



Burial sites or clearance cairns? Interpreting the stone cairns of Koigi

Karin Rannaäär and Mairi Kaseorg

Tartu Ülikool, ajaloo ja arheoloogia instituut, arheoloogia osakond (University of Tartu, Institute of History and Archaeology, Department of Archaeology), Jakobi 2, 51005 Tartu, Estonia; karin.rannaaar@ut.ee

Marko Kohv

Tartu Ülikool, ökoloogia ja maateaduste instituut, geoloogia osakond (University of Tartu, Institute of Ecology and Earth Sciences, Department of Geology), Ravila 14a, 50411 Tartu, Estonia

INTRODUCTION

Man-made stone cairns hold significant potential for archaeological investigation. The primary questions surrounding these cairns are when and why they were constructed, and whether they functioned as burial sites or agricultural stone heaps. In the case of burial sites, the research questions include the construction of stone graves – whether the stones were irregularly piled together or whether there are additional features such as stone circles or even stone cists. Unfortunately, these questions cannot be answered through external observation alone; excavation of the cairns is necessary.

The article summarizes the research conducted in 2021–2023 in Koigi, eastern Saaremaa (Fig. 1). There, a number of stone cairns spread over the territory of 18 000 m², which had previously not caught archaeological interest. In 2021, archaeology students Mairi Kaseorg, Karin Rannaäär, and Kristo Oks from the University of Tartu (TÜ) conducted a survey to inspect those stone cairns. A trench was dug in one of the cairns, revealing a few bone fragments and a pottery sherd. The cairns are densely clustered in a slightly elevated and drier area, about 1.5 km

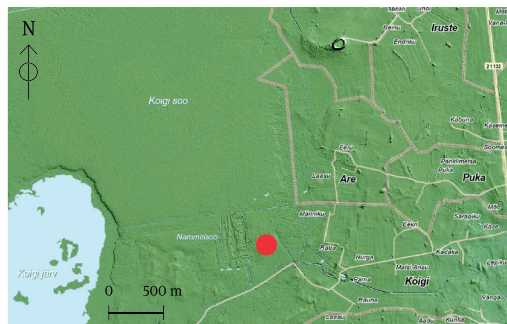


Fig. 1. The surveyed location is marked with a red dot.
Jn 1. Uuritud koht on märgitud punase täpiga.
Map / Kaart: Estonian Land Board / Maa-amet

east of Lake Koigi. Adjacent to this area is a peat bog forest, while the soil in the studied area is predominantly gravelly and stony.

In July 2022, further investigations were conducted in the same location (Kaseorg *et al.* 2022), aiming to distinguish burial cairns from other piles and to establish the boundaries of the burial area for radiocarbon dating.

The objective of the 2023 investigations (Rannaäär *et al.* 2023) was to excavate one stone cairn to determine whether it was a burial cairn or a fieldstone heap, to ascertain its period, and to identify any constructions within the cairn. The cairn selected for investigation was cairn no. 17, according to the 2022 numbering system (see below).

The majority of the stone cist graves from the Late Bronze Age and Early Pre-Roman Iron Age in Estonia have been found in Saaremaa (Lang 2007, 90). Tarand graves from the Pre-Roman Iron Age are generally found in the same areas as stone cist graves and often occur within the same grave groups (*ibid.*, 91). Clearance cairn fields are formed when individual fields are not separated by stone or earth fences. It is likely that some form of fences existed to protect the fields from animals, but no traces of these have been preserved. In the archaeological record, such fields appear as clusters of stone heaps, with the cairns typically having a diameter of 3–5 metres (Lang 2007, 96).

In the Pöide parish, an Early Bronze Age settlement has been identified at Kuninguste (Lang 2007, 21, fig. 3), located approximately 6.5 km northwest of the Koigi stone cairns, on the opposite side of the Koigi bog. Additionally, the Pöide settlement site, dated to the Late Bronze Age and Early Iron Age (Lang 2007, 50, fig. 15), is situated about 2 km northeast of the Koigi site under investigation. Among the most renowned Bronze Age fortified settlements in Saaremaa are those at Ridala and Asva. Ridala is located about 5 km southeast of the area under study, while Asva lies approximately 9.3 km to the south-southeast.

