Tangled worlds – The Swedish, the Sámi and the reindeer

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Abstract

Reindeer pastoralism developed among the indigenous Sámi of northern Fennoscandia, but the established colonial relationship with Sweden brought on an expanded use of reindeer. Tradesmen, priests, and officials of Swedish origin benefited from domesticated reindeer in many ways – trading reindeer products and using reindeer as transport during winter trips to marketplaces. Reindeer were, therefore, in many ways focal in the encounters between the Sámi and the Swedish. In this paper, we use zooarchaeology, stable isotope analysis, and ancient DNA analysis to interpret reindeer remains from towns, marketplaces, and agrarian settlements in medieval and early modern northern Fennoscandia. We argue that reindeer played important roles in contacts and encounters. The Sámi, the Swedish, and the reindeer formed a multispecies community. The exploration of the relationships in this multispecies community captures the complexity of human and human-animal relationships in colonial encounters. Moreover, it emphasizes the importance and agency of animals in colonial histories.

Key words Sámi archaeology, Fennoscandia, Reindeer, Zooarchaeology, Stable isotope analysis, Ancient DNA analysis

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Introduction

Reindeer are ubiquitous in northern Fennoscandia. Wild and later domesticated reindeer have played important roles in the subsistence, lifeways, and cosmology of northern peoples from the Stone Age onwards (Helskog 2011). Reindeer remains are also common at archaeological sites in Fennoscandia, including medieval and early modern urban and agrarian sites (Backe 1995; Vretemark 1995; Puputti 2010; Salmi 2011; Salmi and Kuokkanen 2014; Vretemark 2014).

However, their origin and domestication status has remained a mystery because of the presence of two reindeer subspecies, the co-occurrence of wild reindeer hunting and reindeer pastoralism, and the methodological difficulties in identifying different types of reindeer.

This paper addresses these problems by means of zooarchaeological, stable isotope, and ancient DNA (aDNA) analyses of reindeer remains. We combine faunal analyses from seven archaeological sites in present-day northern Finland and Sweden with a small sample of stable isotope and aDNA data to look at the different kinds of reindeer present at these sites. Morphological analysis and age profiles are usually not indicative of reindeer domestication status in faunal assemblages from northern Fennoscandia due to reasons related to reindeer biology and the variability of reindeer herding practices. However, the anatomical distribution of reindeer remains can be used to infer whether the animals were slaughtered locally or whether people mainly bought reindeer meat as meat cuts. Stable isotopes (^{15}N and ^{13}C) may indicate reindeer feeding practices. Ancient DNA is used to infer whether the animals were wild or domesticated. We targeted the mitochondrial control region, because as mitochondria are present in multiple copies per cell, mitochondrial DNA is more likely to be recovered from degraded specimens. Additionally, mitochondrial control region sequences have previously been used to identify possible wild and domestic individuals (Røed et al. 2008; Bjørnstad et al. 2012; Røed et al. 2012; Røed et al. 2014), whereas at present, no nuclear DNA markers are known that are suitable for degraded DNA and could be used for this purpose.

After this, the paper expands into an exploration of reindeer as a nexus of colonial relationships between the Swedish and the indigenous Sámi. Medieval and early modern northern Fennoscandia was a melting pot of cultures, languages, and lifeways, as well as an area increasingly enmeshed in colonial relationships. Reindeer pastoralism developed among the Sámi from the Late Iron Age onwards (Bjørklund 2013). Later, in the medieval and early modern periods, some tradesmen,

officials, and priests also owned the reindeer they used for winter transportation (Mäntylä 1971:109; Kortesalmi 2008:63–64,73–81). Reindeer products such as meat, skins, and crafts were important trade goods in the trade between the Sámi and the growing agrarian and urban populations in the northern parts of Fennoscandia (Luukko 1954:396–397; Virrankoski 1973:453–454). Moreover, the use of reindeer as a means of transportation in the vast northern landscape without roads was common to both tradesmen and Sámi reindeer herders. The paper presents a detailed look into the different types of reindeer present at these sites, as well as the range of social and multi-species relationships that were linked to the presence of these animals. It also allows the examination of animals as historical actors along with humans in a colonial world (DeJohn Anderson 2004).

