that can be reused for either comparative analysis with other graves or studying other aspects relating to the funerary customs of the discussed *tarand*-graves. The spatial analysis will be commingled with statistical tests that will secure the assumptions and back up the data.

Another important factor is to show how the data should be handled and how important it is to keep the raw osteological data available. The raw data is essential to both archaeologists and osteologists for analyses. Graves cannot be compared osteologically or statistically based solely on the results of someone else’s interpretations. It can be done only based on well-recorded raw data that can be re-checked context-wise, if needed. Unfortunately, that has not been done much in Estonia; raw data was not available for the cases analysed here and full re-analysis was necessary. Also, as previous osteological research has shown some shortcomings, the need to reanalyse the bones has been deemed important to be able to continue (Kivirüüt 2011; Varul 2012).

This time the bones will be addressed first and only then their location and characteristics will be analysed in connection with the artefacts to give the bones and bone-related rituals a broader context. The results will show how the burial practice in *tarand*-graves has changed during Early Iron Age and give us more insight of the lives and minds of the people living during that era.

2 Material and methods

2.1 Material

The material of the analysis comes from two northern Estonian *tarand*-graves. As the goal of the study was to focus on burial places with *tarand*s in north of the country, it was important to find suitable and excavated material for the analysis.

The studied graves were chosen because of their location, representative size and relatively good documentation. The choice of Viimsi I, one of the latest conjoined *tarand*-graves in Northern Estonia, was already done in 2011 while choosing topic for the BA dissertation (Lang 1993: 55; 2007a: 195; Kivirüüt 2011). The comparative material comes from Võhma Tandemäe which is one of the earliest graves of that kind in the area. A grave with similar form dating to a different era was chosen to see whether there are any general differences in burial customs in the beginning and end of the Early Iron Age. I particularly interested in seeing the scatter pattern and distinctive handling of different body parts.

Some reasons behind choosing the bone material from Võhma Tandemäe were purely functional as the bones were present in the bone depot and the amount of bone material was similar to Viimsi I. Also, as the bones had been studied before, the material seemed comparable to the one of Viimsi I, but had to be reanalysed due to same reasons as the material from Viimsi I.

The bone material of the other *tarand*-grave close to the Viimsi I, Viimsi II was wished to be added as it is almost concurrent with Viimsi I and may give us more information about why it was necessary to build new graves while another one was probably still in use. Unfortunately, the available bone contexts[3] that were labelled to originate from Viimsi II grave turned out to have come from Viimsi I grave instead.

As mentioned before, the graves had already been studied once in the 1990s (Kalling 1993; Kalman 2000b). Firstly, I was hoping to use the results of the previous analyses and merely add some data relevant to my own research. Unfortunately, the raw data was nowhere to be found and the published results were not useable for an in-depth osteological spatial analysis. Therefore, the need to reanalyse the material emerged.

Both of the graves had good on-site documentation, the precision of the record varied as the most precise documented contexts in Viimsi I were marked on excavation plans as dotw while most of the bones from Võhma Tandemäe were associated with a 1x1 meters large square in the grid. The graves had been excavated in layers with similar methods: topsoil was removed; grave area opened and stones cleaned, recorded and detached. In Võhma, the location of the finds was recorded in a 1x1 meter grid; but in Viimsi, close bones or artefacts were grouped together and were given a number that was marked on the excavation plans (Moora 1973; Lang 1990). The soil was not sieved and there were no osteologists present (*ibid.*).

The focus of the study was set on the Viimsi I *tarand*-grave that had the least disturbed material of the two analysed graves. Over the years, the bones of Viimsi I *tarand*-grave had slightly commingled in the storage boxes, but the data was still acceptable for further analysis

[3] A bone context can refer to a small bone cluster that has been marked with a spot (in most cases of Viimsi I) or to a bone set originating from up to 9 different 1x1 meter grid squares. The disparity in the precision of bone location of contexts can be compared with the precision of bone units' location in Põlgaste (Allmäe 2013).

as conclusions about the layout of the cemetery could still be made. Viimsi I *tarand*-grave was also set in focus as the items have been recently studied and analysed and the artefactual data was helpful for the interpretations (Olli 2013; Olli & Kivirüüt 2014).

2.1.1 Viimsi I and II *tarand*-grave

The excavated late *tarand*-graves of Viimsi I and Viimsi II, located in Harjumaa, are dated to Late Roman Iron Age (Lang 1993: 54–55). The material was collected during salvage excavations, led by Valter Lang in 1990 (ibid.). According to his evaluation, most of the grave had been destroyed (Lang 1990). Based on the grave goods, the graves were supposedly used during the period AD 350–500 (Lang 2007b: 133). The Viimsi I grave consists of four and Viimsi II grave of two interconnected *tarand*s built on flat land on the cliff of Viimsi peninsula (Lang 1990). Viimsi II grave is situated about 40m southeast from the Viimsi I grave and was notably smaller than the first (Lang 1993: 7, 15).

Lang has thoroughly analysed the artefactual material and the grave constructions and has published the results several times (Lang 1993, 1996). Based on the found material he used to be certain that Viimsi graves represented an interesting Late Roman Iron Age phenomenon – distinctive and modern grave goods in an archaic type of burial place, without any Scandinavian import (Lang 1993: 58). Nevertheless, he has stated after more than ten years of new research that the grave goods in Viimsi I had been rather typical for the time and place (Lang 2007a: 195). He also noted (1990) that the cremated bones had been buried earlier than the inhumations.

The osteological material was first analysed in early 1990s by Ken Kalling (1993). The material was highly fragmented and there were no intact burials recorded except an almost complete male cranium that is no longer among the material. He found that there were at least 21 cremated individuals based on the count of petrous portion of the temporal bone and 11 inhumation burials based on the count of different clavicles and child bones in the Viimsi I grave (Kalling 1993: 67–68). Viimsi II grave was not that rich in funerals, he identified the bones of one cremated and two inhumed individuals (*ibid*.). The second time the cremated remains of Viimsi I were analysed and discussed, it turned out that several individuals and characteristics had gone unnoticed in the previous study: there were at least 26 cremated individuals in the grave (Kivirüüt 2011).

The analysis in 2011 did not comprise the inhumed bones and in 2014 the data about cremated bones was re-checked in some contexts where doubtfulness in interpreting the remains had been expressed. There were some surprises during inhumed bone analysis – some of the bones that had fitted nicely had been glued together, probably to simplify the work for future osteologists, but also disabling the determination of old and new breaks as the bone surface had been damaged. Also, during three last years in the depot, the bones had commingled more and several contexts that had been apart in 2011 were not separable any more. In most cases, the commingled contexts had been located rather close together, but in some cases, the material seemingly came from different *tarand*s. Luckily for some cases, the previous osteologist had written context numbers on the bones.

2.1.2 Võhma Tandemäe

Võhma Tandemäe early *tarand*-grave, situated in Lääne-Virumaa, is dated to early Pre-Roman Iron Age and was probably built between 500–200 BC based on the found artefacts (Lang 2000: 205). The grave was excavated in the course of scientific excavations in 1971–1972 by Tanel Moora (1973). There was no osteologist present and the soil was not sieved (Moora 1973). Despite this, some very small bone fragments had found their way to the depot. Finds and skeletal material were recorded in 1x1 meter grid and in three layers: I, II and IV (Moora 1973).

The interconnected *tarand*s in Võhma Tandemäe were built on south-eastern edge of a small ridge, covered with burial places from different eras (Moora 1973). This study will focus mainly on the south-eastern part of the ridge where the *tarand*s were located. The grave construction constitutes three *tarand*s (Moora 1973). The osteological material there has been analysed, raw data is no longer available (Kalman 2000c). Even though most of the skeletal material was commingled, Võhma *tarand*-grave contained six intact west headed inhumations, three in *tarand* II and three in *tarand* III (Moora 1973). The burials were recovered anatomically correct opposed to the other (at least 44) inhumation burials that were represented merely by commingled bone fragments (Kalman 2000c: 425). Three intact inhumations in *tarand* II were buried directly on limestone floor and other three intercut the wall between *tarand*s 1 and 2 (Moora 1973). The number of identified inhumed individuals recovered by Kalman was 50 (Kalman 2000c: 428). Kalman distinguished the burials of at least 9 infants, 9 children, 4 adolescents and 21 adults (7 male, 5 female and 9 unidentified) individuals (Kalman 2000c: 424pp). He noted that he had used the documentation about intact burials, the count of recurrent bone elements, mostly mandibles and cranial fragments to identify the individuals, but did not specify more (Kalman 200c: 425pp).

The skeletal material came across well-preserved and documented as everything had been repacked in zip-lock bags with their contextual information (Moora 1973; Lang 2000: 131–144; Kalman 2000c: 423–436). Unfortunately, the previous osteologist analysing the remains, Jonathan Kalman, had compiled some of the interesting material in large zip-lock bags without adding the original context numbers. In some cases, he had written the context number on the bone or on Scotch tape, but the latter had mostly come off the bones. Therefore, there were several bones, especially the most interesting cremated ones, without any location information. As these bones were by hazard in last analysed boxes, the absence of some context numbers was discovered rather late. Altogether, 4543 grams of cremated bones were sorted into those contextless ‘’bags of curiosities’’ as I started to call them.

The contextless bones without were not included in the location analysis due to obvious reasons, but were still relevant for counting the minimum number of individuals and interesting traits. The inhumation burials were in much better state – the bones had been picked up context-wise; only inhumed skull and mandible fragments had mostly been picked out and taped together, maybe in hope to reconstruct some of the crania. In most cases, the context numbers had been written on the skull or mandibular fragments but some of the inhumed bones had also lost their location information.

Several contexts did not lack of context information, but the info on the label was ambiguous - some of the slips referred to ‘’skeletons from the *tarand*s’’ which was not very helpful. Nevertheless, most of the labels pertaining to the intact inhumations were deciphered.

The results of the previous osteological analysis have been published and the information in the publication was not enough for comparison and statistical analyses (Kalman 2000c). In his osteological analysis, Kalman (ibid.) suggested that the grave contained at least five cremated and 50 inhumed individuals (*ibid*.: 427–428). The relative amount of cranial bones (59% of the total cremated bone weight) indicates interesting bone-related rituals, although he did not specify the type of ritual (*ibid.*). He also suggests that the less burned bones were cremated long after defleshing and fragmentation while calcined bones were cremated while still being covered in flesh (*ibid.*). All of his observations have been kept in mind, but further investigation was deemed essential.

2.1.3 Osteological limitations

Even though at first the osteological material seemed well documented and preserved, closer observation stated otherwise. Leaving aside the pre- and post-excavational commingling of the bones, the main problem was severe fragmentation of the bones. The breaks were both old and new, so that finding or reconstructing complete measurable bones was almost impossible. (*ibid.*). That set limitations to the amount of bones that were possible to reassemble and the osteological metric data retrievable from the bones.

Also, it seems that some of the bones of the Viimsi graves had gone missing over the years. Firstly, contrary to what some context labels claimed, none of the boxes contained the bones of Viimsi II grave[4]. Secondly, Kalling had identified an adult male individual based on the cranial bones buried north of the Viimsi I *tarand*s (Kalling 1993: 67). That individual was no longer present in the available material as only one small adult cranial vault fragment was found from the contexts of the area. The loss of weight among the cremated bones was noticed already in 2011 when re-analysis of the bones stated that bone weight had reduced 4.4% from the results in 1990 (Kivirüüt 2011: 37). In addition to that, Kalling had identified the minimal number of individuals mostly with the number of recurrent fragments of clavicle – 9 different individuals (*ibid.:* 67). Unfortunately, only six individuals were identified in 2014 based on the recurrent fragments of the clavicle (contexts 65, 150, 172, 237, 247, 259). That ascertains the assumption that several bones have been lost through the years.

The bones from Võhma Tandemäe *tarand*-grave were nicely packed in zip-lock bags but several contexts that displayed fresh breaks contained only one part of the fractured element; in some cases the other side was recovered from another zip-lock bag. The fracturing of the bones could have occurred during excavations, but fragments found close together should logically have ended up in the same context.

Also, the quantity of the bones used for the location analysis was solely dependent on the amount of bones that still had identifiable contexts that had location information. The cremated ‘’bags of curiosities’’ that were sorted out by Kalman were left aside as well as the context numbers that are not connectable with any of the square ID[5]-s. In Viimsi, the same is applicable for most of the petrous parts of the temporal bone as they also had been sorted in a

[4] As there was confusion with the context numbers of Viimsi I and Viimsi II *tarand*s, the weights of the contexts were compared with the ones from Viimsi I (Lang 1990) and the differences between those results from the 1990s were only a few grams. Therefore, all of the bones from Viimsi II were considered unavailable for analysis.

[5] Every square in the excavation grid had a unique square ID that helped to track the location of the bone contexts.

separate envelope, marked with numbers, but the marking system was not described and some of the numbers did not refer to any located contexts.

2.1.4 Limitations related to dating

Another important piece of information about ancient graves is their dating to be able to put the bone findings into a broader context. The graves under discussion have been dated by the grave goods. Viimsi I *tarand*-grave has been dated to the middle of 4th – end of 5th centuries and Viimsi II to the end of 4th – end of 5th centuries (Lang 1993: 54, 55). It is also thought that there has been a gap in burying the dead into Viimsi II grave as its second *tarand* was built later and the number of burials is so small that it is not possible for it to have been in use for 100 years successively (*ibid.).* Based on the dating of the items it seems that ceramics have been rather dated to a later period (second half of 5th century and later) than other finds (mostly 4th–5th centuries) (*ibid*.: 54).

Võhma Tandemäe *tarand*-grave has been divided into two stages – at first two rectangles were built during early Pre-Roman Iron Age and the third probably after a while during late Pre-Roman Iron Age (Lang 2000: 145). It is certain that the first burials in the grave were inhumations and the cremation tradition emerged later, but the cremated bones have not been dated and their exact time of burial remains unknown.

Even though the general item-based chronology seems accurate, the exact time span of burials is not known and it is not possible to make valid demographical calculations based on the material. Recent studies and radiocarbon dating have shown that some stone-cist graves have definitely been used as burial places centuries later its first usage period and *tarand*-graves have been used earlier than the finds have indicated (Laneman 2012; Allmäe 2013; Lang & Laneman 2013). Therefore, the concurrence of the bones (and artefacts) has to be approached critically and carefully as not all of the burials have had grave goods and the osteological material was severely commingled. The possibility that some of the burials have been deposited centuries later than the others in the *tarand*-graves should be considered until not proven differently.

2.2 Methods

The materials analysed for the dissertation come from two cemeteries of different size and time period. The information about cemeteries and finds has been gathered slightly differently and in order to be able to compare the osteological contents of the graves, the data was analysed and transformed to be as similar and comparable as possible.

2.2.1 Osteological methods

Bone determination

The osteological assessment of the bone material was based on the guidelines by McKinley and Roberts (1993), Buikstra and Ubelaker (1994), Brickley and McKinley (2004), Holck (2008) and Ubelaker (2009). All of the bone fragments were tried to be recognised. Nevertheless, several kilograms of bones, mainly long bone fragments remained more specifically unidentifiable. Most of these unidentified bones were cremated, but some bone flakes originating from inhumed bones were also determined merely as long bone or cortical bone fragments. Where possible, bone fragments that fitted together were recorded and it was noted when the breakage was not new in order to find traces of injuries.

There were several animal bones among the Viimsi I and Võhma Tandemäe osteological material. In case animal bone fragments were seen, their presence was recorded (Appendix 3). Some of the animal bone fragments were identified with the help of zooarchaeologist Eve Rannamäe but as not all of the animal bone fragments were identified and the focus of the study is elsewhere, the presence of animal bones was merely noted and not thoroughly analysed. Additionally, there could be some more animal bones among the yet unidentified bone flakes and cortical bone fragments, but the unidentified osteological material should be reviewed with the help of a zooarchaeologist to spot and identify more animal bones.

All of the cremated bone contexts were analysed for both Viimsi I and Võhma Tandemäe graves. The inhumed bones of Viimsi I were also thoroughly analysed. After starting the analysis of Võhma inhumation burials, it seemed very complicated to record the osteological data for it to be comparable with Viimsi I inhumations. Therefore, the inhumed bones of only one of the *tarand*s (*tarand* 3[6]) were comprised in addition to all of the intact inhumation burials. Identifiable bone fragments together with age and sex-related traits were recorded and the clusters were weighed.

For recognised bone fragments, the bone, preferably more specific bone element, side and relative size (inhumed long bones were measured with a digital calliper if the any of the suitable locations were present[7]) were recorded. Based on any morphological and developmental traits, the age and sex of the individual was also assessed. The final minimum number of individuals (MNI) was mostly decided upon the number of petrous portions of the occipital bone on cremated human remains and recurrent characteristical bone fragments on inhumed material.

Altogether, about 35% of the cremated bones were identified up to the extent of the body part. As about 70% of these bones were long bone or small cranial vault fragments of which the exact location in the body was not determinable, the percentage of fully determined bone fragments was about 10%. The recognition rate was much higher concerning inhumed bones – more than 90% of the bones among intact burials were fully identifiable. As the commingled contexts contained slightly more fragmented bones, the percentage of fully identified bones was around 70%. The recognition of the bone elements was not uniform, the differences in it were mostly due to high fragmentation and/or cremation of the bones.

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[6] The amount of inhumed bones from *tarand* 3 seemed the most represtntative and comparable. Also, as Kalman had verified the presence of cildren's burial area in *tarand* 1,

[7] the long bone measurements were used in this study merely to determine the age of children.

On recognised bones and teeth, standard ageing and sexing methods were used. In this study I used tooth growth charts by Ubelaker (1989), tooth wear patterns by Lovejoy (1985), fusion charts of the epiphyses and sexing guidelines by Buikstra and Ubelaker (1994), juvenile bone development patterns by Scheuer and Black (2004) and Hoppa (1990) and tried to use age determination by pubic symphysis surface by Brooks and Suchey (1990). Adult individual age was not assessed because of the fragmented material. Nevertheless, the general represented age groups were determined. These methods helped to distinguish some individuals from the commingled remains.

Bone weight

Bones were weighed in order to compare the amount of bones. This amount may have been expressed otherwise, but as there were no sieves that could have been used at all times, they were not used at all. Also, because of several thousand unidentifiable bone flakes, counting the bones was found impractical due to time consummation and the focus of the study. The weight of the bones together with the list of identified body parts was used to express the amount of bones in the contexts or the quantity of various body parts in one context. The study was conducted keeping in mind that that the weight of same bone elements either inhumed or cremated differs due to loss of the organic material during cremation process. The volumes of cremated and inhumed bones were therefore not comparatively analysed.

The distinguished categories of osteological material were: cranium, upper extremities, hands, thorax (comprises ribs, sternum, clavicles and scapulae), axial skeleton (comprises vertebra and sacrum), pelvis, lower extremities, feet and large unidentified long bone fragments. Small unidentified long bone and cortical bone fragments were left aside for the body part analysis, but were comprised in the weight of the contexts.

For the cremated bones, bone weight was recorded for each context and for each body part separately. Bone weight for the inhumed bones was not recorded separately per each body part because the fragments were of various sizes (almost complete femur vs incomplete femur in 10 or more fragments) and the volume of the bones was more represented in the number of identified bone elements. Inhumed bone weight was recorded per each context.

Bone colour, pyre temperatures and cremation stages

Figure 1. Five bones of different colour. From left to right: Grade 1 (sooted); Grade 2 (sooted, but partially grey); Grade 3 (grey and white); Grade 3 (white, but does not smear); Grade 4 (bone is white, soft and chalk-like). Cranial fragments from Viimsi I *tarand*-grave context 162.

The colour of the bone was assessed by visual methods and given only for cremated bones. Inhumed bones were simply classified as apparently unburned (stage 0) as there were no microscopic or collagen determination methods used and the visual aspect of unburned and apparently unburned bones is mostly the same (Holck 2008: 92pp; Figure 1; Table 1). The bones to which had been assigned cremation grade 0 were considered to have been in the pyre only for a few cases. The se bones of grade 0 were considered cremated when bone colour showed no change but the bone seemed as if it had been weathered.

For references, the cremation colour chart by Walker and colleagues (2008: 136–137) was used alongside with the colour descriptions by Holck (2008: 90pp), during the work, hue of the bones was described either as yellow (apparently unburned), black (charred or sooty), blue (bluish), grey (greyish) and white or calcined. For white coloured bones, the bone texture was also characterised; it was noted whether the bone surface was soft and chalk-like or still hard (*ibid.*).

Table 1. Cremation stages and the descriptions that were used in interpreting burned bone fragments. Compiled from Holck 2008: 99.

Grade	Colour	Other Characteristics	Heat that affected the bone
Grade 0	Yellow, apparently unburned	Although looks like unburned bone, collagen is no more intact. The shape of the bone is unaltered by the fire.	Up to 200ºC
Grade 1	Yellow, brownish, sooted	Has burned for a short time in an environment with not much oxygen. Bones may be fractured in the fire and the fractured surfaces can be sooted, too.	Up to 400ºC
Grade 2	From black to grey	Curved, parallel cracks on bones. Mineral crystals fuse and bone volume reduces. Changes in the lamellar construction of the osteons occur, but the bone is still hard.	Up to 700 - 800ºC
Grade 3	White or grey	Further shrinkage and deformation of the bone. Mineral structure of the bone fuses, cracking with gill-pattern may occyur. Oval microscopic holes in the bone surface. Scratching will leave a stripe on the surface.	Up to 1000-1100ºC
Grade 4	White	Bone is chalk-like, white, and porous. Microstructure of the bone is decomposed.	1100-1300ºC or even more

Based on the combination of the charts, cremation temperatures and grades were assigned to each bone element in case of cremated bones (Holck 2008: 90; Walker *et al.*: 2008: 136–137). Each of the existing contexts was designated a cremation stage considering its colour and physical characteristics (Table 1). The cremation grades were given per skeletal element per context as the number of individual bone fragments was very high and focusing on every piece separately would have been another osteological study. In some cases several stages were assigned and their mean was used in the following analysis as average cremation stage per context.

2.2.2 Spatial analysis

One of the main outcomes of the research is the intra-site spatial analysis of the human remains. The weight of cremated and inhumed bones per contexts, the location of different body parts and individuals was analysed either point- or grid-based. The results are depicted as intra-site distribution maps where any common features or a pattern are illustrated. The suggested cremation temperatures of the burned bone material are also be represented on grave area maps and used as help in reaching a conclusion.

The results of the study rely heavily on the spatial analysis. The study will discuss any found regularities and attempt to provide possible causes and explanation for each. If possible, the system of placing the dead is unfolded and the burial process is reconstructed as accurately as possible.

The bone material of Viimsi was recorded in contexts which were mostly marked on excavation plans (Appendix 1.2–1.13). Some of the contexts had not been depicted and therefore were not included in the spatial analysis. In general, the location of the bone clusters was easily determined and perfectly suitable for analysis. In case of contexts commingled inside the storage boxes the bone weight was divided by the number of mixed contexts whereas all of the commingled contexts' bone contents were described as the same.

The bone material of Võhma Tandemäe was recorded in a 1x1 meter grid. All of the squares were given unique identification numbers, but some of the contexts were assigned to several squares. In these cases bone weight was distributed evenly between the squares, but the presence of body parts in contexts was recorded identically for all of the excavation squares as the exact location of the bones could not be determined. For example, if the context in 4 different squares weighed 20 grams and contained foot and hand bones, each of the squares was analysed as it contained foot and hand bones and weighed 5 grams. That solution was the most reasonable and representative that I came up with.

The spatial analysis was fulfilled with the help of QuantumGIS 2.2 (Valmiera) programme and all of the grave area distribution plans in appendices have been created using the same programme.

Grave construction

The grave constructions were used to define the spatial organisation of the bones and items. The analysed graves were divided into grave areas according to the *tarand*s and other features that could have been meaningful to the Iron Age people for the spatial and statistical part of the study. Grave construction will not be discussed in depth in the following analysis, but does feature in the discussion part. In interpreting the grave constructions the author relies on previous studies (Moora 1973, Lang 1993, 2000).

All areas covered with stones and containing bones or artefacts were interpreted as the grave, including the side ruins or ruins (e.g. Lang 2007a: 177) which are stone formations around tarand-areas with an unknown purpose, structures comparable to the *tarand*s as in some cases the ruins have served as burial/grave good deposit area as has been observed in Viimsi I and Tõugu IIB and Pada (Lang 2007a: 177, 194–195). In some other cases e.g. in Tarbja, the side ruins have not been used as burial places or only few bones had been placed there such as in Virunuka II (Lang 2007a: 197, 200)

Viimsi I grave was divided into 14 different grave areas (Appendix 1.1). The grave was first divided into *tarand*s A, B, C, D – the last two *tarand*s were analysed separately not as one large *tarand* as it could have been. Some of the possible inter-*tarand* wall was observable between C and D and the bone contexts were assigned to the areas according to that (Lang 1993: 8, 11). The excavated area was delimited to the side ruins, therefore everything was considered as a possible grave area. The region outside the *tarand*s was divided into 10 zones connected with the closest *tarand*, e.g area to the west of *tarand* B.

For Võhma Tandemäe, the *tarand*-borders were also tried to be observed. As the bones had been collected by squares, sometimes the squares' edges did not coincide with the sides of *tarand*s. In these cases the bones were assigned to the *tarand* in which most of the square was located. First, the grave was divided into four – *tarand*s 1, 2, 3 and the area outside the walls. Additionally, some of the contexts were assigned to the areas on and in between the *tarand* walls and all of the contextless bones were handled together. Altogether, there were 9 different grave areas created (Appendix 2.1).

Statistics

The differences in location analysis will be backed up by statistical tests where the differences and variation between and among the variables can be considered either statistically significant or not. This will enhance the strength of the inferences as the mere observation of the location schemes of the bone material can be deceptive.

Statistical tests on the collected data were performed with the help of IBM SPSS Statistics 20 programme. IBM SPSS Statistics 21 Core System User's Guide and Quantifying Archaeology were used to help sorting out the datasets (Shennan 2004, IBM 2011).

3 Osteological analysis

In this study, as mentioned in the methodological chapter, the main focus is set on the analysis of bones and their location from Viimsi I grave. As I have not the competence to reanalyse the artefacts or grave constructions, from the following chapter, only the osteological contents of the graves will be described. These items will be added in the discussion part to help the interpretation of the bone analysis and the data about the grave constructions will be used in the spatial analysis.

3.1 Viimsi I

Altogether, there were 272 contexts analysed. The number of contexts in the excavation report was 264, but as some of the bone contexts contained both inhumed and cremated bones, the analysed number of excavated bone units was slightly larger (Lang 1990). Most of the bones were spread on the ground seemingly randomly but nevertheless there were four bone clusters identified. Three of these clusters had been noticed while excavating and one was added during analysis based on the clustering of bones and artefacts.

The first cluster (I) was located in *tarand* D, just outside the northern wall of *tarand* B. The second cluster (II) was outside the western wall of *tarand* B. The first two clusters contained cremated human remains. The third cluster (III) was located north to the wall of *tarand* A and the fourth cluster (IV) was a few meters east to the walls of *tarand*s C and D. Clusters III and IV contained inhumed bones. In the analysis, the clusters were recorded the same way as any other bone context[8].

3.1.1 Cremated bones

The cremated bones of Viimsi I *tarand*-grave may as well be the most studied cremated set of remains in Estonia as they have been analysed in 1993, 2011 and briefly revised in 2014 (Kalling 1993; Kivirüüt 2011).

The bones were fragmented and commingled, but among them, all of the body parts were present. The percentage of cranial bones was mostly in the gap of 30–38% of all bones. In some of the areas (west to *tarand* A and East to *tarand* B), more than 50% of the bones were cranial fragments and the area with the smallest proportion of skull was *tarand* A (Table 2). The extraordinarily high prevalence can be explained with the small number of contexts in these areas and therefore the percentage may be skewed.

The location of the bones, its characteristics and peculiarities are closely analysed in Chapter 4.1.

[8] Except cluster III that contained cranial fragments of a 20–30 year old man (Kalling 1993: 67). These bones were not found among the analysed remains.

Table 2: The overall weight of all and of cranial bones in the Viimsi I grave areas and the proportion of cranial bones across the grave areas. N – number of contexts.

Grave area	N	Weight (g) (overall)	N (contexts with cranial fragments)	Weight (g) (cranium)	Cranium percentage
Tarand A	24	751,5	22	195,1	26
Tarand B	23	2182	21	681	31,2
Tarand C	24	821	24	315	38,4
Tarand D	19	2347	18	803	34,2
North to *tarand* A	15	835	15	324	38,8
East to *tarand* A	17	719	17	240	33,4
East to *tarand* C	10	325	10	125	38,5
East to *tarand* D	4	211	4	77,5	36,7
East to *tarand* B	3	68	3	36	52,9
South to *tarand* B	11	1105	11	416	37,6
West to *tarand* B	3	343	3	127	37,0
West to *tarand* D	3	250	3	73	29,2
West to *tarand* C	0	0	0	0	-
West to *tarand* A	3	46	3	24	52,1
Total	159	10003,5	154	3432,6	34,3

Minimum number of individuals

The minimum number of cremated individuals was ascertained by the recurrent fragments of petrous portion of the temporal bone. Altogether, there were 26 right and 21 left petrous portions of the temporal bone and 2 fragments of the same bone but of unknown body side represented. The material was briefly rechecked and the fragments of two more left petrous portions and one of unknown side identified, but it dii not alter the minimal number of individuals. All of the petrous portions belonged to adults by their size and development, but among the cremated bone material, there were the remains of at least 3 children (Table 3) and 2 adolescents, too. Some of the smaller adult petrous portions could belong to adolescents, but definitely not to children. Therefore, it can be said that there were cremated cranial bones from at least 29 individuals present.

Age and sex composition

Large muscle attachments on the occipital bone (robusticity 5) helped to identify at least 5 male individuals, two in *tarand*s C and D, two in *tarand* B and one outside the *tarand*-area. The same method determined the presence of two probable female individuals (robusticity 1), one in *tarand* D, second outside the *tarand* area and third of unknown location. Altogether, there were at least five men and three women cremated and buried in Viimsi I *tarand*-grave.

Based on teeth, there was an individual at least 14 years old and a third molar indicated the presence of someone younger than 17 years in *tarand* A. As these contexts were very close together, it is probable that those teeth belonged to one 14–17 year old individual. An immature permanent mandibular second molar hinted that there was at least another child present outside the *tarand*-area, aged 6-10 years. Based on the epiphyseal growth, there was an individual with an unfused proximal epiphysis of a proximal phalanx, aged no more than 14 years and someone with an unfused, but rather large humeral head, aged less than 23 in *tarand* C (Kivirüüt 2011: 48). There was also some cremated baby bones (fragment of ulna, rib and mastoid process of the temporal bone) recovered from some contexts indicating the presence of a baby (Kivirüüt 2011: 49). Altogether, at least three cremated juveniles: a baby, a child aged 6-10 and an adolescent aged 14–17 were buried in Viimsi I.

Table 3. The identified cremated individuals of Viimsi I grave.

Context	Age (years)	Sex	Basis for determination
72	4–9	unknown	dental development
161 (cluster IV)	6–10	unknown	dental development
72, 264	7–14	unknown	epiphyseal growth
30–32, 34, 35	14–17	unknown	dental development
167	8–18	unknown	epiphyseal growth
8	adult	female	nuchal crest robusticity 1
28	adult	female	nuchal crest robusticity 1
227	adult	female	nuchal crest robusticity 1
95	adult	male	nuchal crest robusticity 5
110	adult	male	nuchal crest robusticity 5
137	adult	male	nuchal crest robusticity 5
162 (cluster I)	adult	male	nuchal crest robusticity 5
203	adult	male	nuchal crest robusticity 5

Cremation stages

The cremation stages were assigned for all of the body parts with the exception of teeth as tooth enamel is more durable in the fire than regular bone material. Some of the cremated bone contexts presented minimum cremation stage of 0 which indicates that the bones did not show definite signs of burning and looked as if they were unburned but did show sooted stains or denser surface.