EXCAVATIONS IN 2022

During the 2022 survey, trial pits of approximately 50 × 50 cm were dug on each cairn located in the area's perimeter. In total, 17 cairns were investigated. On the 10th cairn, the trench was expanded to 1 × 1 m, as a greater abundance of ceramics, animal and human bones in this area were discovered.

Human remains were discovered in five cairns (nos 3, 4, 10, 11, 22, Fig. 2) with burnt human remains identified in two of these (nos 10, 22, Fig. 2). The most significant concentration of human bones was found in cairn no. 10, where human bones were present in every layer, while burnt human remains were absent from the last layer. In other cairns, human bones were predominantly found at the depths of 20 to 35 cm, measured from the top of the cairn.

Animal bones were discovered in six cairns (nos 2, 3, 10, 11, 17, and 22, Fig. 2), with three of these cairns also containing burnt animal bones (nos 10, 11, and 13). Animal bones were typically located at the depths of 20–25 cm, though some were found at both higher and lower levels. Both animal and human remains were co-located in three cairns (nos 3, 10, and 11, Tab. 1). In ten cairns, no bones were found (nos 1, 7, 12, 23, 24, 26, 31, 32, 33, and 35). Ceramics and bones together were present in four instances (nos 3, 4, 10, 22), while in three instances (nos. 1, 12, 31), only ceramics were found. The majority of ceramics were discovered in cairn no. 10, with a stratigraphic distribution ranging from 5 to 50 cm in depth. In the remaining cairns, ceramics were located at the depths between 10 and 30 cm. Ceramics can be categorized into two distinctive groups: one with coarse inclusions and the other notably finer (see below).

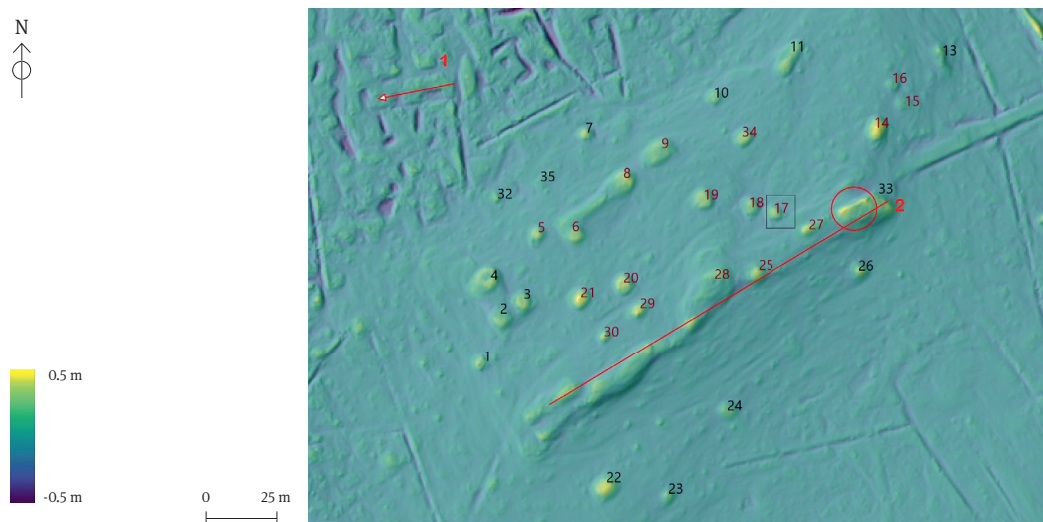


Fig. 2. Koigi cairns with their respective numbers on the lidar scan map.

Jn 2. Koigi vared numbritega lidari kaardil.