The Swedish and the Sámi

From the thirteenth century onwards, the Swedish crown, as well as the state of Novgorod, took an increased interest in the northern areas. According to the historical record, trade and settlement politics and Christianization were the main tools used to attach local societies to the state (e.g., Wallerström 1995a:52–63; Vahtola 1991:184). More specifically, parishes, marketplaces, and towns were established, churches were built, and rights to appropriate land for farming and tax breaks were promised to farmers settling in the northern river valleys on both sides of the Gulf of Bothnia (Wallerström 1995a:52–63; Vahtola 1991:184). Recent research has revealed, however, that local populations had considerable impact on and agency in the colonization process, acting as mediators and negotiating the terms with the crown and its officials – in fact, the cooperation of local societies was essential for the successful Swedish colonization of the area (Bergman and Edlund 2016; Kuusela et al. 2016).

In the late medieval and early modern periods (ca. 1400–1700 AD), the area that later became northern Sweden and present-day northern Finland was inhabited by the indigenous Sámi, who

practiced a mixed livelihood of reindeer herding, fishing, hunting, and gathering, as well as by an agrarian society using a variety of wild resources. The identity and cultural practices of the agrarian population were the results of an amalgamation of identities of local Iron Age societies and settlers from southern Fennoscandia and Karelia (in present-day eastern Finland and southeastern Russia) (Ylimaunu et al. 2014; Bergman and Edlund 2016; Kuusela et al. 2016). These societies mixed and interacted in many ways. For instance, the *birkarls*, an organization of powerful merchant-farmers residing on the western coast of the Gulf of Bothnia and in the southern parts of the Tornio River valley, acted as middlemen in the trade between the Sámi and local farmers, and eventually the king of Sweden (Vahtola 1991:218–224; Bergman and Edlund 2016). They also collected taxes (Vahtola 1991:218–224; Bergman and Edlund 2016). Officials of the crown and priests resided in coastal parishes and towns, performing official and business duties with the Sámi and other inland populations on their winter trips to the north (Kortesalmi 2008: 66–73).

The Swedish state effectively colonized the Sámi and their lands. However, the process was slow. It included multiple types of interaction between societies, and the day-to-day interactions between people of different ethnicities were complicated. Late medieval and early modern northern Fennoscandia was a melting pot where people of different origins met and created new hybridized cultural practices (e.g., Olsen et al. 2011; Salmi et al. 2014; Ylimaunu et al. 2014; Kuusela et al. 2016). Moreover, the Swedish and the Sámi were linked by economic and familial ties (Vahtola 1991:190; Bergman and Edlund 2016). They also shared social customs, subsistence activities, lifestyles, and material culture (Vahtola 1991:190; Bergman and Edlund 2016; Salmi et al. 2014).

In the seventeenth century, a clearer colonial agenda and an ideology with clearly unequal power relations emerged. Colonialism refers to a situation of unequal power relations between peoples where one is able to exploit the other based on political, economic, or ideological differences (e.g.,

Reinhard 2001; Piñón 2002:114). The way the Swedish crown acted in the Sámi land is consistent with the characteristics of colonialism (Lehtola 2015). In the seventeenth century, the crown began to control and use the northern resources by concentrating trade in certain towns and marketplaces and by establishing mines and other related production sites (Luukko 1954:196–199,204; Wallerström 1983:44,50; Vahtola 1987; 2005; Lindmark 2013). An agrarian and sedentary lifestyle became seen as the proper Swedish way to live (Nurmi 2009; Lindmark 2013). Moreover, the crown attempted to replace the traditional Sámi social organization, the *siida*, by Swedish administration (Lehtola 2015). Christianization of the Sámi also intensified from the seventeenth century onwards (Kylli 2012).

People and reindeer in northern Fennoscandia

Mainland northern Fennoscandia is home to two reindeer subspecies, mountain reindeer (*Rangifer tarandus tarandus*) and forest reindeer (*R.t. fennicus*). Wild mountain reindeer were previously extant in the whole mountain area of northern Fennoscandia and forest reindeer all over the taiga zone of northern Finland (Helle 1982: 13). Wild reindeer hunting was an important source of livelihood for the different populations inhabiting the area from the Stone Age onwards (e.g., Myrvoll et al. 2011). It continued until the seventeenth century and even later in spite of the decreasing numbers of wild reindeer and the onset of reindeer pastoralism (Tegengren 1952; Luukko 1954:111; Virrankoski 1973:271–272; Enbuske 1995:171,350; Kortesalmi 2008: 23–24; Myrvoll et al. 2011).

