Investigating Animal Remains in Estonia

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Abstract. In Estonia, faunal remains have been an important part of archaeological material since the 19th century. During the 20th century, the interest in faunal history was rather volatile, but gained some stability during the 1990s. Since then, zooarchaeology in Estonia has developed substantially, focusing on a variety of topics. Together with methods from traditional zooarchaeology, interdisciplinary methods like the studies of ancient DNA and stable isotopes are increasingly used. However, despite the growing understanding of the importance of faunal remains in archaeological and historical research, there are still problems with collecting animal remains during the fieldwork and documenting and organising them. On the other hand, interest in scientific methods and destructive sampling of the osseous remains have become increasingly popular in science projects and international collaboration. In order to use osteological collections reasonably and ethically, proper systemisation is essential.

In Estonia, there are two research centres for zooarchaeology, where scientific collections are administered – Tallinn University and the University of Tartu. Tallinn collections comprise material mostly from the northern part of the country, plus an extensive reference collection for fish has been developed there. In Tartu, mostly material from southern Estonia is managed, together with continuously expanding reference collection of mammals and birds. To improve the gathering and management of the osteological material in Estonia and reduce the shortage for storage space, a new central repository for osteological collections (both human and animal) was established in 2019. Concurrently, a new central database for the osteological data was created.

In this paper, we introduce the zooarchaeological collections and some of the latest research topics in Estonia with an aim to broaden the understanding and potential of zooarchaeology in the Baltic region.

Keywords: zooarchaeology, research collections, reference collections, Estonia.
Introduction

It is evident that for successful research in zooarchaeology, proper collections are needed. There are two main collection types the zooarchaeologists are involved with: faunal remains from archaeological sites and reference material. Building the collections, maintaining them, and managing their contents is a large-scale undertaking which needs proper infrastructure, facilities, knowledge, and time.

In Estonia, animal remains have been collected from archaeological sites since the 19th century. In over a hundred years, the intention for collecting the bones, level of gathering (e.g., hand picking vs. fine sieving), precision of recording, and quality of storing have been very different. Many zooarchaeological finds have even been discarded or not collected in the first place. Nevertheless, a vast amount of archaeological bones have been collected, stored, and studied. Research history of faunal remains and zooarchaeology in Estonia has been overviewed in several publications (e.g., Lõugas 1988; Kriiska & Lõugas 2006; Rannamäe 2016), so here we present only a short summary of it.

Zooarchaeological research in Estonia on a scientific level started with paleozoological interest by Baltic-German scholars in the end of the 19th century. The main focus was on the distant past – the Stone Age – and one of the main sites studied was the well known Kunda Lammasmägi (north-eastern Estonia) or more precisely, the old lake marl around it. Interest in faunal remains continued into the beginning of the 20th century, but after that, in the 1920s, the archaeofaunal studies were conducted only as minor tasks.

The next important stage in Estonian zooarchaeology began in the 1930s, when Johannes Lepiksaar specialised in palaeozoology and analysed many bone assemblages from Estonian settlement sites. In addition to his research on ancient and modern animal populations in Estonia and Fennoscandia, he created a large reference collection of fish, which is now stored in the Archaeological Research Collection of Tallinn University. As the growth of the animal bone collections accelerated in the 1930s, the bone collections were separated from other archaeological finds. It was an optimal decision since the storage space became narrower. Also, since the conditions for storing bones and other find types are different, keeping them in one room would not have been a good solution. Thus, after the 1930s, bones were mainly collected into special boxes and stored separately from other collections. Around the same time, interdisciplinary methods were started to be applied to osteological material from several important sites like Asva (Saaremaa Island), Iru (northern Estonia), and Kunda Lammasmägi – these collections are still actively used and complemented by new excavations. The Second World War brought a low-point in the research field and also faunal assemblages from that time are modest. Still, in 1942–1943, excavations were carried out in Stone Age sites Tamula (south-eastern Estonia) and Undva (Saaremaa Island).