Relief map / Reljееfkaart: Marko Kohv, drawing / joonis: Mairi Kaseorg

Table 1. The presence of human and animal bones and ceramics in the cairns

Tabel 1. Inim- ja loomaluude ning keraamika esinemine varedes

Compiled by / Koostanud: Karin Rannaäär

Heap no. / Vare nr	Weight of human bones (g) / Inimluude kaal (g)	No. of human bones / Inimluude arv	No. of animal bones / Looma- luude arv	No. of pot sherds / Keraamikakildude arv	Comments / Kommentaariid
1	-	-	-	1	
2	-	-	1	-	
3	6	3	1	1	
4	1	5	-	2	
10	170	155	10	10	13 human bone fragments are burnt, 4 animal bone fragments are burnt
11	36	46	1	-	Animal bone fragment is burnt
12	-	-	-	4	
13	-	-	3	-	
16	-	-	3	-	Animal bone fragments are burnt
22	2	4	-	1	Human bone fragments are burnt
31	-	-	-	2	

EXCAVATIONS IN 2023

Based on the findings from 2022, it can be inferred that the area contains both burial mounds and field stone cairns. It was decided in 2023 to excavate one cairn in half to determine if there were any constructions or findings and if this was a clearance cairn or a stone grave. Cairn no. 17 in the middle of the area was chosen, because no. 17 is the same cairn that was first studied in 2021.

The structure is a round stone pile with relatively gentle edges, the height of the pile is about 70 cm at its highest point (in square E1). Hazel bushes grow on the edges and partially on top of the cairn, and due to a large pine tree in the southeastern part of the excavation, one corner was left unexcavated.

The diameter of the excavated ruin from east to west is about 6 metres, and the length of the excavated part from north to south is about 2.5 metres at its widest point, making the total length from north to south about 5 metres. The southern side of the cairn was excavated, with the profile running across the centre of the cairn (Fig. 3).

The cairn consists of stones with sizes ranging from approximately 10 to 30 cm, with some larger stones reaching up to 40 cm in length. No distinct constructions were identified. However, in the eighth layer, it was observed that several larger stones were concentrated on the western side of the excavation, suggesting that these may have been the initial stones that were piled together (Fig. 4).

The natural substrate beneath the stone cairn consisted of light, gravelly soil, and stones, making it occasionally difficult to distinguish between the stones of the cairn and those naturally occurring in the area.



Fig. 3. Profile of cairn no. 17.

Jn 3. 17. kivivare profil.

Photo / Foto: Karin Rannaäär



Fig. 4. The first layer of cairn no. 17.

Jn 4. 17. kivivare esimene kiht.

Photo / Foto: Karin Rannaäär

First, the cairn was documented and marked out, then we began to open it layer by layer. It was not possible to excavate in 10 cm thick layers. When distinguishing the layers, the principle was to remove, with each subsequent layer, those stones that were visible in the photos of the previous layer and did not extend into the next layer. The average thickness of the stone layers was 5–10 cm, and a total of 11 layers were distinguished. The heights of the layers were measured with a levelling instrument, with measurements taken at the centre of each square, and the most prominent stones and finds were recorded with square precision.

ANIMAL BONES, HUMAN BONES AND POTTERY

Skeletal remains discovered in 2022

There were about 200 grams of mixed and fragmented human bones altogether from all the cairns excavated in 2022, and 14 pieces with burn marks. Some bones were mildly burned, while others had been exposed to very intense heat and had become calcified. Also, there were two human teeth from cairn no. 10, from which one was burnt. Based on preliminary analyses, osteologist Maris Niinesalu-Moon (TÜ) has suggested that due to the absence of recurring bone elements in the cairns, it can be inferred that the bones belong to at least six individuals. Cairn no. 10 contains the remains of at least one individual aged 25–35 years (M. Niinesalu-Moon, pers. comm.).

In 2022, animal bones were found in six cairns. Zooarchaeologist Freydis Ehrlich (TÜ) determined that remarkably the stone debris contained only animal teeth – five belonged to horses, one to cattle, one to an ungulate, and three were mammal teeth, which cannot be determined more precisely. Two mammal teeth and one horse tooth were also burnt (F. Ehrlich, pers. comm.).