The domesticated reindeer of Scandinavia were domesticated from the wild mountain reindeer (Roed et al. 2008). The transition to reindeer pastoralism probably began between the eighth and eleventh century (Bergman et al. 2013; Bjørklund 2013). It was a focal means of livelihood around the sixteenth century in the mountain areas of Sweden and Norway (e.g., Bjørnstad et al. 2012;

Bergman et al. 2013; Bjørklund 2013). From then on, reindeer pastoralism spread and became a major source of livelihood, as well as the basis for social organization, in many areas (Wallerström 2000; Sommerseth 2011; Mulk 2009; Bjørnstad et al. 2012; Bergman et al. 2013; Bjørklund 2013; Hansen and Olsen 2014: 195-206). It has to be noted, though, that the transition to pastoralism occurred at different times in different areas (Tegengren 1952).

In addition to the Sámi, domesticated reindeer were important to other groups as well. The *birkarls,* merchants in towns, crown officials, and priests owned reindeer that they used for pulling sleighs during winter voyages to marketplaces. Sámi reindeer herders took care of these reindeer (Mäntylä 1971:109; Kortesalmi 2008:44–52, 73–81). The agrarian population in northeastern Finland adopted reindeer husbandry from the Sámi from the late seventeenth century onwards (Kortesalmi 2008:137–174).

Archaeological material

The archaeological sites are farm sites, urban sites, and marketplaces situated in present-day northern Sweden and Finland (Fig. 1). Faunal analyses (Table 1) from these sites have been previously reported or published. In this paper, we rely on osteological reports and published data (Ohtonen 1984; Backe 1995; Vretemark 1995; Puputti 2010; Salmi 2011; Salmi & Kuokkanen 2014; Vretemark 2014). Samples for stable isotope and aDNA analyses were taken from the assemblages from Oulu, Tornio, Oravaisensaari, and Ylikylä (Table 2).

Oulu

The town of Oulu was founded on the mouth of the Oulujoki River in 1605. A number of archaeological excavations have taken place in the town. The faunal material analyzed derives from the excavations conducted in Pikisaari, Byströmin talo, Virastotalo, Lyseo, Kajaaninkatu, and

Franzenin puisto. The locations were residential plots that belonged to various social groups, such as merchants and in some cases craftsmen, along with their families (Salmi and Kuokkanen 2014). The faunal remains from these excavations date from the early seventeenth century to the turn of the eighteenth and nineteenth centuries (Salmi & Kuokkanen 2014).

Björsbyn

Björsbyn was a village situated to the north of the town of Luleå and partially excavated in 1921. Two foundations of timber-framed houses with two fireplaces and the remains of a cellar were excavated. Archaeological evidence suggests that the houses were inhabited in the fifteenth and sixteenth centuries (Liedgren and Bergman 2015).

Gamla Kyrkby

In the medieval period, the archaeological site of Gamla Kyrkby was a marketplace situated on the mouth of the Piteå River. Archaeological excavations were conducted at the site in the late 1960s and early 1970s. During the excavations, a number of building remains along with a large artefact assemblage indicative of a wide trade network were investigated. Archaeological evidence suggests that the site was used in the fourteenth and fifteenth centuries (Wallerström 1995b).

Tornio

The town of Tornio was founded on a former marketplace in 1621 (Mäntylä 1971:33–36). Archaeological excavations were conducted in Tornio throughout the 1990s and 2000s. Plots in different areas of the town were excavated and archaeological remains dating from the seventeenth to the nineteenth century were discovered. The faunal materials covered in this paper derive from excavations at the sites of Keskikatu, Westring, Purra and Aho, Aspio and Viippola, and Välikatu. They date from 1621 to ca. 1800 (Puputti 2010). The cultural layers investigated in these

excavations represent residential plots inhabited by merchants, with the exception of the richest ones, whose households were located in areas that have not yet been investigated (Mäntylä 1971:125–126,244; Ylimaunu 2007:18–19).

Oravaisensaari

Oravaisensaari is an island located in the Tornionjoki River a few kilometers upstream from the river mouth. The island was part of the village of Vojakkala, which was one of the largest villages in the river valley (Koivunen 1991:142; Vahtola 1991:241). Historical records indicate that there was agrarian settlement at the site from the sixteenth century onwards (Vahtola 1991:241). The village of Vojakkala was home to a number of *birkarl* families throughout the sixteenth and early seventeenth centuries (Vahtola 1991:241).