A new period of concentrated zooarchaeological work together with extensive excavations started in the 1950s, when zoologist Kalju Paaver analysed ancient faunal remains from many archaeological sites. Today, some of his identification labels still remain in the bone boxes, for example, Rõuge (south-eastern Estonia) and Iru archaeological sites, and unless new studies have been conducted, his monograph on the faunal history of the eastern Baltic Holocene is still widely relied on (Paaver 1965). In the 1960s to 1980s, animal remains were continued to be collected and studied, for example, during extensive excavations in the city centres of Tartu (southern central Estonia) and Tallinn (northern Estonia), but there was no concentrated zooarchaeological research done. Those capacious collections are preserved and stored, but still rather unorganised and lacking contextual information due to incomplete documentation and reporting.
Contemporary Estonian zooarchaeology started in the 1990s with Liina Maldi and Lembi Lõugas. In the 2010s, Eve Rannamäe and Freydis Ehrlich joined. Today’s research is characterised by specialisation, international networking, wide-scale analyses, development of the collections and methods, training students, and popularising.

To date, zooarchaeology in Estonia is facing an increasing number of animal remains together with growing interest and better acknowledgement in zooarchaeological research. Moreover, science projects and international collaboration increasingly rely on the use of scientific methods such as the analyses of stable isotopes and ancient DNA (aDNA), which calls upon ethical challenges surrounding destructive sampling of archaeofaunal remains (Pálsdóttir et al. 2019). All these developments demand enhanced storage conditions and more efficient management. Therefore, to better maintain and organise osteological collections in Estonia, two universities – Tallinn University and the University of Tartu – recently started to create a joint collection, which means, first of all, a general database for animal bones, and thereafter, a common repository for archaeological bone finds. Both the database and repository give an opportunity for the universities, also for the museums, to store zooarchaeological data and material in one place. In this paper, we give a detailed overview of zooarchaeological collections, systematisation, and research at the universities of Tallinn and Tartu within the last decade.

Zooarchaeological collections at the universities of Tallinn and Tartu

The overall archaeological research collection of the Tallinn University is divided into subcollections: artefacts, precious metals, osteo-archaeological collections (human and animal remains), faunal and floral reference collections, environmental samples, and archaeology archive and library. At the University of Tartu, the archaeological collections are divided into artefacts, human remains, animal remains and faunal reference collection, archaeological samples, and archaeology archive. The research collections in Tallinn and Tartu are supported by the Estonian Ministry of Education and Research. The osteological collections are the largest (at least, in sense of capacity). In Tallinn, they mostly comprise the material excavated from the northern and western part of the country, while in Tartu, the material is mostly from southern Estonia. In addition to osteological collections, environmental samples that consist mainly of soil, can also contain small animal bones (fish, reptiles, micromammals) and vegetal macrofossils.

Faunal reference collections are those used in bone identification. In Tallinn, fish reference collection includes the most common commercial fish species in the Baltic basin and some also from the Atlantic and even Mediterranean Sea. This is thanks to Lepiksaar’s collection which he handed to Tallinn University about 15 years ago. Reference collections of wild and domestic mammals and birds are somewhat limited in Tallinn, but more developed at the University of Tartu. In Tartu, the mammal reference collection comprises both domestic and wild species, including over a dozen (partial) skeletons of modern-day Kihnu native sheep, prepared in collaboration with the Kihnu Native Sheep Society. Rest of the mammal and bird skeletons have been prepared in the facilities of the Estonian University of Life Sciences. The bird reference collection is increasingly growing and includes Estonian avifauna. There is also a good collection of mammal and bird skeletons in the Anatomy Museum of the Estonian University of Life Sciences in Tallinn and in the Natural History Museum of Tartu University.

In 2018, a practical guideline for collecting and storing faunal remains was published (Lõugas 2018). It is aimed for Estonian zooarchaeologists and archaeologists and gives a general overview of what faunal remains are, how they should be excavated, stored, and sampled, and how zooarchaeological data should be managed. At the same time with publishing the guidelines, a new central repository for both human and animal remains was being established in Tallinn. It was opened in 2019 and named Ossa. The new building was intended to reduce the shortage for space and improve the collection and management of osteological material (Fig. 1). The repository was designed especially for preserving bones in proper temperature and air conditions and includes a laboratory for researchers and technical work (e.g., washing, packing, watersieving). Storage (shelf) space can hold up to 20 000 bone boxes (see Fig. 2), of which ca. 2/3 is filled so far. Simultaneously, many assemblages are still stored in research institutes, especially those that are actively studied (Fig. 3).
Figure 1. New repository for archaeological bone collections in Tallinn (01/09/2019). Outer view.


