Estonian Journal of Archaeology, 2021, **25**, 2, 160–181
https://doi.org/10.3176/arch.2021.2.04

Freydis Ehrlich, Eve Rannamäe, Margot Laneman, Mari Tõrv, Valter Lang, Ester Oras and Lembi Lõugas

IN SEARCH OF ESTONIA'S EARLIEST CHICKEN

Received 18 March 2021, accepted 2 June 2021, available online 30 September 2021

It has been hypothesised that the chicken (*Gallus gallus domesticus*) was introduced to the area of what is now modern-day Estonia around the Pre-Roman or Roman Iron Age. However, none of the earliest chicken bones found in the area had been radiocarbon dated and due to a complex contextual background, the question of its first appearance has been left open. With the aim of finding the earliest evidence for the chicken in Estonia, we looked into the zooarchaeological material from twelve archaeological sites, including burial grounds, settlement sites, and hillforts. The earliest evidence had been reported at four of these sites, but during the taxonomic reassessment, no chicken bones were identified. From the remaining eight sites, nine chicken bones were radiocarbon dated by AMS. The sample from a stone-cist grave at Rebala (northern Estonia) was dated to 200 calBCE – 5 calCE, which means that this individual is the earliest confirmed chicken in Estonia. The other dates range from the Pre-Viking Age to the Modern Period, with some of them illustrating the complicated nature of faunal remains in archaeological contexts. Although this study elucidates the first appearance of the chicken in Estonia and in the Baltic region in general, its origin, ways of exploitation, and the extent of its spreading remain to be studied.

Freydis Ehrlich, Department of Archaeology, Institute of History and Archaeology, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; freydis.ehrlich@ut.ee
Eve Rannamäe, Department of Archaeology, Institute of History and Archaeology, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; eve.rannamae@ut.ee
Margot Laneman, Department of Archaeology, Institute of History and Archaeology, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; margot.laneman@ut.ee
Mari Tõrv, Department of Archaeology, Institute of History and Archaeology, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; mari.torv@ut.ee
Valter Lang, Department of Archaeology, Institute of History and Archaeology, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; valter.lang@ut.ee
Ester Oras, Department of Archaeology, Institute of History and Archaeology; Chair of Analytical Chemistry, Institute of Chemistry, University of Tartu, 18 Ülikooli St., 50090 Tartu, Estonia; ester.oras@ut.ee
Lembi Lõugas, Archaeological Research Collection, Tallinn University, 10 Rüütli St., 10130 Tallinn, Estonia; lembilgs@tlu.ee

Introduction

The chicken (*Gallus gallus domesticus*) is one of the most numerous and widespread domestic animals in the world (FAO, Faostat), yet its origin and subsequent dispersal is still an ongoing debate. Additional and/or improved identification, contextualizing, and dating is needed in this regard. The spread of the chicken into the northern part of Europe is an equally unresolved problem, therefore any new evidence is deemed highly valuable. To contribute to the discussion on the earliest evidence for it in Europe, we provide a brief background about its domestication and spread and its early presence in the Baltics and Scandinavia, which we then complement with new data from Estonia.

Origin of the domestic chicken

Although scholars have shown interest in the origin and dispersal of the domestic chicken for centuries (Storey et al. 2012, 2), little is known about this matter (Pitt et al. 2016, 1). The domestic chicken originates from southern and south-eastern Asia, where the red junglefowl (*Gallus gallus*) subspecies *Gallus gallus spadiceus* was domesticated and interbred with highly divergent local jungle fowl species, mainly with the grey junglefowl (*Gallus sonneratii*; Girdland Flink et al. 2014; Wang et al. 2020). But there is no clear chronology for the early domestication of chicken, largely due to potential misidentification of the skeletal remains, lack of secure context, or poor dating evidence (Pitt et al. 2016, 2). However, based on archaeological finds and mitochondrial DNA, the domestication is known to have occurred in multiple independent centres in China and southern and south-eastern Asia (Storey et al. 2012, 2; Miao et al. 2013). It has been suggested that the earliest domestication event happened in Nanzhuangtou, China, around 8050 BCE (Xiang et al. 2014; 2015). However, this date has been contested, because after morphological comparison, the bones identified as chicken turned out to be pheasants (Phasianidae) instead or could not be linked to an exact species (Peters et al. 2015; 2016; Eda et al. 2016; 2019). The oldest evidence from a secure archaeological context in the Indus Valley, India, suggests that chicken must have been domesticated by 4000 BCE at the latest (Larson & Fuller 2014, 123).

Spread to Europe

The exact timing and route of spreading to Europe is still uncertain. Considering one of the more recent discussions by Pitt et al. (2016), there seems to be two main candidates for the migration routes: a northern route via Russia and a southern route via the Phoenician trade network. Chicken remains found from a Hallstatt period fortified settlement site in Biskupin, Poland (ca 650 BCE), may favour the northern route (ibid., 6). However, there is more evidence for the southern route, which would also have offered a potentially suitable ecology for the survival of the early version

of the domesticated chicken (ibid., 1). The southern route corresponds with some of the earliest proposed evidence for chicken outside Asia, including finds from Bulgaria ca 5550 BCE, the southern Levant ca 2500 BCE, and Iberia ca 2000 BCE (ibid., 2). However, this very early evidence is thought to be unusual and in need of verification (e.g. Kysely 2010; Peters et al. 2015). More reliable evidence for the southern spreading route comes from the Mediterranean region, but from a much later date: such as the depiction of cocks on the 7th century BCE Greek coins and vases and also the number of different breeds known to Roman writers by the 1st century BCE (Serjeantson 2009, 270; Kysely 2010, 11).

In the northern part of Europe, the earliest evidence for chickens comes from Skedemosse fen in Öland, Sweden, and dates to the 1st century BCE (Lepiksaar 1977; Ericson & Tyrberg 2004, 15, 43). In Denmark, the earliest bones are known to be from the Roman Iron Age (ca 1–375 CE; Gotfredsen 2013, table 4). In both Sweden and Denmark, the chicken only seems to have become abundant between 550–1060 CE (Tyrberg 2002, 219; Gotfredsen 2014, table 2; Walker et al. 2019, 25). The current radiocarbon dated evidence in Finland places its introduction to the 8th century CE (Wessman et al. 2018, 446). The earliest bones in Norway are dated to the 9th century CE, but whether they represent a locally established population or evidence of imported goods presumably from Denmark or Sweden is unknown (Barrett et al. 2007, 283, 308). The current evidence when compared to Sweden and Denmark tentatively suggests a somewhat delayed introduction to Norway and Finland, where the chicken only became abundant by the Middle Ages around 1300 CE (Walker et al. 2019, 25; Walker & Meijer 2020, 125). In Finland and Sweden, the evidence is scarce for their introduction; their bones are especially difficult to find because of the acidic soil of the Fennoscandian shield, where unburnt bone is rarely preserved (Ericson & Tyrberg 2004, 12; Tourunen 2011, 57).

Research into the earliest appearance in the Baltic countries and north-western Russia has been scarce. It has been suggested that settlers of Staraya Ladoga practised the breeding of domestic chickens in the 9th–10th centuries CE (Shaymuratova et al. 2019, 110), and it probably became common in north-western Russia between the 10th and mid-12th centuries CE (Maltby 2012, 271). In Lithuania, the oldest evidence for the chicken comprises three bones from the Vilnius Lower Castle, dated by context to the 5th–9th centuries CE (Rumbutis et al. 2018, 106). In Latvia, to the best of our knowledge, the question has not been addressed.

Zooarchaeological evidence in Estonia

Different aspects regarding the chicken and its history in Estonia and also the rest of the Baltic region were already being discussed in the 1980s (Lõugas 1981). But only a few more detailed discussions have been published in recent years and many of these publications have focused on the period from the Late Iron Age to the Early Modern Period (e.g. Jonuks et al. 2018; Maltby et al. 2019; Rannamäe &

Lõugas 2019; Ehrlich et al. 2020). However, detailed discussion or precise dates for any earlier finds are missing as the chicken has only briefly been mentioned (see following).