In 1973–74 and 1980, archaeological excavations were conducted in the area where the house of *birkarl* Niilo Niilonpoika Oravainen was supposedly located in the late sixteenth century (Koivunen 1991:142). In the excavations, the identity of the farm's inhabitants remained unconfirmed, but building remains and other finds, including animal remains, were unearthed. The building remains and most of the finds dated from the fifteenth to the seventeenth century (Koivunen 1991:142–145).

Kyrkudden

Kyrkudden is located on the western shore of the Tornionjoki River. During the excavation, a cemetery dating from the eleventh to the seventeenth century was investigated. In addition to the cemetery, there were remains of a marketplace that was established in the fourteenth century. The marketplace remained in use until the seventeenth century (Wallerström 1995b). The faunal remains derive from the marketplace (Vretemark 1995).

Ylikylä

The oldest agrarian settlement in the Rovaniemi parish was probably located in the village of Ylikylä (Paavola 1995). The village is located on the bank of the Ounasjoki River. Historical records of settlement at the site date back to the late medieval period, possibly to the mid-fifteenth century (Kostet & Närhi 1979; Paavola 1985).

The site was excavated in 1978–79 and 1982–83. During the excavations, building remains and other finds dating from the late fourteenth to the seventeenth century were discovered (Paavola 1995). The faunal remains analyzed originate from contexts interpreted as remains of fireplaces dating from ca. 1400–1700 (Salmi 2011).

Zooarchaeological analysis

Due to morphological similarity and overlapping size, it is often impossible to tell apart wild forest reindeer, wild mountain reindeer, and domesticated reindeer based on fragmentary archaeological remains. Moreover, the identification of hunting or herding cultures is complicated by the various hunting and herding strategies employed (Luukko 1954:162–164; Vuorela 1975:57–58; Hambleton and Rowley-Conwy 1997; Jomppanen and Näkkäläjärvi 2000; Myrvoll et al. 2011; Lahti 2006; Korhonen 2008:137). Therefore, the analysis of age profiles provides inconclusive results on the domestication status of the animals. However, the analysis of skeletal frequencies can be used to obtain information on meat supply networks.

The anatomical distribution of reindeer remains is presented as the number of identified specimens (NISP), minimum number of elements (MNE), and modified anatomical units (MAU) (Table 3). The underlying assumption is that unequal skeletal frequencies may indicate meat cut trade. Here, the amounts of upper limb bones and vertebrae on one hand, and cranium and extremities on the

other, are analyzed based on NISP counts. Percentages based on MNE counts – that circumvent the problem of different numbers of bone elements in the cranium and extremities in comparison with the upper limbs and vertebrae – are presented for Ylikylä, Oravaisensaari, Tornio, and Oulu. For Gamla Kyrkby, Kyrkudden, and Björsbyn, MNE counts could not be calculated due to missing information in the publications or osteological reports. Therefore, we rely on NISP-based anatomical distributions for these sites and compare them to the NISP-based values from the other sites. It is assumed that although virtually all body parts of reindeer could be used for food preparation (Soppela 2000), the meat-poor cuts, including cranial bones and extremities, were rarely traded.

The MNEs of meatier body parts (upper limb bones and vertebrae) and less meaty body parts (extremities and cranium) are roughly equal between the Ylikylä and Oravaisensaari assemblages (Table 3; Fig. 2). This suggests that animals were slaughtered and consumed locally. When using NISP counts for these two sites, the percentages of meatier body parts are lower, ca. 20–40%, due to the high degree of fragmentation and high number of cranial bones in the mammalian skeleton. The NISP-based distributions from Gamla Kyrkby and Kyrkudden are similar to those from Oravaisensaari and Ylikylä, suggesting that a similar interpretation of animals being butchered and consumed locally is likely to be valid. On the contrary, in Oulu, Tornio, and Björsbyn, meaty body parts are clearly more abundant. This points towards the trade of meat cuts. However, it should be noted that the sample sizes of some of the assemblages were very small. Furthermore, the different quantification methods used due to the lack of data in some of the osteological reports complicated the comparison of anatomical distributions of reindeer remains from different sites.

In sum, zooarchaeological data suggests that reindeer were slaughtered locally in Oravaisensaari, Ylikylä, Gamla Kyrkby, and Kyrkudden, whereas in Oulu, Tornio, and Björsbyn, the reindeer remains probably originate from meat cuts.