Table 4. Number of represented contexts and cremation stages of different body parts in Viimsi I.

Body part	Number of contexts	Cremation stage		
		Min	Max	Mean
Cranium	169	1	3	1,85
Arms and forearms	27	1	4	2,15
Hands	14	0	3	2,07
Thorax	16	0	3	2,22
Vertebra	14	1	3	1,82
Pelvis	12	1	3	1,92
Thighs and legs	23	1	3	1,91
Feet	10	0	4	1,50
Total (+ cranium)	170	1	3	1,853
Total (no cranium)	54	0,67	3	1,930

The mean cremation stages for body parts varied from 1,50 (feet) and 1,82 (vertebra) up to 2,15 (arms and forearms) and 2,22 (thoracic bones) (Table 4). The overall mean cremation stage was calculated based on the mean cremation stage of the body parts present in each context. There were two overall means calculated. First, the total (+ cranium) that included the mean cremation stages of cranium in the calculations of mean cremation stages per context. This total (+ cranium) mean was closer to the mean cremation stage of the cranial bones which is not surprising as the number of cranial bones dominated the cremated bones and they were represented in 169 contexts out of 170. Then, to acquire a less cranium-biased mean cremation stage for most of the body parts, the cranial bones were left out while calculating the mean cremation stage of the contexts. The result was 1,930 which was luckily only slightly different from the cranium-biased total (+ cranium).

Therefore, it can be said that the bones were slightly cremated; the pyre temperatures were mostly around 400ºC. The colour of the bones by Holck (2008: 99) of that grade of burning is black or dark grey which correlates with the general impression of the bones. The crania were treated differently than other parts of the body and its mean cremation temperature was slightly lower than of the rest of the body.

Pathologies and interesting traits

The cremated bones from Viimsi I did not show many pathological conditions. One of the reasons for that could be the fact that cremation process firstly affects and destructs the bones with pathologies as disease usually weakens the tissue (Holck 2008: 130pp).

Some of the cremated long bones from Viimsi I showed straight transverse breaks either with or without a protruding beak (Figure 2). Most of the bones presenting this trait were fragments of humeri and the cremation was not very strong – bones were either black or sooty which indicates temperatures up to 400ºC. The phenomenon is believed to be connected with quick cooling of the bones (Binford 1972, through Stewart 1979: 61-62).

Figure 2: A larger humeral fragment with straight edge on the left side and a breakaway point on top (indicated by the arrow). Note the usual and uneven right side of the fragment from Võhma Tandemäe, context unknown.

The first analysis of Viimsi I *tarand*-grave stated that some of the bones had been burned after the flesh had decayed (Kalling 1993: 68). The reason to consider this could have been[9] the occurrence of some longitudinal splitting but little warping on the surface of the bones in both

[9] Kalling did not specify reasons behind his argument (Kalling 1993: 67pp).

Viimsi graves (Ubelaker 2009). During the new analyses both warping and some longitudinal splitting and checking in the cremated bone material of Viimsi I was observed, but the latter phenomena were not very common among long bones. That suggests even though some of the bones had probably been cremated after the flesh had decayed, most of bones had been cremated fresh (Buikstra & Ubelaker 1994: 96). Nevertheless, numerous cranial vault fragments showed stronger cremation on the inside rather than on the outside surface which in turn indicates that skulls may have been cremated after the initial burial and decomposition.

Figure 3. Fragment of the parietal bone showing cut-marks and magnification of the indicated area, context 167. Length of the cut-mark is 13,27 mm.

Among the cranial fragments of Viimsi I, there was a fragment of parietal bone (context 167) with a straight shallow mark on it (Figure 3). Closer inspection of the skull fragment revealed that there were more scratch marks on the bone but as the surface had deteriorated, not all of them were visible any more. The largest of the scratches should be definitely identified as a cut mark.

3.1.2 Inhumations

Minimum number of individuals

The minimum number of inhumation burials in Viimsi I *tarand*-grave was determined by the count of fifth metatarsals. Altogether there were 16 5th metatarsals, 10 of the left and 6 of the right side. Seven of the bones belonged to adults and two to children. The count of inhumed individuals increased as there were recurrent bone fragments of at least one new-born baby based on the long bone measurements, identifying the teeth and determining the ages of the individuals, three more juvenile individuals were added to the count. Therefore, it can be said that at least 14 inhumed individuals were buried in the Viimsi I *tarand*-grave.

Age and sex composition

The sex of the individuals was mainly determined by the robusticity of the bones. Altogether, there were at least two women based on the gracile recurrent fragments of mandible (robusticity 1–2) and three male individuals who were determined by the significantly robust recurrent fractions of mandibles (robusticity 4–5) (Table 5). Based on long bone measurements, dental development and bone fusion stages, there were at least six juvenile individuals buried in Viimsi: one new-born, children aged 1–3, 0,5–5 and 4–12 and two adolescents aged 11–18 and 16–20.

Table 5. The identified inhumed individuals of Viimsi I grave.

Context	Age (years)	Sex	Basis for determination
111, 114, 199	0 (new-born)	unknown	long bone measurements
118	0,5–5	unknown	fusion of cranial bones
155, 239	1–3	unknown	fusion of cranial bones; long bone measurements
207, 233, 236, 238	4–12	unknown	dental development; fusion of cranial bones; fusion of vertebra
251, 172	11–18	unknown	immature metatarsals
19, 160	16–20	unknown	immature phalanges; dental development
81	adult	female	robusticity of the mandible 1
237	adult	female	robusticity of the mandible 2
222,223,225,228	adult	male	robusticity of the mandible 5
237	adult	male	robusticity of the mandible 5
252	adult	male	robusticity of the mandible 4

Pathologies and interesting traits

The main interesting phenomenon concerning the inhumed bones of Viimsi I was the small number of cranial fragments. Out of 96, cranial bones were present in merely 40 contexts. Most of the cranial fragments were parts of the frontal or parietal bones. There were no inhumed parts of petrous portion of the temporal found. The only uncremated occipital bone fragments belonged to juvenile individuals (contexts 118, 123, 155, 233/236, 239). Nevertheless, there were several inhumed adult mandibular fragments and teeth (both maxillary and mandibular) present.

In general, the bones showed that people were rather healthy, even their teeth were in good condition. There were only a few cases of dental caries, most of the people lacked dental calculus and linear enamel hypoplasia. There were some signs of work-related trauma or stress as some individuals had Schmorls' nodes on fragmented thoracic vertebra (Waldron 2009: 45). Also, some individuals showed signs of spondylosis and ankylosis on thoracic and cervical vertebrae, which indicated the presence of an interesting genetic defect and of older individuals as both conditions are associated with degeneration and stress (Ortner & Putchar 1985: 357–359; Waldron 2009: 51, 58).

There were no fractures that could have occurred during the people's lifetime noticed. Nevertheless, there were two cases of cut-marks. First, there was a 4 mm long cut mark on the posterior side of the ramus of a manly mandible (Figure 4). The cut was made diagonally and from the superior side. Cut marks on posterior side of the mandible often refer to decapitation (Roberts & Manchester 2005: 63). The mandible was also coloured green, probably as the result of a bronze object nearby. The bone had definitely been moved from its original context as there were no more bronze objects nearby.

Figure 4. Mandibular fragment with cut mark on the posterior side of its right ramus. From up to down: medial view, posterior view, lateral view. Context 238, Viimsi I.

Secondly, there was a diagonal cut mark on the posterior side of a right radius, rather small in size (Figure 5). As no corresponding ulna was found, it is not known whether the cut was made on a whole intact arm or solely on the radius. The nature of this cut mark is not very clear.

Both of the bones with cut marks were found outside the *tarand*s from the eastern side ruins, but should not have belonged to the same person as the relative size of the radius makes highly improbable for it to belong to a male individual.

Figure 5. Fragment of a right radius with a cut mark on its distal 1/3 of diaphysis. Context 237, Viimsi I.

There were also few musculoskeletal markers observed. First, the insertion point of costoclavicular ligament on the medial inferior side of the clavicle was usually pitted, the edges had minor osteophytes and the insertion showed severe stress. Due to fragmentation, only four clavicles had both lateral and medial sides visible and in these cases the insertion sites of deltoid muscle were also pronounced. This could indicate intensive rotation, elevation and depression of the upper limb – lifting, pulling and pushing (Palastanga *et al.* 2008: 19).

3.2 Võhma Tandemäe

Altogether there were 252 contexts from Võhma Tandemäe analysed. The number of bone contexts present in the containers was higher but commingled inhumed bones from *tarand*s 1 and 2 were not analysed for the present study. Therefore, the counts of inhumed vs cremated body parts inside and outside the *tarand*-areas as was done for Viimsi I cannot be presented and discussed. The same applies for the general cremation stage for the whole grave.

3.2.1 Cremated bones

In Võhma Tandemäe the cremated bones were present in 216 contexts (Table 6). The bones were fragmented and commingled and all of the body parts were present. The overall percentage of cranial bones was 26,7%, but some areas showed significantly higher or lower proportions. The area between *tarand*s 1 and 2 definitely stands out as almost 77% of the excavated cremated bones were cranial fragments. The wall areas south-east to *tarand* 2 did show rather low percentage of cranial bones – 10,7% and 19%. As in Viimsi , the outstanding contexts did not contain many bones and therefore the contents may not be representative.

Table 6. The overall weight of all and of cranial bones in the Võhma Tandemäe grave areas and the proportion of cranial bones across the grave areas. N – number of contexts.

Grave area	N	Weight (g) (overall)	N (contexts with cranial fragments)	Weight (g) (cranium)	Cranium percentage
outside the walls	28	762	21	216	28,3
tarand 1	71	2109	54	564	26,7
tarand 2	30	326	19	82	25,1
tarand 3	53	1960	37	633	32,3
area between 1 and 3	5	84	4	16	19
area between 1 and 2	2	13	2	10	76,9
area between 2 and 3	1	205	1	22	10,7
close to the walls	7	124	6	61	49,2
location unknown	19	4543	16	1101	24,2
All	216	10126	160	2705	26,7

Minimum number of individuals

Võhma Tandemäe *tarand*s contained at least 15 cremated individuals based on the amount of recurrent bone fragments, more specifically the number of petrous portion of the temporal bone. In the cremated bone contexts, there were 12 right and 15 left petrous portions of the temporal bone present and four of the left ones belonged to children. Two of the internal auditory meatuses were of a very pronounced size and most probably belonged to male individuals. Therefore, the material contained at least the remains of four children and two men based on the size and maturity level of the internal auditory meatus of the *pars petrosa.*

Age and sex composition

Sex of the individuals of the Võhma Tandemäe cremated individuals was assessed for twelve individuals, mainly by the robusticity of the supraorbital ridge of the frontal bone and the sex diagnostics of the petrous portions were not included as the orbits and temporal bones could have belonged to same individuals (Table 7). There were four manly fragments of frontal bones with glabella and both supraorbital ridges present and two robust fragments with only left side of the ridge present indicating cremation burials of at least six men. A female individual was identified with the help of a great sciatic notch of the innominate bone with a very female obtuse angle.

Table 7. The identified inhumed individuals of Võhma Tandemäe grave.

Context	Age (years)	Sex	Basis for determination
131, 238B	2–5	unknown	dental development
241	3,5–6,5	unknown	dental development
142	2–4 or 5–9	unknown	dental development
143	less than 19	unknown	epiphyseal growth
158; random bones 2	14–23	unknown	epiphyseal growth
97	adult	female	angle of greater sciatic notch 1
6	adult	male	supraorbital ridge robusticity 5
11	adult	male	supraorbital ridge robusticity 5
49	adult	male	supraorbital ridge robusticity 5
97	adult	male	supraorbital ridge robusticity 5
330	adult	male	supraorbital ridge robusticity 5
cranial fragments 2	adult	male	supraorbital ridge robusticity 4

Children were aged with the help of the recovered teeth. Based on two immature permanent first molars, a child aged 2-5 was identified. Also, a fragmentary deciduous maxillary molar (either 1st or 2nd) suggested the presence of a 2-4 or 5-9 years old child. In the case of the molar being the 1st molar, it is probable that all of the three molars belonged to only one child aged 2-5 years. Nevertheless, an immature permanent mandibular 1st molar helped to identify at least one more child, aged 3,5–6,5 years.

Unfused epiphyses indicated that in the material, there was an adolescent younger than 19 years (unfused proximal epiphyses of radius) and younger than 18 or 23 (unfused sternal end of clavicle and humeral head). Also, vertebral neural arches unfused with the body were present which confirms the age of the young child, aged less than 3-4 years.

Cremation stages

In Võhma Tandemäe, most of the bones were not strongly cremated; the overall mean cremation based on all the cremated bone material was 2,07 which indicates that the pyre temperature could have been around 400ºC (Table 1; Table 8). Unlike in Viimsi I, eliminating the cranial fragments from the formula did not create any difference in the overall mean stage of cremation. This suggests that the body parts had been cremated uniformly.

Table 8. Number of represented contexts and cremation stages of different body parts in Võhma Tandemäe.

Body part	Number of contexts	Cremation stage		
		Min	Max	Mean
Cranium	172	1	4	2,13
Arms and forearms	94	1	4	2,06
Hands	43	1	3	1,79
Thorax	65	1	4	2
Vertebra	76	1	4	2,12
Pelvis	33	1	4	2,12
Thighs and legs	89	1	4	2,07
Feet	26	1	3	1,92
Total (+ cranium)	212	1	4	2,07
Total (no cranium)	41	1	3,5	2,06

Cremation stages per different skeletal elements recorded for Võhma Tandemäe *tarand*-grave did not show much variability – hands and feet were burned the least (stage 1,79 and 1,92, respectively) whereas cremation was the strongest among cranial fragments, pelvis and vertebra (2,13 and 2,12, respectively) (Figure 4). Most of the body parts in Võhma Tandemäe had their average cremation stage above 2 with the exception of hands and feet. As the extremities tend to suffer less from the heat in the pyre than other parts of body, their slightly lower cremation stage could have been expected (Holck 2008: 112; Symes *et al.* 2008: 30 pp.).

Pathologies and interesting traits

The cremated bone material of Võhma Tandemäe was not very exciting in terms of pathologies – there were almost no deviations from normal healthy bones. Even pyre-related additional changes[10] on bone surface were almost non-existent. Most of the bones with visible splitting and warps that are possibly related to the cremation techniques were found from the last analysed zip-lock bags[11] with no contextual information. As the location information of the phenomena had been lost, the presence of bone modification will be only briefly analysed as it cannot be associated with any specific grave areas or individuals.

The most encountered phenomenon was the presence of straight horizontal transverse fracture lines with a small projection of bone still intact on one end of the long bone fragments (Figure 1) as in Viimsi I. These strange fractures were especially common among fragments of humeri. Most of the bones with these fracture lines were found among the material without context which suggests that Kalman had also sorted them out for some reason. He has not mentioned anything about this phenomenon in his research about Võhma Tandemäe, but noted the same cut-mark like breaks in the cremated material of Uusküla *tarand*-grave (Kalman 2000d: 438). The appearance of the bones was probably the result of quick cooling of pyre, perhaps with water as Kalman pointed out (Binford 1972, through Stewart 1979: 61-62; Kalman 2000d: 438).

[10] Additional changes to the calcination process.
[11] The ’’bags of curiosities’’.

The amount of longitudinal splitting and warping in the bone material of Võhma Tandemäe was not large. Most of the heat induced modification was in the form of parabolic fractures which is one of the indicators that the dead have been cremated while the flesh was still on the bones (Ubelaker 1978, through Whyte 2001:439; Whyte 2001: 439). Most of the cranial fragments that were not strongly cremated showed black lacquered, glistening appearance as in Viimsi I, indicating cremation while the organic matter was still on bones (Holck 2008: 96).

3.2.2 Inhumations

For inhumed bones in Võhma Tandemäe, only intact inhumation burials and material from *tarand* 3 were analysed to acquire some comparative data for Viimsi I grave. The grave contents were compared in means of preservation and representation of bones, individuals' health and the placement of the bones inside the grave. Interestingly, *tarand* 3 did not contain many inhumed body parts apart from the three burials in the south-western section.

Minimum number of individuals

The minimum number of inhumed individuals from *tarand* 3 was determined based on the recurrent fragments of mandible. Eight inhumed individuals were identified: three of these were the intact burials from the south-western area and five more individuals were added based on the count of recurrent mandibular fragments. Altogether, the following comprises the remains of at least 12 inhumed individuals: 8 of them were located in *tarand* 3, three individuals constituted the intact burials from *tarand* 2 and one rather intact burial had been unearthed south-west of *tarand* 1.

Age and sex composition

There were three groups of intact inhumation burials. There were two adults buried in *tarand* 2 and east to the feet of the northern skeleton were located fragmented remains of a child aged 6–8 years and fragments of head ornaments. The age of the man close to the child was 30–35 years. The northern skeleton was slightly more fragmented and the number of identifiable characteristic body parts was smaller. Based on the remaining commingled remains among ''the eastern mixed burial'' and the drawing from the excavations, it seems that the eastern skeleton belonged to a very young adult, aged 16–20 years. Sex of the individual is hard to assess due to the young age, but the mandibular fragments refer to a female individual.

One intact burial was discovered from south-west to the *tarand*s. The body was very intact; almost all of the individuals' bones were present and well preserved. The individual was male and died at the age of 30–40 years.

There were three inhumed bodies buried in the south-western side of the *tarand* 3. Their exact location is not known any more, but it is certain that the dead were headed north-west and had been placed in a row so that the south-eastern one had its head on the north-western one's chest (Appendix 2.4). The bones of the three individuals were commingled. Based on the sex characteristics of pelvis and cranial fragments, the ‘’western mixed burial’’ contained the bones of at least one male and two female individuals. One of the female individuals was aged 18–24 years and the other had died at the age of 30–40 years. The age of the male individual at time of death was approximately the same as of the older lady – 30–40 years.

In addition to those three intact inhumation burials, there were at least 5 more inhumed individuals in *tarand* 3. Four of these individuals were identified based on recurrent fragments of mandible: a man aged more than 45, an adult of unknown age and sex, an adolescent aged 12–18 years and a juvenile individual aged 8,5–18 years. In addition to the bones that can be associated with the aforementioned individuals, there were some bones that belong to at least one younger child.

Comparing the new results of with the ones from Kalman (2000c) there are not many disparities (Table 9). As it is known that the bones have been regrouped, it is not known whether the same skeletal elements were present or used to determine the age and sex of the individuals. The largest discrepancies concerned the male and a female individual of the triple burial from *tarand* 3 and the northern skeleton with the neck-ring from *tarand* 2.

Table 9. Comparison of the age and sex assessment of the individuals buried in Võhma Tandemäe *tarand* 3. Note that the aligned columns do not necessarily refer to the same individuals as is is not known whether the osteologists were using the same exact bones for the assessment.

Kalman (2000c)			**Kivirüüt (2014)**		
Age	**Sex**	**Notes**	**Age**	**Sex**	**Notes**
***Tarand* 3**					
1–2	unknown		<6	unknown	close to the intact skeletons
3–6	unknown		8,5–18	unknown	close to the intact skeletons
10–13	unknown		12–18	unknown	close to the intact skeletons
25–30	male	one of the three in a row	30–40	male	one of the three in a row
30–40	female	one of the three in a row	30–40	female	one of the three in a row
35–45	female	one of the three in a row	18–24	female	one of the three in a row
35–45	male		45+	male	north-western part of *tarand* 3
50+	unknown		adult	unknown	south-eastern corner of *tarand* 3
***Tarand* 2**					
6–7	unknown	between the two skeletons with necklaces	6–8	unknown	between the two skeletons with necklaces
20–25	male	southern skeleton with necklace	30–35	male	southern skeleton with necklace
30–35	male	northern skeleton with necklace	16–20	female ???	northern skeleton with necklace
Outside the *tarand*s					
30–40	male	south-west to *tarand* 1	30–40	male	south-west to *tarand* 1

The age attributed to the male individual in *tarand* 3 was relatively older and for the female individual relatively younger. It is possible that the contexts have been mixed up to an extent where those bones used to determine the individuals' age 15 years ago have commingled or become contextless. Nevertheless, based on the data that is available today, the individuals' age was distributed in a slightly different way than before

Reasons behind the different determination of the northern skeleton with the neck-ring can be similar to the ones behind the inhumations from *tarand* 3. The bones had been severely commingled and the contexts contained commingled bones of at least two more individuals[12]. Based on the drawings and matching probable existing skeletal elements with those ones on the plan, it is certain that the northernmost skeleton was a young adult as the bones were of mature size but several epiphyses had not fused yet. Mandibular fragments of a female individual of the same age range and from the same context were convincing enough to say that the northern skeleton was indeed a young adult, possibly female[13].

Pathologies and interesting traits

The inhumed individuals of Võhma Tandemäe were relatively healthy. There were some signs of injuries or interpersonal violence as the material contained fractured and healed ribs (at least one of the individuals from the triple burial in *tarand* 3). Few individuals showed osteophytes and Schmorl's nodes on vertebral fragments, possibly due to high age or heavy workload (Waldron 2009: 33, 45).

The teeth of individuals over the age of 40 years showed dental caries and calculus, and the older female individual from triple grave in *tarand* 3 showed periodontal disease – retraction of alveolar bone. This requires for development the presence of plaque and bacteria which is not a rare combination (Waldron 2009: 240). Therefore, it can be said that nothing very population-specific was found among the analysed inhumed bones of Võhma Tandemäe.

[12] These individuals are not comprised in this study as the commingled bones of only *tarand* 3 were included.
[13] This coincides with the information of the excavating archaeologist T.Moora who is convinced that both tof the skeletons were young adult and female. His assumptions were mostly based on short osteological training at M.Gerassimov's laboratory i Moscow. (pers. comm. 2013, 2014)

4 Intra-site spatial analysis

The goal of the spatial analysis of the bones was to determine whether there were any differences, which could have also been picked up with statistical tests, in the location of the bones and also to visualize the dry statistical results which are hard to grasp. Additionally, spatial analysis of the bones greatly helped determining whether the items and bone clusters could be connected and analysed together. The material illustrating the location of different body parts, cremated and not and of cremation stages is located in the appendices (Appendix 1.2–1.14; 1.16; 2.2–2.13).

4.1 Viimsi I

The grave areas with the most diverse bone material in Viimsi were north-eastern corners of *tarand*s A and C. These were the areas that were the least damaged as the top layers containing the bones from south-western areas of the grave had been shifted on top of that area by the excavator. The bottom layers of that area were intact. As the inhumation burials were placed in the grave later than cremations, the inhumed bones were probably mostly in the top layers that had been shifted off to north-east (Lang 1990). The depth of the bones in Viimsi is not known, therefore it cannot be analysed, although it would have been interesting to know the stratigraphy.

The destructed areas of the grave are well observable in the bone distribution plans. The central part of the *tarand*-surface with sparse stones did not contain many bones as well as the holes which had been dug for fruiters were almost empty of finds. The grave area plans to accompany the spatial analyses are located in the appendices (Appendix 1.2–1.14), where any information described in the following subchapters is presented visually.

Before moving forward with the spatial analysis, to accompany the complemented excavation plans, the differences in the presence of cremated and inhumed bone fragments in the grave areas were tested statistically. Comparing the occurrence of cremated and inhumed bone contexts in the 14 *tarand*-areas (Chi-square[14] 28,055, df 13, sig. 0,009<0,05) indicates that they had ended up in the grave areas in a non-random fashion and there should be patterns in the placement of the bones.

As there were fourteen distinguished grave areas and the excavator had definitely meddled some of them, the Chi-square test was run also on the presence of cremated and inhumed bone contexts inside and outside the *tarand* walls (Appendix 1.1, 1.4). The test showed even higher statistical significance (Chi-square 18,894, df 1, sig 0,000<0,05) than when it was conducted on the 14 separate areas which suggests that there could have been customs behind placing the dead either inside or outside the *tarand* walls depending on the way of burial (cremation/inhumation). While the cremated contexts are distributed evenly inside and outside the *tarand*s, the inhumed bones were mostly found from outside the walls (Table 10).

[14] Chi-square test compared frequencies of the variables and tested whether the relative proportions of one variable were similar or different to the relative proportions of another variable. The null hypothesis of the data varying similarily in groups was rejected when there was less than 5% of probability of the null hypothesis being true (p=0,05).

Nevertheless, the overall weight of bone contexts (both cremated and inhumed), was rather similar inside and outside the *tarand*-areas (Kruskal-Wallis[15] sig. 0,898>0,05).

Table 10. The presence of cremated and inhumed bone contexts inside and outside the *tarand*s of Viimsi I.

Bones	**Inside the *tarand*s**	**Outside the *tarand*s**	**Total**
Cremated	90	86	176
Inhumed	23	73	96
Total	113	159	272

4.1.1 The general distribution of body parts and their treatment

The difference in the location of the body parts was tested with Chi-square tests where the presence of bones in the inside and in the outside of the *tarand* walls was compared. It appeared that most of the bones were similarly distributed, only the prevalence of the fragments of feet showed statistically significant differences inside and outside the *tarand* walls – but as the number of contexts containing foot bones was low, especially inside the *tarand*s, the result may not be representative (Table 11; Appendix 1.5–1.14)).

Table 11. The crosstabulation and results of chi-square tests (df 1) conducted on the presence or absence of the bone elements inside and outside of the Viimsi I *tarand*s, statistically significant differences (sig. <0,05) are highlighted.

Body part		**Count of contexts inside *tarand*s**	**Count of contexts outside *tarand*s**	**Total**	**Pearson's Chi-square**	**Sig. (2-sided)**
Cranium	present	87	98	185	0,727	0,394
	missing	24	35	59		
Teeth	present	19	30	49	1,263	0,261
	missing	94	103	197		
Arms and forearms	present	46	47	93	0,749	0,387
	missing	67	86	153		
Hands	present	34	52	86	2,181	0,140
	missing	79	81	160		
Thorax	present	29	48	77	3,089	0,790
	missing	84	85	169		
Vertebra	present	30	32	62	0,201	0,654
	missing	83	101	184		
Pelvis	present	6	14	20	2,226	0,136
	missing	107	119	226		
Thighs and legs	present	31	33	64	0,218	0,640
	missing	82	100	182		
Feet	present	17	45	62	11,443	0,001
	missing	96	88	184		

In addition to the general dispersion of different body parts, the variety in the degrees of cremation of the same skeletal element originating from inside or from outside of the *tarand*-

[15] Kruskal-Wallis test compares three or more sets of ranked data and indicates whether the datasets are part of one large group or belong to different subgroups. The difference among the data is considered significant and the null hypothesis rejected when signivicance is less than the p-value. The p-value used in current dissertation is 0,05 which means the null hypothesis of the variables belonging to the same large group was rejected when there was a probability of 5% or less that the null hypothesis was true i.e. the tested subgroups were considered statistically signigicantly different.

areas were tested. Interestingly, the cremation stages inside and outside of the *tarand*s did generally show statistical significances (with the exception of pelvis and feet). It must be noted that the cremation stages were assessed with numbers from 0 (unburned) until 4 (very strongly cremated) and not all of the stages were represented by every body part as the degrees of freedom (df) indicate (Table 12). Most of the body parts showed that the difference in their mean cremation stages inside and outside the *tarand*s were statistically significant, i.e. only innominate bones and feet showed uniform cremation over all of the grave areas.

Table 12. Pearson Chi-Square values, degrees of freedom and asymptotic significance (2-sided). Teeth were not given cremation stages. The highlighted boxes indicate statistically significant (sig.<0.05) differences in cremation stages of different body parts among the grave areas inside and outside the *tarand*s.

Body part	Pearson Chi-Square	df	Sig. (2-sided)
Cranium	11,076	3	0,011
Arms and forearms	9,919	3	0,019
Hands	4,473	1	0,034
Thorax	9,792	4	0,044
Vertebra	11,770	4	0,019
Pelvis	6,930	3	0,074
Thighs and legs	13,698	3	0,003
Feet	3,095	3	0,377

Based on the general overview of Viimsi I *tarand*-grave, the distinguishable facets of the burial practice should come forward rather in the differential placement of the body parts of various cremation stages than in merely in the placement of body parts while not considering the cremation stages. Therefore, in the following subchapters, the location of the bones will be studied in two groups: cremated and inhumed.

4.1.2 Cremated bones

The percentage of cremated bone contexts with valid location information was 74% (131 out of 176 contexts). Not all grave areas contained the same amount of contexts or volume of cremated bones (Table 2). Surprisingly, the seemingly least disturbed area, *tarand* A did not contain bones the most, but the weight of cremated bones was largest in the southern areas of *tarand*s B and D. The area south to *tarand* B also contained more than a kilogram of cremated bones which could be easily the amount of bones for at least one individual (McKinley 2002: 408–409). The area west to *tarand* C did not contain any cremated bones at all; the western area was rather poor in cremated bones in general. The largest amount of cremated bones by weight was in *tarand* D – 2347 grams.

Using Chi-Square tests on the cremated bone contexts and their weight, the difference in their presence in 14 different *tarand*-areas, that were additionally categorised into two: the area inside and outside of the *tarand* walls, was analysed (Table 13). There was no statistically significant association in the prevalence of cremated body parts or bones and the area inside or outside the *tarand*s.

Most of the bone groups (teeth, arms, hands, thorax, vertebra, thighs and feet) were rather evenly distributed inside and outside the *tarand*s and were most represented in the less disturbed areas (the eastern parts of *tarand* A and C, the central part of *tarand* B) (Appendices

1.5–1.13). The main concentration area of the cremated bones in the eastern area of *tarand*s A and C can be partially explained by the fact that the excavator had pushed the top layers of the middle section of the grave towards north-east and some of the bones were originally from the western part of *tarand*s C and D.

Table 13. The presence of body parts in contexts inside (number of contexts present) and outside (number of contexts present) the *tarand*s of Viimsi I. The term ''all body parts'' refers to all contexts containing any cremated body part. df = 1.

	Cremated			
Body part	**Inside**	**Outside**	**Chi sq**	**Sig**
Cranium	83	67	0,703	0,402
Teeth	14	6	1,671	0,196
Arms and forearms	38	21	2,325	0,127
Hands	21	9	2,701	0,100
Thorax	24	14	0,873	0,350
Vertebra	20	10	1,524	,0217
Pelvis	5	2	0,655	0,418
Thighs and legs	22	14	0,385	0,535
Feet	8	8	0,316	0,574
All body parts	90	69	2,774	0,096

Interestingly, fragments of innominate bones were present almost exclusively in the eastern area of *tarand*s A and C. This phenomenon can also be partially explained with the works of the excavator as described previously. Nevertheless, it is possible that only few innominate bone fragments had preserved in the soil as the pelvic bone fragments tend not to survive the cremation process very well (Holck 2008: 47). The fragments that remain of the innominate bones after cremation are often cortical bone fragments which are hard to identify. Therefore, the slightly different spread of the innominate bone fragments may have also been caused by their lesser preservation and recognition, which decreased even more due to destructive action of the excavator.