Domestic animal husbandry had been established in the area of present-day Estonia by the Late Bronze Age (850–500 BCE). This is evidenced by abundant zooarchaeological data for domestic livestock from fortified settlement sites such as Asva and Ridala (Paaver 1965; Lõugas 1994; Lõugas et al. 2007; Maldre 2008). At Ridala, the faunal assemblages did not include chicken (Tomek et al. 2010). At Asva, on the other hand, chicken bones were present, but their association with the Late Bronze Age or Middle Iron Age is not clear due to uncertain contexts (ibid.). In the Pre-Roman (500 BCE – 50 CE) and Roman Iron Age (50–450 CE), the zooarchaeological data comes mainly from graves (Lang 2007, 110) and the find quantities therefore are not directly comparable to the Late Bronze Age fortified settlements. However, the occurrence of chicken bones in the graves has been considered noteworthy and together with the finds from contemporaneous fossil fields have led to suggestions that the chicken might have arrived in the area of modern-day Estonia during the Late Pre-Roman or Roman Iron Age (Lang 2000, 215; 2007, 111; Maldre 2000).

Zooarchaeological material from the settlements, burial sites, and forts of the following Migration (450–550 CE), Pre-Viking (550–800 CE), and Viking (800–1050 CE) periods have been investigated to a limited extent (Tvauri 2012, 105 f.). The material has only been studied in more detail at a few burial sites and forts, but any general conclusions have been very difficult to specify (ibid., 106, 108). Nevertheless, regarding chicken husbandry, it has been suggested that they were bred throughout the Migration and Viking periods (ibid., 107 f.). Chicken husbandry had become well established by the later part of the Viking Age (e.g. Rammo & Veldi 2005, 102; Valk & Rannamäe 2015, 128; Ehrlich et al. 2020), as reflected in the abundance of chicken remains among the faunal assemblages (ca 2–8% of the total number of identified faunal specimens at a site). This has (together with more secure find contexts) allowed greater study into the use, meaning, and breeding of the chicken from the Late Iron Age to Early Modern Period in more detail (Ehrlich et al. 2020).

Aims of the study

Currently, the general opinion is that the domestic chicken was introduced to Estonia sometime during the Pre-Roman or Roman Iron Age (Lang 2000, 215; 2007, 111; Maldre 2000). However, the temporal identification of chicken bones from the archaeological sites is problematic. Most of the finds are contextually dated and no direct dates for the bones are available. Dating by context is problematic because the sites have been used for a long time and different stratigraphic units might have been mixed up. While artefacts can often be dated by their typology, technology, or other features, this kind of certainty for faunal remains is impossible. These issues are especially true for the animal bones from the stone graves, which were normally

in use for a long time and where the burials are often commingled. For example, it has been shown that zooarchaeological material can be centuries or even millennia younger than the graves and burials they were found in (e.g. Laneman et al. 2015; Rannamäe et al. 2016; Laneman 2021a).

The main aim of this study was to find the earliest evidence for the chicken in Estonia, by (re-)identifying the archaeological bones and then radiocarbon dating them by AMS. We then discuss the contextual and chronological issues of the finds and place our results into the wider framework of chicken domestication and spread to Europe. Our results contribute to the zooarchaeological research of the earliest chicken in the Baltics and northern Europe and the overall understanding of ancient dietary substances available in this region.

Material and methods

Selection of archaeological sites and samples

We selected twelve potential sites to search for the earliest chicken finds in Estonia, based on the following criteria (Fig. 1): firstly, the sites that had been previously reported to include the earliest chicken (Loona, Tõugu II, Poanse I and

Fig. 1. Locations of archaeological sites mentioned in this study. Red circle – sites with confirmed chicken finds, blue triangle – sites where after reassessment, no chicken bones were identified. 1 – Kurevere, 2 – Loona, 3 – Asva, 4 – Poanse, 5 – Ilmandu, 6 – Iru, 7 – Saha-Loo, 8 – Jõelähtme, 9 – Rebala, 10 – Tõugu, 11 – Uusküla, 12 – Joaorg at Narva. Map by Freydis Ehrlich, made in QGIS.

II, Ilmandu III, Uusküla II, Saha-Loo); and secondly, the sites with inhabitation phases that would fit into the previous hypothesis of the earliest appearance of the chicken (Joaorg at Narva, Iru, Asva, Jõelähtme, Rebala, Kurevere). For Loona, Ilmandu III, Joaorg at Narva, Asva, Jõelähtme, and Kurevere, the zooarchaeological material had been identified before and only the chicken specimens were re-examined for this study. For Iru and Rebala, the faunal remains had been partially analysed in the past; the chicken specimens had been found in the unidentified part of the assemblages during previous unrelated work on the collections. They were thereafter examined in this study. For Tõugu II, Uusküla II, and Poanse I and II stone graves and Saha-Loo fossil fields, the zooarchaeological material had been previously identified and the presence of chicken had been reported[1] (in Lang 1996a, Appendix; Maldre 1998a; 1998b; 1999; 2000), but during this study, all of the faunal material from these four sites was cursorily reviewed and no chicken bones were detected. Therefore, this material is not discussed further in this article.

Nine chicken bones from eight archaeological sites were sampled for radiocarbon dating[2] and are briefly introduced as follows.

The burial site at **Kurevere** consisted of 30–40 stone graves (Lõugas & Selirand 1989, 218). Five cairns were excavated in the 1870s, three in 1965, and one in the 1970s (Lõugas 1977, 48; Mägi 2002, 45). The excavation results and stray finds indicate that the burial ground was used from the Late Bronze Age to Pre-Roman Iron Age and from the 7th/8th to 12th/early 13th centuries CE (Mägi 2002, 45; Lang 2007, 171). Five chicken bones, including the one that was selected for radiocarbon dating, were added to the find collection in 1880, and are thus most probably from the excavations in 1877. The artefacts that have survived from these excavations have been dated to the 10th–11th centuries CE (Mägi 2002, 45). There is no formal identification report – the animal bones, including the selected chicken specimen, were accompanied by identification notes by an unknown analyst. The bones from the 20th century excavations have not been analysed.

The Neolithic and Early Bronze Age settlement site at **Loona** was excavated in the 1950s (Jaanits et al. 1982, 60, 84, 130). The stratigraphy of the settlement had been partly disturbed by a Bronze and Early Iron Age stone-cist grave and the 13th–14th century CE cemetery (Jaanits 1965, 30). Because of the disturbances, the precise context of the zooarchaeological material is impossible to ascertain (e.g. a sheep specimen has been radiocarbon dated to the Modern Period, Rannamäe et al. 2016) and the different inhabitation phases have not been discussed in detail in the osteological reports (see Paaver 1965; Lõugas et al. 1996; Mannermaa &

[1] The bones from Tõugu II (collection ID AI 6003), Uusküla II (AI 6342), and Saha-Loo (AI 5975) are stored in the Archaeological Research Collection at Tallinn University; the bones from Poanse I (AM A 483) and Poanse II (AM A 490) are stored in the Estonian History Museum.

[2] Sampling permissions given by the holding institutions as stated in the sampling protocols AI PP Nos 436, 438, 488, and 489 (Archaeological Research Collection at Tallinn University) and TÜ PP No. 100 (Department of Archaeology at the University of Tartu). Chicken specimens from Asva were dated already during the zooarchaeological analysis in the course of the project SF0130012s08 (PI: L. Lõugas); for specimen recordings see Tomek & Lõugas 2009.

Lõugas 2005). It has been suggested that the four chicken bones in the assemblage derive from the Bronze Age because of their different colour and better preservation compared to the other bird bones (Mannermaa 2008, 38). One of these was selected for radiocarbon dating in this study.

At **Joaorg at Narva**, a settlement site and an adjacent hilltop site were inhabited from the Mesolithic to Modern Period (Jaanits 1965, 37; Kriiska 1996, 361, Appendix; Lang 2007, 66; Tõnisson 2008, 236). The settlement site was excavated in the 1950s and 1960s (Kriiska 1996, 361). The faunal material has been previously identified and includes nineteen chicken bones; the selected specimen comes from the upper disturbed layer excavated in 1957 (Paaver 1965; Kriiska 1996, Appendix; Mannermaa pers. comm.).

The hilltop site at **Asva** has been extensively excavated since the 1930s (see e.g. Sperling 2014, 32; Sperling et al. 2019; 2020). At least three occupation layers date from the Late Bronze Age (900/800–600 BCE), and after a longer hiatus, the site was inhabited again in the Pre-Viking Age between 600 and 800 CE (Lang 2007, 60; Sperling et al. 2019, 47; 2020, 52). The osteological reports include at least twelve chicken bones (Paaver 1965; Lõugas 1994; Tomek & Lõugas 2009; Tomek et al. 2010), but their association with the Late Bronze Age or the Middle Iron Age is not certain by the context. The two radiocarbon-dated chicken bones come from the excavations of 1966 in the south-eastern part of the hill, from a disturbed layer (Lõugas 1966, 1, 8 ff.; Tomek & Lõugas 2009; Sperling et al. 2019, 48). The samples were dated already during the zooarchaeological analysis (Tomek & Lõugas 2009), but are presented here as part of a wider research project.