Ancient DNA analysis

Ancient DNA analyses were made on four samples (Table 2: samples 5–8) with the aim of finding out whether the animals were wild or domesticated. All laboratory work prior to PCR cycling was conducted in a dedicated ancient DNA laboratory located at the Center of Microscopy and Nanotechnology at the University of Oulu. Stringent measures were followed in order to prevent contamination. First, the outer layer of the bones was removed using a drill bit, after which bone powder was obtained by drilling inside the bone. DNA was extracted from the bone powder using the protocol described by Yang et al. (1998) with the modifications proposed by Gamba et al. (2014) and Gamba et al. (2016), with the exception that double digestion was not performed. Blank extraction controls were included in the batch to monitor contamination.

PCR was used to amplify part of the mitochondrial control region in three overlapping fragments. The PCR primers used are shown in Table 4. PCR reactions were performed in volumes of 25 µl with 1X PCR Buffer (QIAGEN), 2.5 mM MgCl2, 0.2 µM of each primer, 0.2 mM dNTPs, 1 mg/ml BSA, 2 units of HotStarTaq DNA Polymerase (QIAGEN), and 2 µl of DNA extract. The cycling protocol consisted of initial denaturation at 95°C for 10 minutes, followed by cycling between denaturation at 94°C for 30 seconds, annealing for 30 seconds, and extension at 72°C for 30 seconds, so that the annealing temperature was lowered from the initial 58°C by one °C in every cycle until an annealing temperature of 50°C was reached. After this, the cycling was continued for 55 cycles with the annealing temperature of 50°C, and the PCR was ended with final extension at 72°C for 7 minutes. In order to identify possible misincorporated bases resulting from post-mortem

DNA damage, each PCR was replicated. Negative controls were included in PCR. The PCR reactions were purified using Exonuclease I and Shrimp Alkaline Phosphatase, after which sequencing reactions were performed using the BigDye® Terminator v1.1 Cycle Sequencing Kit (Thermo Fisher Scientific). Sequencing products were run on ABI 3730 DNA Analyzer (Applied Biosystems). DNA sequences were inspected and edited using the CodonCode Aligner program (Version 4.0.4, CodonCode Corporation). We were able to replicate all PCR fragments except one fragment for sample 8. In this case, the corresponding PCR primer pair did not amplify a second time. None of the extraction or PCR blanks amplified in any PCRs. The sequences from this study are deposited in GenBank under the accession numbers MH010859-MH010862.

We compared the obtained consensus sequences to a large reference data set consisting of modern (Røed et al. 2008) and historical (Bjørnstad and Røed 2010; Røed et al. 2011; Bjørnstad et al. 2012) reindeer from Fennoscandia. Sequences were aligned in MEGA7 (Kumar et al. 2015) using the ClustalW algorithm and truncated to equal lengths. The final data set was 183 bp in length and consisted of 488 sequences. PopART (Version 1.7, http://popart.otago.ac.nz) was used to build a Median-Joining network (Bandelt et al. 1999).

As seen in the network (Fig. 3), the study samples are most closely affiliated with ancient reindeer from Finnmark in Norway and modern Finnish forest reindeer. They are not closely related to modern domestic reindeer from Fennoscandia or the domestic reindeer of the twentieth century from northern Fennoscandia. More specific affiliations of the study samples are described here. Sample 5 (Table 2) is located in the central part of the network with a unique haplotype, which is one mutation away from ancient reindeer from Finnmark and modern Finnish forest reindeer. Samples 6 and 7 share a haplotype with ancient reindeer from Finnmark mostly from the period between ca. 3400 and 500 BCE. Sample 8 has a haplotype typical of modern Finnish forest

reindeer. Sample 8 had one base Y (C or T) in a position that has variation in the data set. We therefore also built a Median-Joining network without this sample. The resulting network (not shown) is similar to that in Figure 3, except for samples 6 and 7, which have haplotypes that differ from each other by one mutation. Both of them, however, share their haplotype with ancient reindeer from Finnmark.