Skeletal remains discovered in 2023

During the excavation in 2023 of cairn no. 17, no human bones were found. The animal bones were very fragmented, mostly 1–2 centimetres long, but the biggest ones measured approximately 10 centimetres. Animal bones will be analyzed by zooarchaeologist Eve Rannamäe (TÜ).

Bones were found all over the excavated area. In the first layer, there were relatively few bones, yet the quantity of the bones increased in each layer. An interesting exception is the 7th layer, where significantly fewer bones were found compared to the 6th and 8th layers. Relatively few bones were found close to the natural ground (in layers 10 and 11).

The largest amount of bones was found in layers 6 and 8 (Table 2). The highest number of bones in each layer was found in the middle of the cairn (Fig. 5). Burned animal bones were found in the 4th layer and from the 6th to the 8th layers, with the highest concentration of burned bones in the 6th and 7th layers (Fig. 5).

Pottery found in 2022 and 2023

Ceramics were discovered from seven cairns in 2022, with the largest quantity unearthed in cairn no. 10, presumably due to a 1 × 1 m excavation conducted at that particular site.

During excavations in 2023 in cairn no. 17 ceramics were discovered spanning from the third to the ninth layers, with the highest concentration observed in the fifth and sixth layers. Notably, the sixth layer exhibited the most widespread distribution of ceramics (C1–2, D2, and E1), while the third, fourth, and ninth layers each contained ceramics in only one square. Square C2, D2, and E2, situated within the central part of the cairn (Fig. 5), displayed

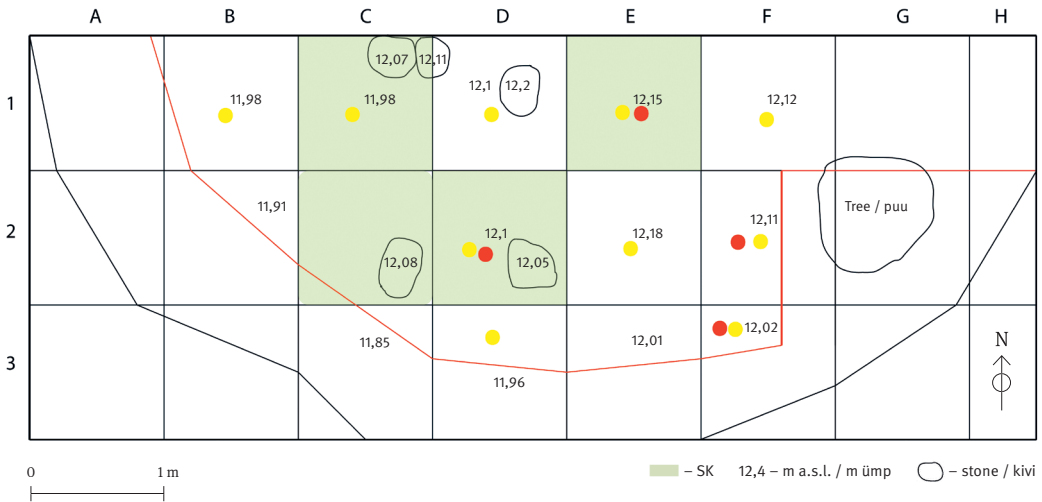


Fig. 5. Plan of cairn no. 17, the black line marks the edge of the excavation, the red line indicates the edge of the ruin. Unburned animal bones are marked with yellow dots, burned animal bones are marked with red dots (with square accuracy), and green squares represent the presence of ceramics.

Jn 5. 17. vare plaan, must joon markerib kaevandi serva ja punane joon kivivare serva. Põlemata loomaluud on märgitud kollaste täppidega, põlenud loomaluud punaste täppidega (ruudu täpsusega), rohelised ruudud tähistavad keraamika leiuala.