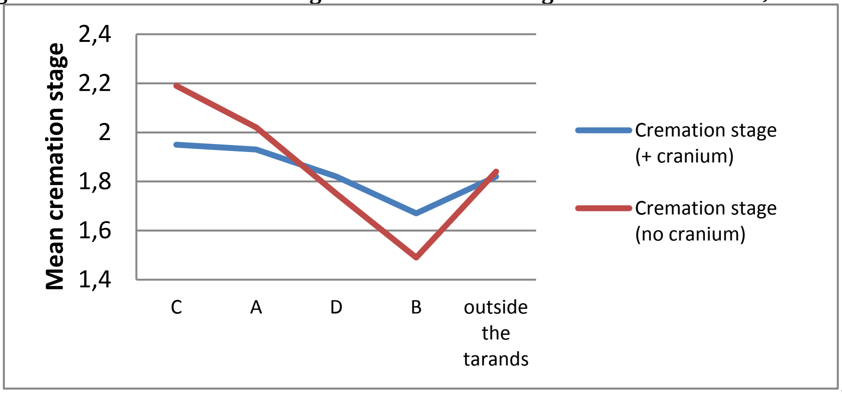
The spread of the cranial bones, however, is very interesting. At first, it seems that skull fragments are spread across all of the grave area, but the lack of cremated cranial fragments in the eastern area of *tarand*s A and C cannot be disregarded (Appendix 1.5). This phenomenon cannot be explained by the works of the excavator as well as this was the area where the soil together with all of the other body parts had been shifted onto and by that logic should have contained many cranial fragments as it did enclose all of the other body parts. There were though, several contexts containing cremated skull fragments in the western areas of *tarand*s C and D from where the excavator supposedly started and shifted the bones away from.

Also, the less severed *tarand* A contained fewer cremated crania (195 g) than the more disturbed *tarand* B (681 g). Had the proportions always been like that? Was *tarand* B assigned for cremated bones only? The excavation data of the bones shows that the inside of the *tarand* B walls does contain only cremated bones and *tarand* A contains merely two contexts of inhumed bones which could be associated with the disturbances of the excavator. Therefore it seems that the inside of the *tarand* walls may have been meant to contain only cremated bones.

Cremation stages

The mean overall cremation stage in Viimsi I *tarand*s did not differ much, but some trends were still possible to follow (Figure 6). The cremation stages computed including the cranium did show the same trends as the ones computed without cranium, but the latter showed a more pronounced variety. Interestingly, the cremation stages were the lowest in the areas where the amount of bones was the largest – in *tarand*s B and D.

Figure 6: Illustration of the change in the cremation stage of Viimsi I tarands, ascending



In order to see how evenly the cremation stages inside and outside the *tarand*s were distributed across the grave areas; Chi-Square tests on the overall mean cremation stage of the bone contexts were performed (Table 14). It appeared that there was no statistically significant difference in the cremation stage of the cremated bone contexts across the 14 *tarand*-areas from inside and outside of the *tarand* walls. Taking under the spotlight the bones that were found from inside the *tarand*s, it appears that the cremation of the body parts was more uniform, i.e. in one *tarand* the bones of one body part were of similar cremation stages.

Table 14: Results of Chi-Square tests comparing the cremation stages of different body parts and context means in the grave areas inside and outside the *tarand*s. The highlighted boxes indicate statistically significant (sig.<0.05) differences in the overall mean cremation stages of the contexts.

Body part	Inside the *tarand*-area			Outside the *tarand*-area		
	Pearson Chi-Square	**df**	**Sig.**	**Pearson Chi-Square**	**df**	**Sig.**
Cranium	5,672	6	0,461	32,697	16	0,008
Arms and forearms	4,886	4	0,299	7,500	6	0,277
Hands	1,556	3	0,670	cannot be computed[16]		
Thorax	12,240	6	0,057	5,000	4	0,287
Vertebra	4,133	4	0,388	3,000	2	0,223
Pelvis	5,000	4	0,287	cannot be computed[17]		
Thighs and legs	9,541	6	0,145	3,000	3	0,392
Feet	4,000	1	0,046[18]	8,000	6	0,239
Total (+ cranium)	23,134	24	0,512	59,073	64	0,651
Total (no cranium)	26,255	21	0,197	27,813	16	0,033

[16] There were only three fragments of hand bones in the areas outside the *tarand*s and the cremation stage was a constant – all the fragments were of cremation stage 2.
[17] There were only two fragments of pelvis in the areas outside the *tarand*s and the cremation stage was a constant – both fragments were of cremation stage 1.
[18] The statistically significant difference may have occurred due to the small number of contexts (N=4). Yhe qualifying Fischer's Exact Test showed Exact 2-sided significance of 0,333 (<0,05).

The difference in the cremation stages of the bones can be observed among the bones that were placed or had ended up outside the *tarand*s. The difference between the cremation stages of cranial fragments outside the *tarand*-areas was statistically significant which means that the degree of burning of cranial fragments from outside the *tarand*s was not evenly distributed across the smaller areas. Interestingly, there was no statistically significant difference among the overall mean cremation stages of the contexts that was calculated comprising the cremation of the cranium (+ cranium), but statistically significant difference was observable in the distribution of mean cremation stages of the contexts outside the *tarand* areas computed without the cranial fragments.

4.1.3 Inhumations

In general, the distribution of the inhumed bones was similar to the spread of cremated bones – the fragments of different body parts (teeth, arms, hands, thorax, vertebra, thighs and feet) were present in most of the grave areas. The main clustering of the bones was in the north-eastern part of the *tarand*s A and C, but an additional concentration areas were observed around the walls of *tarand*s A and B.

The distribution of bone weight in contexts was not statistically significantly different across the 14 *tarand*-areas (Kruskal-Wallis sig. 0,071>0,05). Nevertheless, there was a statistically significant difference in the distribution of inhumed bone weight inside or outside the *tarand* walls (Kruskal-Wallis sig. 0,013<0,05). Therefore, it can be said that considering the grave area as a whole, the inhumed body parts were scattered with a rather similar occurrence, but there definitely was a difference in the presence of the inhumed bones either inside or outside the *tarand*s. The areas outside the *tarand*s contained clearly more inhumed bones than the stone rectangles.

Table 15: The presence of body parts in contexts inside and outside the tarands of Viimsi I. The term ''all body parts'' refers to all contexts containing any inhumed body part.

	Inhumed			
Body part	Inside	Outside	Chi sq	Sig
Cranium	4	36	25,600	0,000
Teeth	5	28	16,030	0,000
Arms and forearms	8	31	13,564	0,000
Hands	13	51	22,563	0,000
Thorax	5	38	25,326	0,000
Vertebra	10	24	5,765	0,016
Pelvis	1	14	11,267	0,001
Thighs and legs	9	21	4,800	0,028
Feet	9	44	23,113	0,000
All body parts	23	73	26,042	0,000

Fragments of inhumed bone in Viimsi I were largely found outside the *tarand*-areas (Table 15). Based on grave area plans and the previous osteological work, there could have been some inhumation burials in the topsoil of the *tarand*s but the amount of associable inhumed bones was minimal. The only evidence of any intact burials was a fragmented male cranium (cluster III) which was unearthed from the mid-part of the northern wall, outside the *tarand*s.

Nevertheless, the lack of inhumed bones inside *tarand*s does not seem occasional – if the people would have inhumed their dead into that area, there should be at least some remnants of such action. Statistical data backs up the assumption that inhumed human remains had preferably been placed outside the *tarand*s, in the ruins.

Again, as among the cremated bones of Viimsi, there were differences in the placement of innominate bone fragments. The inhumed fragments of pelvis were present merely in the northern area outside *tarand* A. The number of fragments was low and some rather well preserved innominate bones (e.g. 207, 222/223/225/228) suggest that there were no problems with bone preservation, but as cortical bone and pelvis are sensitive to external factors, the well preserved may be handled as exceptions as well.

4.2 Viimsi II

Viimsi II, the smaller *tarand*-grave next to Viimsi I. As the bones are currently not available for study, the osteological material was not discussed and no intra-grave spatial analysis was conducted on Viimsi II grave. Nevertheless, the grave is worth mentioning because the burial area was well recorded and can be helpful in interpreting the Viimsi I grave (Appendix 1.15).

During the excavations it was recorded that the bones inside the *tarand*s of Viimsi II had been placed both in compact clusters and seemingly randomly (Lang 1993: 17). The clusters are well visible on the excavation plans, but cannot be connected with the bones for obvious reasons. Nevertheless, some trends were observed based on the excavation plans and knowing them will be useful in interpreting the distribution patterns of other *tarand*-graves, especially Viimsi I.

Ken Kalling has identified the remains of one cremated and two inhumed individuals (Kalling 1993: 68). As there were sixteen clusters on the excavation plan, it seems that the bones of the individuals have been separated and buried in several pits. The number of individuals in the grave may definitely be larger than three, but it is doubtful that the count could reach sixteen.

There were altogether seven clusters in the larger and earlier built north-westernmost *tarand* and six of these deposits contained only cremated bones. A cluster excavated from the southern corner of *tarand* A included both cremated and some inhumed bones. There were two similar deposits of cremated and inhumed bones in the southern corner of *tarand* B.

4.3 Võhma Tandemäe

4.3.1 Cremated bones

All of the cremated bones from Võhma Tandemäe were reanalysed. It must be noted that the amount of cremated bones with known location information was 55 %. Not all of the bones that had location information could have been assigned to a specific *tarand*, but the amount of bones assigned to the area inside the walls was 4821 grams (47,6 %). Even though the results cannot be fully interpreted due to the loss of data, the main trends should be observable.

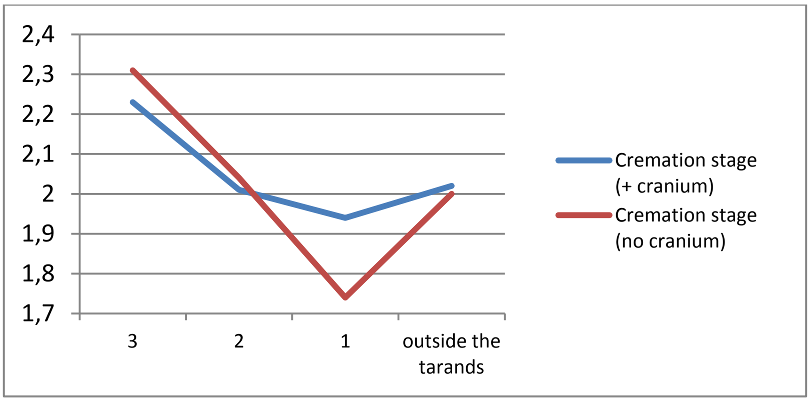
Most of the body parts were distributed evenly across the eight *tarand*-areas. Fragments of the bones from arms, hands, thorax, vertebra, pelvis, thighs and feet were found from all of the three *tarand*s with the concentration areas in the eastern part of the grave (*tarand*s 1 and 3) (Appendix 2.7–2.14). Fragments of crania were diffused across the whole grave area and reached the farthest to the south of the grave (Appendix 2.5). Similar pattern was formed by the fragments of teeth as cremated dentition had been collected from all of the grave areas (Appendix 2.6).

Based on the weight of the bones, the areas with the most cremated bones were the southern half of *tarand* 1 and the southern 2/3 of *tarand* 3 (Appendix 2.2). Interestingly, the north-eastern area of *tarand* 2 contained less than 50 grams of cremated bones (*ibid.*). Inhumed bones from this area should definitely be addressed to see whether the area contains any more human remains. As I noticed a hint of a wall construction in the north-eastern part of *tarand* 2, the area poor in cremated bones may not have been assigned for burying.

Cremation stages

Chi-Square tests comparing the prevalence of different cremation stages among body parts did not mostly show any statistically significant differences in cremation stages between the groups of different body parts in the three *tarand*s and the area outside the walls. Only the difference between the cremation stages of innominate bone fragments showed statistically significant difference (sig. 0,006<0,05) in between the areas inside and outside the wall.

Figure 7. Illustration of the change in the cremation stage of Võhma Tandemäe tarands, ascending.



Relying on the reputed building sequence of the *tarand*s in Võhma Tandemäe (1, 2, 3), it seems that cremation got stronger when the time passed (Figure 7). The mean cremation stage in *tarand* 1 was 1,94 while it contained the largest volume of bones. In comparison, the bones in the newest, *tarand* 3 with similar weight had average cremation stage of 2,23. The degree of cremation of the bones from *tarand* 2 fits nicely in between the previously discussed results with an average cremation stage of 2,01. Bones found from outside the *tarand* areas had the average stage of cremation of 2,02. These differences in cremation stages did not show a statistically significant variability (Chi-Square sig. 0,192>0,05).

In addition to the analysis of cremation stages among *tarand*s, average stages in two excavation layers were also analysed to see whether there could be any differences between deposit layers. Comparing the average cremation stages in excavation layers and *tarand*s did not give consistent stratigraphically different and statistically significant results (chi-square sig. 0,333>0,05).

All of the bone material from outside the *tarand*s came from the southern end of the grave, close to *tarand* 1. It was assumed that the bones could have ended up outside the *tarand*s due to erosion processes as the grave had been built on the edge of a ridge.

All in all, it seems that the cremation of the bones deposited in the grave was rather uniform and the average pyre temperature influencing the bones was around 400ºC, although the calcined chalk-like bones from Võhma Tandemäe 3rd *tarand* had definitely been in the heat exceeding 1100ºC.

The area on the northern corner of *tarand* 3 which does not contain many of the bones is also worth mentioning. The area constitutes a small bone cluster containing cranial bones, teeth, upper limbs and fragments of axial skeleton; altogether 8 grams of cremated bone, mostly belonging to immature individual(s). Unfortunately, it was not possible to associate the remains other than spatially; there were no specific age-related characteristics present.

The patterns do not suggest differential placing of any body parts. Nevertheless, the wide spread of cranial fragments is exemplary.

4.3.2 Inhumations

As the number of inhumed bones in *tarand* 3 was surprisingly low, the spatial analysis was not very informative. The inhumed bones clustered mainly close to the triple burial and the southern half of the *tarand*. The area with few cremated bones in the northern corner of *tarand* 3 contained also 2 grams of inhumed bone, mostly fragments from an immature individual.

The intact inhumation burials were all headed west or north-west and based on the drawings and reports, they had all been placed inside the *tarand* walls except the 30–40 years old male south-west to *tarand* 1. As this individual was very well preserved and Lang (2000: 125, 375) seems to have evidence of a rural cemetery south to the ridge, it can be possible that the male individual did not live during Iron Age, but later or may have been an outcast or there could have been some other reasons for placing him differently than the others.

Based on the information available, the bones had preserved more or less in an anatomically correct position and it seems plausible that the three dead from *tarand* 3 had been placed into the grave together. Also, the inhumations from *tarand* 2 must have been placed into the grave during a time not far apart as these graves had not been intercut by each other.

5 Discussion

5.1 Representation of bones

Representation of bones in the grave gives insight to several actions. First, the human body is treated for the funeral based on the beliefs of both the deceased and the buriers. Primary ritual can be followed by secondary ritual(s) and the time span between the two cannot often be determined (Jonuks 2009: 175). The differential treatment of body parts is known from several different archaeological assemblages and the fragmentation or breaking human body was a pattern that has been widely recognised during Iron Age, but known already from the Neolithic (Parker Pearson 2008: 51-52; Redfern 2008; Armit 2012: 9). In addition to the possible socio-cultural reasons behind the choice of bones to be handled or buried, there are additional factors behind the representation of cremated bones – not all of the bones survive the pyre (Holck 2008: 46pp). During or after active use of the burial place, the grave and the initial deposit may be disturbed by marauders. The area may also have been used for building, quarrying or other purposes that destruct the grave constructions, e.g. the first was the case in Viimsi I.

Last but not least, the material often reaches archaeologists through colleagues' eyes and reports which are, usually unwillingly, loaded with their interpretations and opinions. The choice of excavation methods and of what to collect has not always been the choice of the person who analyses the material. The amount and entity of the osteological material is influenced by all of the above and, of course, by the main influencer – nature.

Taking into account that the bones had been moved by the excavating machine and some of the top layers had probably been scoured off Viimsi I grave, it could be implied that the inhumed bones had been scattered all over the burial area as were the cremated bones, but not much as the bottom layers still seem intact. Additionally, it can be observed that the artefacts had been bulldozed further north-west than the bones. This suggests that the artefacts were in the topmost layers and the bones had been buried relatively deeper – most of the bone deposits had probably not been moved. Therefore, it may be assumed that the grave was not as destroyed as it seemed at first and I would suggest that more than half of the initial grave contents were still present during the excavations.

Of course, the original situation cannot be fully assessed as the grave area had been disturbed, but leaving aside all of the lost data and the trend of placing inhumations outside the *tarand* walls stands out, the less destroyed *tarand* A contained only few non-cremated bones and there were no inhumed bones inside the walls of *tarand* B. Therefore, it seems possible that the spatial organisation was skewed only slightly in the mid-section of the grave.

The amount and composition of the inhumed bones in Viimsi I was quite representative. All of the body parts were present and their proportions corresponded to the ones in human body, except that the amount of innominate and cranial bones was relatively low. The preservation of bones was generally good (Figure 8). Therefore, the existence combined with the location of the bones should give us a fairly accurate idea how the Iron Age people perceived the dead and the grave. Even though cortical bone fragments were often very friable and innominate bones degenerate fast, the cranial fragments are not composed of fragile spongy cortical bone. Based on the presumption that poor preservation could not have been the main reason for the lack of inhumed skull elements, it is certain that the missing uncremated cranial fragments were handled somehow differently than other bones.

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Figure 8. The most eroded inhumed mandibular fragment from Viimsi I. The teeth are broken, but mandible is quite intact and well recognisable. Superior view on the left and anterio-lateral view on the right.

The underrepresentation of inhumed cranial fragments in Viimsi I is accompanied with the overrepresentation of cremated skull fragments as the percentage of the cranial bones among all bones of the body in Viimsi I was 34% while the ‘’standard’’ is 20% (Chamberlain 1994: 11). Considering this underrepresentation and lack of the most commonly found cranial fragments among the Viimsi I inhumed bones and trying to explain the overrepresentation of cremated cranial fragments at the same time, it seems that for some reason, the remains (or merely skull) of the inhumed individuals were exhumed, cremated and then reburied in the *tarand*-grave. As the differential treatment of the skulls is known from several burial places and the phenomenon of the head is a matter to be discussed, there will be a chapter (5.3) dedicated to head and its role in funerary rituals.

The osteological material from Võhma Tandemäe was less intriguing. All of the body parts were represented among the cremated bones in more or less correct proportions. The deviation from the normative percentage of 20% in the prevalence of the cranial fragments (26,7%) seemed not enough to confirm any skull-specific rituals. The amount of commingled inhumed remains in the analysed *tarand* 3 was unfortunately too small to reach conclusions about the whole grave, but no skewness in the representation of bones was noticed. Skull fragments were well represented and their preservation compared to the crania in Viimsi I was the same or worse which also indicates that the underrepresentation of inhumed skull fragments in Viimsi I was probably not connected with bone preservation, but deliberate actions.

However, several body parts of the intact inhumations of Võhma Tandemäe were missing, but as the material has also commingled after the excavation and initial analysis, the seemingly vanished bones may be in another zip-lock bag. Six of the dead were headed north-west, the placement of the one who had been buried south-west to *tarand* 1 is not known. The 30–40 years old male was very well preserved and no artefacts were found close to him. Due to that it seemed at first that the burial may be connected to the rural cemetery[19] that was supposed to be located south to the *tarand*-grave (Lang 2000: 125). Nevertheless, it would be good to continue with the osteological analysis of the inhumed bones from the two other *tarand*s to see whether the results are the same.

[19] Lang (2000: 375) refers to the report (Moora 1973) which does not mention anything about possible rural cemetery.

5.2 Cremation and inhumation

The differential treatment of the bones is not manifested solely in the representativeness of body parts, but also in the differential handling of the bones. The analysed graves contained both cremated and inhumed bones which suggest that there may or may have not been a reason behind the choice of inhumation or cremation ritual. Also, the disparities in the cremation process can give insight to several rituals that may have been conducted with the dead.

Two main ways how to dispose of corpses are inhumation and cremation and the choice between them could have been done based on many different parameters: religion or beliefs, convenience, weather conditions, distance of the place of death from home etc. In Viimsi I and Võhma Tandemäe, both of the burial customs were represented and in the excavated material there should be at least some indicators of the reasons why some people were cremated and some inhumed. However, the trends showed rather how the differently handled bodies were treated, placed in the grave and gave insight to the rituals.

Kalling (1993: 68) had noted that some of the bones in the Viimsi *tarand*s may have been cremated after the dead had been buried for some period of time but he did not specify more. The occurrence of some longitudinal splitting and little warping on the surface of the long bones of Viimsi I grave were noticed which may indicate cremating bone material that has already been buried, decomposed and dried (Ubelaker 2009). Nevertheless, the determination of cremation time after death based on the occurrence of splitting and warping has been proved ambiguous (Gonçalves *et al*. 2011). Considering the precariousness of the method and rather scant presence of longitudinal splitting, I would suggest that most of the long bones in Viimsi I were cremated fresh and fleshed.

This was not the case for the skull fragments. Several cremated cranial bones from Viimsi I showed a glistening sooty appearance, especially from the inside which indicates that the bones had been cremated fresh, in the presence of organic matter (Holck 2008: 96). The glistening appearance fades during further heating which suggests that the crania were not cremated for very long (*ibid.*). The exact pyre duration and temperature cannot be determined, but as Holck (2008: 96, 99) has associated the phenomenon with cremation grade 1, the temperature should not have exceeded 400ºC. Large portion of skull bones were cremated more densely from the inside or on the break surfaces rather than from the outside, it seems that the skull had been cracked open in the beginning of the cremation process or cranial bones had been cremated after some period of time (Oestigaard 2003: 13).

Same applies to Võhma Tandemäe grave – there were some signs referring to the bodies being cremated after the flesh had rotten and bone dried, but the amount of longitudinal splitting of the bones was not very large. It can be suggested that there may have been several burial ritual practices present and some of the bones may have been cremated dry and some of the deceased were cremated as bodies.

It is certain that both in Viimsi I and Võhma Tandemäe, some of the bones had been cooled down quickly as the temperature shock had caused long bones to break on a straight transverse line, sometimes with a protruding beak (Figure 2) (Binford 1972, through Stewart 1979: 61–62). The quick cooling may have been deliberate as the mourners may have poured water on the pyre site to be able to collect the bones faster or incidental due to sudden weather changes (heavy rain, snowfall etc.).

5.3 Iron Age head-cult

The representation of cremated bones relies largely on actions that were undertaken by the buriers – which bones that had survived the pyre were collected and placed into the grave was their decision. The phenomenon, that after cremation process not all of the human remains were collected from the pyre and buried, has been widely noticed (McKinley 2002: 414; Parker Pearson 2008: 7; Joy 2011: 409). Viimsi I is not an exception – based on the relative amount of cranial bones, skull fragments seem to have been preferred while collecting the bone from the pyre.

The differential treatment of crania is not uncommon, the heads of others have fascinated people and there are several beliefs and rituals associated with skulls and their handling. In Anatolia, there is a place called the Skull Building which was used between 9400–6400 BC (Croucher 2011: 830). The name of the place is very accurate as the building, erected during many phases, contained almost a hundred skulls placed is a cellar together with stacks of long bones (*ibid.*: 831). The skulls in the House were mostly accompanied by mandibles and sometimes vertebrae which suggest that the heads had been placed there while soft tissues were still intact (*ibid.*).

Time passed, but the special handling of bones continued, there are several examples known from Great Britain and even from Estonia (Redfern 2008; Armit 2012). Decapitation seems to have been an important ritual prior to burial in Romano-British cemeteries (Egging Dinwiddy 2009: 41–42). Special interest in cranial bones has been noticed in Kunda *tarand*-grave, Rebala stone-cist graves, Tõugu *tarand*-grave, Tõnija *tarand*-grave, and also in Võhma *tarand*-graves (Kalman 2000c: 427; Kalman 2000b: 405; Jonuks & Konsa 2005, Lang 2007b: 180). In Kunda, though, it is known that at least one of the separately placed skulls was accompanied by mandibular fragments[20]. The head had either been in the pit as a whole or skull and mandible were held equally important.

In Võhma Tandemäe, this time, no signs of cranium-related rituals were noticed. There were altogether 7 intact inhumations: two in groups of three and one single burial, all of them had their heads intact, although fragmented, none of the body parts showed evidence of cremation.

The cremated bones had some concentration areas, mostly in the mid-section of the graves and southern part of *tarand* 1. Based on the commingled inhumed remains, the distribution areas were roughly the same. Therefore, the evidence from Võhma Tandemäe suggests that there was no segregation between inhumed and cremated bones.

Returning to Viimsi I grave, there are many interesting pieces of information that give an intriguing picture of the possible actions on the grave. There were no intact inhumation burials in Viimsi I, even the missing cranium (cluster III) referring to ‘’skeleton I’’ constituted only the skull. Some of the foot bones a little less than two meters west to the burial may suggest that these belonged to the same individual who was buried parallel to the northern wall of *tarand* A headed east, but this interpretation is very imaginative and cannot be set as the basis of a discussion.

As mentioned before, the overrepresentation of cremated and underrepresentation of inhumed cranial fragments in Viimsi suggests along with the controversial cremation pattern suggests

[20] Marge Konsa, pers. comm. 2014.

that the inhumed bones had been moved, parts of the body (the crania[21]) removed and cremated. The space of time between the initial burial and the cremation of the head could not have been very long as cranial vault fragments showed black glistening surface on the inside that is characteristic to the cremation of bones with organic material still intact. Some marks on bones indicate that the cranium may have been separated from the rest of the body while at least some soft tissue was intact.

One of the right rami had a 5 mm wide and 2 mm deep cut mark on its posterior side. The cut mark was directed from the superior-posterior side downwards and is similar to the description of possible injuries that may occur during beheading (Figure 4; Waldron 2009: 165). In the Iron Age Viimsi I context, beheading could have accompanied the preparation of the body for the secondary – cremation ritual and as crania were considered the most important parts of the human body, they had to be severed from the rest of the body.

Other indicators of separating crania from other parts of the body are cut marks on a parietal bone fragment close to the attachment site of the temporalis muscle. As the temporalis muscle connects the parietal bone and the coronoid process of mandible, the cut marks can be interpreted as an attempt to detach mandible from the cranium so that the latter could be cremated and the mandible may have been re-inhumed.

As most of the inhumed bones were found from outside the *tarand* walls and most of the cremated bones from the inside, there may have been an important difference between the meaning of the areas inside and outside the walls. Parts of the inhumed bodies, initially placed outside the walls, were cremated, ritually cleaned or killed and after the secondary ritual were placed or scattered inside the walls. According to Indian beliefs, the dead is not dead until it has been cremated and the spirit of the dead that lives inside the skull will be freed only after the head is cracked open (Oestigaard 2003: 13–14). Of course, Indian beliefs do not reflect the ones of Iron Age Estonia, but some parallels may be drawn with a possible ritual sacrifice of the dead, in this case only part of the dead was sacrificed (Jonuks 2009: 178). As the people burying into the stone graves did not care much of the completeness of the skeleton of the deceased and were engaged in different rituals involving exhumation and re-inhumation, their ability to tamper the remains of the dead should not be questioned (Jonuks 2009: 168, 174). There may have been a variety of beliefs behind the need to cremate the dead or merely the skull, starting from the idea of a proper burial and finishing with the rituals to prevent the ancestors from coming back to haunt the living (Oestigaard 2003: 13; Jonuks 2009: 179). Even the possibility that the inhumed skulls were removed and taken elsewhere cannot be ruled out.

The differential handling of the head and the body does call the determined minimum number of individuals in question. How can we be sure that the individuals were not counted twice? Therefore, I would cautiously reduce the inhumed individual count and say that at least 31 individuals who had been partially inhumed and partially cremated had been buried in the Viimsi I grave as all of the individuals, except the new-born and the child aged up to five years, whose inhumed remains were distinguished, may as well be represented among the cremated individuals. Unfortunately, it is impossible to verify whether the burned cranial bones and unburned bones of the body belong to the same individual as the organic matter along with DNA perishes around 500ºC and cremation alters the bone structure (Holck 2008: 92–93). Hopefully, the future will give us a technology which could help with this problem.

[21] In osteological terms ’’skull’’ refers to cranium with mandible and ’’cranium’’ refers only to the cranial wault and facial skeleton without the mandible.

All in all, two different burial episodes in Viimsi I grave can be distinguished, cult of the heads can be associated with the latter – period of inhumation burials. First, it was the period of cremation burials. Based on the building order, these cremation burials should mainly have been found from inside the *tarand*s A and B (Lang 1990). Secondly were placed the inhumation burials and only after these corpses had been in the ground for some time, the remains were partially exhumed. Partial cremation of the exhumed remains and the continuation of inhumation burial were probably accompanying each other.

5.4 Intra-site spatial distribution of burials and grave goods

5.4.1 Bones

The bones had been placed both inside and outside the *tarand*s. The ruins around the walls in Viimsi I were observed during excavations and the stones were marked on the plans. For Võhma Tandemäe, the ruins have been mentioned but their extent is not known as the ruins have not been marked on the plans. Supposedly, the ruins were not as large as in Viimsi I because the ridge set limitations to the building. Nevertheless, the edge ruins of both analysed graves contained human bones and were used for burial purposes.

The bones in Viimsi I were scattered evenly on the burial area, but I noticed that cremated bones tended to have been placed rather inside the *tarand* walls while inhumed bones were mostly outside the walls (Appendix 1.4). The differences in the location of inhumed and cremated bones were proved statistically significant (Chapter 4.1).

The distribution of bone elements was uniform inside and outside the *tarand*s, but the weight of the bones showed that most of the cremated bones were concentrated in southern area of the grave, mainly in *tarand* 3. The weight of inhumed bones, on the other hand, was the heaviest to the north and north-west of the grave, outside the *tarand* walls – in the shifted layer. As inhumation burials in Viimsi I are considered younger than cremation burials, it is evident that the inhumed bones had ended up in the top layers (Lang 1990). Therefore, inhumed bones were more affected by the destructive action of the excavator, but based on the amount of inhumed bones still left on the southern and western side of the grave, the amount of lost information was probably smaller than expected – most of the bone material was in the place as it was during the Iron Age.

For a few cases in Viimsi I, bone concentration areas or clusters were noticed, which suggests that at first the cremated bones may have been placed in pits. This presumption is backed up with data from Viimsi II grave where most of the bones had been placed in distinctive clusters or pits, however one wishes to call these (Lang 1990; 1993: 17; Appendix 1.15). Inhumed bones could have got into the pits from the intact but damaged burials that at first had been laid in between the pebbles and were cut by the pits dug for placing the cremations. In Võhma, bones had also been scattered all over the grave area.

5.4.2 Individuals and social groups

The placement of the individuals into the grave areas could have also differed based on the deceased's social status, age, sex, colour of their eyes or any other trait that could have been held important by the Iron Age people. In Estonia, the grouping of child burials has been observed, e.g. Kalman (2000c: 425) noticed that in Võhma Tandemäe, the southern area of *tarand* 1 contained mainly child bones (Lang 2000: 132). The trend of men and women having designated grave areas inside stone graves has not been noticed.

One of the reasons for that may be that the determination of sex among fragmented human remains is complex and skewed as women are always underrepresented. The morphological data of osteological sex attributes comes in bits and pieces; while male traits are prominent and better preserved, the female traits are more prone to decay and the remaining fragments can often be characteristic to both of the sexes.

In Viimsi I, the differential placement of the dead was not evident. There were no signs of identified individuals clustering together in one area of the grave. Nevertheless, taking all cremated juvenile bones into consideration, they were located in the southern half of the grave. The bones of male individuals were present in most of the grave areas and even the bones of the few female individuals do not show any concentration areas. Therefore, it could be suggested that there were no specific rules where to bury the deceased of different social groups, although it seems that when it came to burying children, the southern areas of the grave were preferred, especially for the cremation burials, even though the northern areas were not excluded.