The close relationship of the study samples and the ancient samples from Finnmark is interesting. Based on the size of the archaeological reindeer from Gressbakken in Finnmark (2000–1500 BCE), on their genetic proximity to modern Finnish forest reindeer, and on the fluctuating vegetation history, Bjørnstad et al. 2012 hypothesized that these reindeer may have been forest reindeer. When this is taken into consideration, along with the backcast distribution of forest reindeer in Finland in historical times (Luukko 1954:111; Virrankoski 1973:271–272; Lundmark 1982:161) and the relatedness to modern Finnish forest reindeer, the most parsimonious interpretation for the status of the reindeer studied here is that they are forest reindeer. Because Finnish forest reindeer are not known to have provided a significant genetic contribution to the modern Fennoscandian domestic pool (Røed et al. 2008), the genetic results suggest that these individuals were wild. This interpretation, however, is not without caveats. Firstly, modern and early-twentieth-century domestic populations do not necessarily represent all the genetic diversity of historical domestic reindeer in northern Europe. The genetic composition of Fennoscandian wild and domestic herds has changed significantly during historical times (Bjørnstad and Røed 2009; Røed et al. 2011; Bjørnstad et al. 2012; Røed et al. 2014). Secondly, domestic and wild reindeer readily interbreed. This sometimes makes it difficult to use maternally inherited mitochondrial DNA to distinguish with full certainty between wild, domestic, tundra, and forest reindeer individuals. Because of these issues, more powerful genetic analyses, such as those based on ancient genome-wide data, are warranted to more securely identify between historical wild and domestic individuals. In sum, the

aDNA suggests that the individuals analyzed were wild, but more detailed data would be needed to show this conclusively.

Stable isotope analysis

Stable isotope analysis can be used to assess a number of factors ranging from mobility to diet and weaning age. Here, the analyses of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) are used to evaluate human influence on reindeer diet. $\delta^{13}C$ is indicative of terrestrial/marine components in the diet, as well as environmental factors, whereas $\delta^{15}N$ can be used to assess the trophic level of the individual (Eriksson 2013). Analysis of samples 1–4 is described in detail in Lahtinen & Salmi (2018). Samples 5–8 were radiocarbon dated and analyzed for stable isotopes at the Laboratory of Chronology at the University of Helsinki. Collagen was extracted using a modified Longin (1971) method. Radiocarbon analysis was conducted using an AMS instrument and stable isotope analysis using the EA-IRMS (Elemental Analyzer-IRMS; NC 2500 + Thermo Finnigan Delta Plus Advantage) instrument (Oinonen 2017a; 2017b). Dating results are presented in Table 2.

The mean $\delta^{13}C$ value in the reindeer bone samples was -19.8‰, with a range from -19‰ to -21.6‰ and a standard deviation of 1.0 (Table 2; Fig. 4), which is within the expected range for reindeer on a terrestrial, lichen-rich diet (Drucker et al. 2008; Salmi & Fjellström n.d.).

The mean $\delta^{15}N$ value in the reindeer bone samples was 4.2‰, ranging from 2.0‰ to 5.6‰. The standard deviation was 1.4 (Table 2). The bone $\delta^{15}N$ values of reindeer with lichen-rich diets and not influenced by humans are ca. 1.4–3.1‰ (Drucker et al. 2001; Fjellström 2011; Salmi and Fjellström n.d.). We have preliminary evidence suggesting that reindeer feeding, specifically supplementary winter feeding with twigs and grasses that have higher $\delta^{15}N$ values than lichen, which comprises the natural winter diet, elevates $\delta^{15}N$ values in reindeer (Salmi and Fjellström

n.d.). The $\delta^{15}N$ values are also elevated in young reindeer up to the age of ca. one year. Lactation, which continues up to the age of ca. 6–7 months (Nieminen and Pietilä 1999:116), elevates nitrogen values because the calf is in effect feeding on its mother (Eriksson 2013). After weaning, $\delta^{15}N$ values stay elevated up to the age of ca. one year due to the recycling of body protein in the winter (Nieminen 1994; Parker et al. 2005; Barboza and Parker 2006). Starvation elevates $\delta^{15}N$ because muscle proteins are consumed for energy (Eriksson 2013).

Six samples had elevated $\delta^{15}N$ values, indicating young age, starvation, or a human-influenced diet. Young age cannot be ruled out as an explanation for three of these (3–4, 8). In the assemblage from Oulu, one individual with an elevated $\delta^{15}N$ value was over 1.5 years of age (1). In Ylikylä, two adult individuals had elevated $\delta^{15}N$ values (6–7). The individuals with a $\delta^{15}N$ within a normal reindeer range can derive either from wild reindeer or domesticated reindeer that were not given supplementary fodder. In sum, the isotope analyses did not yield conclusive indication of the presence or absence of human influence on reindeer diet.