Drawing / Joonis: Karin Rannaäär

Table 2. The distribution of bones and ceramics in cairn no. 17 excavated in 2023

Tabel 2. Luude ja keraamika levik 2023. aastal kaevatud vares nr 17

Compiled by / Koostanud: Karin Rannaäär

Layer no. / korrisse nr	No. of bone fragments / luufragmentide arv	Weight of bones (g) / luude kaal (g)	Ceramic fragments / keraamikakatkete arv
1	35	54	1
2	29	110.4	-
3	46	118.5	2
4	45	126.8	5
5	63	168.7	6
6	74	243.7	9
7	60	76.4	3
8	72	226.3	4
9	38	117.9	1
10	12	5	-
11	2	0.6	-

the highest prevalence of ceramics. The hand-made pottery from Koigi is quite robust with a partially striated texture, characteristic of the East Baltic pottery from the Bronze Age and Early Iron Age (Lang 2007, 127). Notably, one small sherd (SM 10925: 10/2) exhibits a distinct round impression, which was most common during the Late Bronze Age and the Early Pre-Roman Iron Age (Lang 2007, 127).

Generally, the sherds from both excavation years are small and exhibit compositional variation, with the clay containing both coarse and finer temper, although there were significantly fewer pieces of the finer sherds than the coarser sherds found during the excavations.

Finer pieces demonstrate a slightly lighter and warmer colour, while coarser fragments range from dark brown to dark grey (Fig. 6). Initial observations suggest that the coarser sherds contain relatively large quartz and whitish lime- or granite stone fragments.

The coarser pottery exhibits a composition akin to analogues found in Asva (between 900–500 BC). However, the Koigi finer sherds do not align with the composition of the fine ceramics discovered during the Asva Bronze Age excavations (Sperling 2014, 194). It should not be ruled out that those finer pieces could also be daub fragments or burned clay from walls, but it is presently uncertain.

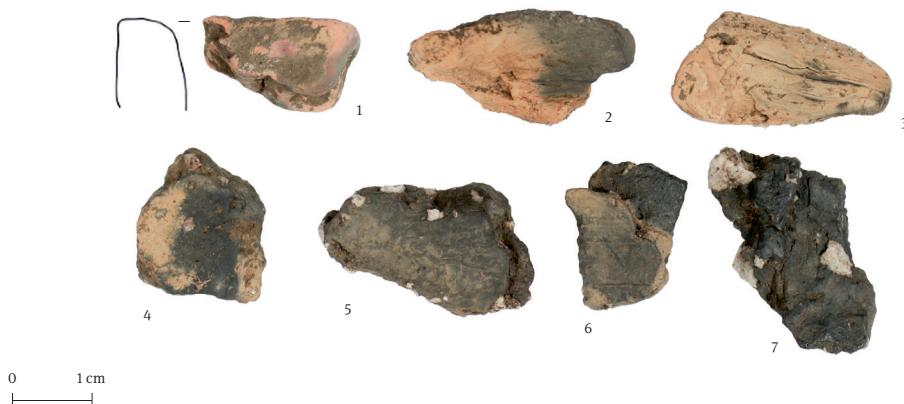


Fig. 6. Pottery from Koigi. 1–3 – examples of the fine ware, 4–7 – examples of the coarse ware. 2 – with slight striation. **Jn 6.** Keraamika Koigist. 1–3 – näited peenemast keraamikast, 4–7 – näited jämedamast keraamikast. 2 – nõrgalt riibitud. (SM 10925: 15 (3×), 12, 23 (2×), 16.)

Photo / Foto: Karin Rannaäär, drawing / joonis: Mairi Kaseorg

RADIOCARBON DATES

In 2023, an animal bone from square F1, layer 10 (cairn no. 17) was sent for ^{14}C analysis to the Poznań Radiocarbon Laboratory. The resulting calibrated date (with 95.4% probability) was 1050–900 calBC¹, hence it dates from the Middle or the Late Bronze Age (based on Lang 2007, 15). Given the fact that the bone fragment was too small to be identified, a portion of it has been sent to the laboratory in York for ZooMS (Zooarchaeology by Mass Spectrometry) analysis. Additionally, a human tooth (mandibular right first molar) obtained from cairn no. 10 of the 2022 excavation was also sent to the laboratory, yielding the calibrated date (with 95.4% probability) 350–540 calAD², and it thus originates from the Late Roman Iron Age (based on Lang 2007, 15).