The hilltop site at **Iru** was excavated in the 1930s, 1950s, and 1980s (Lang 1996b, 35 f.). The earliest stage of inhabitation was a Late Neolithic Corded Ware settlement site, followed by Late Bronze Age and Pre-Roman Iron Age settlements and a fort that was used from the Migration Period to Viking Age (ibid., 37, 51). Only the faunal remains from the 1950s have been analysed, with no detailed taxonomic identification for bird bones (Paaver 1966). The radiocarbon dated chicken bone is from the 1986 excavations at the area of the central rampart under the 10th-century stone walls that included ceramics from both the Late Bronze Age and Viking Age (Lang 1988, 1, 6).

The thirty-six stone-cist graves at **Jõelähtme** have served as an exemplary Bronze Age cemetery since the rescue excavation in the 1980s (Kraut 1985). The site was used for inhumation burial around the 10th century BCE (Laneman 2021a). Some artefact finds, unrelated to the burials, date from various Iron Age periods, as do the bones of a dog, a cat, and a sheep that were radiocarbon dated from grave 19 (Rannamäe et al. 2016; Laneman 2021a). The radiocarbon dating of a sheep bone from grave 15 yielded a result from the Modern Period (Rannamäe et al. 2016). The chicken bone subjected to AMS dating was the only representative of the species in the site's faunal assemblage. It was uncovered in grave 34 along with at least two inhumation burials with radiocarbon dates ranging from ca 1100–800 calBCE (Laneman 2021a; zooarchaeological report by Rannamäe & Tomek 2015). The grave had been damaged by the insertion of a telephone pole and perhaps other

activities during the 20th century, and the skeletons were found in a disturbed state. The location of the chicken bone within the cairn is unknown.

Tarand grave III at **Ilmandu** was excavated in 1994 (Lang 1995). At least three layers of burials were observed at the site. The first and the earliest layer consisted of cremations underneath the stone grave, where the charcoal has been radiocarbon dated to the 12th–9th centuries calBCE (Lang 1996b, 299). The second and the main stage of the burial ground featured at least six *tarand*s and two cist-like constructions, where four inhumed skeletons (including three from *tarand* IV) have been radiocarbon dated to between 790–370 calBCE (Laneman & Lang 2013, 112; Oras et al. 2016, 13; Saag et al. 2019). The third and the uppermost layer involved cremations from the Late Roman Iron Age and Early Migration Period with an associated radiocarbon date from a burnt human bone of 440–620 calCE (Lang 1996b, 299 f.; Oras et al. 2016, 12). A sheep bone from the damaged part of the stone grave has also been radiocarbon dated to the Late Iron Age (Rannamäe et al. 2016). According to the previous identifications, there were at least one certain and three questionable chicken bones in the material (Maldre 1997). The bones were reassessed for this study and as a result, two of them turned out to be from other species and the other two appeared to be missing from the collection. Instead, a bone found with the inhumation burials from *tarand* IV that had been previously reported as an "unidentified bird" (ibid.) was determined as a chicken and radiocarbon dated. The fossil fields near the burial ground were used from the Pre-Roman Iron Age to the Modern Period (Lang et al. 2004, table 1).

At **Rebala**, a group of at least six stone-cist graves was excavated in the 1980s and 2000 (Lõugas 1983; Lang et al. 2001). The site has a complicated chronology (Laneman 2021b). Ambiguous indications of a Corded Ware (Late Neolithic) settlement site were observed under grave I, but radiocarbon dating of the charcoal from under the lowermost stones of the cairn resulted in a Bronze Age date of the 12th–9th centuries calBCE. A similar date was obtained for charcoal from similar contexts in two other graves. The majority of the burials had been interred between 800 and 400 calBCE, and Pre-Roman Iron Age burials from between 400 and 50 calBCE were also present. The use of the cemetery was probably shorter, within the indicated limits, and/or in more than one temporally separate episode, although the boundaries thereof are difficult to determine. Grave II also contained infant burials from the Middle Ages. The cemetery was surrounded by block-shaped fields enclosed with stone baulks. The two associated radiocarbon dates from ca 350 calBCE – 250 calCE come from charcoal of ambiguous origin, and the date of the establishment of the field system within the Pre-Roman Iron Age and the Roman Iron Age is therefore difficult to pinpoint. The zooarchaeological material from Rebala has not been studied, except for a minor part (NISP < 100), collected from a small trench next to grave I (Laneman 2006). The chicken bone was found between the lowermost stones of grave I slightly east of the central cist (Figs 2 and 3). Grave I only contained inhumation burials in two cists, with radiocarbon dates between 790 and 410 calBCE. The chicken bone was identified with the help from Teresa Tomek (pers. comm.).

Fig. 2. Grave I at Rebala. View from the west. Photo by Valter Lang, 2000.

Fig. 3. The chicken bone from Rebala. A – before the sampling for AMS, B – the leftover after the sampling. Photo by Eve Rannmäe and Freydis Ehrlich.

Methods

This research was based on two methodological approaches: firstly, morphological identification and then secondly, the radiocarbon dating of bones. For the specimens included in this study that had previously been identified as chicken by other scholars, the species was reassessed and/or confirmed based on bone morphology. Reassessment was necessary because of the possibility of

confusing chicken with other species, especially with other galliforms. The wild relatives in Estonia that are skeletally very similar to the chicken, are the black grouse (*Tetrao tetrix*) and western capercaillie (*Tetrao urogallus*). Both of them are frequently encountered in Estonian zooarchaeological assemblages (e.g. Tomek et al. 2010; Lõugas et al. 2019; Ehrlich et al. 2020), and in case of very fragmented material, the distinction between chicken, black grouse, and western capercaillie can be very difficult. Moreover, the sizes of the three species partially overlap. Although the male western capercaillie is notably bigger, the female is in the size range of both chicken and black grouse, which makes their distinction by measurements complicated. Most of the re-identified bones were first studied years ago when access to suitable reference collections was quite limited and fewer handbooks were available. New identifications were based on the reference collections of the Department of Archaeology at the University of Tartu (Estonia), Archaeological Research Collection at Tallinn University (Estonia), and the Institute of Systematics and Evolution of Animals at the Polish Academy of Sciences in Kraków (Poland). The bones studied were only slightly fragmented and therefore well comparable to the skeletal references. Where necessary, the handbook by Tomek and Bocheński (2009) was used.

The other key approach in our study was the AMS (accelerator mass spectrometer) radiocarbon dating of nine selected chicken bones. Ca 1 g of sample was removed from the bones and submitted to AMS radiocarbon dating at the Poznań Radiocarbon Laboratory, the Finnish Museum of Natural History Dating Laboratory, and the CHRONO Centre in Queen's University Belfast. In each laboratory, collagen was extracted using different pretreatment protocols (Hela: Longin 1971; Poz: Longin 1971; Piotrowska & Goslar 2002; Bronk Ramsey et al. 2004; and UBA: Brown et al. 1988; Bronk Ramsey et al. 2004). The degree of preservation of the bone protein and thus the reliability of the dates was assessed as a combination of the %C, %N, atomic C:N ratio, and the collagen yield (>1%) (van Klinken 1999; Bronk Ramsey et al. 2004). Since the Finnish Museum of Natural History Dating Laboratory did not provide the measurements for the quality criteria at the time the dates were received (pers. comm. M. Oinonen 21.2.2021), these criteria cannot be applied to the dates from Asva. Additionally, the $\delta^{13}C$ values were measured with EA-IRMS (elemental analyser isotope ratio mass spectrometer) and reported together with the AMS dates; these were not accompanying the dates obtained from Poznan. The obtained AMS dates were calibrated with the OxCal v4.4.2 (Bronk Ramsey 2009), using the IntCal20 atmospheric calibration curve (Reimer et al. 2020) and rounded by five.