The cremated individuals from Võhma Tandemäe showed much more systematic placement. All of the bones used to identify children were found from *tarand* 1 or from *tarand 3* adjacent to the previous. Additionally, the male bones were found from *tarand* 3, except for one who had been placed south-east to *tarand* 2, outside the walls. As there was only on identified female individual, no conclusions can be drawn from her location, but her bone fragments was found from *tarand* 3. The inhumation burials showed that age and sex did not matter while choosing into which *tarand* to bury – in *tarand*s 2 and 3 there were individuals of both sexes and different ages. Nevertheless, it seems that Kalman (2000c: 425) was correct as the southern part of *tarand* 1 was designated for children. As I am not yet familiar with the inhumed bones of that *tarand*, I cannot confirm the presence of inhumed children in the area, but it seems promising.

It can be said that *tarand*-graves were indeed collective burial places as several age groups and both sexes were represented. The presence of intact burials in Võhma Tandemäe indicates that at first the people may have been approached more individually and depending on the depth of the grave, the bones were commingled in the course of time. In Viimsi, the collectivity of the grave is more pronounced as no intact burials were found and merely four bone clusters emerged.

5.4.3 Artefacts

The bones in Viimsi I, Viimsi II and Võhma Tandemäe were placed in the grave with some goods. All of the graves contained numerous artefacts, some of which can be associated with clothing and personal adornment, but there were several items that can be grouped as utensils and creamics were present as well (Lang 1993: 30pp, 2000: 134pp; Olli & Kivirüüt 2014[22]).

[22] The artefacts of Viimsi I were reviewed by Maarja Olli in 2014 to determine whether the artefacts had been burned or not.

The following will be a brief insight to the grave goods mainly from Viimsi I and their association with burials.

In Viimsi I, there were several items that were found from inside or very close to the four bone clusters (Appendix 1.16). It seems that the deposit of the bones and items was made at the same time and in case of cremated individuals the artefacts had been in the pyre with the individual, e.g. the male individual from cluster I had been adorned with a crossbow fibula that had signs of being in fire. As fibulae were part of the attire it suggests that the dead may have been cremated fully clothed or with at least some of the objects they had used daily, e.g. razors. As the items had been at the pyre site and were picked up together with bones from the pyre debris, it must have been important to keep them somehow connected.

The location of artefacts and identified individuals did not show many firm links. It seems that crossbow fibulae were mostly connected with male individuals as they were identified close to four male individuals. None of the other items showed repeated spatial association with specific social groups. Nevertheless, it must be noted that the juvenile individual from bone cluster IV had been given a mini-spearhead. The assumption that the small spearhead may belong to a child was suggested also by Lang (1993: 44) and the discovery of the juvenile individual nearby ascertains the speculation.

The items from Võhma Tandemäe have been studied by Valter Lang (2000: 134–145). As the excavation report did not reveal the location of the finds and the location was not mentioned in the storage boxes, I focused only on the items that were connected with the intact inhumation burials as these were the only ones I was able to locate.

The adult individuals in *tarand* 2 were both adorned with a neck-ring and bracelets which both can be classified as jewellery. The northern possibly female individual was accompanied by a bronze decorative pin, but as the pin was located north to the skeleton’s head, it was probably not used to fasten the deceased’s clothes during the burial. The pin could have been placed there as a grave good or may have initially not been connected with the particular skeleton at all. The child burial next to the northern skeleton was adorned with temple ornaments. All of the three skeletons have been dated to Pre-Roman Iron Age (Lang 1996: 287–285, 2000: 142).

The triple burial in *tarand* 3 contained mainly iron shepherd-crook pins – each of the skeletons had two (Lang 2000: 141). Even though there are no excavation plans or drawings, it seems plausible that the pins got into the grave as clothing fasteners. The north-easternmost of the skeletons had an axe nearby (*ibid.:* 133). The axe may have been used as both weapon and a tool, but based on analogues has been dated to late Pre-Roman Iron Age or early Roman Iron Age which indicates that there has been a time lag in between the burials in *tarand* 3 and 2.

The lack of personal adornment items among the later burials may be meaningful, but no further conclusions can be made as the amount of analysed material was rather small. Distributing items found from Viimsi I into groups based on their purpose (personal adornment items, utensils, weapons, and ceramics), there were also no associations or clustering detected, the items were merely more numerous on the north-eastern corner of the grave.

The placement of the artefacts together with the scattered bones gives information about the society. Even in Viimsi I, the bone clusters showed presence of personal grave goods which indicates an individual approach.

6 Conclusions

This MA dissertation comprised the osteological and intra-site spatial analysis of two Iron Age *tarand*-graves in Northern Estonia – Viimsi I and Võhma Tandemäe. The main focus was set on Viimsi I and the main goal was to see whether there was a normative way of placing the dead or the bones into the grave and whether some bone-related ritual actions could be reconstructed based on the osteological material and its relative location. The co-usage of osteological and spatial analysis methods brought up new data concerning the Iron Age people, their burial rituals, grave layout and society in Northern Estonia. Some of the previous results were complemented, some were changed and new information was recovered.

In Viimsi I *tarand*-grave, there were at least 31 buried individuals: five male, three female and seven immature individuals who may have been inhumed at first, but partially cremated later or whose corpse was cremated as a whole shortly after death. The small group of immature individuals comprised both children and adolescents. In the analysed material of Võhma Tandemäe, there were 15 cremated and 12 inhumed individuals. Among the cremated, there were six male, one female and five immature individuals identified. Similarly, age and sex was not determined for all of the inhumed individuals, based on the material, there were two female, two male adult and three immature individuals in *tarand* 3, a female, a male adult and a child in *tarand* 2 and a male individual south-west outside the walls of *tarand* 1.

These results differ greatly from the previous osteological analyses. Firstly, the minimal number of 21 cremated individuals ascertained by Kalling in 1993 augmented to 29 – three individuals were added even to my own results from 2011. Nevertheless, I had to decrease the overall minimum number of individuals buried into the Viimsi I grave to 31 due to the rituals that have made the distinguishing of definite exclusively cremation or inhumation burials impossible. The minimum amount of 8 inhumed individuals in Võhma Tandemäe *tarand* 3 remained the same as Kalman found in 2000 whereas the minimum number of cremated individuals in Võhma Tandemäe was tripled from 5 to 15. All of that shows that the previous studies had not considered all of the important osteological details and lacked technical know-how, especially in the field of analysing cremated human remains.

The bones had mostly been cremated at the temperatures 300–700ºC, but some osteological material had been in a pyre exceeding 1100ºC. Even though the cremation was rather uniform and most of the bones result from burning corpses, some were cremated dry, after the flesh had decomposed. At least in some cases, the mourners did not stay waiting until the pyre and the bones cooled down gradually, but cooled the pyre site down quickly, perhaps by pouring water on the hot bones causing specific fracture patterns on the bones.

There were no specific age and sex-related placement patterns noticed in Viimsi I. Nevertheless, it seemed that cremated juvenile individuals had rather been placed in the southern half of the grave. In Võhma Tandemäe, on the other hand, there certainly was a designated area for placing the deceased children in the southern *tarand* 1 and there also may be a custom of placing male burials mainly in the northern *tarand* 3. It seems that there may have been many normative ways how to place the deceased, but the tradition of distinguishing heads was time-proof as skull-related rituals are known from one of the first *tarand*-graves in Kunda as well as from Viimsi I.

Even though, there were not many age and sex related placement patterns found among the Viimsi I *tarand*s, there was a normative way in the placement of cremated and inhumed bones

– the inhumed bones had mostly been placed outside the *tarand* walls and cremated bones were scattered throughout the grave area. This suggested that at least some of the bones had been treated differently than the others. However, most of the body parts had been cremated and distributed evenly in the grave area. The only body part showing differential treatment in Viimsi I was skull as the crania had been cremated at relatively low heat and not for a very long period of time. The markers on bones showed that the crania had been cremated while there was some organic material present and the few cut marks indicated that the skulls may have been severed from the body and the mandibles. This suggests that the Roman Iron Age people of Viimsi I had beliefs that probably prioritized skulls and therefore at least some of the skulls were exhumed and cremated.

While conducting the analysis, several bottlenecks were encountered. Some of the data was missing and some never created – e.g. radiocarbon dating of the bones seemed essential at some point as I imagined how much more information it would give about the sites as with exact dates, the sequence of the actions with the dead could be affirmed. The analysis created several new questions which can be addressed in the future as the study convinced at least the author that regularities are distinguishable in the seemingly chaotic site and further study may reveal even more of interesting ritual or locational aspects.

All in all, the questions asked in the introduction found an answer. Bone-related rituals were observed and the ritual aspect was definitely important in determining the way a person was buried. There were also normative ways of burying people into *tarand*s – the norms were associated with the individuals' age, sex and burial ritual and different groups probably had separated areas in the grave.

Hopefully this dissertation showed, how important it is to conduct full osteological analysis of *tarand*-graves and what kind of interesting information may still be hidden in the bones, their location and way of handling the corpses. I must say that the previous study motivated me to engage even deeper into studying *tarand*-graves and continue unravelling the information that is hidden in those complex monumental stone graves full of ritual evidence.

7 Literature

Allmäe, R. 1996 (?). Tõnija kalme osteoloogiline analüüs. In Mägi-Lõugas, M. *Kaevamisaruanne Tõnija Tuulingumäe tarandkalmel 1995, aastal toimunud arheoloogilistest kaevamistest*, 39–44. Manuscript in the archive of Cabinet of Archaeology.

Allmäe, R. 2013. *Observations on Estonian Iron Age cremations*. Archaeologia Baltica 19, 14–28.

Armit, I. 2012. *Headhunting and the Body in the Iron Age Europe*. Cambrigde.

Binford, L. R. 1972. *An Archaeological Perspective*. New York.

Brickley, M., McKinley, J.I. 2004 Guidelines to the Standards for Recording Human Remains. *IFA paper no 7*. Southampton, Reading: BABAO, IFA.

Brooks, S. Suchey, J.M. 1990. Skeletal age determination based on the os pubis: a comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Human Evolution*, 5: 227–238.

Buikstra, J.E., Ubelaker, D.H. 1994. *Standards for Data Collection from Human Skeletal Remains, Arkansas Archaeological Survey Report Number 44.* Arkansas

Chamberlain, A. 1994. *Human Remains.* London.

Conçalves, C., Thompson, T.J.U., Cunha, E. 2011. Implications of heat-induced changes in bone on the interpretation of funerary behaviour and practice. *Journal of Archaeological Science 38*, 1308-1311.

Croucher, K. 2011. Anatolia. *Oxford Handbook of the Archaeology of Ritual and Religion*: 826–845. Oxford.

During, E.M., Nilsson, L. 1991. Mechanical Surface Analysis of Bone: A Case Study of Cut Marks and Enamel Hypoplasia on a Neolithic Cranium from Sweden. *American Journal of Physical Anthropology*, 84: 113–125.

Egging Dinwiddy, K. 2009. *A late Roman Cemetery at Little Keep, Dorchester, Dorset.* Wessex Archaeology.

Holck, P. 2008. *Cremated Bones. A Medical-Anthropological Study of an Archaeological Material on Cremated Bones*. Anatomical Institute. Oslo.

IBM. 2011. *IBM SPSS Statistics 20 Core System User's Guide*. IBM Corporation.

Jonuks, T., Konsa, M. 2005. Kunda hiiemägi – kalmeväli ja pühakoht. *Eesti Loodus 3/2005.*

Jonuks, T. 2009. Eesti muinasusund. *Dissertationes archaeologiae universitatis Tartuensis, 2.*Tartu.

Joy, J. 2011. The Iron Age. *Oxford Handbook of the Archaeology of Ritual and Religion*: 405–421. Oxford.

Kalling, K. 1993. Viimsi kalmete luuainese antropoloogiline analüüs. In Lang, V. (editor) *Kaks tarandkalmet Viimsis, Jõelähtme kihelkonnas*: 67-69. Tallinn.

Kalman, J. year unknown. Stone grave II of Tõugu – skeletal report. Report. Tallinn University Institute of History, Tallinn.

Kalman, J. 2000a. Skeletal analysis of the graves of Kaseküla, Poanse I and Poanse II. In Pauts, H. (editor) *Eesti Ajaloomuuseum. Töid ajaloo alalt, 2,* 17–40. Tallinn.

Kalman, J. 2000b. Stone Grave II of Tõugu – skeletal report. In Lang, V. (editor) *Keskusest ääremaaks, Muinasaja Teadus 7,* 387–408. Tallinn.

Kalman, J. 2000c. Tandemägi stone grave – osteological report. In Lang, V. (editor) *Keskusest ääremaaks, Muinasaja Teadus 7,* 423–434. Tallinn.

Kalman, J. 2000d. Uusküla II skeletal analysis. In Lang, V. (editor) *Keskusest ääremaaks, Muinasaja Teadus 7,* 437–440. Tallinn.

Kivirüüt, A. 2011. *Põletatud luude uurimine: metoodika ning praktika Viimsi I tarandkalme leiukompleksi näitel.* BA dissertation. University of Tartu, Tartu.

Laneman, M. 2012. Stone-cist grave in Kaseküla, Western Estonia, in the light of AMS dates of the human bones. *Estonian Journal of Archaeology, 16/*2, 91–117.

Laneman, M., Lang, V. 2013. New radiocarbon dates for two stone-cist graves at Muuksi, Northern Estonia. *Estonian Journal of Archaeology 17/2*, 89–122.

Lang, V. 1990. Viimsi I tarandkalme kaevamisaruanne. Excavation report. University Institute of History, Tallinn.

Lang, V. 1993. *Kaks tarandkalmet Viimsis, Jõelähtme kihelkonnas*. Tallinn.

Lang, V. 1996 *Muistne Rävala. Muistised, kronoloogia ja maaviljelusliku asustuse kujunemine Loode-Eestis, eriti Pirita jõe alamjooksu piirkonnas, I–II*. Muinasaja teadus 4. Tallinn.

Lang. V. 2000. *Keskusest ääremaaks. Muinasaja Teadus 7.* Tallinn.

Lang, V. 2006a. *Research into the Bronze and Early Iron Ages. In Lang, V. and Laneman, M (editors) Archaeological research in Estonia 1865 – 2005*, Estonian Archaeology 1, 77-104. Tartu

Lang, V. 2006b. Varased tarandkalmed Eestis. In Valk, H. (editor) *Etnos ja kultuur uurimusi Silvia Laulu auks, Muinasaja teadus 18,* 53-78. Tartu-Tallinn.

Lang, V. 2007a. *The Bronze and Early Iron Ages in Estonia*, *Estonian archaeology 3*. Tartu.

Lang, V. 2007b. *Baltimaade pronksi- ja rauaaeg.* Tartu.

Lang, V., Ligi, P. 1991. Muistsed kalmed ajaloolise demograafia allikana. In Jaanits, L., Lang, V. (editors) *Arheoloogiline kogumik, Muinasaja teadus 1,* 216 – 238. Tallinn.

Laul, S. 2001. *Rauaaja kultuuri kujunemine Eesti kaguosas (500 eKr – 500 pKr), Muinasaja Teadus 9, ÕES Kirjad 7*. Tallinn.

Lovejoy, C.O. 1985. Dental wear in the Libben population: its functional pattern and role in the determination of adult skeletal age at death. *American Journal of Physical Anthropology 68*, 47–56.

McKinley, J. I., Roberts, C. 1993. Excavation and post–excavation treatment of cremated and inhumed human remains. *Institute of Field Archaeologists, Technical Paper Number 13,* 1–12.

McKinley, J. I. 2002. The analysis of cremated bone. In Cox, M., Mays, S (editors) *Human osteology: in archaeology and forensic science*, 403–421. Cambridge : Cambridge University Press.

McKinley, J. I. 2008. In the heat of the pyre: efficiency of oxidation in Romano – British cremations – did it really matter? In Schmidt, C. W. & Symes, S. A (editors) *The Analysis of Burned Human Remains,* 163–184. London.

Moora, T. 1973. Ülevaade arheoloogilistest kaevamistest Võhma Tandemäel 1969.–1972. aastatel. Excavation report. Tallinn University Institute of History, Tallinn.

Oestigaard, T. 2003. *An Archaeology of Hell: Fire, Water and Sin in Christianity*. Lindome.

Olli, M. 2013. *Rooma rauaaegsed ehted ja ornamendid Eestis*. MA dissertation. University of Tartu, Tartu.

Olli, M., Kivirüüt, A. 2014 (unpublished). Individual and Collective Based on the Viimsi *Tarand*-Graves, North Estonia. *Approaches to Culture Theory, 4*. Tartu.

Ortner, D.J., Putchar, W.G.J. 1985. *Identification of Pathological Conditions In Human Skeletal Remains.* Smithsonian Institution Press. Washington.

Palastanga, N., Soames, R., Palastanga, D. 2008. *Anatomy and human movement pocketbook.* Elsevier.

Parker Pearson, M. 2008. *The Archaeology of Death and Burial*. Texas.

Redfern, R. 2008. New evidence for Iron Age secondary burial practice and bone modification from Gussage All Saints and Maiden Castle (Dorset, England). *Oxford Journal of Archaeology, 27*: 281–301.

Roberts, C.A., Manchester, K. 2005. *Archaeology of disease*. Stroud.

Rohtla, M-L. 2003. *Ambsõled Eestis*. Dissertation. University of Tartu, Tartu.

Scheuer, L., Black, S. (2004) *The juvenile skeleton.* London, Academic Press.

Schmiedehelm, M. 1955. *Археологические памятники периода разложения родового строя на северо-востоке Эстонии (V в. до н. э. – V в. н. э.)*. Tallinn.

Shennan, S. 2004. *Quantifying Archaeology*. Edinburgh.

Stewart, T.D. 1979. *Essentials of forensic anthropology, especially as developed in the United States.* Springfield.

Symes, S.A., Rainwater, C. W., Chapman, E.N., Gipson, D. R., Piper, A.L. 2008. Patterned Thermal Destruction of Human Remains in a Forensic Setting. In Schmidt, C. W. & Symes, S. A (editors) *The Analysis of Burned Human Remains,* 15–54. London.

Ubelaker, D.H. 1989. *Human Skeletal Remains: Excavation, Analysis, Interpretation.* Washington.

Ubelaker, D.H. 2009. The forensic evaluation of burned skeletal remains: A synthesis. *Forensic Science International,* 183: 1–5.

Varul, L. 2012. *Kivikirstkalmete uurimine osteoloogiliste meetodite abil Jõelähtme kalmete nr 6, 7, 15, 16 ja 19 näitel*. BA dissertation. University of Tartu, Tartu.

Vassar, A. 1943. *Nurmsi kivikalme Eestis ja tarandkalmete areng.* PhD thesis. University of Tartu, Tartu.

Waldron, T. 2009. *Palaeopathology; Cambridge manuals in archaeology.* Cambridge.

Walker, P. L., Miller, K. W. P., Richman, R. 2008. Time, temperature, and oxygen availability: an experimental study of the effects of environmental conditions on the color and organic content of cremated bone. In Schmidt, C. W. & Symes, S. A (editors) *The Analysis of Burned Human Remains,* 129–136. London.

Whyte, T. R. 2001. Distinguishing Remains of Human Cremations from Burned Animal Bones. Journal of Field Archaeology 28, 437–448.

Kokkuvõte

Tarandkalmete võrdlev osteoloogiline ja kalmesisene ruumiline analüüs

Keskendun oma magistritöös tarandkalmete leiuainese osteoloogilisele ja ruumilisele analüüsile – teemale, mis seni on uuringutest lubamatult kõrvale jäänud. Täpsemalt uurin seda, kas ja milliseid seoseid või erinevusi on võimalik näha luumaterjali ruumilisel analüüsil.

Uurimistöö ajendiks olid tarandkalmeid puudutavaid varasemaid uurimusi lugedes tekkinud küsimused: miks matsid inimesed mitmel erineval viisil? millest see sõltus? kuidas luud fragmenteerusid ja segunesid? kas kalme osadel olid eri funktsioonid? Olen veendunud, et luuainese osteoloogilisel ja ruumilisel analüüsimisel on võimalik mõista, kas luude, kehaosade ja indiviidide paiknemine kalmes on juhuslik või on luud kalmesse asetatud kindlate normide järgi.

Magistritöös analüüsin kokku 524 põlenud ja põletamata luukogumit Viimsi I ja Võhma Tandemäe kalmeist. Analüüsi tulemused on lisatud kokkuvõtvate tabelitena töö lõppu. Viimsi I ja Võhma Tandemäe on mõlemad tarandkalmed, kuid eriaegsed. Viimsi I kalme oli esemete dateeringute järgi kasutusel Rooma rauaajal 3.–5. sajandeil pKr, Võhma Tandemäe kalme oli aga kasutusel eelrooma rauaajal, vahemikus 5. sajand eKr – 1. sajand pKr. Luude analüüsimisel määran luu asukoha skeletis ja püüan aru saada indiviidide soost ja vanusest, kaalusin luukogumeid, hindasin nende põletusastet ning otsisin märke patoloogiatest või muudest erilistest märkidest luudel.

Uurimus koosneb neljast suuremast sisupeatükist. Esimeses neist kirjeldan täpsemalt kasutatud meetodeid ning analüüsitud materjali. Viimsi I ja Võhma Tandemäe tarandkalmed on mõlemad juba varem läbi uuritud, kuid osteoloogiline analüüs oli publitseeritud vaid osaliselt ning algandmed ei ole saadaval (Lang 1993; Kalling 1993; Lang 2000; Kalman 2000c). See oli ka peamiseks põhjuseks, miks alustasin luuainese uuesti läbi vaatamisega. 2011. aastal kaitstud bakalaureusetöös, mis käsitles Viimsi I tarandkalme põlenud luid, leidsin, et 1990. aastatel kasutatud meetodites oli tõenäoliselt mitmeid vajakajäämisi ning luumaterjali mitmekordne analüüsimine on igati põhjendatud (Kivirüüt 2011). Seekordne uurimus on edasiarendus bakalaureusetööst: võtan vaatluse alla lisaks põlenud luudele ka põletamata luud ning uurin võrdluseks Võhma Tandemäe põletatud luid, kaheksa täielikumat luustikku ja 3. tarandi põletamata luud.

Magistritöö teises sisupeatükis keskendun Viimsi I ja Võhma Tandemäe tarandkalmete seekordse luuanalüüsi tulemustele. Ilmneb, et Viimsi I kalmesse on maetud minimaalselt 32 indiviidi. 29 neist on olnud vähemalt osaliselt põletatud, kaks last olid kalmes esindatud aga ainult põletamata luudega. Võhma Tandemäele oli põletatult maetud vähemalt 15 indiviidi. Põletamata indiviide oli analüüsitud 3. tarandis kokku kaheksa. Lisaks vaatan üle täielikumalt algses asendis säilinud luustikud: üks indiviid oli maetud tarandikust välja ning kolm isikut olid asetatud üksteise kõrvale 2. tarandisse. Seegi kord täieneb kalmesse maetud indiviidide hulk ning teen mõningaid korrektuure maetute soos ja vanuses. Samuti leian luude pinnalt mitmeid huvitavaid märke: lõikejälgi ning tõendust, et tuleriit ja luud olid kiirelt maha jahutatud. Suurem osa põlenud luudest oli talunud u 400°C kuumust.

Kolmas peatükk on pühendatud tarandkalmete sisemisele ruumianalüüsile. Leitud seaduspärasuste juhuslikkust kontrollin statistiliste testidega. Luude leviku analüüsimisel selgub, et Viimsi I kalmes paiknesid põlemata inimluud pigem tarandimüüridest väljaspool ja põlenud luukilde esines enim tarandimüüride sees. Erinevus põlenud ja põlemata luude paiknemises tuleb välja ka statistiliste meetoditega. Võhma Tandemäel ei olnud märgata seoseid luude põletusastme ja leviku vahel. See-eest leiab kinnitust, et lõunapoolseim, esimene tarand sisaldas väga palju põlenud lasteluid ning põlenud luud, millel oli mehiseid tunnuseid, paiknesid pigem põhjapoolsemas, kolmandas tarandis. Ilmselt on olnud seaduspära erinevate indiviidide ning põlenud ja põlemata luude paigutamises kalmesse.

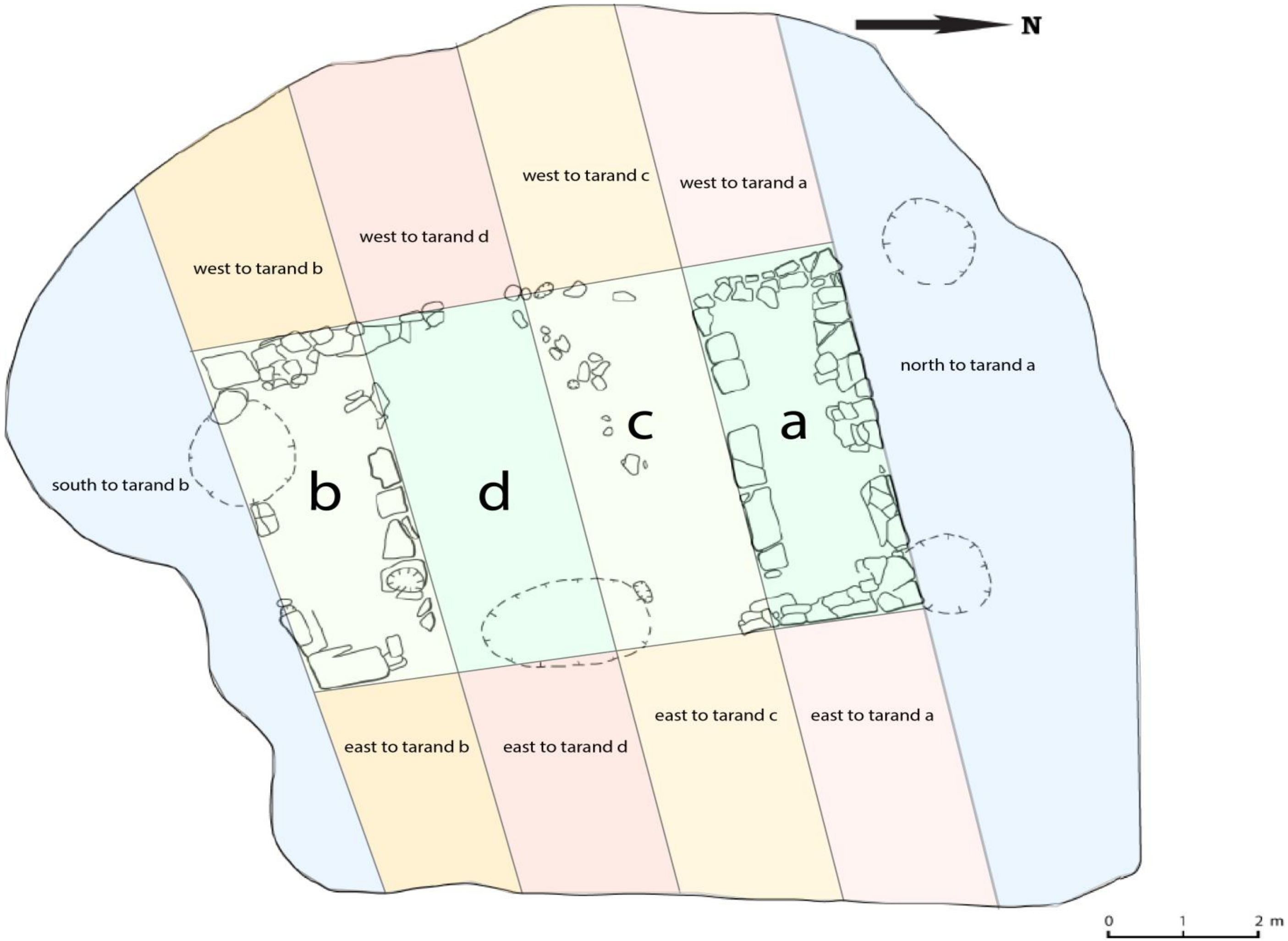
Neljandas peatükis arutlen analüüsitu üle ning kirjeldan täpsemalt võimalikke rituaale, milles tarandkalmeisse maetud surnud osalised on olnud. Põlemata ja põlenud koljufragmentide koguste omavaheline võrdlus näitab, et Viimsi I kalmes oli põlemata koljufragmente ülejäänud materjaliga võrreldes liialt vähe säilinud. Lõikejäljed koljul ning alalõualuul ja põletusmuster, mis viitab krematsioonile pärast surnukeha lagunemist, annavad mõista, et pead ja keha on käsitletud erinevalt. Pead on peetud eriliseks, sellega on läbi viidud lisatoiminguid, näiteks on pea kehast eraldi põletatud. Saadud andmete põhjal rekonstrueerin sündmuste käigu, kus esmalt on põletamata surnukeha maetud kalmemüüridest väljapoole. Seejärel on haud lahti kaevatud, eemaldatud kolju, ilma alalõuata, pea põletatud ning tahmunud koljufragmendid kalme alale, tarandimüüride sisse, laiali puistatud. Võhma Tandemäel selliseid tegevusi ei olnud võimalik täheldada.

Käesolev magistritöö annab põhjaliku ülevaate Viimsi I kalme luuainesest ning võtab kokku ka suure osa Võhma Tandemäe osteoloogilisest materjalist. Analüüsides luid ja nende asukohti, on võimalik täheldada seoseid nii erinevate indiviidide paiknemisel kui ka põlenud ja põletamata luude levikus kalme alal. Samuti on võimalik selgitada välja jooni rauaaja inimeste rituaalses käitumises ning leida materjali, mis viitab pea erilisusele ja erinevale käitlemisele matmiskombestikus.

Magistritöö näitab muuhulgas, kuivõrd oluline on osteoloogilise analüüsi põhjalikkus ja dokumenteeritus. Elementaarseid luude põhjal tehtavaid määranguid, nagu minimaalne indiviidide arv kalmes, võivad mõjutada mitmed matmisrituaaliga seotud tegevused. Needki nõuavad väljaselgitamist, sest ilma tervikliku pildita ei ole võimalik teada, kuidas kogutud andmeid tõlgendada.