To ensure the accuracy of the dating and eliminate the potential influence of the reservoir effect, an isotope analysis was conducted. The delta values of the animal bone were $\delta^{13}\text{C}=-21.5\text{‰}$, $\delta^{15}\text{N}=5\text{‰}$ and of the human tooth $\delta^{13}\text{C}=-20.8\text{‰}$, $\delta^{15}\text{N}=11.1\text{‰}$. The results indicate the absence of a reservoir effect, confirming that both samples have a terrestrial dietary base, which consequently does not impact the dating process.

¹ Poz-21641/24; 2825±35 BP. The results are calibrated with OxCal programme ver. 4.4 (Bronk Ramsey 2009) using IntCal20 calibration curve (Reimer *et al.* 2020).

² Poz-21912/24; 1655±30 BP.

DRONE LIDAR SCANNING

The lidar scanning was conducted with a DJI M300 RK Drone Equipped with a YellowScan Surveyor Ultra Lidar Scanner. The flight was conducted at an altitude of 50 metres, using two intersecting flight plans with a line spacing of 60 metres. The point cloud obtained from the laser scanner was georeferenced using GNSS corrections from the Estonian Land Board's servers. Based on previous similar work, the accuracy of this georeferencing is approximately 5 cm.

After georeferencing, the point clouds were classified to separate ground reflections from those of vegetation. The average density of points classified as ground using drone lidar is about 400–600 points/m². In comparison, the density of points classified as ground in the most recent lidar dataset from the Estonian Land Board for this area is 1–2 points/m². The two orders of magnitude higher data density of drone lidar allows for the detection of small landforms through dense vegetation, which is particularly important for archaeological research.

In further processing, a digital terrain model (DTM) with a pixel size of 0.5 metres was created from the median height of the ground points using CloudCompare software. The terrain model was smoothed with a Lee filter to reduce noise (mainly tree 'remnants'), and then a relief shading with double exaggeration was performed. To better visualize smaller landforms, a high-pass filter was applied to the terrain model, which highlights the ground elevations relative to a broader area (in this case, a 10-metre pixel) (see Fig. 2).

Cairns marked with black numbers were excavated in 2022. Cairn no. 17, excavated in 2023, is marked with a square on the map. No further research has been conducted on the remaining cairns. To the north of the elevated area, peat pits, labelled as number 1 on the map, have been identified. The central elevated ridge, marked as number 2, appears to be of natural origin and is likely a segment of a beach ridge.

The hypothesis that the ridge is of natural rather than archaeological origin is supported by the results of trial pit excavations. In cairn no. 33, no artefacts or structures were discovered. Similarly, in the majority of the cairns situated to the northeast of the ridge (specifically cairns nos 23 and 26), no archaeological finds were recovered. Notably, cairn no. 22 yielded a single burnt bone fragment, which was identified as human. Furthermore, analysis of the elevation map suggests that these cairns may have been submerged at certain points in time, in contrast to the cairns situated on the elevated area, which would have remained above water. This topographical evidence aligns with the hypothesis that the ridge is a natural feature.

An additional insight provided by the map concerns the elevated area situated between cairns nos 6 and 8. During the archaeological survey, this area appeared to potentially contain tarand-graves. It was suspected that it might be a tarand-grave because the mound was more oblong and even slightly square-shaped, in contrast to the other mounds, which were round. We plan to make a trench in the future to investigate whether any underlying constructions might confirm the presence of a tarand-grave. However, it remains unclear whether this elevation is of natural origin. The map suggests that this elevated region may not be part of a continuous beach ridge, but instead may represent an independent feature. Also, it should be noted that no finds were discovered in the cairns located below this area (cairns nos 35, 32, and 7). This lack of finds further complicates the interpretation of the elevated area's origin and significance and warrants further excavations.