Results

Early evidence for the chicken had been previously reported from four sites (Saha-Loo, Tõugu, Poanse, Uusküla), but none of the bird bones were subsequently identified as chicken. The presumed chicken specimens turned out to be mainly

wild galliforms (*Tetrao* sp.) instead. From the rest of the eight sites, nine examples were confirmed as chicken and were all successfully radiocarbon dated by AMS spectrometer (Table 1; Fig. 4). All samples yielded enough collagen (2.9–9.1%); the C:N ratios of the bone collagen remained within the accepted range (3.15–3.3). Of the specimens analysed, samples from Rebala, Iru, and Asva roughly coincided with the time period suggested by their archaeological context, the samples from Ilmandu and Loona were younger, and the samples from Jõelähtme, Kurevere, and Joaorg at Narva turned out to be early modern or modern and are therefore discussed in less detail.

The specimen from Rebala was dated to 200 calBCE – 5 calCE, making it the earliest known chicken in the eastern Baltics. The bone's find context was between the lowermost stones of grave I, which could be associated with either the grave or the assumed Late Neolithic settlement site under the grave. With the radiocarbon date placing the chicken in the Pre-Roman Iron Age, the latter idea was discarded. However, the question remains as to how the chicken relates to the burials. We cannot make a direct link between them, because the burials in grave I are exclusively from the cists, but the chicken bone was found outside of the cists, and moreover, the human remains predate the chicken by at least two centuries (Laneman 2021b). However, the few human bones from other graves at Rebala that have been radiocarbon dated to 400–50 calBCE (ibid.), provide a firmer yet speculative link between the activities at the graves and subsequently the chicken. More complexity to the issue is added by the nearby fossil fields, which seemingly coincide with the date of the chicken bone (Lõugas & Selirand 1989, 152; Laneman 2006). But, considering the chicken was found under the grave and not among the field remains, together with the ambiguity of the fields charcoal based radiocarbon dates, there is a reduced probability of them being related. Therefore, in the current state of the research, we could assume that the Rebala chicken find is related to the activities taken place in the grave field sometime around the last two centuries BCE, but there is no evidence to associate it with any burial rituals except the mere fact of it being found among the grave finds.

The two specimens from Asva and one from Ilmandu turned out to be from the Pre-Viking Age, while the specimen from Iru was from the Pre-Viking or Viking Age. The two samples from Asva which by context represented either the Late Bronze Age or the later occupation phase of the site (600–800 CE), gave the radiocarbon dates between 600–775 calCE. Being from two different skeletal elements and found in the vicinity of each other, it cannot be excluded that these two bones come from a single individual. Their adjacent find contexts and very similar radiocarbon dates seemingly reinforce this possibility. But they are certainly not enough to affirm it. The bone from Ilmandu was dated to a very similar period with the bones from Asva, to 665–775 calCE. This is a little later than the last phase of the site's use as a cemetery, as the burials have been associated with the Late Roman Iron Age and Early Migration Period (Lang 1996b, 299 f.; Oras et al. 2016, 12). Whether the close radiocarbon dates of a single human and chicken bone could mean that the latter could be (vaguely) associated with the burial activities, remains

Table 1. Radiocarbon dates for analysed chicken bones. Lab codes according to Poznań Radiocarbon Laboratory (Poz), Finnish Museum of Natural History Dating Laboratory (Hela), and CHRONO Centre in Queen's University Belfast (UBA). Bones abbreviated as Tbt – tibiotarsus; Fem – femur; Hum – humerus

Specimen ID in ARHEST* database	Site	Bone	Lab No.	^{14}C age	cal BCE/CE date (68.3%)	cal BCE/CE date (95.4%)	δ^{13}C	%C	%N	C:N	Coll. yield (%)
AI-1394/1877/AZ-1	Kurevere	Tbt	Poz-116215	102.87, 0.32 pMC	–	–	–	56	20.2	3.23	9.1
AI-4129/1958/AZ-1	Loona	Tbt	Poz-122349	280 ± 30 BP	1520–1660 calCE	1505–1795 calCE	–	52.5	19.4	3.15	2.9
AI-4305/1957/AZ-1	Joaorg at Narva	Tbt	Poz-116217	130 ± 30 BP	1685–1930 calCE	1675–1945 calCE	–	52.5	19.1	3.2	7
AI-4366/1966/AZ-2:012	Asva**	Tbt	Hela-1921	1390 ± 30 BP	605–665 calCE	600–675 calCE	–20.7	–	–	–	–
AI-4366/1966/AZ-2:013	Asva**	Fem	Hela-1920	1330 ± 30 BP	655–775 calCE	645–775 calCE	–19.1	–	–	–	–
AI-5302/1986/AZ-2:001	Iru	Fem	UBA-40306	1213 ± 39 BP	770–885 calCE	675–950 calCE	–20.7	–	–	3.3	3.6
AI-5306/1984/AZ-1148	Jõelähtme 34	Hum	Poz-116214	162.17, 0.4 pMC	–	–	–	50.7	18.3	3.21	7.1
AI-6009/1994/AZ-14:2	Ilmandu III	Tbt	UBA-40308	1293 ± 24 BP	670–775 calCE	665–775 calCE	–20	–	–	3.26	8.1
AI-6435/AZ-94:1	Rebala I	Tbt	Poz-116213	2090 ± 30 BP	155–50 calBCE	200 calBCE–5 calCE	–	49.8	17.7	3.28	8.7

* Open access data for each specimen is available online in the ARHEST database (https://andmekogud.arheoloogia.ee/#/leiud/arheozooloogia).
** Both bones from Asva were radiocarbon dated along the zooarchaeological analysis (Tomek & Lõugas 2009).

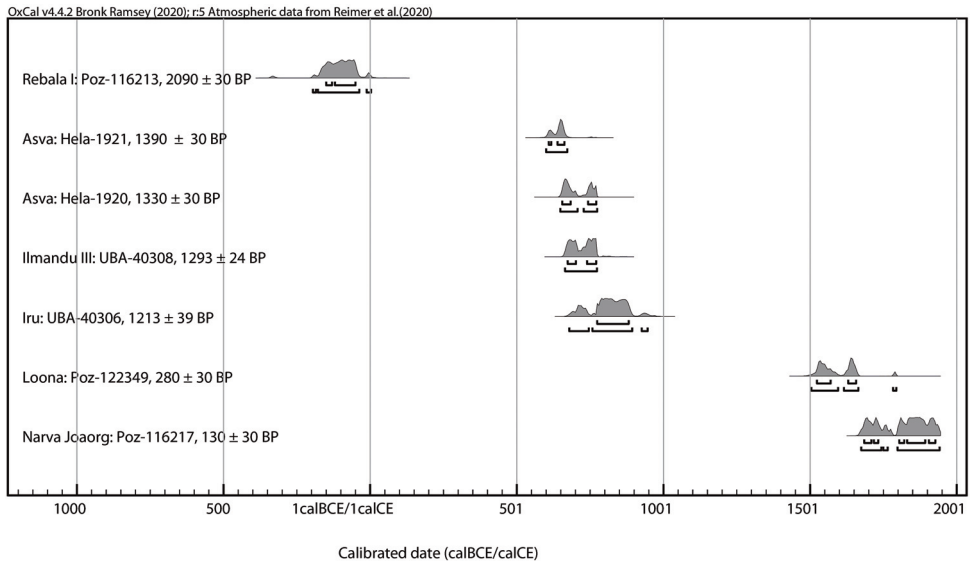

Fig. 4. Calibrated AMS dates for the chicken bones analysed in this study.

open. The chicken specimen from Ilmandu could also be related to the fossil fields nearby that were used from the Pre-Roman Iron Age to the Modern Period (Lang et al. 2004, table 1). At Iru, the dated chicken bone was taken from a mixed layer that included finds from both the Late Bronze Age and Viking Age (Lang 1988, 6); the radiocarbon dates of 675–950 calCE confirmed that the chicken originates from the later occupation phase.

The remaining samples from Loona, Joaorg at Narva, Jõelähtme, and Kurevere returned with rather recent radiocarbon ages. All four sites feature several later phases and a lot of disturbance over time. Therefore, the chicken being medieval/early modern (Loona), early modern/modern (Joaorg at Narva), or entirely modern (Jõelähtme, Kurevere) was not surprising.