Figure 2. New repository for archaeological bone collection in Tallinn (01/09/2020). Inner view.


Figure 3. Repository for the zooarchaeological collections at the University of Tartu. Here, both archaeological remains and reference collections are stored and worked with.

3 pav. Zooarcheologinės kolekcijos saugykla Tartu universitete, kur saugoma archeologinė ir pažinamoji kolekcija ir atliekami tyrimai
Databases

In order to systematize the collections of archaeological animal remains and make them available to other researchers and the general public, digital databases are essential. Currently, there are three databases in Estonia (TALAR, TARA, and ARHIS), where the zooarchaeological data are stored. In addition, a central dataset or search module (ARHEST) is in its developmental stage.

Among the three databases, where the zooarchaeological data is stored, two are general archaeological collection databases: one at the Tallinn University (TALAR – Tallinna Ülikooli Arheoloogia andmebaas) and the other at the University of Tartu (TARA – Tartu Ülikooli Arheoloogia infosüsteem). In these databases, animal bone collections are registered by bone boxes and/or find contexts and contain information about their actual location in the repositories (shelf number). TALAR and TARA are accessible for registered users, but also for guest users, who have limited access to some sensitive data. The third database is the most recent one (ARHIS – Arheoloogia Infosüsteem) and was developed within the Estonian Roadmap project. At the moment, the only module available in ARHIS is archaeozoology, but archaeobotany will be developed in the near future. The purpose of ARHIS is to register the detailed content of every single box, i.e., which taxa and which skeletal elements are there, in order to easily find a single bone specimen within an archaeological site and in the repository. For that purpose, a special ID number is generated to every specimen or group of specimens. The data in ARHIS include find location, taxon, anatomical part, bone unit, descriptive details, basic measurements, and of course, the repository and box number in which the specimen is stored.

ARHIS is only for registered users, but the identification details will be publicly available (open access) via ARHEST (Eesti arheoloogia andmekogud), which means that the authorship of bone analyses is an important issue. According to the ethics of scientific work, all data taken from ARHIS or ARHEST require correct referencing. Therefore, the name of the analyst is also registered in every database entry. When citing someone’s identification, the reference should contain the name of an analyst, year of the analysis, and reference to the database (e.g., Lõugas, L. 2020, Asva bone identifications, Estonian Archaeology Dataset ARHEST https://andmekogud.arheoloogia.ee. Tallinn University).

Another opportunity to save and publish research data is an open access repository at the University of Tartu (DataDOI). There, research data get a DOI (Digital Object Identifier) index and are therefore easily referrable.

Zooarchaeological research in Estonia in the last decade

Zooarchaeological research in Estonia is based in Tallinn and Tartu. At both universities, traditional methods, that is, taxonomical and anatomical identifications are applied with a support of the reference collections. Additionally, stable isotope and ancient DNA studies have become a common methodology within the ongoing science projects. Stable isotope analyses are being implemented in both Tartu and Tallinn. Ancient DNA studies are conducted at the University of Tartu in collaboration between the Department of Archaeology and the Department of Zoology, of which the latter manages the laboratories for both sterile and nonsterile work.

Zooarchaeological research in Estonia is generally not restricted to some certain time period, but includes materials from the Stone and Metal Ages up to the Modern Period. For a long time, animal remains from times as recent as the 18th or 19th century were usually discarded or not collected with precision, but recently, they have been started to be acknowledged as valuable evidence, and therefore, should be collected and recorded as any other zooarchaeological finds. For example, one exciting topic covering the last few hundred years is the first attempt of improving livestock and horses, and subsequently, the start of large-scale breeding. Although the period is covered with written documents, publications, and photos, the actual skeletal material (and the molecular data it contains) makes valuable evidence that could fill gaps in the history of breed development or provide essential information for the preservation of indigenous populations.
Basically, we have two types of zooarchaeological research projects in Estonia: those, where research questions are focused on animals and/or animal products, and those, where bone analyses help to answer archaeological questions. Below, we provide a few examples of the projects where animal bones constitute an important part of the study material.