CONCLUSIONS

Based on the research conducted in the Koigi bog forest, it can be assumed that among the cairns in the area there are burial mounds and clearance cairn fields expanding from the Bronze Age to the Pre-Roman Iron Age. Further datings and archaeological investigations are required to confirm that. Human settlement in this area has thus existed for a very long time, likely connected to the ancient Koigi Lake, which has since transformed into a bog.

ACKNOWLEDGEMENTS

The authors thank Freydis Ehrlich, Eve Rannamäe, and Maris Niinesalu-Moon for their bone analysis, and Heiki Valk and Valter Lang for their excavation and interpretative assistance.

REFERENCES

- Bronk Ramsey, C. 2009.** Bayesian analysis of radiocarbon dates. – *Radiocarbon*, 51: 1, 337–360.
- Kaseorg, M., Rannaäär, K. & Valk, H. 2022.** Aruanne arheoloogilisest uuringust Koigi külas Saaremaa vallas Saare maakonnas. Tartu. (*Manuscript in the archaeological archives of TÜ.*)
- Lang, V. 2007.** The Bronze and Early Iron Ages in Estonia. *Estonian Archaeology*, 3. Tartu. DOI: 10.26530/OAPEN_423939
- Rannaäär, K., Kaseorg, M. & Valk, H. 2023.** Aruanne arheoloogilisest uuringust Koigi külas Saaremaa vallas Saare maakonnas. Tartu. (*Manuscript in the archaeological archives of TÜ.*)
- Reimer, P. J., Austin, W. E., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I.,**
- Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R., Palmer, J. G., Pearson, C., van der Plicht, J., Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Turney, C. S. M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S. M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A. & Talamo, S. 2020.** The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). – *Radiocarbon*, 62: 4, 725–757.
- Sperling, U. 2014.** Aspekte des Wandels in der Bronzezeit im Ostbaltikum: die Siedlungen der Asva-Gruppe in Estland. – *EJA*, 18, Supplementary Series, 2. DOI:10.3176/arch.2014.2S.01

MATMISKOHAD VÕI PÖLLUKIVIHUNNIKUD? KOIGI KIVIHUNNIKUTE TÖLGENDUSI

Karin Rannaäär, Mairi Kaseorg ja Marko Kohv

Arheoloogilised uuringud Koigi metsas Ida-Saaremaal algasid 2021. aastal, kui Tartu Ülikooli tudengid Mairi Kaseorg, Karin Rannaäär ja Kristo Oks käisid inspekteerimas u 18 000 m² suurusele alale jäävaid kivivareid Koigi raba servas (jn 1). Ühele varele kaevati šurf ja sealt leiti mõned luukillud ja keraamikakild.

2022. aasta jätku-uuringuil tehti ala servas olevate kivikuhelike lagedele šurfe, hindamaks, kas tegu on kalmete või põllukivihunnikutega. Kokku kaevati 17 šurfi suurusega 50 × 50 cm, neist leiti nii põletatud kui ka põletamata inim- ja loomaluid ning keraamikat. Vare number 10 (jn 2) laele tehti 1 × 1 m kaevand, kuna sealt avastati teiste kivihunnikutega võrreldes tunduvalt rohkem luid ja keraamikat.

Kokku leiti viiest varest umbes 200 g segatud ja lõhutud inimluid, 14 killul on märke põletamisest. Põlemisastmed varieerusid nõrgast kuni tugeva põle-

mise ja kaltsineerumiseni. Inimluude hulga põhjal oletas osteoloog Maris Niinesalu-Moon, et kokku leiti vähemalt 6 inimese luid, kusjuures 10. varesse on maetud vähemalt üks inimene vanuses 25–35 aastat. Loomaluid leiti samuti viiest varest. Tähelepanu väärrib, et leiti vaid loomahambaid, kuna loomade luid ei tulnud. Freydis Ehrlichi määrangul oli kogutute hulgas viis hobuse, üks veise, üks sõralise ja kolm imetaja hammast.