Discussion

Several problems may appear in connection with the earliest finds of chicken bones and their interpretation. Besides the lack of detailed zooarchaeological analysis from previous excavations, there are two main challenges: erroneous species identification and complex contextual background. These problems are not characteristic only to Estonian material but have been reported in many studies of chicken domestication (Peters et al. 2015; 2016; Eda et al. 2016; 2019; Pitt et al. 2016, 2) and possible misidentifications have also been mentioned in Scandinavia (Walker et al. 2019, 26). As shown above, until now, the bones from Tõugu II, Poanse I and II, and Uusküla II stone graves and Saha-Loo fossil fields were thought

to be the earliest evidence of the chicken in Estonia (Lang 2000, 215; 2007, 111; Maldre 2000). However, according to the re-identifications, these collections did not include any chicken bones. The second challenge – accurate dating by the context – is especially complicated if the bones come from stone graves. The possibility that animal remains in the graves are even centuries younger than the burials, has been acknowledged before (Laneman et al. 2015; Rannamäe et al. 2016; Laneman 2021a), but this can be a problem also with multi-layered settlement sites (Bläuer & Kantanen 2013). In our analysis, two out of nine presumably prehistoric samples turned out to be modern, one was early modern or modern, and one sample was medieval or early modern – this confirms the necessity for precaution when dating animal bones according to their context in sites with complex stratigraphy.

We are now certain that the introduction of the chicken to the area of present-day Estonia happened in the Pre-Roman Iron Age, at around 200 calBCE – 5 calCE at the latest. However, a single bone is not sufficient evidence for a detailed discussion regarding the origin, importance, or abundance of this species during the last centuries BCE. The question regarding abundance could be explored by identifying, analysing, and radiocarbon dating more zooarchaeological material from the Pre-Roman Iron Age sites. Regarding the importance or the role of the first chicken, we cannot draw any far-reaching conclusions from the current research either. In many other parts of the world, the earliest records for the chicken come from graves and have occasionally been associated with symbolic or sacred practices (e.g. Serjeantson 2009, 362; Kysely 2010; Wessman et al. 2018, 446). In the case of Rebala, the grave context seemingly agrees with this wider phenomenon, but is far from solid evidence.

The origin of the earliest chicken in present-day Estonia is another question in which we need to remain speculative. It has been previously suggested that at the turn of the era, the people of north-eastern Estonia could have introduced the first chickens to the area through contact with central Europe and/or the region north of the Black Sea (Lõugas 1981, 97). As a result of this study, we now have certain evidence of the earliest chicken, which allows us to discuss these possible contacts further. In the Late Bronze Age and Pre-Roman Iron Age, coastal Estonia had frequent communication with south-western Finland and central Sweden, the southern coast of the Baltic Sea, the middle and lower reaches of the Dnieper River, and with the eastern European forest belt as far east as the middle reaches of the Volga River (Lang 2007, 255 f.; 2018, 190). Bearing these contacts in mind, the Pre-Roman Iron Age chicken might have been brought to Rebala from any of the above mentioned directions. In the middle Volga Region, the earliest chicken bones and the first appearance of domestic birds so far have been suggested to be from the 4th–7th centuries CE (Galimova et al. 2014, 349 f.). Although these finds seemingly disagree with the possibility of the chicken being introduced from the east – since they are much later than the chicken from Rebala – more evidence is needed in order to affirm or reject the idea of the eastern origin. In Sweden, Slovakia, and Germany, on the other hand, the first known chickens are from the 1st century BCE (Lepiksaar 1977; Serjeantson 2009, 362), and in Czech Republic

and Poland, the first known evidence is even earlier, from the second half of the 9th century BCE and ca 650 BCE, respectively (Kysely 2010, 17; Pitt et al. 2016, 6). Where the lower Dnieper region is concerned, the earliest reported evidence comes from the Ukraine from the 11th–8th centuries BCE (Kysely 2010, 20). The mix of these European sites and dates allows us to speculate that the earliest chicken finds in the northern part of Europe, including Estonia, could be related to the spreading from central or eastern Europe, but this needs further research.

The single find from Rebala and (chronologically) the next three finds from Asva, Ilmandu, and also Iru leave a time gap of at least six hundred years between them. It is hard to assess how and if chicken husbandry developed during this time. The Pre-Viking samples from Asva and Ilmandu and the Pre-Viking/Viking Age sample from Iru partially support the earlier suggestions on the continuation of chicken husbandry throughout the Migration Period to the Viking Age (Tvauri 2012, 107 f.). However, it remains somewhat speculative at this present state of the research. Thus, for now it remains unclear whether the chicken husbandry was continuous between its first known arrival in the Pre-Roman Iron Age and the later part of the Viking Age when it became well established, or if there were multiple introductions.

Conclusions

Zooarchaeological material by its nature is incomplete and encompasses many challenges. While seemingly abundant, an assemblage of faunal remains can be reduced to only a few specimens of desired taxon and bone elements from a certain time period. Lack of research, difficulties in contextual dating, and conditions of preservation add more complexity to the issue. Compared to mammals, bird bones in Estonia have received less attention. The introduction of domestic bird species to the area of present-day Estonia is only one topic among many that needs to be addressed.

In this paper, we discussed the arrival of chicken to the area of present-day Estonia by (re-)identifying and radiocarbon dating nine chicken bones from eight archaeological sites. From this, we were able to confirm what had previously been hypothesized – that the chicken was introduced to this area in the Pre-Roman Iron Age at the latest, i.e. in the 2nd century calBCE – 1st century calCE. Our study also drew attention to some of the challenges that characterise studies in chicken domestication and spreading elsewhere in the world. Namely, that identifying the species based on even whole elements can be a complex task (several bones we re-examined turned out to have been wrongly identified) and associating a bone find with a certain context or phase within an archaeological site can turn out to be false (out of nine bones we radiocarbon dated, four were significantly younger than expected).

Some of the very important questions were not addressed here in detail. For example, the origin of the earliest chicken currently remains speculative. Possible

introduction routes could be via the eastern European forest belt or the southern coast of the Baltic Sea, but a Scandinavian direction cannot be ruled out either. With the little evidence so far, it is also difficult to discuss how and why the chicken was brought here. This includes any meaning this exotic bird could have held when first introduced to local people. Also, the subsequent development of chicken husbandry after its first known appearance remains open, as does the possibility for multiple introductions. Lastly, there is always a chance for new discoveries both in the zooarchaeological collections or in new excavations. The arrival of the chicken could therefore be shifted to even earlier times. To answer these questions, further research in Estonia and in the Baltic region in general is much needed.

Acknowledgements

This work was supported by the Estonian Research Council grants Nos PRG29, PSG492, and MOBERC14, and the Estonian and Polish Academies of Sciences.

We are grateful to Teresa Tomek and Kristiina Mannermaa for the permission to use their unpublished identifications, Liina Maldre for the help with literature and with previously identified specimens, Kristi Tasuja and Krista Sarv for their assistance in navigating the archaeological collections, Aivar Kriiska for consultation on the archaeological contexts of Joaorg at Narva, and Giedrė Piličiauskienė for the information about chicken finds in Lithuania. The publication costs of this article were covered by the Estonian Academy of Sciences, the Institute of History and Archaeology at the University of Tartu, and the Institute of History, Archaeology and Art History of Tallinn University.

References

Barrett, J., Hall, A., Johnstone, C., Kenward, H., O'Connor, T. & Ashby, S. 2007. Interpreting the plant and animal remains from Viking-Age Kaupang. – Kaupang in Skiringssal. Ed. D. Skre. (Kaupang Excavation Project Publication Series, 1; Norske Oldfunn, XXII.) Narayana Press, Denmark, 283–319.

Bläuer, A. & Kantanen, J. 2013. Transition from hunting to animal husbandry in southern, western and eastern Finland: new dated osteological evidence. – Journal of Archaeological Science, 40: 4, 1646–1666.

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. – Radiocarbon, 51: 1, 337–360.

Bronk Ramsey, C., Higham, T., Bowles, A. & Hedges, R. 2004. Improvements to the pretreatment of bone at Oxford. – Radiocarbon, 46: 1, 155–163.

Brown, T. A., Nelson, D. E., Vogel, J. S. & Southon, J. R. 1988. Improved collagen extraction by modified Longin method. – Radiocarbon, 30: 2, 171–177.

Eda, M., Lu, P., Kikuchi, H., Li, Z., Li, F. & Yuan, J. 2016. Reevaluation of early Holocene chicken domestication in northern China. – Journal of Archaeological Science, 67, 25–31.

Eda, M., Kikuchi, H., Sun, G. & Matsui, A. 2019. Were chicken exploited in the Neolithic early rice cultivation society of the lower Yangtze River? – Archaeological and Anthropological Sciences, 11, 6423–6430.