Open access data in a contemporary scientific world has become very important, both for the researchers and funders, and for public users also. Therefore, projects that focus on organising data and developing databases, are essential. One of these is a three-year-project at Tallinn University (2020–2022, supported by the Research Foundation of Tallinn University) that focuses on archaeozoology and archaeobotany data management with the aim to develop databases and make previously obtained data publicly available. With a similar aim the project for the infrastructure of archaeozoological collections was done, where the above introduced repository Ossa and the ARHIS database were developed. The collections were included in the Estonian research infrastructures roadmap project “Natural history archives and information network” (NATARC), which developed services related to hosting and computing of scientific repositories and data archives. The project was carried out in 2016–2020 by the University of Tartu, and Tallinn University acted as a partner institution.

In addition to open access, the second important keyword for scientific research is interdisciplinarity. One of the late projects that involves specialists from many research fields, has focused on Viking Age boat burials in Salme, Saaremaa Island (supported by Uppsala University, Sweden, and Tallinn University), and investigated both human burials and mammal and bird remains (Peets et al. 2013; Maldre et al. 2018). International collaboration has also concerned topics like Bronze Age fauna in the eastern Baltic, including O- and Sr-isotope analyses; the archaeofauna of the southern Poland (e.g., Wilczyński et al. 2020); a history of seals in the Baltic with many new data of stable isotope analyses (Glykou et al. 2021) and a genetic history of horses, including samples from all over the world (e.g., Fages et al. 2019).

Another good example of interdisciplinary research is the team grant project “Foreign vs. local in Medieval and Modern Age foodways in the eastern Baltic: tracing the changing food consumption through provenance analyses” (2018–2022, supported by the Estonian Research Council). This is a true team project since it includes researchers and students from both universities, Tallinn and Tartu, and from different disciplines such as zooarchaeology, human osteology, archaeology, and history. The project focuses on archaeological and historical evidence and the extent of imported vs. local food, explores foodways of people who lived in the 13th–18th century Livonia, and carries out spatiotemporal provenance analyses, including stable isotope and aDNA studies (e.g., Aguraiuja-Lätti & Lõugas 2019; Lõugas & Bläuer 2020).

At Tartu, one of the most focused and again, very interdisciplinary work has been about domestic sheep and their population development through the last three thousand years, from the Late Bronze Age individuals to modern-day native breed (several projects between 2011–2019, supported by various funders, including the Estonian Research Council, Estonian Ministry of Education and Research, and European Union’s Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement). The research has been based on aDNA analysis (mitochondrial lineages, whole genome analysis, retroviral insertions), morphometrics, and the study of general sheep husbandry and consumption patterns in the zooarchaeological material. The research has demonstrated well how zooarchaeological data can be applied on the study and conservation of modern-day populations (e.g., Rannamäe 2016; Rannamäe et al. 2020).

Past animal husbandry and exploitation of faunal resources in general has been a very common research topic in Estonian zooarchaeology. At both universities, a large part of the zooarchaeological research has covered the utilisation of animals in the past and their role in human economy, culture, and society (e.g., Jonuks & Rannamäe 2018; Lõugas et al. 2019; Rannamäe & Lõugas 2019). Among other domestic species, cattle and goats have received lately more attention. In collaboration between Tartu and the University of Turku, Finland, and funded by the Academy of Finland, cattle and goats have been studied with an aim to reveal past cultural contacts in the Baltic Sea region. Cattle study has focused on oxen in Estonia and Finland, their use and distribution, and how
to distinguish them among the cattle bones (including molecular sexing). Goats, on the other hand, have been investigated through aDNA analysis in order to explore the maternal lineages in past and modern populations.

A major development at Tartu has been in the field of avian zooarchaeology. Since 2014, bird bones have gained a long-awaited attention. Together with the vast development of the bird reference collection, studies on Late Iron Age, medieval, and early modern bird utilisation have revealed a variety of consumption patterns and opened new discussions on the role of birds in the past (e.g., Ehrlich et al. 2020).

**Summary**

Last decade in zooarchaeological research and collection management in Estonia has shown quite good success. This progress is expressed by ongoing research projects and development of the infrastructure – digital databases and physical storage facilities. However, digital and physical collections will never be totally finished. They need continuous development and improvement. One of the important issues in modern research is data management, i.e., basic research data should be stored and should be re-usable by the next generation. The main aim of creating the archaeozoology databases and repository in Estonia was to make previously obtained data and collections available for the researchers and students. Because only if the collections are open and usable, new knowledge can be created. And only if the collections are managed properly, the faunal remains will preserve for future research.