2022. aasta uuringute tulemusel saab öelda, et alal on koos nii põllukivihunnikud kui ka kalmed. 2023. aastal otsustati 17. vare pooles ulatuses lahti kaevata, et näha, kas kivikuhelikus esineb leide või konstruktsioone. Uuritud vare on kergelt piklik, u 6 × 5 m läbimõelduga ja võrdlemisi laugete nõlvadega, vare kõrgus kõige kõrgemas punktis (ruudus E1) on ligikaudu 70 cm. Kaevand rajati kivihunniku lõunaosale

nii, et kaevandi põhjaküljel kulges üle vare keskosa. Kivikuhjatis koosneb u 10–30 cm läbimõõduga kividest, mõned suuremad on isegi 40 cm läbimõõduga. Kokku eristati 11 kivikihti. Ühtegi kindlat kivikonstruktsiooni ei leitud, kuid kaevandi lääneosas pandi tähele suurte kivide koondumist – võib oletada, et need on esimesed kivid, mis kokku kuhjati.

2023. aasta uuringutel inimluid ei leitud. Leitud loomaluud olid väga fragmentaarsed, 1–2 cm pikkused, suurimad olid u 10 cm pikkused. Luid leiti peaaegu kogu vare ulatuses, kuid peamiselt koondusid need vare keskossa.

Suurem osa Koigi käsitsikeraamikast (jn 6) on robustne ja riibitud tekstuuriga, mis on tüüpiline varasele metalliajale. Kildude koostis varieerub veidi: vormimismass sisaldab nii jämedakoelist kui ka peenemat purdu. Jämedam keraamika sarnaneb varasematele Asva leidudele, erinedes peenemast, mis ei vasta Asva pronksiaja keraamika koostisele. Lisaks on Koigi jäme keraamika riiped tüüpilisest pronksiaja keraamikast märkimisväärselt nõrgemad.

Ühest 2023. aastal leitud loomaluust ja 2022. aastal leitud inimhambast tehtud radiosüsiniku dateeringutest selgus, et loomaluu dateering on 2825 ± 35 BP, kalibreeritult (95,4% tõenäosusega) 1050–900 eKr. 10. varest leitud inimhamba dateering oli 1655 ± 30 BP, kalibreeritud vanus (95,4% tõenäosusega) 350–540 eKr.

Uuringuala lidarskannerimine viidi läbi DJI m300 RK drooniga, millele oli kinnitatud Yellowscan Surveyor Ultra lidarskanner. Skaneerimine toimus 50 meetri kõrguselt, kasutades kahte ristuvat lennuplaani 60-meetrise lennujoonte vahekaugusega. Saadud punktipilv georefereeriti Maa-ameti serveritest saadud GNSS parandite abil, mille tulemusel saavutati ligikaudu 5 cm täpsus. Punktide klassifitseerimise käigus eraldati maapinnalt tulnud tagasipeegeldused taimestikust tulnud peegeldustest.

Droonilidari suurem andmetihedus võimaldab näha ka läbi tiheda taimestiku väikeseid pinnavorme, mis on olulised arheoloogiliste uuringute jaoks. Tulemuste analüüsimisel täheldati, et mõned struktuurid, mis esialgu tundusid olevat kalmed, võivad tegelikult olla osa looduslikust rannavallist. See viitab sellele, et teatud ajaperioodidel võisid mõned struktuurid, mis paiknevad madalamal kui enamik varesid, olla üle ujutatud, samas kui teised struktuurid jäid veepinnale.

Koigi rabametsas toimunud arheoloogiliste väljakaevamiste tulemusel selgus, et alal leidub nii põllukivihunnikuid kui ka kalmeid. Esimesed dateeringud lubavad varede rajamisega piiritleda pronksiajast eelrooma rauaajani, kuid inimasustus piirkonnas on olnud pikaajaline ja selle ajalisi raame aitavad loodetavasti täpsustada edasised uuringud.