Discussion: Tangled worlds

In Ylikylä, Oravaisensaari, Gamla Kyrkby, and Kyrkudden, faunal data point towards local butchery and consumption of reindeer. According to the historical records, the farmers settling in the Ylikylä and Oravaisensaari areas owned reindeer used for transportation purposes (Enbuske 1995:171,350; Kortesalmi 2008: 44–52). In the Ylikylä assemblage, two reindeer had elevated $\delta^{15}N$ values, possibly indicating a human-influenced diet. However, the aDNA evidence points towards wild reindeer both in Ylikylä and Oravaisensaari. Moreover, wild reindeer hunting was practiced in or near these areas up to the seventeenth century (Luukko 1954:111; Virrankoski 1973:271–272; Lundmark 1982:161; Enbuske 1995:171,350; Kortesalmi 2008:44), supporting the interpretation of the aDNA evidence as being indicative of wild forest reindeer. The faunal remains from Kyrkudden

and Gamla Kyrkby derive from cultural layers associated with marketplaces (Wallesträm 1995b;78,178–180). The reindeer from these assemblages may derive from domesticated reindeer that were slaughtered for consumption or sale at the marketplace (Wallerstöm 1995b:78). Marketplaces were meeting grounds for Swedish tradesmen and Sámi.

In the assemblages from Oulu, Tornio, and Björsbyn, meaty body parts were clearly more abundant. This probably means that the people in these places mostly bought the reindeer meat cuts they consumed. The merchants of Tornio owned reindeer that they used as draft animals on winter trade trips, but the relatively low number of reindeer bones in the urban faunal assemblage and their uneven skeletal profile suggest that most of the reindeer remains originated from meat cuts bought from the Sámi. In the assemblage from Oulu, one individual had an elevated $\delta^{15}N$ value, possibly indicating human influence on its diet. If that was the case, its meat was most likely sold to the consumer from Oulu by a reindeer herder, based on the fact that the population in the area did not herd or own reindeer themselves (Kortesalmi 2008:40).

This ambiguous interpretation of the data illustrates well the methodological challenges in interpreting reindeer remains from northern Fennoscandia. However, the complex and contradictory data can also be interpreted as evidence of the complexity of the relationships people at each site had with reindeer. There were many types of reindeer around: domesticated herds, transport reindeer, wild reindeer living in different ecological niches. Moreover, people engaged with the animals in different ways: as merchandise, wild game, property, companions, and helpers on winter journeys.

The environment and its animals are usually situated as the subjects of appropriation, disruption, and destruction in colonial contacts between Europeans and natives in different parts of the globe

(e.g., Crosby 1986). Indeed, the colonization of the Sámi lands has been described as environmental colonialism, where the natural resources of marginal areas are exploited for the benefit of others (Åström 1978:113; Massa 1994). The utilization of the natural resources of former colonies continues up to today (Huggan and Tiffin 2007). Also disputes about land use in Sámi areas continue today. For example, the mining industry and its effects on the environment and animals are debated in northern Fennoscandia (Ojala and Nordin 2015).

However, the roles of the environment and animals have probably been more complex and multifaceted in past colonial encounters. Animals have acted in different roles in colonial contexts. There were symbolic associations between certain ethnicities and animal species. Sometimes animals played active roles in the contacts between ethnic groups (DeJohn Anderson 2006). Recent work on multispecies ethnography (Kirksey and Helmreich 2010) and archaeology (Pilaar Birch 2018) has emphasized that humans and animals are bound together within multispecies webs consisting of several species and that the lives of the organisms bound in these webs are shaped by political, economic, and cultural forces (Haraway 2008:165,216; Kirksey and Helmreich 2010; Domanska 2018). In northern Fennoscandia, the encounters, relationships, and practices that connected the Sámi and the Swedish often had to do with reindeer, which shows how these animals acted as mediators, facilitators, and active agents in colonial contacts. It also shows that the Sámi, the Swedish, and the reindeer formed a web that can be described as a multispecies community, a web of interacting organisms.

Archaeological and historical data suggest that reindeer were central in the trade relationships between the Sámi and the Swedish in many ways. The development of reindeer pastoralism has been linked to the growing need to produce reindeer products for the global market and for paying the taxes exerted by the emerging nation-states (e.g., Wallerström 2000), although reasons internal

to Sámi society contributed to the development of reindeer pastoralism (e.g., Bjørklund 2013). Among the Swedish, reindeer hides were an important export item in international trade. Other reindeer products, such as bone and antler crafts and meat, were bought and used by the Swedish urban and agrarian populations (Luukko 1954:396–397; Virrankoski 1973:453–454). The reindeer remains discovered in the archaeological assemblages from the towns of Tornio and Oulu, the village of Björsbyn, and the marketplaces of Gamla Kyrkby and Kyrkudden are probably indications of such trade.