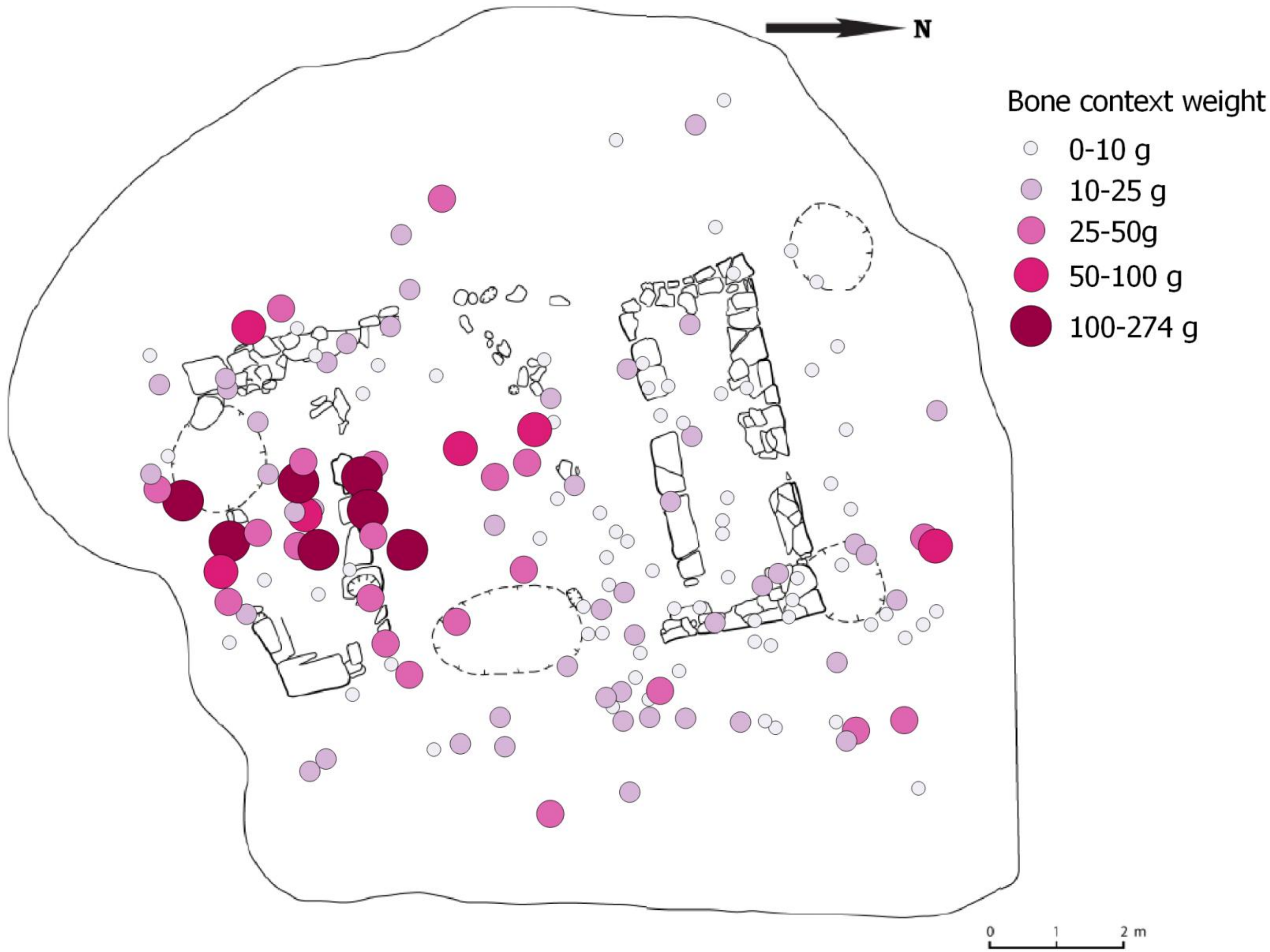
Usun, et uurimus täitis oma eesmärgi, sest avas veelgi juba läbi uuritud kalmete tausta ja sellega koos andis juurde teavet rauaaja inimestele rituaalsest tegevusest. Käesoleva uurimuse baasil on võimalik edasi minna tarandkalmete uurimisega ja kasutada siin esitatud materjali võrdluseks teiste sarnaste kalmevormidega.

Appendix 1. Supplementary plans for Viimsi I *tarand*-grave.



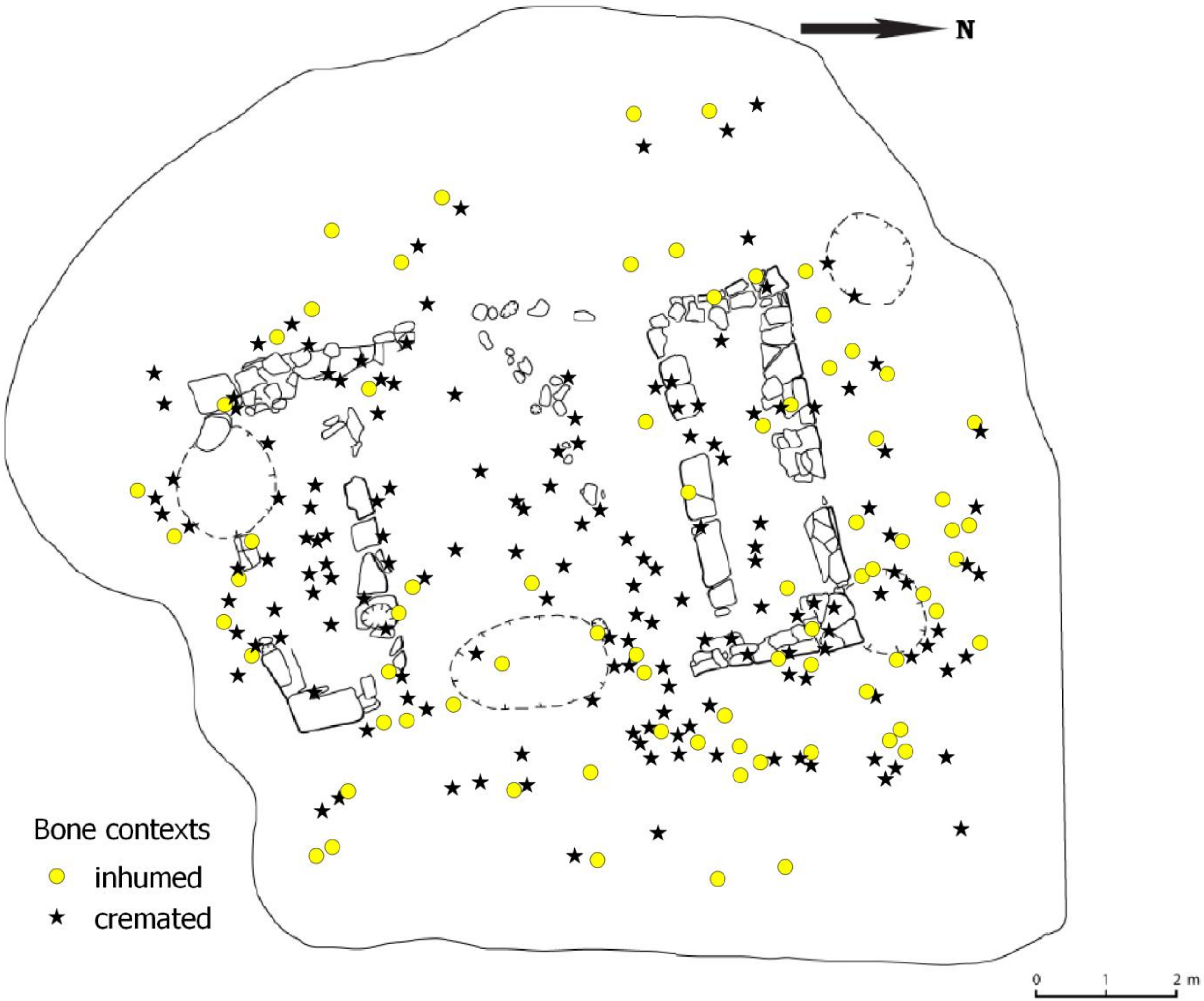
1.1 The different areas and *tarand*s in Viimsi I. Areas A, B, C and D constitute the area inside the walls. The outer line indicates excavation extent.

Image modified from Olli & Kivirüüt 2014.



1.2 Weight of the cremated bone clusters in Viimsi I. Image modified from Olli & Kivirüüt 2014.

1.3 Weight of the inhumed bone clusters in Viimsi I. Image modified from Olli & Kivirüüt 2014.

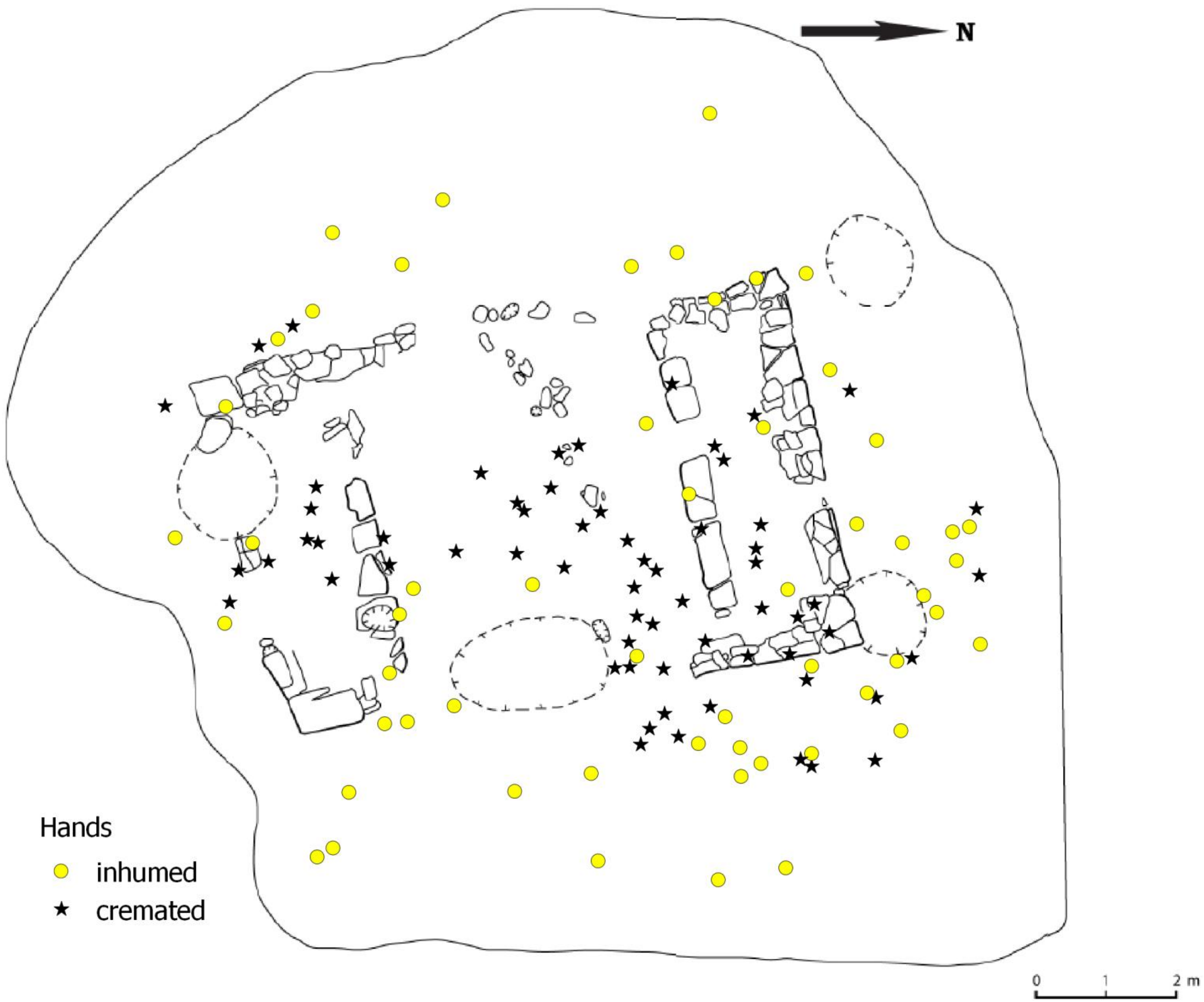


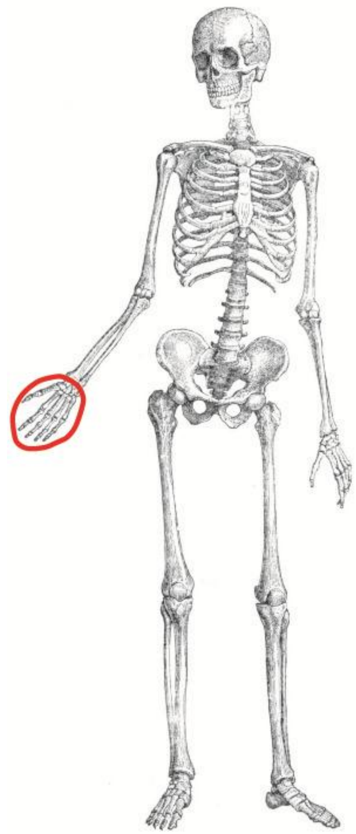
1.4 The location of cremated and inhumed contexts in Viimsi I. Image modified from Olli & Kivirüüt 2014.

1.5 The location of cremated and inhumed cranial fragments in Viimsi I. Image modified from Olli & Kivirüüt 2014.

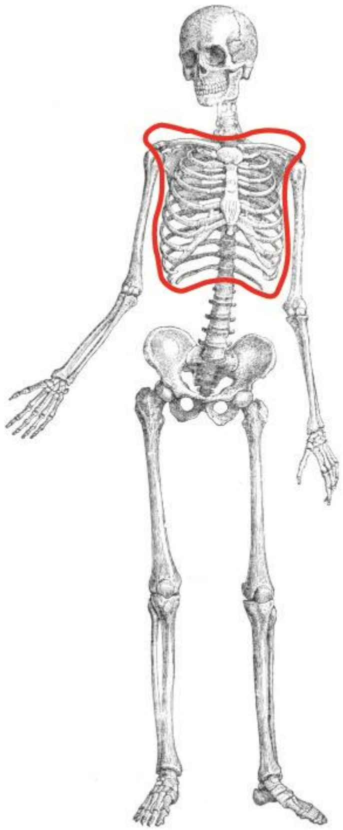
1.6 The location of cremated and inhumed teeth in Viimsi I. Image modified from Olli & Kivirüüt 2014.

1.7 The location of cremated and inhumed arms and forearms in Viimsi I. Image modified from Olli & Kivirüüt 2014.





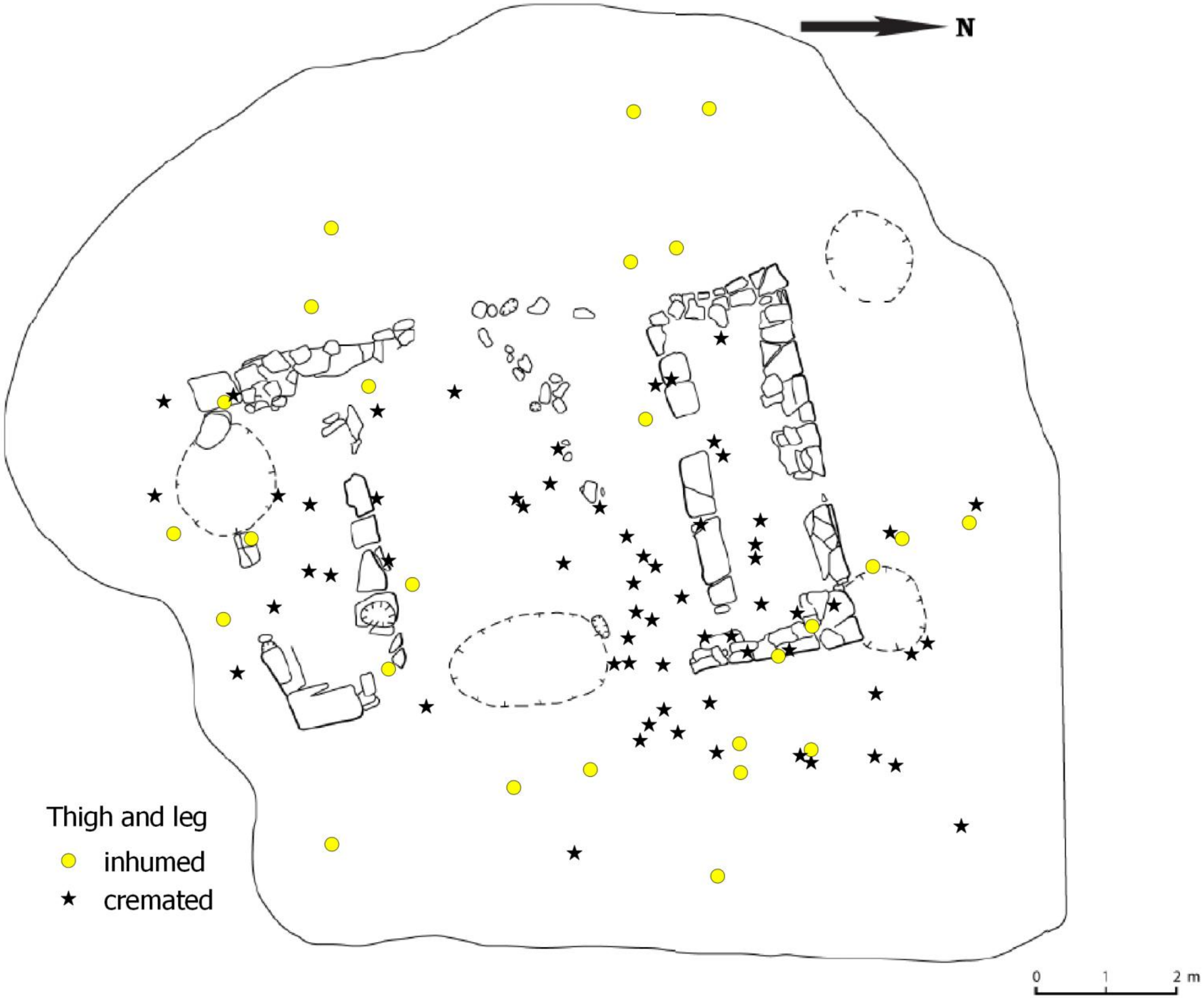
1.8 The location of cremated and inhumed hands in Viimsi I. Image modified from Olli & Kivirüüt 2014.

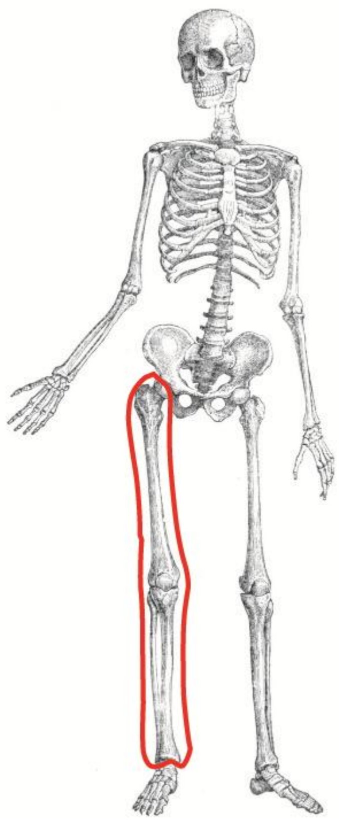


1.9 The location of cremated and inhumed thorax in Viimsi I. Image modified from Olli & Kivirüüt 2014.

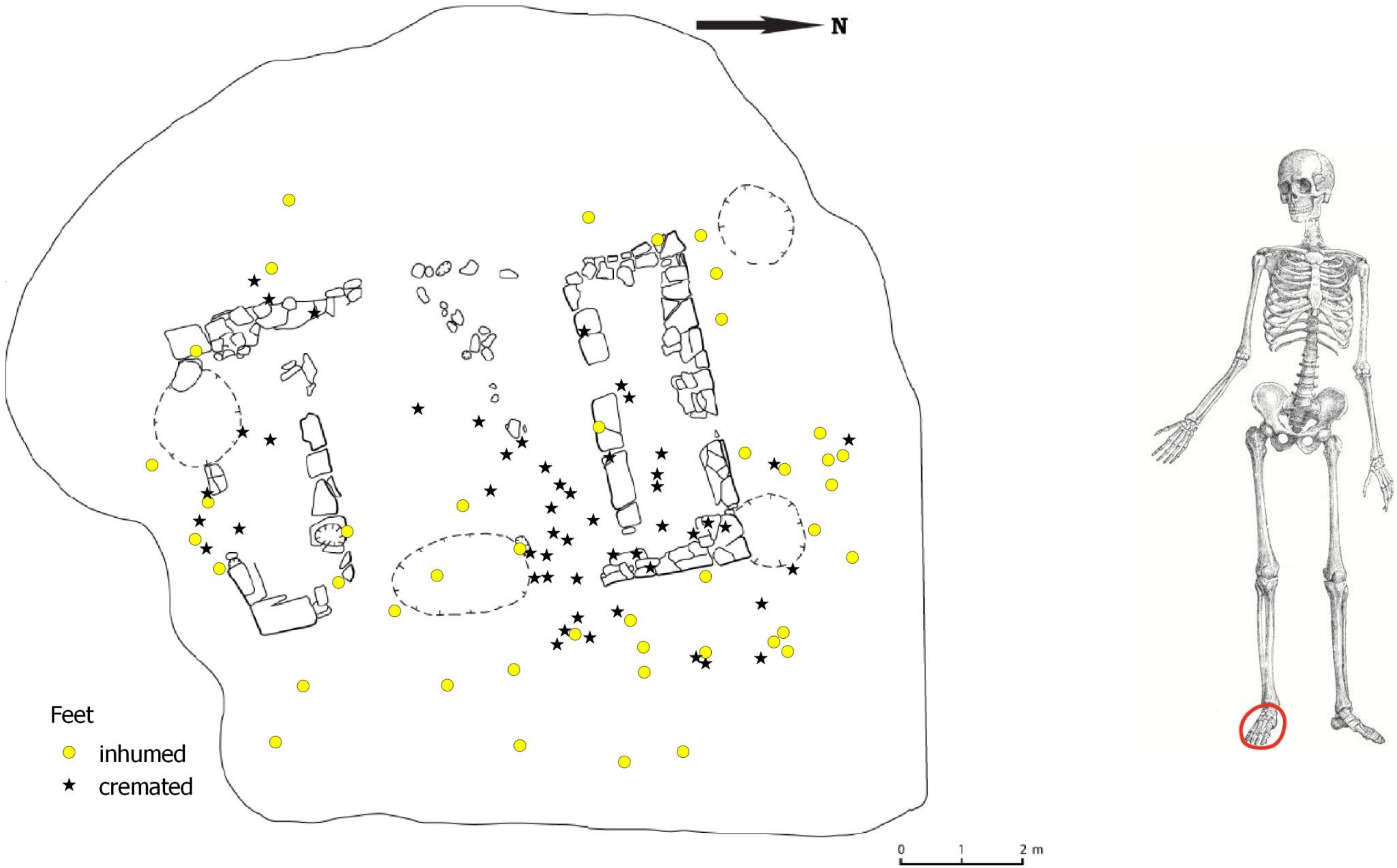
1.10 The location of cremated and inhumed vertebra in Viimsi I. Image modified from Olli & Kivirüüt 2014.

1.11 The location of cremated and inhumed innominate bones in Viimsi I. Image modified from Olli & Kivirüüt 2014.

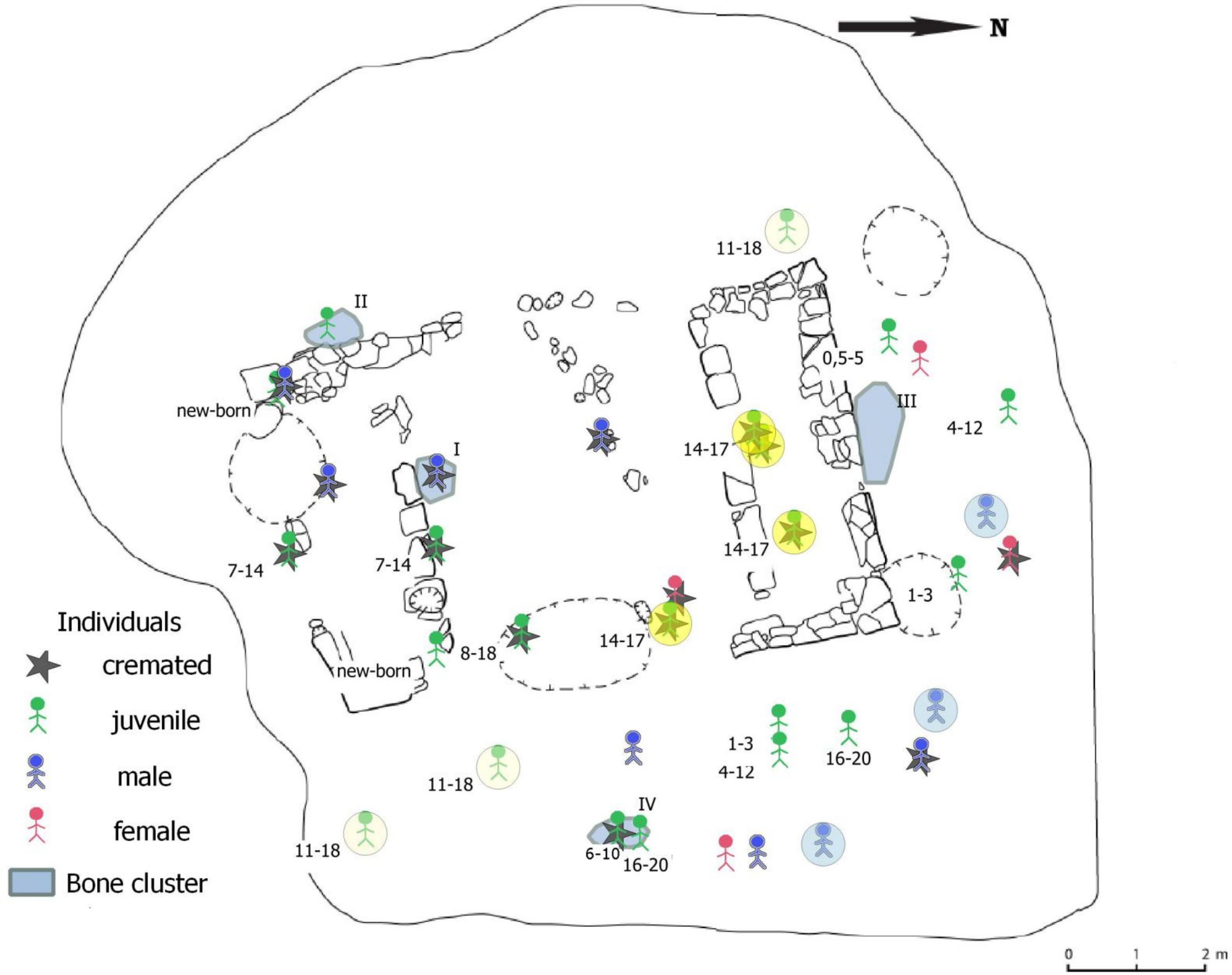




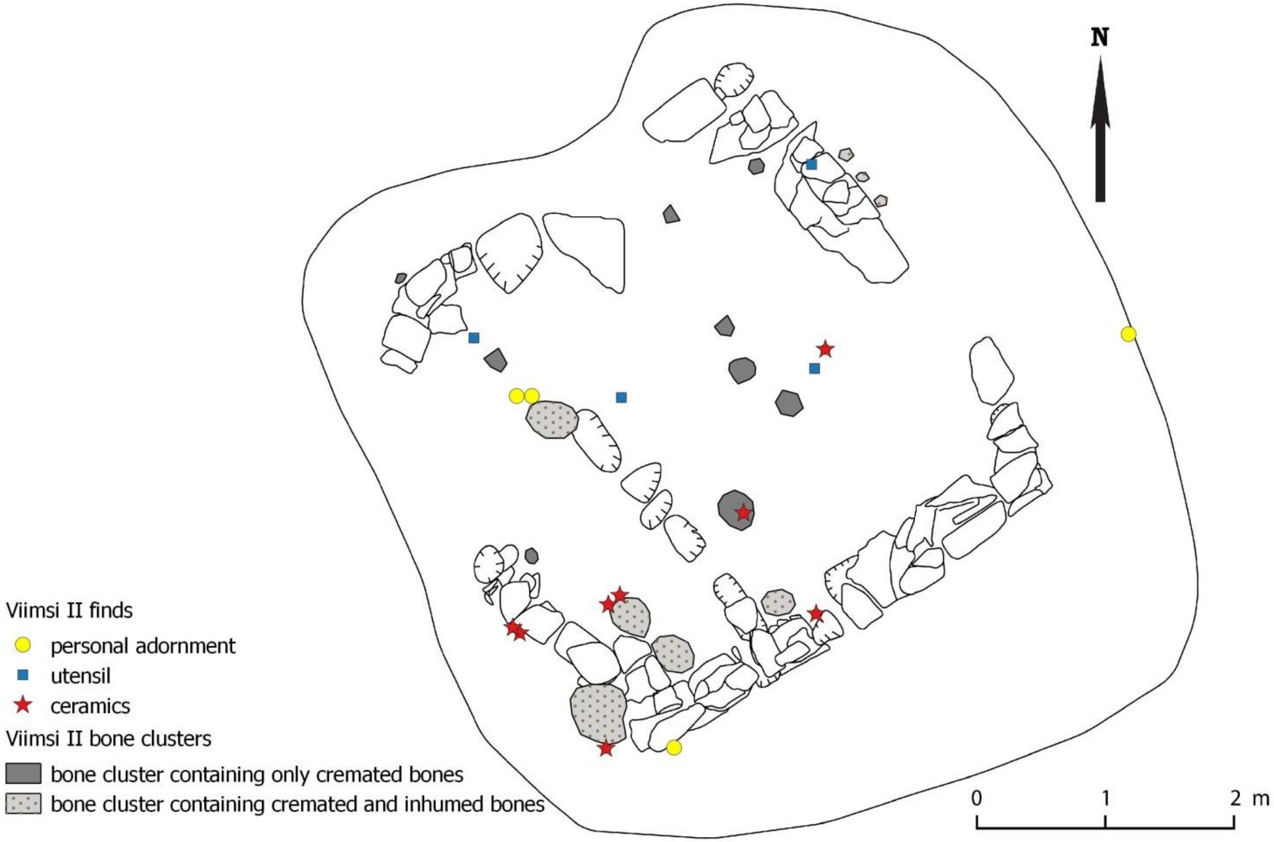
1.12 The location of cremated and inhumed thighs and legs in Viimsi I. Image modified from Olli & Kivirüüt 2014.



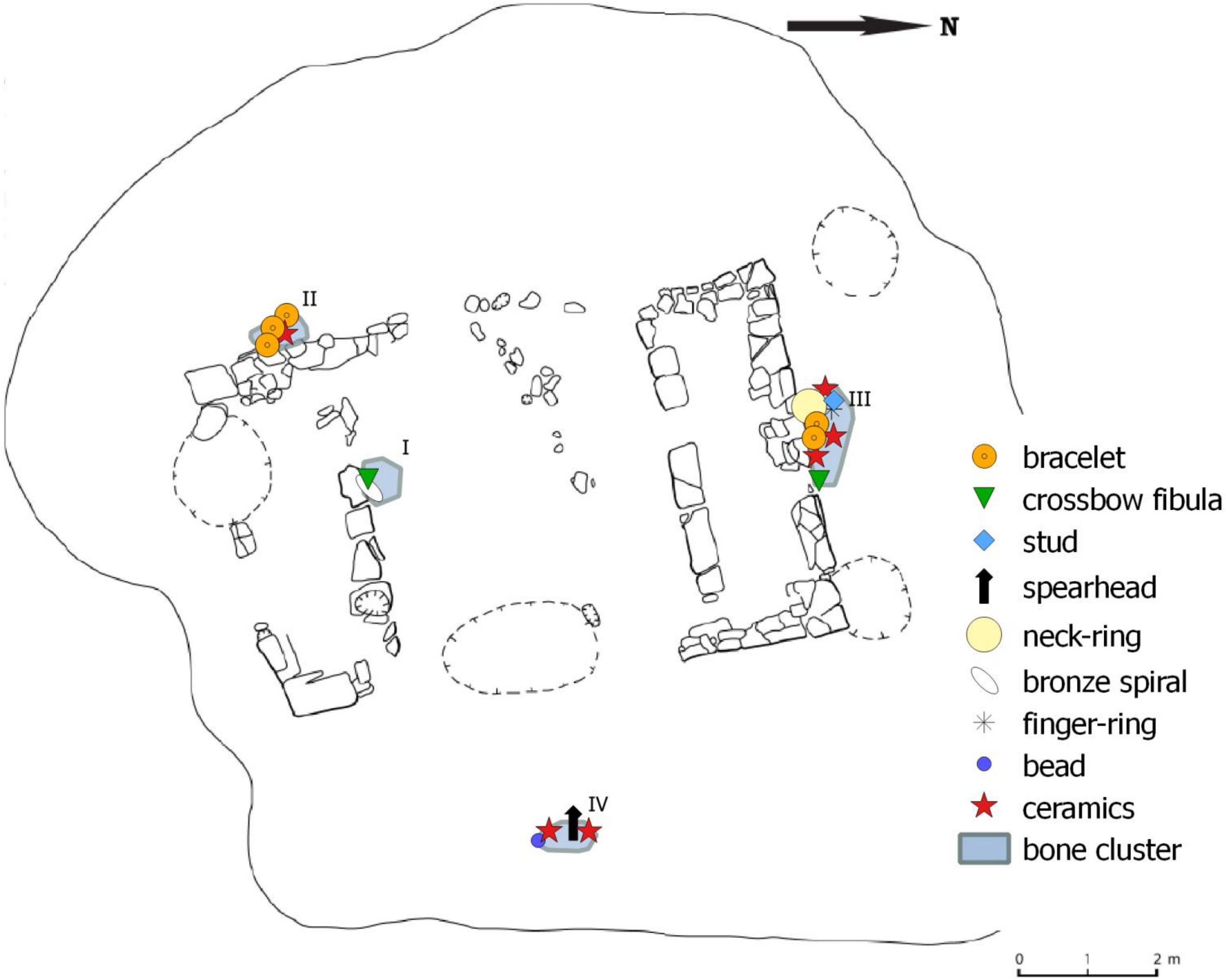
1.13 The location of cremated and inhumed feet in Viimsi I. Image modified from Olli & Kivirüüt 2014.