Ehrlich, F., Rannamäe, E. & Valk, H. 2020. Bird exploitation in Viljandi (Estonia) from the Late Iron Age to the Early Modern Period (c. 950–1700). – Quaternary International. https://doi.org/10.1016/j.quaint.2020.07.018

Ericson, P. G. P. & Tyrberg, T. 2004. The Early History of the Swedish Avifauna: A Review of the Subfossil Record and Early Written Sources. (Antikvariska Serien, 45.) Kungl. Vitterhets Historie och Antikvitets Akademien, Stockholm.

FAO, Faostat. http://www.fao.org/faostat/en/#data/QA (accessed 07 January 2021).

Galimova, D. N., Askeyev, I. V. & Askeyev, O. V. 2014. Bird remains from 5th–17th century AD archaeological sites in the Middle Volga region of Russia. – International Journal of Osteoarchaeology, 24: 3, 347–357.

Girdland Flink, L., Allen, R., Barnett, R., Malmström, H., Peters, J., Eriksson, J., Andersson, L., Dobney, K. & Larson, G. 2014. Establishing the validity of domestication genes using DNA from ancient chickens. – Proceedings of the National Academy of Sciences of the United States of America, 111: 17, 6184–6189.

Gotfredsen, A. B. 2013. The role of birds as grave gifts in richly furnished Roman Iron Age inhumation graves c. 1–375 AD, eastern Denmark. – Anthropozoologica, 48: 2, 355–370.

Gotfredsen, A. B. 2014. Birds in subsistence and culture at Viking Age sites in Denmark. – International Journal of Osteoarchaeology, 24: 3, 365–377.

Jaanits, L. 1965. Über die Ergebnisse der Steinzeitforschung in Sowjetestland. – Finskt Museum, LXXII, 5–46.

Jaanits, L., Laul, S., Lõugas, V. & Tõnisson, E. 1982. Eesti esiajalugu. Eesti Raamat, Tallinn.

Jonuks, T., Oras, E., Best, J., Demarchi, B., Mänd, R., Presslee, S. & Vahur, S. 2018. Multi-method analysis of avian eggs as grave goods: revealing symbolism in Conversion Period burials at Kukruse, NE Estonia. – Environmental Archaeology, 23: 2, 109–122.

Klinken, G. J. van 1999. Bone collagen quality indicators for palaeodietary and radiocarbon measurements. – Journal of Archaeological Science, 26: 6, 687–695.

Kraut, A. 1985. Die Steinkistengräber von Jõelähtme. – TATÜ, 34: 4, 348–350.

Kriiska, A. 1996. Stone Age settlements in the lower reaches of the Narva River. – Coastal Estonia. Recent Advances in Environmental and Cultural History. Eds T. Hackens, S. Hicks, V. Lang, U. Miller & L. Saarse. (PACT, 51.) Council of Europe, PACT Belgium, Strasbourg, Rixensart, 359–372.

Kysely, R. 2010. Review of the oldest evidence of domestic fowl *Gallus gallus* f. *domestica* from the Czech Republic in its European context. – Acta Zoologica Cracoviensia, 53A: 1–2, 9–34.

Laneman, M. 2006. Aruanne arheoloogilistest kaevamistest Rebalas 2004. a. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 1-19-48.

Laneman, M. 2021a. The date of the stone-cist cemetery at Jõelähtme reconsidered. – EJA, 25: 1, 55–89.

Laneman, M. 2021b. Radiocarbon chronology of the stone-cist graves at Rebala, northern Estonia. – EJA, 25: 2, 113–139.

Laneman, M. & Lang, V. 2013. New radiocarbon dates for two stone-cist graves at Muuksi, northern Estonia. – EJA, 17: 2, 89–122.

Laneman, M., Lang, V., Malve, M. & Rannamäe, E. 2015. New data on Jaani stone graves at Väo, northern Estonia. – EJA, 19: 2, 110–137.

Lang, V. 1988. Aruanne arheoloogilistest kaevamistest Iru linnuse keskvallil 1985. ja 1986. a. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 1-19-27B.

Lang, V. 1995. A Pre-Roman *tarand*-grave and late medieval fossil fields of Ilmandu, NW Estonia. – TATÜ, 44: 4, 429–436.

Lang, V. 1996a. The Stone Age to Late Iron Age in the Maardu area, northern Estonia, as revealed by archaeological excavations. The fossil fields at Saha-Loo. – Coastal Estonia. Recent Advances in Environmental and Cultural History. Eds T. Hackens, S. Hicks, V. Lang, U. Miller & L. Saarse. (PACT, 51.) Council of Europe, PACT Belgium, Strasbourg, Rixensart, 128–138.

Lang, V. 1996b. Muistne Rävala. Muistised, kronoloogia ja maaviljelusliku asustuse kujunemine Loode-Eestis, eriti Pirita jõe alamjooksu piirkonnas, I–II. (MT, 4.) Teaduste Akadeemia Kirjastus, Tallinn.
Lang, V. 2000. Keskusest ääremaaks. Viljelusmajandusliku asustuse kujunemine ja areng Vihasoo–Palmse piirkonnas Virumaal. (MT, 7.) Ajaloo Instituut, Tallinn.
Lang, V. 2007. The Bronze and Early Iron Ages in Estonia. (Estonian Archaeology, 3.) Tartu University Press, Tartu.
Lang, V. 2018. Läänemeresoome tulemised. (MT, 28.) University of Tartu Press, Tartu.
Lang, V., Laneman, M., Ilves, K. & Kalman, J. 2001. Fossil fields and stone-cist graves of Rebala revisited. – AVE, 2000, 34–47.
Lang, V., Kaldre, H., Konsa, M., Laneman, M., Lätti, P. & Vaab, H. 2004. Fossil fields of Ilmandu and Muraste, North-Estonia. – AVE, 2003, 72–84.
Larson, G. & Fuller, D. Q. 2014. The evolution of animal domestication. – Annual Review of Ecology, Evolution, and Systematics, 45: 1, 115–136.
Lepiksaar, J. 1977. Människan och husdjuren. – Fauna och Flora, 72, 79–101.
Longin, R. 1971. New method of collagen extraction for radiocarbon dating. – Nature, 230, 241–242.
Lõugas, V. 1966. Asva linnamäe 1966. a kaevamiste aruanne. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 1-70-22.
Lõugas, V. 1977. Ausgrabungsergebnisse eines Steingräberfeldes von Kurevere. – TATÜ, 26: 1, 48–52.
Lõugas, V. 1981. Kana ja muna Baltimaade arheoloogilises materjalis. – Eesti ajaloo probleeme. Toim E. Tarvel. Eesti NSV Teaduste Akadeemia, Ajaloo Instituut, Tallinn, 96–103.
Lõugas, V. 1983. Über die Steingräbergruppe Lastekangrud in Rebala. – TATÜ, 32: 4, 295–297.
Lõugas, L. 1994. Subfossil vertebrate fauna of Asva site, Saaremaa: mammals. – Stilus: Eesti Arheoloogiaseltsi teated, 5, 71–93.
Lõugas, V. & Selirand, J. 1989. Arheoloogiga Eestimaa teedel. Teine, parandatud ja täiendatud trükk. Valgus, Tallinn.
Lõugas, L., Lidén, K. & Nelson, D. E. 1996. Resource utilisation along the Estonian coast during the Stone Age. – Coastal Estonia. Recent Advances in Environmental and Cultural History. Eds T. Hackens, S. Hicks, V. Lang, U. Miller & L. Saarse. (PACT, 51.) Council of Europe, PACT Belgium, Strasbourg, Rixensart, 399–420.
Lõugas, L., Kriiska, A. & Maldre, L. 2007. New dates for the Late Neolithic Corded Ware Culture burials and early animal husbandry in the east Baltic region. – Archaeofauna, 16, 21–31.
Lõugas, L., Rannamäe, E., Ehrlich, F. & Tvauri, A. 2019. Duty on fish: zooarchaeological evidence from Kastre Castle and customs station site between Russia and Estonia. – International Journal of Osteoarchaeology, 29: 3, 432–442.
Mägi, M. 2002. At the Crossroads of Space and Time. Graves, Changing Society and Ideology on Saaremaa (Ösel), 9th–13th Centuries AD. Ajaloo Instituut, Center of Baltic Studies, Tallinn.
Maldre, L. 1997. Aruanne Ilmandu III tarandkalmest 1994. aastal kogutud loomaluudest. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 5-2-34.
Maldre, L. 1998a. Aruanne Poanse kalmest 1975.–1976. aastal kogutud loomaluudest. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 5-2-46.
Maldre, L. 1998b. Aruanne Tõugu II tarandkalmest 1993.–1995. a leitud loomaluudest. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 5-2-37.
Maldre, L. 1999. Aruanne Uusküla II kalmest 1998. aastal kogutud loomaluudest. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 5-2-42.
Maldre, L. 2000. Tõugu II kalme arheozooloogiline materjal. – Lang 2000, Appendix 4, 409–422.
Maldre, L. 2008. Karjakasvatusest Ridala pronksiaja asulas. – Loodus, inimene ja tehnoloogia, 2. Interdistsiplinaarseid uurimusi arheoloogias. Toim L. Jaanits, V. Lang & J. Peets. (MT, 17.) Tallinn, Tartu, 263–276.
Maltby, M. 2012. From Alces to Zander: a summary of the zooarchaeological evidence from Novgorod, Gorodishche and Minino. – The Archaeology of Medieval Novgorod in Context. Studies