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**References**

**Databases**

ARHEST: Estonian Archaeology Dataset. Available at: https://andmekogud.arheoloogia.ee.

ARHIS: database for the archaeozoological records. Available at: https://arhis.arheoloogia.ee.

DataDOI: institutional research data repository of University of Tartu, University of Tartu Library. Available at: https://datadoi.ee.

TALAR: Archaeology Database at the Tallinn University. Available at: https://talar.arheoloogia.ee.

TARA: Archaeology Database at the University of Tartu. Available at: https://tara.ut.ee.

**Publications**


Norint įsivaizduoti zooarcheologinių tyrimų reikšmę Estijoje, reikia suprasti, kiek ir ką mokėme apie gyvūnų praeitį, kaip jie kovojo su aplinka, kaip jie panaikino arba pateko į mūsų gyvenimą. Tai yra ne tik mūsų istorijos dalis, bet ir vienas svarbių žingsnių į priekį įkūnijant mūsų žemės ūkio, gyventojų ir aplinkos praeitį. Gydant gyvūnų kaulus, mums reikia atsiimti į aplinką kelias strategijas, kad būtų galima atspindinti visų trijų gyvūnų kaulų reikšmę Estijoje.
ketvirtajame dešimtmečyje, kai paleozoologiniai tyrimas susidomėjo Johanneselas Lepiksaaras. Jis įstyrė daugybę Estijos gyvenviečių faunos liekanas. Lepiksaaras ne tik tyre šiuolaikinius ir archeologinius Estijos bei Fenoskandijos gyvūnus, bet ir sukaupe didžiulę palyginamąją žuvų kaulų kolekciją, kuri dabar yra saugoma Talino universitete. Gerokai pagausėjo gyvūnų kaulų kolekcijai, kuriai reikėjo ir kitašių saugojimo sąlygų. XX a. ketvirtajame dešimtmečyje faunos liekanas buvo atskirtos nuo kitų archeologinių radinių ir pradėtos saugoti atskirai. XX a. ketvirtajame dešimtmečyje buvo pradėti ir tarpdalykiniai zooarcheologinių medžiagos tyrimai, tirtos žymuių Asvos (Saremos sala), Iru (Šiaurės Estija) ir Kundos Lammasmägi gyvenviečių kolekcijos. Karo metu tyrinėtojai atlikė mažąjį, nors 1942–1943 m. kainės Tamulos (Pietryčių Estija) ir Undva (Saremos sala) gyvenvietės.


bos keliai ir kilmēs vietos, jā vykdī Talino un Tartu universitētēs mokslininkai be studenta (Agraiuja-Lätti, Lōugas, 2019; Lōugas, Bläuer, 2020). Tartu universitēte aktīvi atliekām avi un tyrīmā. Šie tyrīmā atskleādī ūnā un gryvās īstās Estijā nuo vēl vēl broms amžais īk dabartīnu laiā. Keletā projektu šās temā finansuv Estijos un Evropas Sajungos fondu, jā metu buva atliekām avi un tyrīmā, morfoloģiskie tyrīmā, analīzētās avininkstēs pūbūdis un avienos vartojamo tendenciās (Rannamā, 2016; Rannamā et al., 2020). Abienes universitētu un nolātās atliekām īvairu laikotāru gryvininkstēs un gryvīlē eksploatacijas tyrīmā (Jonuks, Rannamā, 2018; Lōugas et al., 2019; Rannamā, Lōugas, 2019). Daugāusia dēmesio sulaukūsios gryvīlē rūsēs šīo metu yra priešistoriās un īstās laiā galvā un ožkās, kuriā genetiās un mor-
fologiskās tyrīmā atliekām Tartu un Turkū (Suomija) universitētu. Nuo 2014 m. dēmesio pagalīu susūlākē un paukšču liekanas – Tartu universitēte gerokā praplēsta palygināmoju jā kolekciju, o pirmieji analīzi rezultātu atskleādī, kokie paukščiās, kaip un kām Estijā buva naudojami priešistoriās un īstās laikās (Ehrlich et al., 2020).