1.14 The location and distribution of identified individuals in Viimsi I. The numbers indicate the age of immature individuals. Circles around the schematic humans refer to individuals that were found from commingled contexts. Circles of one colour refer to one set of commingled contexts. Image modified from Olli & Kivirüüt 2014.

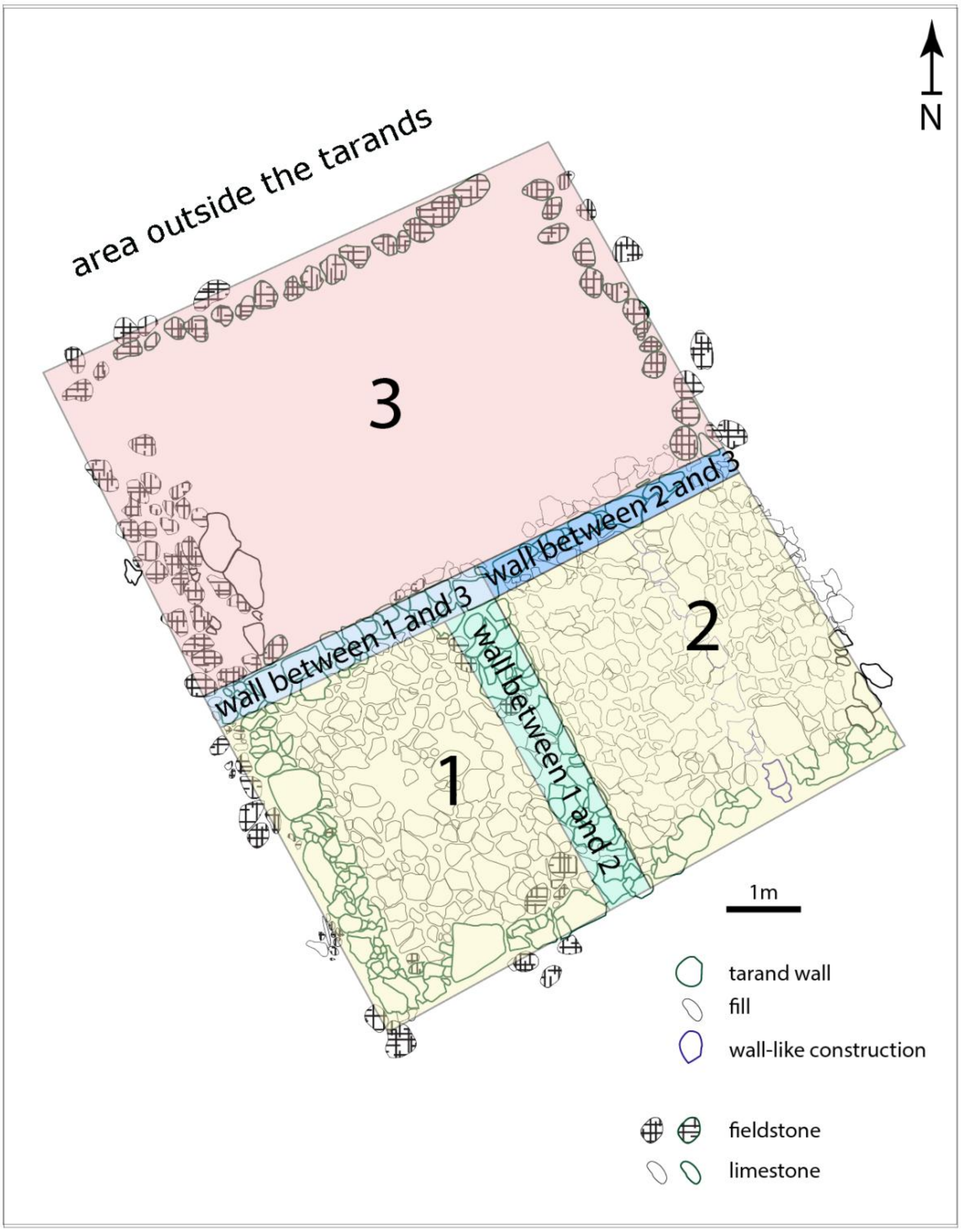


1.15 Grave area plan containing finds' groups and bones from Viimsi II. (Olli & Kivirüüt 2014)

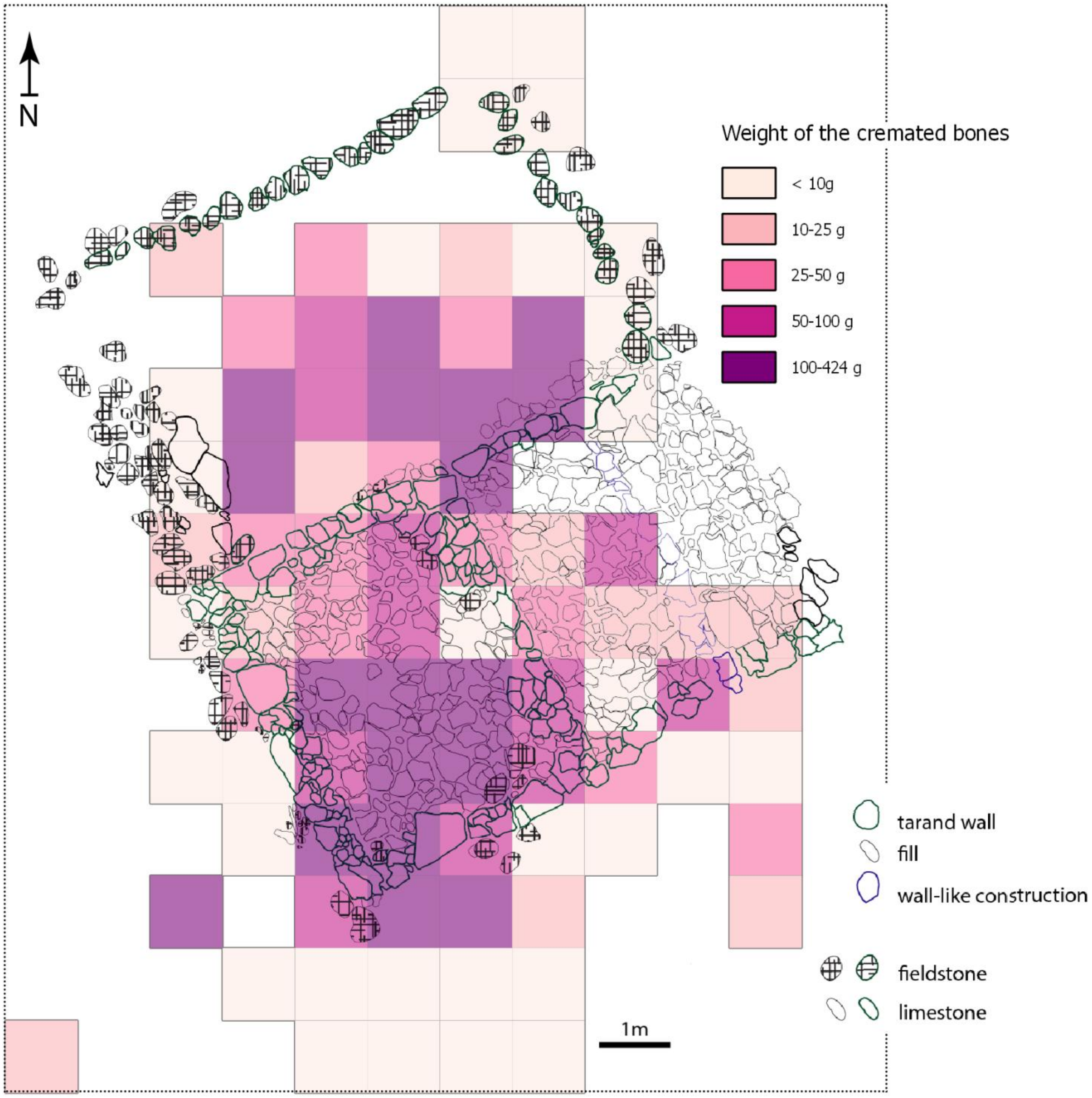


1.16 Clusters and items connected with the clusters in Viimsi I. Image modified from Olli & Kivirüüt 2014.

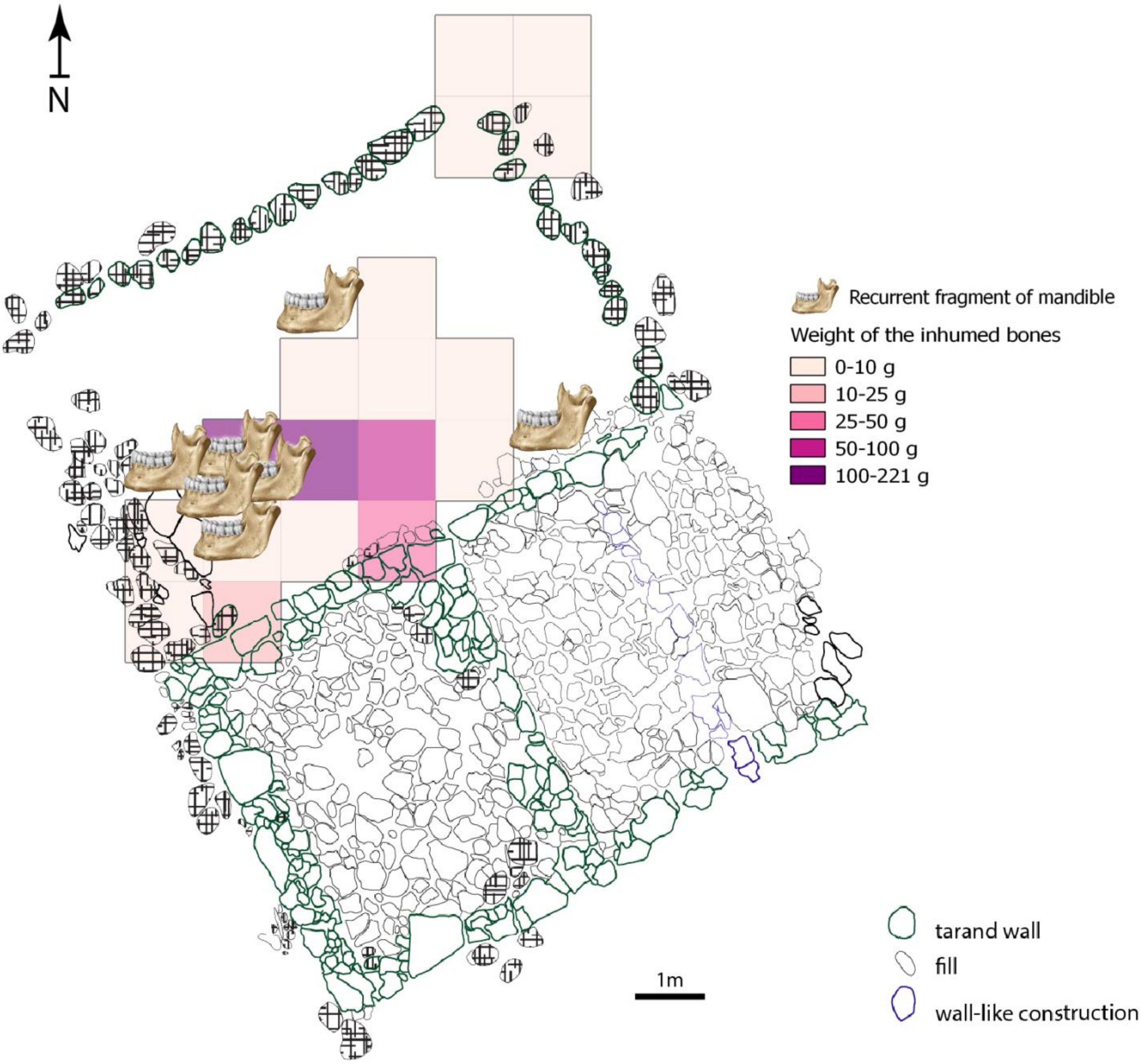
Appendix 2. Supplementary plans for Võhma Tandemäe.



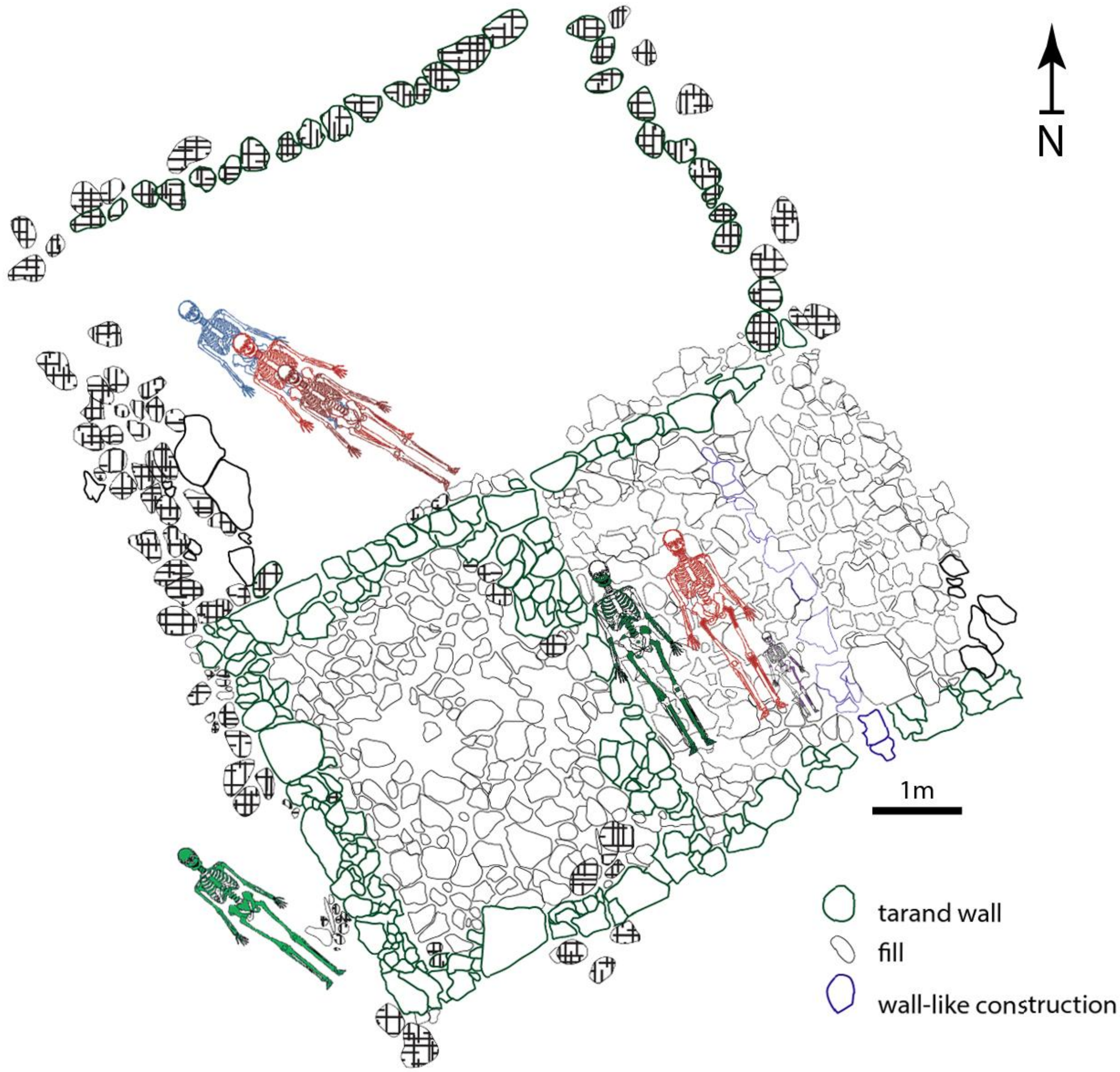
2.1 The different areas and *tarand*s in Võhma Tandemäe, the excavated area is indicated with the largest rectangle.



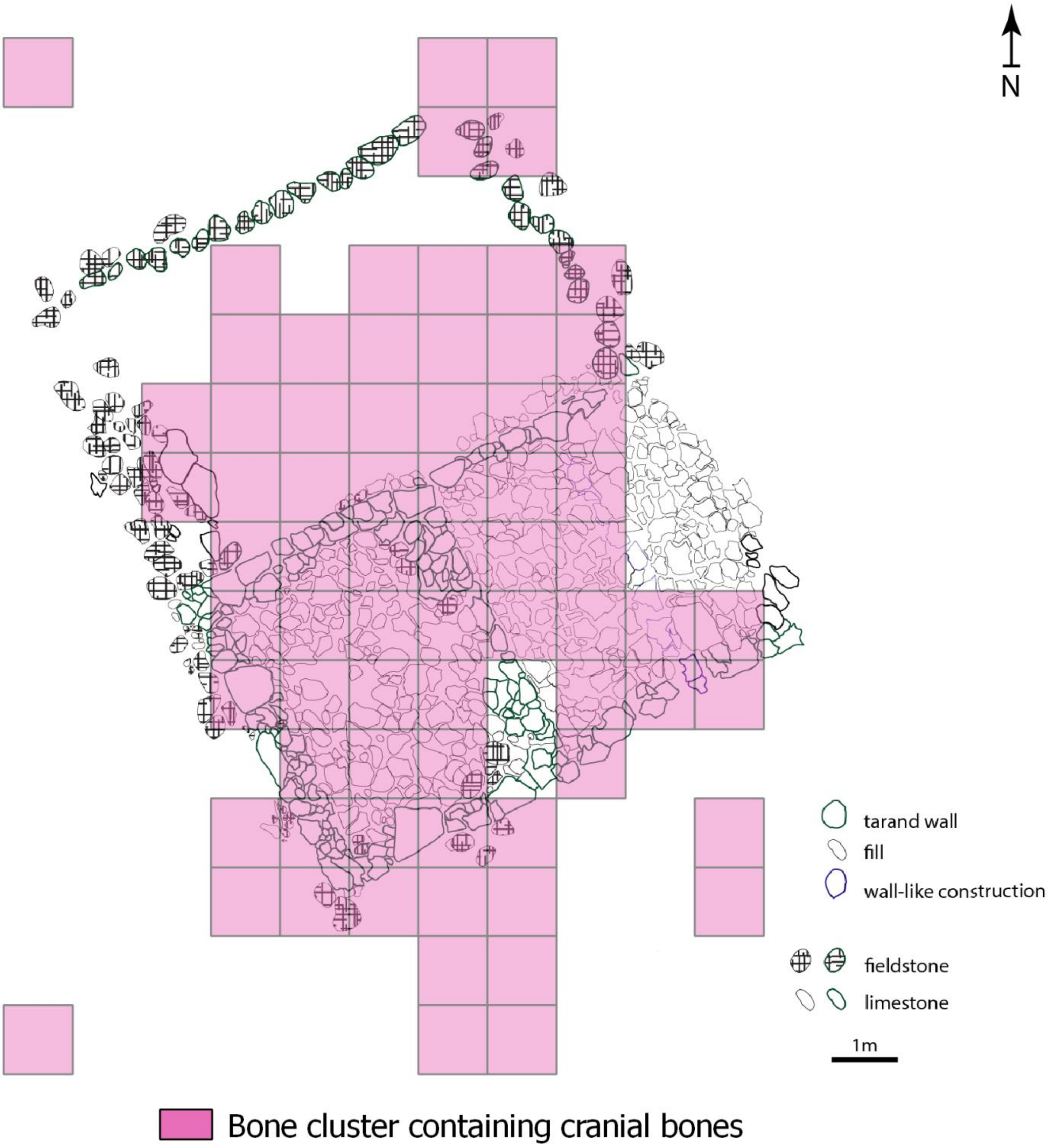
2.2 Weight of cremated bone clusters in Võhma Tandemäe. The whole excavated area is marked with the dotted line.



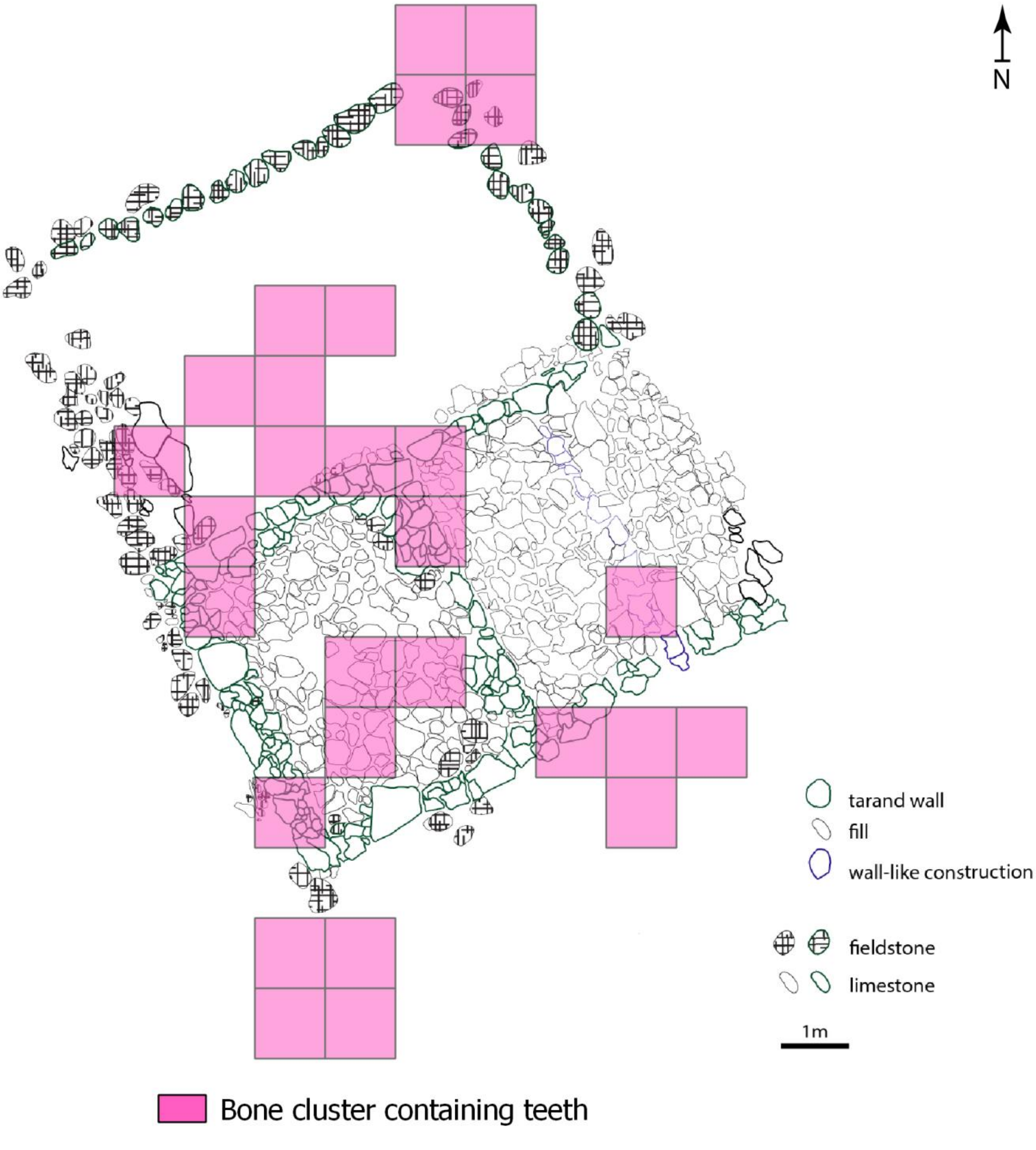
2.3 Weight of inhumed bone clusters in Võhma Tandemäe.



2.4 The placement of intact inhumation burials in Võhma Tandemäe. Note that only the individuals in *tarand* 2 were had been marked on plans; the other individuals were placed based on the descriptions as accurately as possible but their placement may not reflect the exact finds' situation. In the case of four southern skeletons, the body parts that are present have been filled.

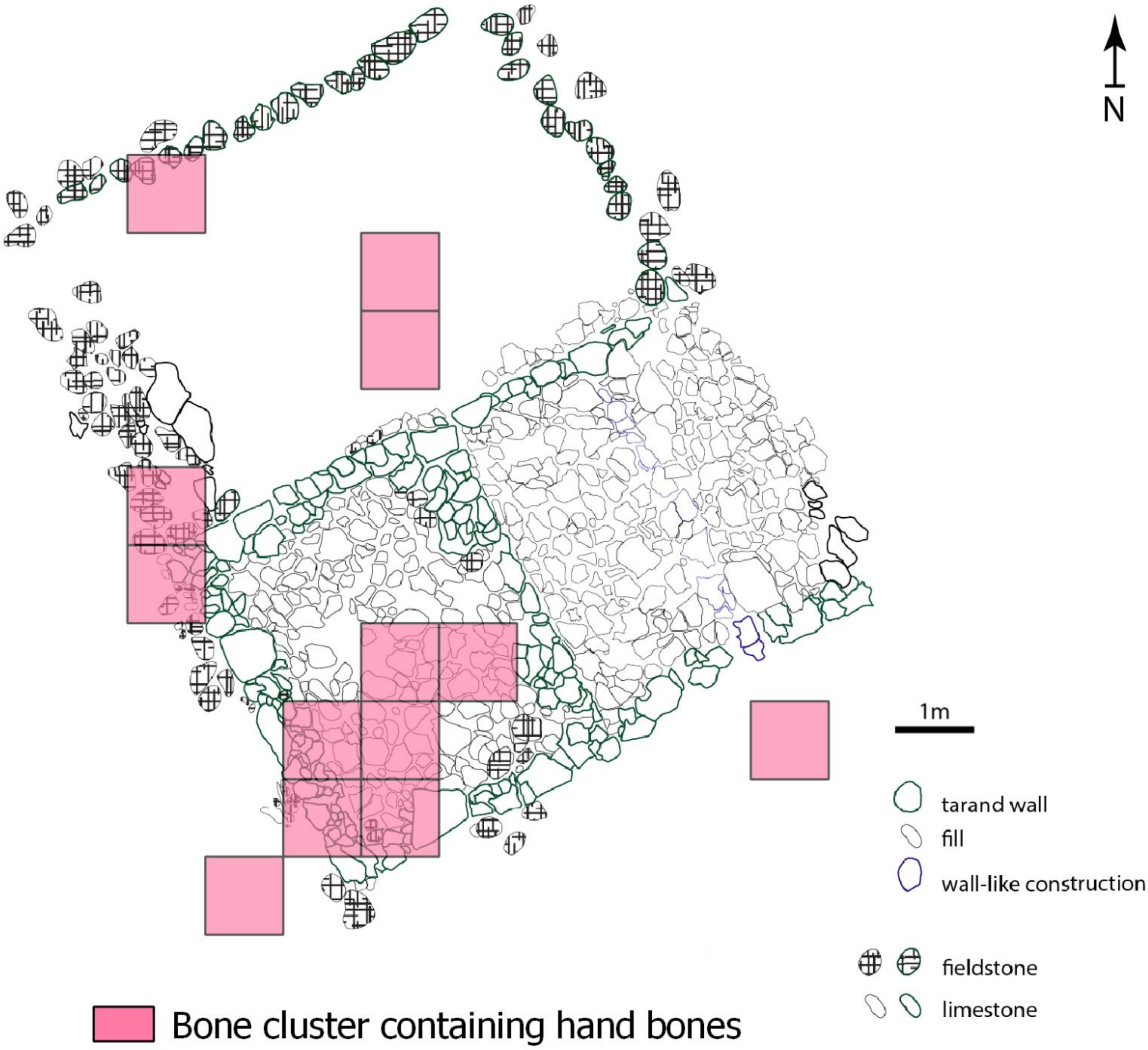


2.5 Distribution of cremated cranial fragments in Võhma Tandemäe.

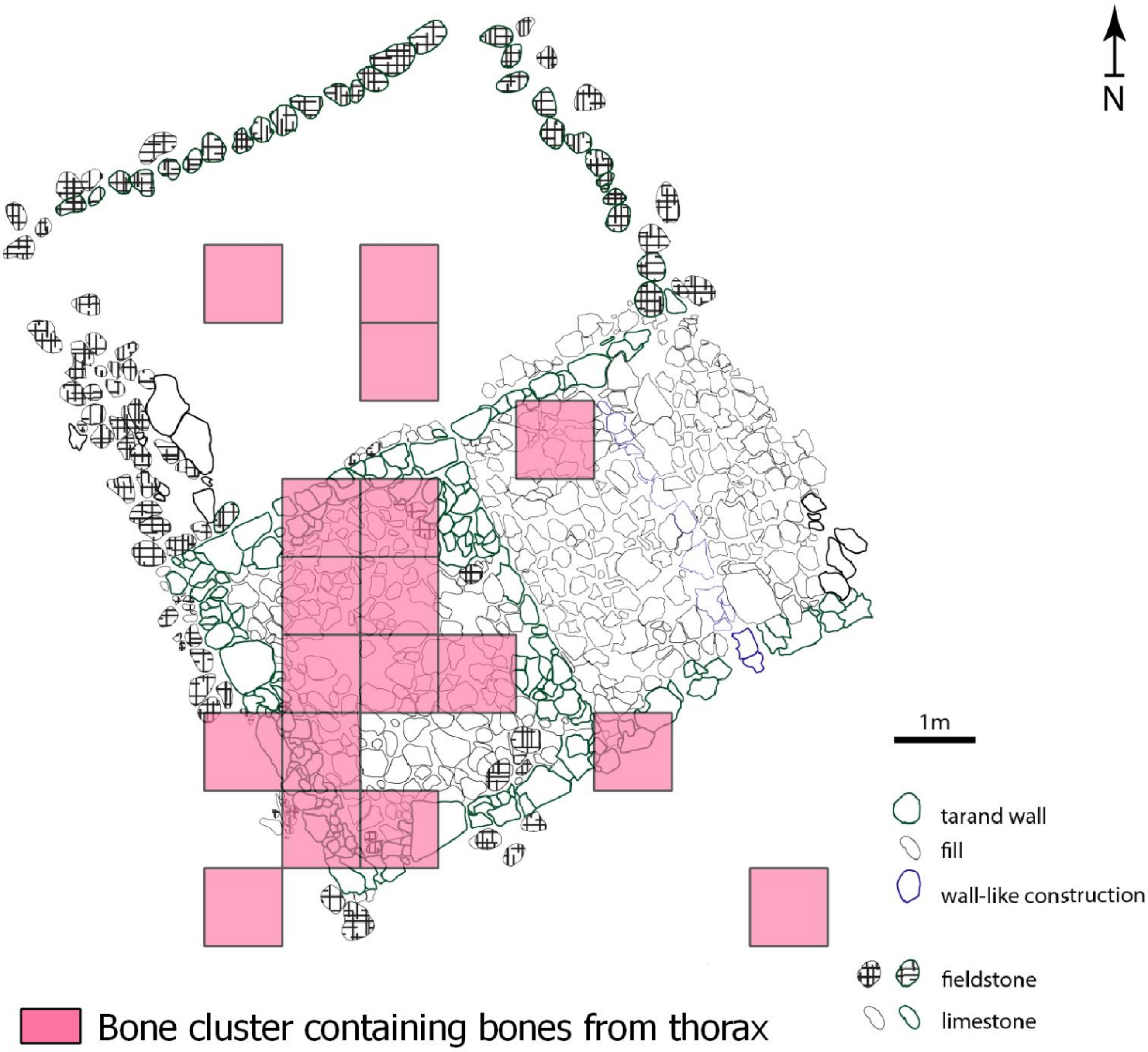


2.6 Distribution of cremated teeth in Võhma Tandemäe.

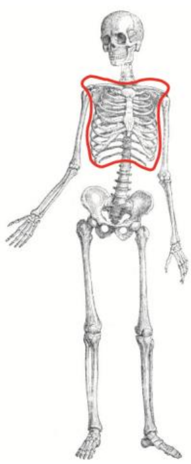
2.7 Distribution of cremated arm and forearm bones in Võhma Tandemäe.