in Centre/Periphery Relations. Eds M. A. Brisbane, N. A. Makarov & E. N. Nosov. Oxbow Books, Oxford, 351–380.

Maltby, M., Pluskowski, A., Rannamäe, E. & Seetah, K. 2019. Farming, hunting and fishing in Medieval Livonia: Zooarchaeological data. – Environment, Colonisation and the Crusader States in Medieval Livonia and Prussia. Ed. A. Pluskowski. (Terra Sacra, I.) Brepols Publishers, Turnhout, 136–174.

Mannermaa, K. 2008. The Archaeology of Wings. Birds and People in the Baltic Sea Region during the Stone Age. Helsingin Yliopisto, Helsinki.

Mannermaa, K. & Lõugas, L. 2005. Birds in the subsistence and cultures on four major Baltic Sea islands in the Neolithic (Hiiumaa, Saaremaa, Gotland and Åland). – Feathers, Grit and Symbolism. Birds and Humans in the Ancient Old and New Worlds: Proceedings of the 5th Meeting of the ICAZ Bird Working Group in Munich 26.7–28.7.2004. Eds G. Grupe & J. Peters. (Documenta Archaeobiologiae, 3.) Verlag Marie Leidorf, Rahden, 179–198.

Miao, Y.-W., Peng, M.-S., Wu, G.-S., Ouyang, Y.-N., Yang, Z.-Y., Yu, N., Liang, J.-P., Pianchou, G., Beja-Pereira, A., Mitra, B., Palanichamy, M. G., Baig, M., Chaudhuri, T. K., Shen, Y.-Y., Kong, Q.-P., Murphy, R. W., Yao, Y.-G. & Zhang, Y.-P. 2013. Chicken domestication: an updated perspective based on mitochondrial genomes. – Heredity, 110, 277–282.

Oras, E., Lang, V., Rannamäe, E., Varul, L., Konsa, M., Limbo-Simovart, J., Vedru, G., Laneman, L., Malve, M. & Price, T. 2016. Tracing prehistoric migrations: Isotope analysis of Bronze and Pre-Roman Iron Age coastal burials in Estonia. – EJA, 20: 1, 3–32.

Paaver, K. 1965. **= Паавер К.** Формирование териофауны и изменчивость млекопитающих Прибалтики в голоцене. Академия наук Эстонской ССР, Тарту.

Paaver, K. 1966. Iru kindlustatud asula ja linnuse kaevamistel 1953.–1957. a. kogutud luumaterjalide määramise esialgsed tulemused. Manuscript in the archive of the Archaeological Research Collection at Tallinn University, AI 5-1-12.

Peters, J., Lebrasseur, O., Best, J., Miller, H., Fothergill, T., Dobney, K., Thomas, R. M., Maltby, M., Sykes, N., Hanotte, O., O'Connor, T., Collins, M. J. & Larson, G. 2015. Questioning new answers regarding Holocene chicken domestication in China. – Proceedings of the National Academy of Sciences of the United States of America, 112: 19, E2415.

Peters, J., Lebrasseur, O., Deng, H. & Larson, G. 2016. Holocene cultural history of Red jungle fowl (*Gallus gallus*) and its domestic descendant in East Asia. – Quaternary Science Reviews, 142, 102–119.

Piotrowska, N. & Goslar, T. 2002. Preparation of bone samples in the Gliwice radiocarbon laboratory for AMS radiocarbon dating. – Isotopes in Environmental and Health Studies, 38: 4, 1–9.

Pitt, J., Gillingham, P. K., Maltby, M. & Stewart, J. R. 2016. New perspectives on the ecology of early domestic fowl: an interdisciplinary approach. – Journal of Archaeological Science, 74, 1–10.

Rammo, R. & Veldi, M. 2005. 2004. aasta kaevamised Viljandi Musumäel. – Viljandi Muuseumi aastaraamat. Toim A. Vislapuu & A. Haak. Viljandi Muuseum, Viljandi, 97–111.

Rannamäe, E. & Lõugas, L. 2019. Animal exploitation in Karksi and Viljandi (Estonia) in the Late Iron Age and Medieval Period. – Ecologies of Crusading, Colonization, and Religious Conversion in the Medieval Baltic. Ed. A. Pluskowski. (Terra Sacra, II.) Brepols Publishers, Turnhout, Belgium, 61–76.

Rannamäe, E. & Tomek, T. 2015. Identifications of the faunal remains from Jõelähtme. https://andmekogud.arheoloogia.ee/#/leiud/arheozooloogia

Rannamäe, E., Lõugas, L., Speller, C. F., Valk, H., Maldre, L., Wilczyński, J., Mikhailov, A. & Saarma, U. 2016. Three thousand years of continuity in the maternal lineages of ancient sheep (*Ovis aries*) in Estonia. – PLoS ONE, 11: 10, e0163676.

Reimer, P. J., Austin, W. E. N., 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.
Rumbutis, S., Blaževičius, P. & Piličiauskienė, G. 2018. Paukščiai Vilniaus pilyse. – Vilniaus pilių fauna: nuo kepsnio iki draugo. Eds P. Blaževičius, N. Dambrauskaitė, H. Luik, G. Piličiauskienė, S. Rumbutis & T. Zarankaitė-Margienė. Vilniaus universiteto leidykla, Vilnius, 104–130.
Saag, L., Laneman, M., Varul, L., Malve, M., Valk, H., Razzak, M. A., Shirobokov, I. G., Khartanovich, V. I., Mikhaylova, E. R., Kushniarevich, A., Scheib, C. L., Solnik, A., Reisberg, T., Parik, J., Saag, L., Metspalu, E., Rootsi, S., Montinaro, F., Remm, M., Mägi, R., D'Atanasio, E., Crema, E. R., Díez-del-Molino, D., Thomas, M. G., Kriiska, A., Kivisild, T., Villems, R., Lang, V., Metspalu, M. & Tambets, K. 2019. The arrival of Siberian ancestry connecting the Eastern Baltic to Uralic speakers further east. – Current Biology, 29: 10, 1701–1711.
Serjeantson, D. 2009. Birds. Cambridge University Press, Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi.
Shaymuratova (Galimova), D., Askeyev, I. & Askeyev, O. 2019. The studies of archaeological bird remains from Medieval Staraya Ladoga. New results and interpretations. – Monographs of the Archaeological Society of Finland. Helsinki Harvest. Proceedings of the 11th Nordic Conference on the Application of Scientific Methods in Archaeology. Eds K. Mannermaa, M. A. Manninen, P. A. P. Pesonen & L. Seppänen. Suomen Arkeologinen Seura, Helsinki, 93–114.
Sperling, U. 2014. Aspekte des Wandels in der Bronzezeit im Ostbaltikum. Die Siedlungen der Asva-Gruppe in Estland. (EJA, 18. Supplementary Volume, 2S.) Estonian Academy Publishers, Tallinn.
Sperling, U., Karlsen, H.-J., Lang, V. & Kimber, A. 2019. Grabungen und geomagnetische Prospektion auf dem vorwikingerzeitlichen Burgberg von Asva. – AVE, 2018, 47–58.
Sperling, U., Karlsen, H.-J., Lang, V., Kimber, A., Lõugas, L. & Lau, R. 2020. Ausgrabungen in der Bronzezeitsiedlung von Asva im Jahr 2019. – AVE, 2019, 51–60.
Storey, A. A., Athens, J. S., Bryant, D., Carson, M., Emery, K., deFrance, S., Higham, C., Huuynen, L., Intoh, M., Jones, S., Kirch, P. V., Ladefoged, T., McCoy, P., Morales-Muñiz, A., Quiroz, D., Reitz, E., Robins, J., Walter, R. & Matisoo-Smith, E. 2012. Investigating the global dispersal of chickens in prehistory using ancient mitochondrial DNA signatures. – PLoS ONE, 7: 7, e39171.
Tomek, T. & Bocheński, Z. M. 2009. A Key for the Identification of Domestic Birds in Europe: Galliformes and Columbiformes. Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków.
Tomek, T. & Lõugas, L. 2009. Identifications and radiocarbon dates of chicken finds from Asva. https://andmekogud.arheoloogia.ee/#/leiud/arheozooloogia
Tomek, T., Bocheński, Z. & Lõugas, L. 2010. The utilization of birds during the Late Bronze Age on the Baltic Sea island of Saaremaa, Estonia. – Poster Presentation. Abstract: 11th International Conference of Archaeozoology. ICAZ 2010. Paris, 23–28 August 2010, 234.
Tõnisson, E. 2008. Eesti muinaslinnad. Toim A. Mäesalu & H. Valk. (MT, 20.) Tartu, Tallinn.
Tourunen, A. 2011. Burnt, fragmented and mixed: identification and interpretation of domestic animal bones in Finnish burnt bone assemblages. – Fennoscandia Archaeologica, XXVIII, 57–69.
Tvauri, A. 2012. The Migration Period, Pre-Viking Age, and Viking Age in Estonia. (Estonian Archaeology, 4.) Tartu University Press, Tartu.
Tyrberg, T. 2002. The archaeological record of domesticated and tamed birds in Sweden. – Acta Zoologica Cracoviensia, 45, 215–231.
Valk, H. & Rannamäe, E. 2015. Investigation of Late Iron Age occupation layers in Viljandi Castle park. – AVE, 2014, 123–132.
Walker, S. J. & Meijer, H. J. M. 2020. More than food; evidence for different breeds and cockfighting in *Gallus gallus* bones from Medieval and Post-Medieval Norway. – Quaternary International, 543, 125–134.
Walker, S. J., Hufthammer, A. K. & Meijer, H. J. M. 2019. Birds in Medieval Norway. – Open Quaternary, 5: 1, 1–33.
Wang, M.-S., Thakur, M., Peng, M.-S., Jiang, Y., Frantz, L. A. F., Li, M., Zhang, J.-J., Wang, S., Peters, J., Otieno Otecko, N., Suwannapoom, C., Guo, X., Zheng, Z.-Q., Esmailizadeh, A.,

Hirimuthugoda, N. Y., Ashari, H., Suladari, S., Zein, M. S. A., Kusza, S., Kharrati-Koopaee, H., Shen, Q.-K., Zeng, L., Yang, M.-M., Wu, Y.-J., Yang, X.-Y., Lu, X.-M., Jia, X.-Z., Nie, Q.-H., Lamont, S. J., Lasagna, E., Ceccobelli, S., Gunwardana, H. G. T. N., Senasige, T. M., Feng, S.-H., Si, J.-F., Zhang, H., Jin, J.-Q., Li, M.-L., Liu, Y.-H., Chen, H.-M., Ma, C., Dai, S.-S., Bhuiyan, A. K. F. H., Khan, M. S., Silva, G. L. L. P., Le, T.-T., Mwai, O. A., Ibrahim, M. N. M., Supple, M., Shapiro, B., Hanotte, O., Zhang, G., Larson, G., Han, J.-L., Wu, D.-D. & Zhang, Y.-P. 2020. 863 genomes reveal the origin and domestication of chicken. – Cell Research, 30, 693–701.

Wessman, A., Alenius, T., Holmqvist, E., Mannermaa, K., Perttola, W., Sundell, T. & Vanhanen, S. 2018. Hidden and remote: new perspectives on the people in the Levänluhta water burial, western Finland (c. AD 300–800). – European Journal of Archaeology, 21: 3, 431–454.

Xiang, H., Gao, J., Yu, B., Zhou, H., Cai, D., Zhang, Y., Chen, X., Wang, X., Hofreiter, M. & Zhao, X. 2014. Early Holocene chicken domestication in northern China. – Proceedings of the National Academy of Sciences of the United States of America, 111: 49, 17564–17569.

Xiang, H., Gao, J., Yu, B., Hofreiter, M. & Zhao, X. 2015. Reply to Peters et al.: Further discussions confirm early Holocene chicken domestication in northern China. – Proceedings of the National Academy of Sciences of the United States of America, 112: 19, E2416.

Freydis Ehrlich, Eve Rannamäe, Margot Laneman, Mari Tõrv, Valter Lang, Ester Oras ja Lembi Lõugas

VARASEIMAD KODUKANAD EESTIS

Resümee

Uuringu eesmärk oli välja selgitada, millal esimesed kodukanad Eesti alale jõudsid. Seni on arvatud, et Eesti vanimad kodukana luuleiud pärinevad eelrooma rauaaja (500 e.m.a – 50 m.a.j) lõpuosast või rooma rauaajast (50–450 m.a.j). Arvatavalt vanimad kodukanade luud olid seni teada kivikalmetest, nagu Tõugu II, Poanse I ja II, Ilmandu III ning Uusküla II, aga ka Saha-Loo põllujäänuste materjalist. Lisaks mainitutele kaasati uuringusse luid Loona ja Narva Joaoru asulakohtadelt, Iru ja Asva linnamäelt ning Rebala, Kurevere ja Jõelähtme kivikalmetest (jn 1).

Alustuseks analüüsiti uuesti varasemalt määratud võimalikud kanaluud morfoloogiliste ehk väliste tunnuste põhjal. Selle käigus Tõugu, Poanse ja Uusküla kalmetest ning Saha-Loo põllujäänustest kogutud luude hulgast kanaluid ei leitud. Ülejäänud kaheksalt muistiselt valitud luud kuulusid kodukanadele. Kuna pikka aega kasutusel olnud kivikalmetest ja linnamägedelt leitud imetaja- ja linnuluude dateerimine vaid konteksti põhjal on keeruline ning kohati võimatu, siis dateeriti need radiosüsinikumeetodiga.

Dateeritud luude hulgast osutus Loonast pärit luu kesk- või uusaegseks, Narva Joaorust leitud luu varauusaegseks või tänapäevaseks ja Kurevere ning Jõelähtme kalmetest leitud luud tänapäevasteks (jn 4; tabel 1). Ilmandu III kalmest leitud luu osutus eelviikingiaegseks ja seega hilisemaks, kui konteksti põhjal eeldati. See luu võis seotud olla ka lähedal asuvate muinaspõldudega, mis olid kasutuses eelrooma rauaajast uusajani. Nii Irust kui ka Asvast leitud luud sobitusid oodatava dateerin-

guga ja on mõlemal juhul seotud linnamägede rauaaegse asustusega vastavalt viikingi- ning eelviikingiajal. Uuringu olulisim tulemus on see, et õnnestus leida kinnitust kanakasvatuse alguse kohta Eestis juba viimastel sajanditel e.m.a. See praegusel hetkel vanim kanaluu pärineb Rebala Lastekangrute I kalmest (jn 2 ja 3). Jääb selgusetuks, kuidas see luu kalmesse jõudis. Samuti ei ole praeguste andmete põhjal võimalik kindlaks teha, kust esimesed kanad Eesti alale toodi.

Seda, kui levinud olid kodukanad Eesti alal eelrooma rauaajal või kas nad võisid siia jõuda veelgi varem, on raske hinnata. Näiteks Asvas, kus on olnud nii hilispronksiaegne kui ka keskmise rauaaja aegne asustus, on zooarheoloogilise materjali hulgas vähesel määral kanaluid, kuid need pärinevad segatud kontekstidest. Kaks neist dateeriti eelviikingiajaga. Vanema ja keskmise rauaaja loomaluid on kogudes küll rohkelt, kuid neid on vähe uuritud ning tolleaegse kanakasvatuse kohta ei saa põhjapanevaid järeldusi teha. Alates hilisrauaajast oli aga kodukana juba üsna levinud.