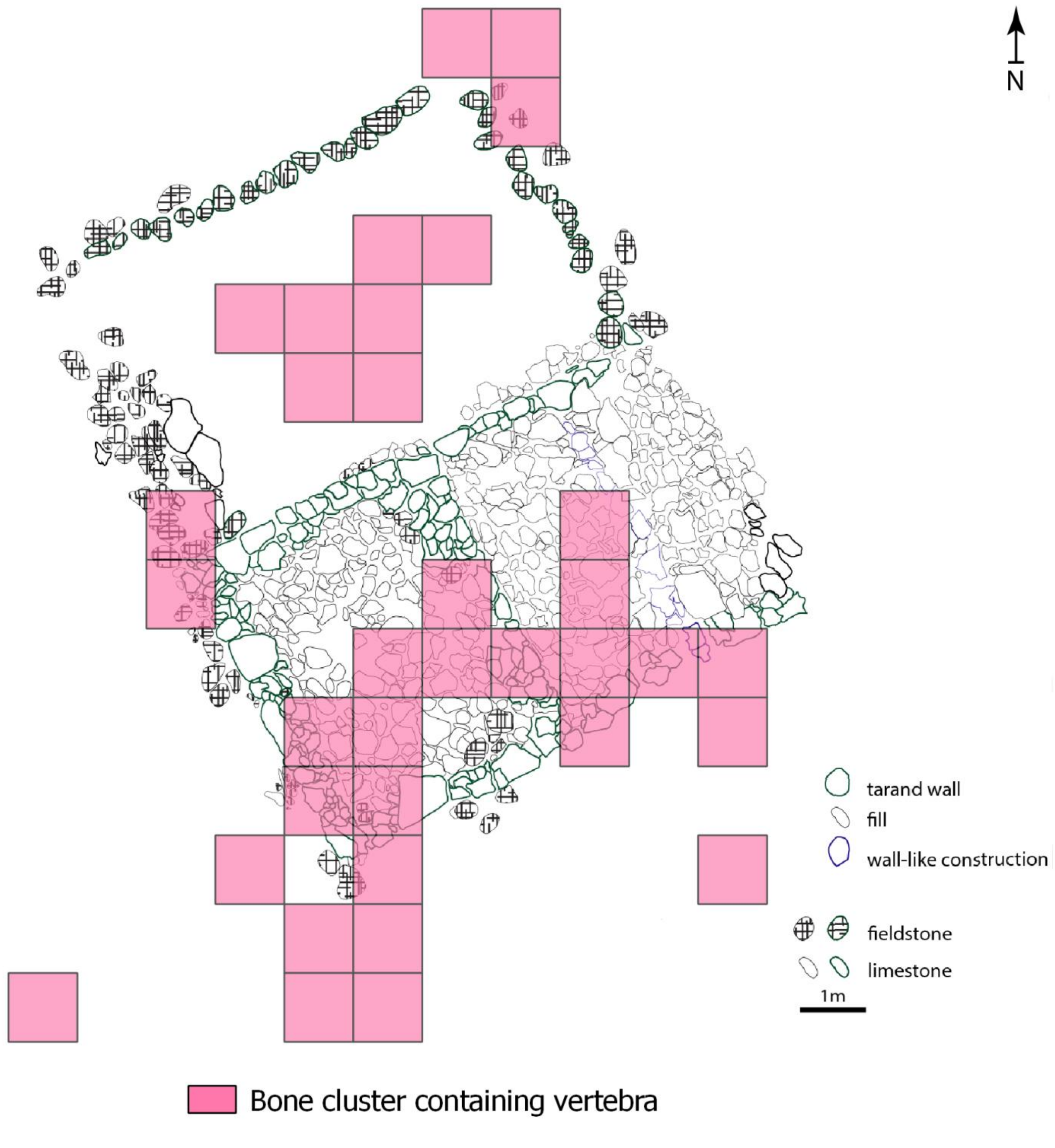


2.8 Distribution of cremated hand bones in Võhma Tandemäe.

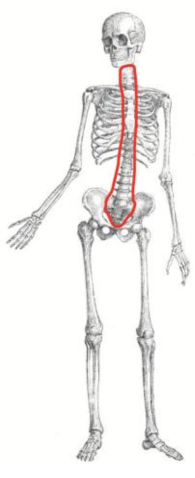


2.9 Distribution of cremated bones from thorax in Võhma Tandemäe.

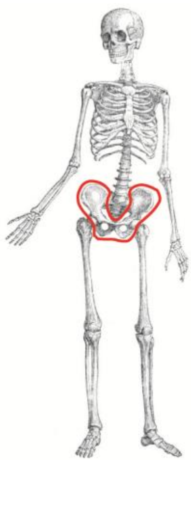


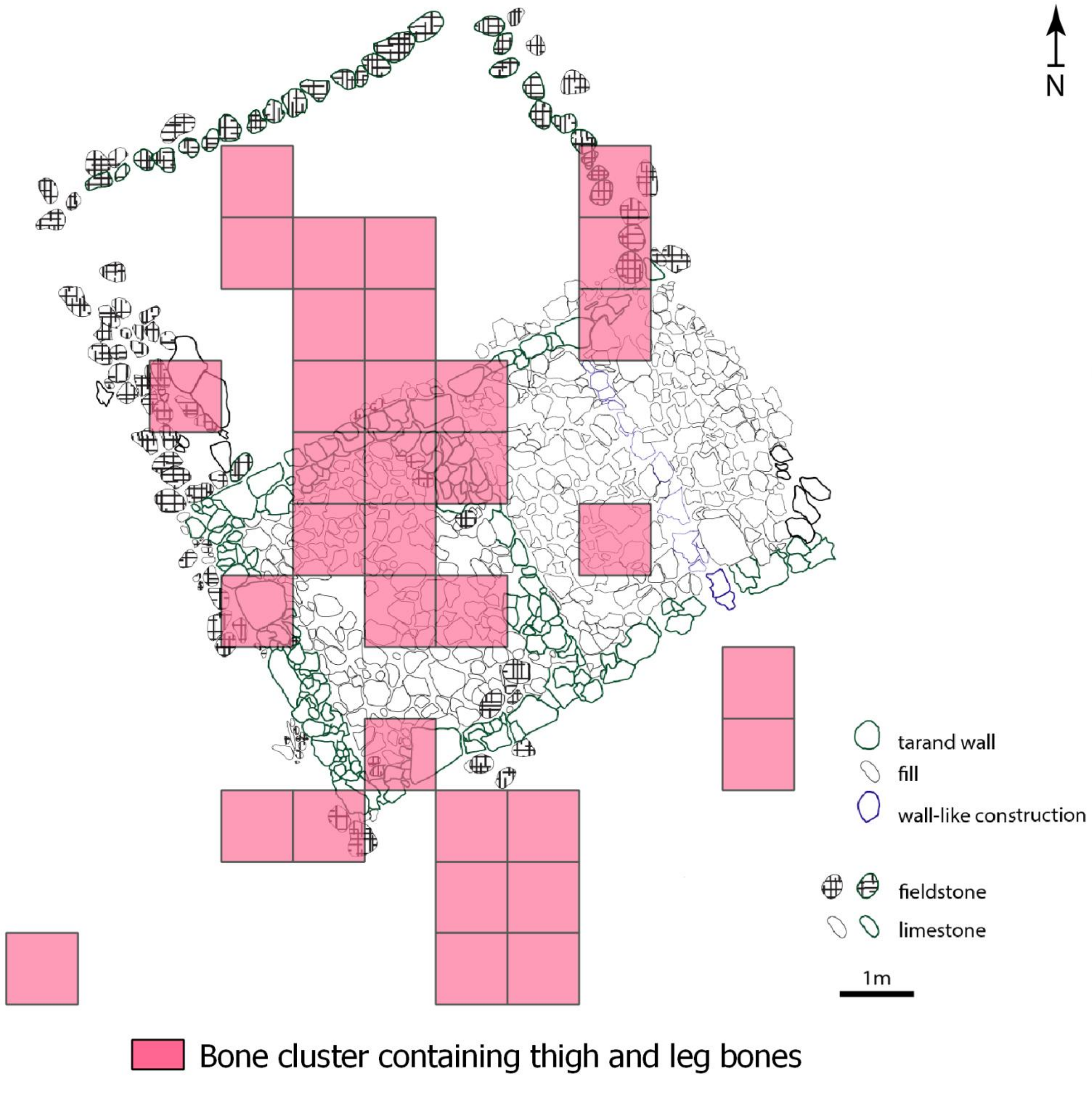


2.10 Distribution of cremated vertebral column in Võhma Tandemäe.

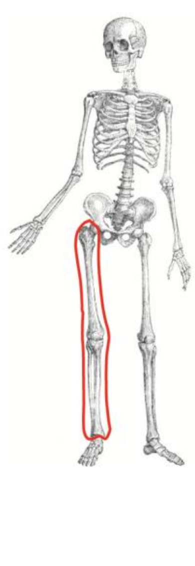


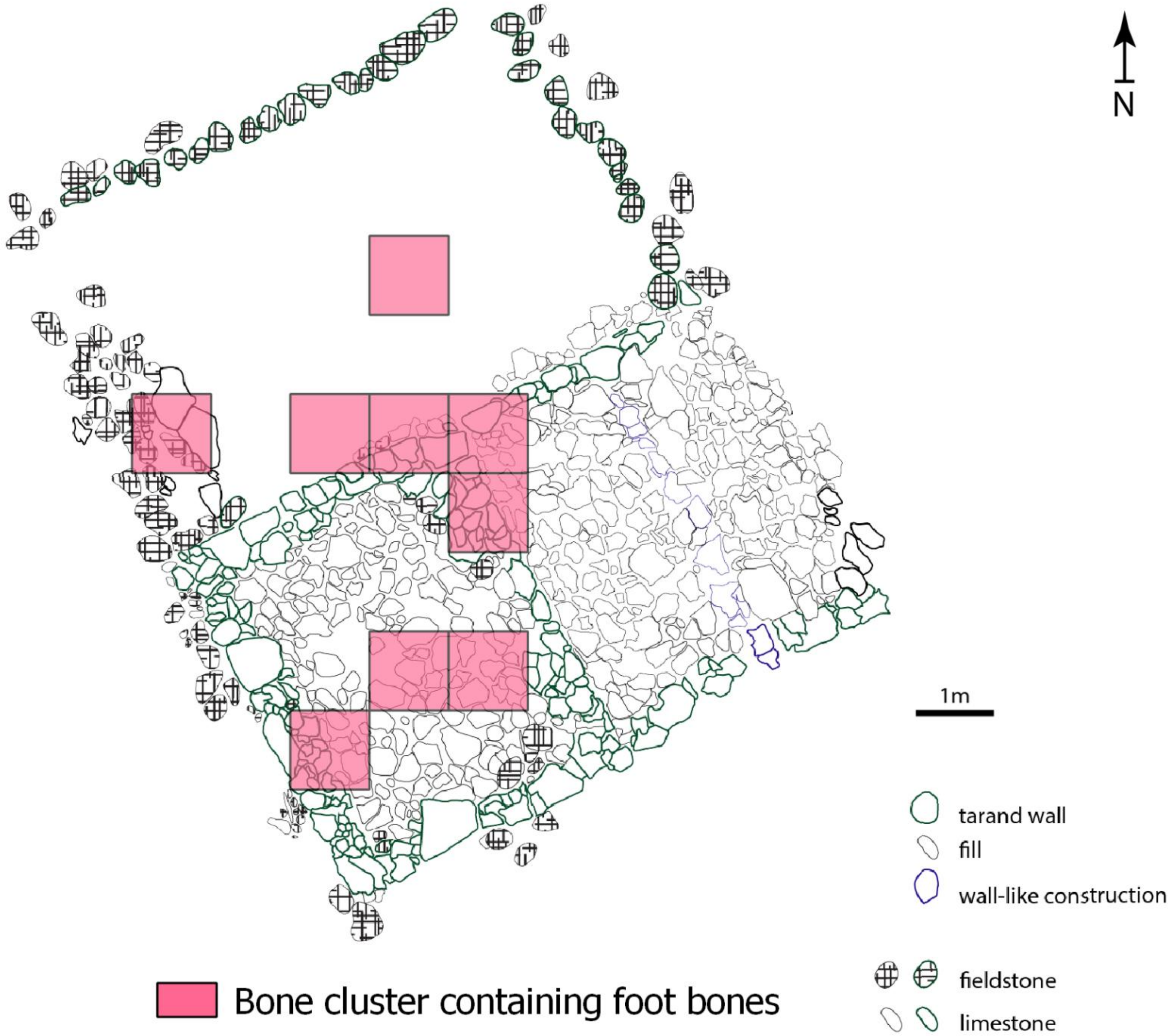
2.11 Distribution of cremated fragments of innominate bones in Võhma Tandemäe.





2.12 Distribution of cremated thigh and leg bones in Võhma Tandemäe.





2.13 Distribution of cremated foot bones in Võhma Tandemäe.

Appendix 3. Analysed contexts from Viimsi I *tarand*-grave, their location and contents.

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
1	c	long bones; cranial bones	no	black; blue	300–700	6	
2	a	long bones; cranial bones	no	grey; white	700–1100	38	
3	a	long bones; cranial bones; foot bones	no	grey	500–700	12	
3	a	foot bones	no	unburnt		6	
4	a	long bones	no	unburnt		15	
5	a	long bones	no	unburnt		15	
6	a	long bones; cranial bones; thorax	no	grey; white	500–1100	79	
7	a	long bones; cranial bones; hand bones	no	black; grey	300–700	30	
8	c	long bones; cranial bones	no	sooted; blue	300–700	14	an adult fragmented occipital bone with female traits

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
9	c	long bones; cranial bones	no	sooted	up to 400	16	
10	c	long bones; cranial bones	no	sooted	up to 400	13	
11	c	teeth; hand bones	no	unburnt		1	
12	east to tarand a	long bones; cranial bones	no	grey; white	700–1100	39	
13	east to tarand a	long bones; cranial fragments; thorax; hand bones; foot bones	no	unburnt		29	
14	east to tarand a	long bones; cranial bones; thorax	no	blue; grey; white	700–1100	30	
15	east to tarand a	long bones; teeth; thorax; hand bones	yes	unburnt		10	
16	east to tarand a	long bones; cranial fragments; teeth; axial skeleton; hand bones	yes	unburnt		5	
17	east to tarand a	long bones; cranial bones; axial skeleton	yes	black; grey; white	300–1100	36	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
18	east to tarand a	long bones; cranial bones; thorax	no	grey; white	500–1100	21	
18	east to tarand a	thorax	no	unburnt		7	
19	east to tarand a	long bones; cranial bones; teeth; hand bones; foot bones	no	unburnt		17	
20	east to tarand a	long bones; cranial bones; thorax	no	sooted; grey	300–700	12	
21	c	long bones; cranial bones; axial skeleton	no	black; blue	300–700	19	
22	a	long bones	no	sooted; grey	300–700	3	
23	c	long bones; cranial bones; thorax	no	sooted; grey	300–700	34	
25	c	long bones; cranial bones; thorax	no	sooted; grey	300–700	34	
26	c	long bones; cranial bones	no	sooted; white	300–1100	34	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
27	c	long bones; cranial bones	no	sooted	up to 400	5	
28	unknown	long bones; cranial bones	no	sooted	up to 400	12	an adult fragmented occipital bone with female traits
29	c	axial skeleton; hand bones	no	unburnt		29	
30	c	long bones; cranial bones; axial skeleton; teeth; hand bones; foot bones	no	sooted; grey; white	300–1100	97	fragment of an immature permanent premolar
31	a	long bones; cranial bones; axial skeleton; teeth; hand bones; foot bones	no	sooted; grey; white	300–1100	97	fragment of an immature permanent premolar
32	a	long bones; cranial bones; axial skeleton	no	sooted; white	300–1100	27	juvenile permanent molar
33	unknown	long bones; cranial bones; teeth; hand bones; foot bones	yes	unburnt		8	
34	unknown	long bones; cranial bones; axial skeleton	no	sooted; white	300–1100	27	juvenile permanent molar
35	a	long bones; cranial bones; axial skeleton	no	sooted; white	300–1100	27	juvenile permanent molar

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
36	a	long bones; cranial bones; axial skeleton	no	sooted; grey; white	300–1100	42	
37	a	long bones; cranial bones; pelvis	no	sooted	up to 400	14	
38	unknown	long bones; cranial bones	no	sooted; grey	300–700	25	
39	east to tarand c	long bones; cranial bones	no	sooted; grey; white	300–1100	44	
41	east to tarand c	long bones; cranial bones; axial skeleton	no	grey	500–700	4	
41	east to tarand c	long bones; cranial bones; thorax; hand bones; teeth	no	unburnt		8	
42	east to tarand c	long bones; cranial bones	no	sooted; grey	300–700	51	
43	east to tarand a	long bones; cranial bones; teeth	no	sooted; grey	300–700	45	
44	east to tarand a	long bones; cranial bones; axial skeleton; hand bones	no	unburnt		14	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
45	east to tarand a	hand bones; foot bones	no	unburnt		8	
46	east to tarand a	long bones	no	white	more than 1100	14	
47	north to tarand a	cranial bones; hand bones; foot bones	yes	unburnt		17	
48	north to tarand a	long bones; cranial bones	no	sooted; grey	300–700	21	
49	c	long bones; cranial bones; pelvis	no	grey	500–700	36	
50	east to tarand c	long bones; cranial bones	no	sooted	up to 400	29	
51	c	long bones; cranial bones; teeth	no	sooted	up to 400	15	
52	c	long bones; cranial bones; teeth	no	black; white	300–1100	75	
53	c	long bones; cranial bones; thorax	no	black; white	300–1100	20	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
54	c	teeth; foot bones	no	unburnt		9	
55	c	long bones; cranial bones; pelvis; hand bones	yes	sooted; grey	300–700	42	
56	c	long bones; cranial bones	no	sooted; grey	300–700	13	
57	east to tarand c	teeth; foot bones	no	unburnt		4	
58	east to tarand c	long bones; cranial bones	no	unburnt		2	
58	east to tarand c	long bones; cranial bones	no	sooted; white	300–1100	33	
59	a	long bones; cranial bones; teeth; hand bones	no	grey	500–700	47	
60	a	long bones; thorax; axial skeleton; hand bones; foot bones	yes	unburnt		16	
61	a	long bones	no	unburnt		3	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
61	a	long bones; cranial bones	no	sooted; grey	300–700	23	
62	unknown	long bones; cranial bones	no	sooted; grey	300–700	30	
63	unknown	thorax; hand bones	no	unburnt		2	
64	a	long bones; cranial bones	no	white	700–1100	5	
65	a	long bones; thorax	no	unburnt		26	lateral fragment of an adult clavicle
66	a	long bones; cranial bones	no	grey; white	700–1100	14	
67	east to tarand a	long bones; cranial bones	no	black; grey; white	300–1100	15	
68	east to tarand a	long bones; cranial bones	no	grey; white	700–1100	9	
69	b	long bones; cranial bones	no	grey; white	700–1100	17	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
70	unknown	axial skeleton; hand bones; foot bones	no	unburnt			
71	b	long bones; cranial bones; thorax	no	sooted	up to 400	23	
72	south to tarand b	long bones; cranial bones; thorax; axial skeleton; pelvis; teeth; hand bones	no	sooted; grey	300–700	330	deciduous maxillary molar; immature hand bones
73	south to tarand b	long bones; foot bones	no	unburnt		12	
74	b	long bones; cranial bones; thorax; teeth; hand bones	no	sooted; blue	300–700	129	
75	d	long bones; cranial bones	no	grey	500–700	6	
76	d	long bones; cranial bones	no	sooted; grey	300–700	14	
77	a	long bones; cranial bones	no	blue; grey; white	500–700	7	
78	a	long bones; cranial bones; thorax; hand bones; foot bones	yes	unburnt		40	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
79	a	long bones; cranial bones	no	grey; white	500–1100	10	
80	north to tarand a	long bones; cranial bones	no	sooted; grey	300–700	12	
81	north to tarand a	cranial bones; teeth	no	unburnt		18	fragmented female adult mandible
82	north to tarand a	long bones; axial skeleton; thorax	yes	unburnt		17	roheline julla
83	north to tarand a	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	24	
84	a	long bones; cranial fragments; axial skeleton; hand bones	no	unburnt		9	
85	a	long bones; cranial bones; hand bones; foot bones	no			95	
86	east to tarand a	axial skeleton; hand bones; foot bones	no	unburnt		7	child (younger than 16)
87	a	long bones; cranial bones	no	black; grey	300–700	36	fragment of an adult right superciliary arch; commingled with 89

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
88	unknown	long bones	no	unburnt		108	
88	unknown	long bones; cranial bones; hand bones; foot bones	no	unburnt		52	
89	b	long bones; cranial bones	no	black; grey	300–700	36	fragment of an adult right superciliary arch; commingled with 87
90	b	long bones; cranial bones	no	black; grey	300–700	66	
91	unknown	long bones; cranial bones; thorax; axial skeleton; teeth; hand bones	no	sooted; grey	300–700	590	fragments of two adult petrous portions
92	b	long bones; cranial bones; thorax; axial skeleton; teeth; hand bones	no	sooted; grey	300–700	590	
93	b	long bones; cranial bones; thorax; axial skeleton; hand bones	no	sooted	up to 400	607	
94	b	long bones; cranial bones; thorax	no	sooted; grey	300–700	153	
95	b	long bones; cranial bones; foot bones	no	sooted	up to 400	85	fragment of a masculine nuchal crest

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
96	b	long bones; cranial bones	no	sooted	up to 400	23	
97	south to tarand b	long bones; cranial bones; thorax	no	sooted	up to 400	36	
98	south to tarand b	thorax; teeth; foot bones	no	unburnt		10	
99	south to tarand b	long bones; cranial bones; thorax	no	sooted	up to 400	37	fragment of a masculine nuchal crest
100	d	long bones; thorax	yes	unburnt		10	
101	d	long bones; cranial bones; hand bones	no	sooted; white	300–1100	48	immature hand bones
102	d	long bones; cranial bones; axial skeleton	no	sooted	up to 400	32	
103	b	long bones; cranial bones	no	sooted	up to 400	16	
104	d	long bones; cranial bones; axial skeleton; teeth; foot bones	no	sooted; blue; white	300–1100	648	fragments of adult male occipital bone

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
105	d	long bones; cranial bones; teeth; hand bones	no	sooted; grey; white	300–1100	263	
106	b	hand bones; foot bones	no	unburnt		15	
107	south to tarand b	long bones; cranial bones; axial skeleton; foot bones	no	black; grey	300–700	81	
108	south to tarand b	long bones; cranial bones; axial skeleton; hand bones; foot bones	no	sooted: grey; white	300–1100	336	immature hand bones
109	south to tarand b	long bones; axial skeleton; hand bones; foot bones	yes	unburnt		45	
110	b	long bones; cranial bones; thorax	no	sooted	up to 400	43	
111	b	long bones; axial skeleton; teeth; hand bones; foot bones	yes	unburnt		38	fragment of immatire humerus
112	d	long bones; cranial bones; axial skeleton; hand bones; foot bones	no	sooted: grey; white	300–1100	336	immature hand bones
113	b	long bones; cranial bones; thorax	no	sooted; grey	300–700	135	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
114	b	long bones; axial skeleton; teeth; hand bones; foot bones	yes	unburnt		38	fragment of immatire humerus
115	a	long bones; cranial bones	no	sooted	up to 400	25	
116	a	long bones; cranial bones	no	grey; white	500–1100	38	
117	a	long bones; axial skeleton; hand bones	no	unburnt		11	
118	north to tarand a	cranial vones; thorax	no	unburnt		12	
119	north to tarand a	long bones; cranial bones; hand bones	no	sooted; grey	300–700	21	
120	a	long bones; cranial bones	no	sooted; grey	300–700	32	
121	north to tarand a	thorax; hand bones; foot bones	no	unburnt		6	
122	north to tarand a	cranial bones; thorax	no	sooted	up to 400	28	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
123	north to tarand a	long bones; cranial bones; thorax; hand bones; foot bones	no	unburnt		43	
124	north to tarand a	long bones; cranial bones; foot bones	no	grey; white	500–1100	26	
125	d	long bones; cranial bones; thorax; hand bones	no	grey	500–700	79	
126	unknown	cranial bones; hand bones; foot bones	no	unburnt		18	
127	a	cranial bones; hand bones; foot bones	no	white	more than 1100	57	
128	unknown	cranial bones; hand bones; foot bones	no	unburnt		18	
129	east to tarand a	long bones; cranial bones; hand bones	no	grey	500–700	29	
130	a	long bones; cranial bones; axial skeleton; teeth; hand bones	no	unburnt		11	
131	a	long bones; cranial bones	no	grey	500–700	22	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
132	north to tarand a	thorax; hand bones; foot bones	no	unburnt		5	
133	north to tarand a	long bones; cranial bones	no	black; grey; white	300–1100	20	
134	north to tarand a	long bones; axial skeleton; pelvis	no	unburnt		21	
135	north to tarand a	long bones; cranial bones	no	black; grey	300–700	33	
136	c	long bones; cranial bones	no	black; grey	300–700	33	
137	c	long bones; cranial bones; thorax; hand bones	no	sooted; white	300–1100	254	fragments of adult male occipital bone
138	b	long bones; cranial bones; thorax; hand bones	no	sooted; white	300–1100	246	
139	b	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	40	
140	b	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	76	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
141	b	long bones; teeth; axial skeleton; hand bones; foot bones	yes	unburnt		10	
142	unknown	long bones; cranial bones	no	sooted; grey	300–700	42	
143	d	long bones; cranial bones; thorax; axial skeleton	no	sooted; grey	300–700	265	
144	d	long bones; teeth; axial skeleton; hand bones; foot bones	yes	unburnt		10	
145	unknown	long bones; cranial bones	no	black; blue	300–700	35	
146	d	long bones; cranial bones	no	black; grey	300–700	43	
147	c	long bones; cranial bones	no	black; grey; white	300–1100	22	
148	unknown	long bones; cranial bones; axial skeleton	no	black; grey	300–700	29	
149	south to tarand b	long bones; cranial bones	no	black; grey	300–700	38	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
150	south to tarand b	thorax	no	unburnt		5	
151	b	long bones; cranial bones	yes	black; grey; white	300–1100	19	
152	b	long bones; cranial bones	no	grey	500–700	15	
153	west to tarand a	long bones; thorax; axial skeleton; hand bones; foot bones	no	unburnt		67	
154	north to tarand a	long bones; cranial bones; teeth	no	grey	500–700	70	
155	north to tarand a	cranial bones; teeth; thorax	no	unburnt		58	
156	c	long bones; cranial bones; axial skeleton; hand bones	no	unburnt		10	
157	east to tarand b	long bones; cranial bones	no	sooted	up to 400	31	
158	d	thorax; hand bones; foot bones	no	unburnt		15	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
159	east to tarand d	long bones; cranial bones; teeth	no	grey	500–700	70	
160	east to tarand c	long bones; thorax; vertebra; teeth; hand bones; foot bones	no	unburnt		27	
161	east to tarand d	long bones; cranial bones; axial skeleton; pelvis	no	sooted	up to 400	124	an immature permanent molar
162	d	long bones; cranial bones; thorax	no	sooted; grey; white	300–1100	151	fragments of adult male occipital bone
163	b	long bones; cranial bones	no	sooted	up to 400	33	
164	b	axial skeleton	no	unburnt		1	
164	b	long bones; cranial bones; axial skeleton; hand bones	no	sooted	up to 400	15	
165	south to tarand b	long bones; cranial fragments	no	sooted	up to 400	10	
166	b	long bones; cranial fragments	no	sooted	up to 400	22	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
167	d	long bones; cranial bones; thorax; axial skeleton	no	sooted; blue; grey	300–700	169	fragment of a juvenile humerus; epiphyses not fused
168	d	foot bones	no	unburnt		3	
169	north to tarand a	long bones; cranial bones	no	sooted	up to 400	6	
170	north to tarand a	axial skeleton	no	unburnt		2	
171	north to tarand a	foot bones	no	unburnt		10	
172	west to tarand a	long bones; cranial bones; thorax; vertebra; teeth; hand bones; foot bones	no	unburnt		70	
172	east to tarand d	long bones; cranial bones	no	black; blue	300–700	9	
173	east to tarand d	long bones; cranial bones	no	black; blue	300–700	43	
174	east to tarand b	long bones; hand bones; foot bones	no	unburnt		22	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
175	east to tarand b	long bones; cranial bones; thorax	no	black; blue	300–700	17	
176	east to tarand b	long bones; thorax; axial skeleton; hand bones	no	unburnt		21	
177	east to tarand b	long bones; cranial bones	no	black; blue	300–700	20	
178	unknown	long bones; cranial bones; foot bones	no	black; blue	300–700	29	
179	c	long bones; cranial bones; foot bones	yes	white	more than 1100	11	
180	c	long bones; cranial bones; thorax; axial skeleton	no	grey	500–700	78	
181	west to tarand d	long bones; cranial bones; thorax; axial skeleton; teeth	no	sooted; white	300–1100	32	immature cranial bone fragments
182	west to tarand b	long bones; cranial bones; thorax; foot bones	no	grey	500–700	35	
183	south to tarand b	long bones; cranial bones	no	sooted	up to 400	24	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
184	south to tarand b	long bones; cranial bones	no	sooted; grey	300–700	46	fragment of an adult right petrous portion
185	c	long bones; cranial bones	no	white; calcined	more than 1100	9	
186	west to tarand c	long bones; pelvis; hand bones	no	unburnt		14	
187	west to tarand a	long bones; cranial bones; thorax; axial skeleton; hand bones	no	unburnt		245	
188	west to tarand a	long bones; cranial bones	no	sooted; blue	300–700	37	
189	west to tarand a	cranial bones	no	sooted; blue	300–700	3	
190	west to tarand a	long bones; cranial bones; hand bones	no	unburnt		51	child and adult (male?) cranial fragments
191	west to tarand a	long bones; cranial bones	no	grey	500–700	6	
192	east to tarand a	long bones; cranial bones	no	grey; white	500–1100	32	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
193	east to tarand c	long bones; cranial bones; thorax; hand bones	no	unburnt		4	
194	east to tarand c	long bones; cranial bones	no	grey; white	500–1100	42	
195	east to tarand b	axial skeleton; hand bones	no	unburnt		12	
196	d	long bones; cranial bones; thorax	no	sooted	up to 400	72	
197	east to tarand c	long bones; cranial bones	no	sooted; grey	300–700	27	
198	c	long bones; cranial bones	no	sooted; grey	300–700	24	
199	unknown	long bones; thorax; teeth; hand bones; foot bones	no	unburnt		31	
200	east to tarand a	long bones; cranial bones; thorax	no	sooted; white	300–1100	16	
201	east to tarand c	long bones; cranial bones	no	sooted; grey	300–700	27	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
202	east to tarand a	long bones; teeth; foot bones	no	unburnt		4	
203	east to tarand a	long bones; cranial bones	no	sooted; grey; white	300–700	45	fragments of adult male occipital bone
204	north to tarand a	cranial bones; pelvis; hand bones; foor bones	no	unburnt		28	
205	north to tarand a	cranial bones	no	unburnt		10	
205	north to tarand a	long bones; cranial bones	no	grey; white	500–1100	84	
206	north to tarand a	pelvis; foot bones	no	unburnt		8	
207	north to tarand a	axial skeleton; pelvis; teeth	no	unburnt		21	
208	north to tarand a	long bones; cranial bones	no	black; white	300–1100	68	
209	west to tarand d	long bones; cranial bones	no	black; white	300–1100	80	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
210	west to tarand d	long bones; hand bones	no	unburnt		29	
211	d	long bones; cranial bones; thorax; foot bones	no	sooted	up to 400	115	
212	unknown	long bones; thorax; hand bones; foot bones	no	unburnt		10	
213	d	long bones; cranial bones	no	sooted; white	300–1100	23	
214	d	long bones; cranial bones; axial skeleton; hand bones; foot bones	no	sooted; white	300–1100	70	
215	south to tarand b	long bones; cranial bones; thorax; axial skeleton; hand bones	no	sooted	up to 400	347	
216	south to tarand b	long bones; cranial bones; thorax; hand bones; foot bones	yes	unburnt		109	
217	south to tarand b	long bones; cranial bones	no	sooted	up to 400	38	
218	west to tarand d	teeth; hand bones	no	unburnt		8	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
219	west to tarand d	long bones; cranial bones; thorax; axial skeleton; hand bones	no	sooted; grey	300–700	138	
220	unknown	long bones; cranial bones	no	blue; white	700–1100	5	
221	east to tarand a	long bones; cranial bones	no	sooted; blue; white	300–1100	292	
222	east to tarand a	long bones; cranial bones; thorax; pelvis; teeth; hand bones; foot bones	no	unburnt		233	
223	east to tarandd a	long bones; cranial bones; thorax; pelvis; teeth; hand bones; foot bones	no	unburnt		233	
224	east to tarand a	long bones; cranial bones	no	sooted; blue; white	300–1100	292	
225	east to tarand a	long bones; cranial bones; thorax; pelvis; teeth; hand bones; foot bones	no	unburnt		233	
227	north to tarand a	teeth; foot bones	no	unburnt		3	
227	north to tarand a	long bones; cranial bones; thorax; hand bones	yes	sooted; grey; white	300–1100	230	fragments of adult male occipital bone

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
228	north to tarand a	cranial bones	no	unburnt		233	
229	east to tarand a	cranial bones	no	unburnt		2	
229	east to tarand a	long bones; cranial bones	no	sooted; grey	300–700	51	
230	unknown	long bones; cranial bones; thorax; axial skeleton	yes	grey; white	500–1100	204	
231	unknown	long bones; foot bones	no	unburnt		10	
232	unknown	long bones; cranial bones; thorax; pelvis	no	sooted; grey	300–700	503	fragment of an immature pelvis
233	unknown	long bones; cranial bones; axial skeleton; pelvis; teeth	no	unburnt		1117	
234	unknown	long bones; cranial bones; thorax; axial skeleton; pelvic; hand bones	no	grey; white	800–1200	537	
235	unknown	long bones; cranial bones; thorax; axial skeleton; hand bones	no	grey; white	800–1200	527	

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
236	unknown	long bones; cranial bones; axial skeleton; pelvis; teeth	no	unburnt		1117	
237	east to tarand c	long bones; cranial bones; axial skeleton; pelvis; teeth	yes	unburnt		484	proximal fragment of right radius, diagonal cut mark on posterior
238	east to tarand a	long bones; cranial bones; axial skeleton; teeth	no	unburnt		292	fragment of a mandibula with cut mark on posterior side;
239	east to tarand a	long bones; cranial bones; axial skeleton	no	unburnt		175	grown up and child
240	east to tarand c	long bones; cranial fragment; thorax	no	sooted; grey; white	300–1100	40	
241	east to tarand a	long bones; cranial bones	no	grey; white	500–1100	33	
242	north to tarand a	long bones; cranial bones; axial skeleton; pelvis; foot bones	no	grey; white	500–1100	224	
243	north to tarand a	long bones; cranial bones; axial skeleton; pelvis; teeth		unburnt		207	two left MC2
244	west to tarand a	long bones; thorax; axial skeleton; hand bones; foot bones	yes	unburnt		68	child (aged 3-6) and adult

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
245	north to tarand a	long bones; cranial bones; thorax	no	black; grey	300–700	20	
246	a	long bones; cranial bones	no	black; blue; white	400–1000	74	fragment of adult left (?) petrous art of the temporal; fragment of two adult calcanei; adult left and right MT5
247	east to tarand d	long bones; thorax; axial skeleton; hand bones; foot bones	no	unburnt		205	
248	east to tarand c	long bones; cranial bones	no	black; grey	300–700	24	cranial fragments more densely burned from the inside
249	unknown	long bones; cranial bones; teeth; thorax; axial skeleton	yes	grey; white	800–1200	184	two adult frontal processes of the left zygomatic
250	b	long bones; cranial bones	no	black; grey	300–700	83	adult left supraorbital margin
251	east to tarand b	teeth; hand bones; foot bones	no	unburnt		10	
252	east to tarand c	long bone; mandible	no	unburnt		7	
252	east to tarand c	long bones; teeth; thorax; axial skeleton; hand bones; foot bones	no	unburnt		?	child and two adult (one aged 20-24) right MC2; adult left MT5

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
253	d	long bones; cranial bones; hand bones	no	grey; white	800–1200	131	commingled with 254, 255; weighed in 2011 comprises both
254	d	long bones; cranial bones; hand bones	no	grey; white	800–1200	131	commingled with 253, 255; weighed in 2011, comprises both
255	c	long bones; cranial bones; hand bones	no	grey; white	800–1200	16	commingled with 253, 254; weighed in 2011
256	unknown	long bones; cranial bones; pelvis	yes	black; grey; white	400–1000	27	now commingled with 258, 260
257	west to tarand d	long bones	yes	unburnt		33	
257	west to tarand d	long bones; hand bones; foot bones	yes	unburnt		43	now commingled with 256, 258, 260
258	west to tarand b	long bones; cranial bones; hand bones; foot bones	yes	black; grey	300–700	122	now commingled with 256, 260
259	west to tarand b	long bones; thorax; foot bones	no	unburnt		130	
260	west to tarand b	long bones; cranial bones; hand bones	yes	black; grey	300–700	186	now commingled with 256, 258

Context	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
261	west to tarand b	axial skeleton; teeth; hand bones	yes	unburnt		23	
262	unknown	long bones; cranial bones; axial skeleton; pelvis; hand bones; foot bones	yes	black; grey	300–700	128	fragment of an adult superciliary arch
263	b	long bones; cranial bones; teeth	no	grey	500–700	23	fragment of an adult superciliary arch
264	d	long bones; cranial bones; thorax; hand bones	no	grey; white	800–1200	100	adult, sagittal suture partially closed

Appendix 4. Analysed contexts from Võhma Tandemäe *tarand*-grave, their location and contents.

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
1	unknown			long bones; cranial bones; hand bones	no	grey	500–700	19	
2	unknown	II		long bones; cranial bones; thorax; axial skeleton; hand bones	no	black	up to 400	14	
6	QR/70	II	3 and 2	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones	no	sooted; grey; white	300–1100	205	immature ribs
6	QR/70	II	3 and 2	cranial bones	no	unburnt			closed coronal suture
10	O-Q/70-71, P/70	II	3	long bones	no	white	800–1100	6	
11	O-Q/70-71, OP/70	II	3	long bones; cranial bones	no	black; grey	300–700	15	
17	W/69	II	outside	long bones; cranial bones; thorax; axial skeleton; teeth; hand bones	no	grey	500–700	74	
18	Õ/69	II	1	pelvis	no	grey	500–700	2	
19	Õ/69	II	1	long bones; cranial bones; thorax; axial skeleton; pelvis; teeth; hand bones	no	sooted	up to 400	43	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
20	QR/67	II	3	long bones; cranial bones; thorax; axial skeleton	no	sooted	up to 400	34	
21	UT/69		1	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; teeth	yes	black; grey; white	300–1100	76	
22	U/69	II	1	long bones; cranial bones; thorax; axial skeleton; teeth; hand bones; foot bones	no	black	up to 400	117	
23	S/72	II	2	long bones; cranial bones; axial skeleton	no	white	800–1100	11	
26	T/74	II	2	long bones; cranial bones	no	black; white	300–1100	6	
28	U/73	II	2	long bones; cranial bones; teeth	no	black; grey	300–700	19	
30	Q/66	II	3	long bones; cranial bones	no	grey	500–700	6	
33	close to the triple burial in *tarand* 3	II	3	long bones; cranial bones	no	black; grey	300–700	2	
39	OP/68-71	II	3	long bones	no	grey; white	700–1100	1	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
41	S/72	II	2	long bones; cranial bones; thorax	no	black	up to 400	42	
46	unknown			cranial bones; pelvis; foot bones	no	black	up to 400	12	
47	PQ/70-71	II	3	long bones; cranial bones; axial skeleton; hand bones	no	black; grey; white	300–1100	92	adult right petrous portion
49	W/74	II	south to *tarand* 2	long bones; cranial bones	yes	grey	500–700	26	
49	W/74	II	south to *tarand* 2	teeth	yes	unburnt		2	
50	T/69-70	II	1	long bones; cranial bones; axial skeleton	no	black; grey	300–700	14	
51	M/70	II	3	cranial bones; teeth	no	black; grey	300–700	1	
52	Q/70	II	3	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	70	adult right petrous portion
53	ÖÜ/64	II	south-wast to *tarand* 1	long bones; cranial bones; axial skeleton	no	black	up to 400	23	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
55	unknown	II		long bones	no	black	up to 400	10	
58	unknown	II		long bones; cranial bones; thorax; axial skeleton		black	up to 400	51	
61	ST/72	II	2	long bones; cranial bones; thorax	no	black	up to 400	24	immature vertebral arch
62	PQ/71	II	3	long bones; cranial bones; axial skeleton; pelvis; hand bones	no	black; white	300–1100	469	adult left petrous portion
67	T/73	II	2	long bones; cranial bones; teeth	no	black	up to 400	2	
68	Q/67	II	3	long bones; cranial bones; teeth	no	black; grey	300–700	5	
71	S/68	II	1 and 3	long bones; cranial bones; teeth	no	black; grey; white	300–1100	6	
72	U/73	II	2	long bones; cranial bones; axial skeleton	no	black; grey	300–700	35	
73	ST/68-69		mainly 1 and some 3	long bones; cranial bones; thorax; axial skeleton; hand bones	no	sooted; grey	300–700	49	immature ribs

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
75	Õ/69		south to *tarand* 1	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	26	immature left neural arch of crevical vertebra
76	W/70		1	long bones; cranial bones	no	grey	500–700	2	
77	U/71	II	1 and 2	long bones; axial skeleton	no	black	up to 400	12	
79	PQ/69	II	3	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; foot bones	no	white	800–1100	85	immature tibia, fragment
80	Õ/68-69		south to *tarand* 1	long bones; cranial bones; pelvis	no	grey	500–700	70	immature right zygomatic
81	S/69	II	1	long bones; cranial bones	no	black; grey; white	300–1100	8	
82	Q/67	II	3	long bones; cranial bones	no	grey	500–700	5	
83	R/67		3	cranial bones	no	unburnt			fragment of mandible
83	R/67		3	long bones; cranial bones	no	grey	500–700	17	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
83	R/67		3	hand bones	no	unburnt		1	
89	O/70		3	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	13	
90	OP/69-71	II	3	long bones; cranial bones; axial skeleton	no	black	up to 400	10	
93	skeletons from *tarand* s			long bones; cranial bones; thorax; axial skeleton; hand bones; teeth	no	black; white	400–1100	22	
94	ST/68-69		mainly 1 and some 3	long bones; cranial bones; thorax	no	sooted; grey	300–700	15	immature long bone
97	PQ/69	II	3	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; foot bones; teeth	no	black; grey; white	300–1100	468	child bones; adult right petrous portion; 2 adult left prtrous portions; 2
109	W/72		south to *tarand* 2	long bones	no	black; grey	300–700	6	
111	OPQ/70-72	II	3 and east to *tarand* 3	long bones; cranial bones	no	black	up to 400	14	
113	PQ/68-69		3	long bones; axial skeleton	no	unburnt		56	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
114	LM/70-71		3 and north to *tarand* 3	long bones; cranial bones; axial skeleton	yes	black	up to 400	7	immature vertebral body
114	LM/70-71		3 and north to *tarand* 3	thorax; pelvis	yes	unburnt		2	immature
118	unknown			long bones; cranial bones; thorax	no	black	up to 400	16	
119	PQ/68-69	II	3	long bones; cranial bones; axial skeleton	no	black; grey	300–700	41	
127	ÕÖ/70-71	II	south to *tarand* 1	long bones; cranial bones; pelvis	no	black; grey	300–700	42	
129	tarand walls	IV		cranial bones; teeth	no	sooted	up to 400	1	
130	U/71		1 and 2	long bones; cranial bones; thorax; axial skeleton	no	black; grey	300–700	18	
131	RS/66-70		mainly 3, also 1 and 2	long bones; cranial bones; foot bones; teeth	yes	black; grey; white	300–1100	107	
131	RS/66-70		mainly 3, also 1 and 2	cranial bones; thorax; foot bones	yes	unburnt		5	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
134	unknown			long bones; cranial bones	no	sooted; grey	300–700	11	
136	T/73		2	long bones; cranial bones	no	sooted; black	up to 400	7	
137	tarand walls	IV		long bones	no	black	up to 400	3	
138	ST/67-68	II	1 and 3	long bones; cranial bones; teeth	no	black; grey	300–700	39	
139	ST/66	II	3 and west to *tarand* s 1 and 3	long bones; axial skeleton; hand bones	no	black; grey	300–700	7	
140	tarand walls	IV		long bones; cranial bones; thorax	no	grey; white	700–1100	17	
141	W/68		1	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; teeth	no	black; grey	300–700	32	
142	V/69	II	1	long bones; cranial bones; axial skeleton; hand bones; teeth	no	black; grey	300–700	10	deciduous maxillary molar, fragmented
142	V/69	II	1	thorax	no	unburnt		1	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
143	V/68	II	1	long bones; cranial bones; pelvis; teeth	no	black; grey	300–700	50	immature left petrous portion
143	V/68	II	1	cranial bones	no	unburnt		2	adult left petrous portion
144	V/69-70	II	1	long bones; cranial bones; thorax; axial skeleton	no	sooted	up to 400	35	
144	V/69-70	II	1	cranial bones	no	unburnt		1	
145	V/68	II	1	long bones; cranial bones; thorax; axial skeleton; pelvis; foot bones	no	sooted; grey	300–700	177	immature left petrous portion; immature vertebral body
146	S/70	II	2 and north-eastern wall of	long bones; cranial bones	no	black; white	400–1100	7	
147	S/71	II	2	long bones; cranial bones; axial skeleton	no	black; grey; white	400–1100	4	
150	S/71	II	2	cranial bones; axial skeleton	no	sooted	up to 400	9	
152	S/67	II	3	long bones; hand bones	no	unburnt		48	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
153	S/70	II	2 and north-eastern wall of	long bones; cranial bones	no	grey; white	500–1100	6	
154	ST/70-71	II	1 and western part of	long bones; cranial bones	no	sooted; grey	300–700	7	
154	ST/70-71	II	1 and western part of	axial skeleton	no	unburnt		1	
155	W/70	II	1 and south to tarand 1	long bones; cranial bones; thorax; axial skeleton; hand bones	no	sooted; grey	300–700	53	
155	W/70	II	1 and south to tarand 1	cranial bones; thorax	no	unburnt		2	child rib
157	V/69	II	1	teeth	no		less than 900	1	
158	W/68	II	1	long bones; cranial bones; thorax; hand bones	no	sooted; grey	300–700	35	immature clavicle, fragment
159	VW/69	II	1	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones	yes	black; white	400–1100	127	
160	T/72	II	2	cranial bones; thorax; hand bones	no	black	up to 400	11	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
161	W/69	II	1	long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones	no	sooted; grey	300–700	136	
162	T/73-74	II	2	long bones; cranial bones	no	black	up to 400	11	
163	PQ/67	II	3	long bones; cranial bones; thorax; axial skeleton; teeth	no	black; grey	300–700	70	
164	ÕÄ/69-71		south to *tarand* 1	long bones; cranial bones; axial skeleton; pelvis	no	black; grey	300–700	15	immature iliac blade fragment
165	U/71	II	1 and 2	long bones; cranial bones; teeth	no	black	up to 400	28	
166	tarand walls	IV		long bones; cranial bones; teeth	no	black; grey	300–700	61	
169	ÕÖ/68-69	II	south to *tarand 1*	long bones; axial skeleton; teeth	no	black; grey	300–700	12	
170	V/70	II	1	cranial bones	no	black	up to 400	1	adult right petrous portion
173	U/70	I	1	long bones; pelvis	no	black; grey	300–700	6	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
174	U/70	I	1	long bones	no	black; grey	300–700	1	
175	U/70	I	1	long bones; cranial bones	no	black; grey	300–700	2	
177	U/69	I	1	long bones; foot bones	no	black	up to 400	1	
179	U/70	I	1	cranial bones	no	sooted	up to 400	1	
179	U/70	I	1	cranial bones	no	unburnt		1	
180	U/70	I	1	long bones; cranial bones; pelvis; teeth	no	grey	500–700	4	
182	U/70	I	1	long bones; cranial bones; axial skeleton	no	grey	500–700	21	
188	S/67	I	3	long bones	no	unburnt		1	
188	S/67	I	1 and 3	long bones; cranial bones; axial skeleton; teeth	no	black	up to 400	3	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
190	P/67	I	3	long bones	no	grey	500–700	2	
193	OP/68-69	I	3	cranial bones	yes	unburnt		1	
194	PQ/70	I	3	long bones	no	white; calcined	800–1200	10	
194	PQ/70	I	3	cranial bones	no	unburnt		5	adult right petrous portion
195	ST/69-70	I	1 and western part of	long bones; cranial bones	no	grey	500–700	2	
196	ST/67-68	I	1	long bones; axial skeleton	no	grey	500–700	5	
197	RS/68-69	I	3	cranial bones	no	unburnt		1	
197	RS/68-69	I	1 and 3	long bones; cranial bones	no	grey; white	400–1100	5	
198	S/67	I	1	long bones; cranial bones	no	white	more than 1100	9	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
199	S/70	I	2 and north-eastern wall of	long bones; cranial bones	no	sooted	up to 400	7	
201	WÕ/69-70	I	1 and south to *tarand* 1	long bones; cranial bones; thorax; axial skeleton; hand bones; teeth	no	black; white	400–1100	191	
202	Õ/70-71	I	south to *tarand* 1	long bones; cranial bones; axial skeleton; hand bones	no	black	up to 400	2	
202	Õ/70-71	I	south to *tarand* 1	cranial bones	no	unburnt			adult occipital crest, male
203	Õ/70-71	I	south to tarand 1	long bones; cranial bones	no	sooted; white	400–1100	14	
204	Õ/70	I	south to tarand 1	long bones; cranial bones	yes	sooted	up to 400	3	
208	VW/70-71	I	1	long bones; cranial bones	no	black	up to 400	14	
210	V/71	I	1	long bones	no	black	up to 400	3	
211	VW/67	I	west to tarand 1	long bones; thorax	no	sooted	up to 400	3	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
214	VW/69	I	1	long bones; cranial bones	no	black	up to 400	38	
216	V/72	I	2	long bones	no	grey	500–700	8	
223	W/69-70	I	1	cranial bones	no	grey	500–700	11	
228	O/68		3	cranial bones	no	unburnt			fragment of mandible
228	O/68	skeleton	3	long bones; cranial bones	no	black	up to 400	28	
231	O/68	II	3	long bones; cranial bones	no	black	up to 400	12	
232	O/66	II	3	long bones; hand bones	no	grey	500–700	2	
233	P/68		3	axial skeleton	no	grey	500–700	4	
234	OP/67	II	3	long bones; cranial bones	no	black	up to 400	1	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
234	OP/67		3	cranial bones	no	unburnt			fragment of mandible
235	P/68	II	3	long bones; cranial bones	no	black	up to 400	10	
239	TU/68-69	II	1	long bones; cranial bones; thorax; axial skeleton; foot bones	no	black	up to 400	54	
240	UT/69	II	1	long bones	no	black	up to 400	9	
241	TU/69-70	II	1	teeth	no		less than 900	1	
242	UT/69	II, skeleton	1	long bones; cranial bones; thorax	no	black	up to 400	12	
245	Q/67	II	3	long bones; cranial bones; thorac; axial skeleton; teeth	no	black	up to 400	14	
246	QR/66	II	3	long bones; thorax	no	grey	500–700	2	
247	Q/70	II	3	long bones; cranial bones	no	white	more than 1100	7	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
248	QR/71	II	3	cranial bones; axial skeleton	no	white	more than 1100	3	
249	Q/67-68		3	long bones; cranial bones; thorax; axial skeleton; hand bones; foot bones	no	unburnt		221	
249	Q/67-68	II	3	long bones; cranial bones; axial skeleton; foot bones	no	black	up to 400	21	
250	UV/70		1	long bones; cranial bones; axial skeleton; pelvis	no	black; grey	300–700	99	
252	W/67	II	west to tarand 1	cranial bones	no	grey	500–700	4	
254	Ä/67	II	outside	long bones	no	grey	500–700	1	
255	Õ/70-71		south to tarand 1	long bones; cranial bones	no	black	up to 400	14	
256	Õ/66	II	outside	long bones; cranial bones; thorax; axial skeleton; pelvis	no	grey	500–700	140	
259	Õ/70	II	outside	long bones; cranial bones; thorax; axial skeleton	no	grey	500–700	42	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
260	Õ/70	II	outside	long bones; cranial bones	no	grey	500–700	10	
261	Õ/70-71	II	outside	long bones; cranial bones; hand bones	no	grey	500–700	7	
262	Õ/74	II	outside	long bones; cranial bones; thorax; axial skeleton	no	black	up to 400	19	
266	R/67	II	3	cranial bones	no	grey	500–700	12	
268	RS/67	II, close to the skeleton	3	long bones; cranial bones	no	grey; white	500 -1100	13	
269	R/70	II	3	long bones; cranial bones; thorax	no	grey	500–700	7	
270	RS/67	II	3	long bones; pelvis	no	white; calcined	800–1200	12	
271	RS/67	II	3	long bones; cranial bones; thorax; pelvis	no	grey	500–700	25	
272	RS/69	II	3	long bones; cranial bones	yes	unburnt		30	includes immature and adult bones

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
273	RS/67	II	3	long bones; foot bones	no	unburnt		78	
273	RS/67	II	3 and northern wall on	long bones; cranial bones; axial skeleton; pelvis; foot bones	yes	black	up to 400	26	
274	WÕ/68-69	II	1	long bones; cranial bones; thorax; axial skeleton; pelvis; foot bones	no	black	up to 400	211	
275	VW/72-73	II	2 and south to *tarand* 2	teeth	no		less than 900	1	
279	OP/69-70	I	3	axial skeleton	no	grey	500–700	1	
280	P/68	I	3	long bones	yes	unburnt		2	
281	O/66	I	3	long bones; hand bones	no	black	up to 400	5	
285	RS/67-68	I	3	long bones	no	grey	500–700	4	
286	Q/70	I	3	cranial bones	no	unburnt		4	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
290	RQ/67	I	3	long bones; thorax	no	grey	500–700	3	
291	R/67	I	3	long bones; thorax	no	unburnt		2	
292	R/67	I	3	long bones; thorax; axial skeleton	no	grey	500–700	7	
293	R/67-68	I	3	long bones	no	black	up to 400	1	
294	Ö/70	I	outside	cranial bones	no	grey	500–700	1	
296	R/67	I	3	long bones; cranial bones	no	grey	500–700	10	
297	QR/72	I	2 and 3	long bones; cranial bones	no	grey; white	500–1100	1	
303	U/72-74		2 and south-east to *tarand* 2	long bones; cranial bones; axial skeleton	no	sooted; grey	300–700	24	
304	O/69		3	long bones; cranial bones; foot bones	yes	unburnt		21	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
304	O/69	I	3	cranial bones	no	black	up to 400	3	
308	Õ/69	I	1	long bones; cranial bones; thorax; axial skeleton; foot bones	no	grey	500–700	198	
309	Õ/69-70	I	outside	long bones; cranial bones	no	grey	500–700	2	
311	Õ/69	I	1	long bones; cranial bones; thorax	no	grey	500–700	18	
312	VU/70		1	long bones; cranial bones; thorax; axial skeleton; foot bones	no	black	up to 400	48	
313	U/68		1	long bones; cranial bones	no	grey	500–700	15	
314	UV/73		2	long bones; cranial bones; teeth	no	black	up to 400	5	
315	U/68	II	1	long bones; cranial bones; thorax	no	black	up to 400	17	
317	O/69	II	3	long bones; cranial bones	yes	unburnt		5	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
318	U/69-70	I	1	long bones; cranial bones	no	black	up to 400	7	
319	T/69	I	1	long bones; cranial bones; thorax	no	black	up to 400	5	
320	U/69	I	1	long bones	no	grey	500–700	1	
321	U/67-68	I	1	long bones; cranial bones	no	grey	500–700	69	
323	U/68	I	1	long bones; cranial bones; thorax; pelvis	no	grey	500–700	26	
327	U/69	I	1	long bones; hand bones	no	black	up to 400	13	
328	U/69	I	1	long bones; cranial bones; foot bones	no	black	up to 400	5	
329	U/68	I	1	long bones; thorax	no	black	up to 400	4	
330	PQ/68-69	II	3	long bones; cranial bones; thorax; axial skeleton	no	black; grey	300–700	168	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
331	W/69	I	1	cranial bones; foot bones	no	black; grey	300–700	7	
334	P/69-70	I	3	long bones	yes	black; white	400–1100	16	
334	P/69-70	I	3	cranial bones	no	unburnt		2	
335	T/71	I	2	long bones; teeth	no	black	up to 400	5	
336	unknown	I		long bones; cranial bones	no	grey	500–700	7	
338	UV/73	I	2	cranial bones; thorax	no	black	up to 400	6	
341	P/69-70	I	3	long bones; cranial bones	no	unburnt		6	
342	T/69-70	I	1	long bones; thorax	no	black	up to 400	2	
344	W/69	I	outside	cranial bones	no	grey	500–700	38	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
346	VU/71	I	2	long bones; thorax; axial skeleton	no	black	up to 400	14	
347	W/68	I	1	cranial bones; pelvis	no	grey	500–700	6	
348	T/71	I, close to the skeleton	2	long bones; cranial bones; thorax; pelvis; teeth	no	black	up to 400	19	
349	T/69	I	1	long bones	no	grey	500–700	4	
350	TU/74	I	2	long bones; cranial bones	no	black	up to 400	3	
357	unknown			long bones; cranial bones; thorax	no	black; grey	300–700	38	immature right petrous portion
360	unknown	II		cranial bones	no	brownish; white	300–1100	1	
369	V/66	II	west to *tarand 1*	long bones	no	black	up to 400	1	
370	S/67	I	3	long bones; cranial bones; thorax	no	unburnt		11	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
374	U/73-74	II	2	long bones; cranial bones	no	sooted	up to 400	7	
375	U/73-74	II	2	long bones; cranial bones	no	grey	500–700	4	
376	U/70	II	1	long bones; cranial bones	no	black; grey	300–300	2	
378	U/72-73	II	2	long bones; cranial bones	no	black	up to 400	4	
380	UV/73-74	II	2	long bones; axial skeleton; teeth; hand bones	no	black	up to 400	14	
381	V/71	II	2	long bones; cranial bones; thorax; axial skeleton; foot bones	no	grey	500–700	84	
382	V/70	II	2	long bones; cranial bones; thorax; axial skeleton; foot bones	no	black	up to 400	61	
383	V/72	II	2	long bones; cranial bones; thorax; axial skeleton; teeth	no	sooted; white	400–1100	8	
385	V/72	II	2	long bones	no	unburnt		1	

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
386	V/72	II	2 and south to tarand 2	long bones; cranial bones; thorax; teeth	no	black; grey	300–700	13	
123, 133	tarand walls	IV		long bones; cranial bones; thorax; axial skeleton	no	grey; white	700–1100	23	
217, 218	V/66	II	outside	long bones	no	grey	500–700	2	
238 B	U/69-70	II	1	long bones; cranial bones; thorax; axial skeleton; hand bones; foot bones; teeth	no	black; grey	300–700	68	immature left mandibular permanent M1
276, 278	VW/72-73	II	2 and south to *tarand* 2	long bones; cranial bones; thorax	no	black	up to 400	5	cut mark on clacicle?
30 (III)	Q/66		3	cranial bones	no	unburnt			fragment of mandible
62 (III)	PQ/71		3	cranial bones	no	unburnt			fragment of mandible
Cranial fragments 1	unknown			long bones; cranial bones; pelvis; teeth	no	grey; white	700–1100	238	adult right petrous portion; 3 adult left petrous portions;
Cranial fragments 2	unknown			cranial bones; axial skeleton	no	grey; white	700–1100	206	adult right petrous portion

Context	Square	Layer	*Tarand*	Bone elements present	Animals	Colour	Pyre temperature (°C)	Weight (g)	Characteristics
Cranial fragments 3	unknown			cranial fragments; teeth	no	grey; white	400–1100	492	adult left petrous portion; includes immature bones
Unknown 1	unknown			long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; foot bones; teeth	no	black; grey; white; calcined	300–1200	1847	includes immature and adult bones
Unknown 2	unknown			long bones; cranial bones; foot bones	no	black; grey	300–700	46	immature proximal epiphysis of humerus, unfused
Unknown 2	unknown			long bones; cranial bones; thorax; axial skeleton; hand bones; teeth	no	unburnt		30	mostly immature bones
Unknown 3	unknown			long bones; cranial bones; thorax; axial skeleton; pelvis; hand bones; foot bones	yes	grey; white	700–1100	236	
Unknown 4	unknown			long bones; cranial bones; thorax; axial skeleton; pelvis	no	black; grey	300–700	329	
Unknown 5	unknown			long bones; cranial bones; thorax; axial skeleton; hand bones; foot bones; teeth	no	black; grey; white; calcined	300–1200	960	

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Mina, Anu Kivirüüt

(sünnikuupäev: 15.12.1988)

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