Tradesmen, officials, and priests also needed a means of transport in the northern landscape without roads, and they used reindeer for that purpose (Fig. 5). Historical data indicates that although tradesmen, officials, and priests sometimes owned the reindeer they used for traction, the animals were in fact kept in the care of Sámi reindeer herders when not used for trips up north (Mäntylä 1971:109; Kortesalmi 2008:44–52). Sámi guides, reindeer drivers, and other helping hands were present during these trips (Kortesalmi 2008:103–108). The *birkarls* usually hired women to take care of their reindeer, probably because of the division of labor in the nomadic reindeer herding practiced in Tornio Lapland. The female reindeer keepers (*lappekonner* or *renekonor* in Swedish) took care of a *birkarl*'s reindeer and also engaged in their business activities. In many instances, there was a sexual relationship between the reindeer keeper and the *birkarl* (Kortesalmi 2008:49–52). Both women and men are mentioned as reindeer keepers for the officials and priests (Kortesalmi 2008:75), and the drivers were in sometimes poor people, women, or children less than ten years old (Kortesalmi 2008:101).

These arrangements add another dimension to the interactions between the Sámi, the Swedish, and the reindeer. The tradesmen, priests, and officials were dependent on the Sámi reindeer keepers, drivers, and guides and their knowledge of the animals and the landscape. Therefore, there were

different types of ties between the Sámi reindeer keepers, drivers, and guides, ranging from close relations between the *birkarls* and their reindeer keepers to one-time employment. In addition, there were also close relationships between the Sámi, the Swedish, and the draught reindeer. Draught reindeer were usually bulls that were castrated and trained for draught use. In such a relationship, a close companionship often forms between the human and animal partners, crossing species boundaries (Argent 2010; Vuojala-Magga 2010). Training a reindeer and working with it creates deep bonds and trust between the animal and the human. These deep bonds are based on trust, knowing the reindeer, and reacting to each other's feelings (Vuojala-Magga 2010). Also cohabitation and care tend to create mutual relationships between humans and individual animals (Oma 2010). Ethnographic evidence also suggests that the Sámi understood reindeer as persons who were capable of communication, emotions, intentional action, and meaningful relationships with people. Although reindeer personhood was different from human personhood, they lived in the same environment as people and shared moments of communication and reciprocity with them (Helander-Renvall 2010). Therefore, there were personal bonds between the Sámi reindeer drivers and herders, tradesmen, officials, priests, and the reindeer they worked with.

Conclusion

The identification of wild and domesticated reindeer in the archaeological record of northern Fennoscandia is complex. In addition to biological reasons, the problems in identifying different types of reindeer in the faunal assemblages stem from the multiple types of relationships people had with these animals – meat and hide production, hunting, transport, and ownership. Some of these relationships can be traced through zooarchaeology, aDNA analysis, and stable isotope analysis, as well as through contextual historical data.

We have traced the complex relationships between the indigenous Sámi, the Swedish, and the reindeer in late medieval and early modern Fennoscandia. Reindeer were central in the relationships between these societies in many ways – they acted as collaborators and mediators, as well as objects of ownership and trade. Reindeer pastoralism developed among the Sámi, but tradesmen, priests, and officials of Swedish origin benefited from domesticated reindeer in many ways – trading reindeer products and using reindeer for transport during winter trips in the northern landscape. The use of draught reindeer and Sámi reindeer herders to take care of them further tied together the Sámi, the Swedish, and the reindeer. From the late seventeenth century onwards, farmers also adopted reindeer husbandry from the Sámi, which illustrates well how both parties of a colonial encounter undergo cultural changes.

Recent research has shown that the interactions and power relations between Late Iron Age and medieval societies in northern Fennoscandia were complex, multifaceted and shifting (Ylimaunu et al. 2014; Bergman and Edlund 2016; Kuusela et al. 2016). We have attempted to show that also animals, especially reindeer, played important roles in the contacts and encounters between these societies. Together, the Sámi, the Swedish, and the reindeer formed a multispecies community, a web of interacting organisms. In the northern landscape, cooperation with reindeer was essential for carrying out a range of activities, including trade and professional responsibilities. Close-knit relationships formed between humans and the reindeer they were dependent on and worked with. Reindeer were active agents in shaping the relationships between the Sámi and the Swedish. The history of colonial contact between the Sámi and the Swedish is therefore also the history of reindeer.

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Figure captions

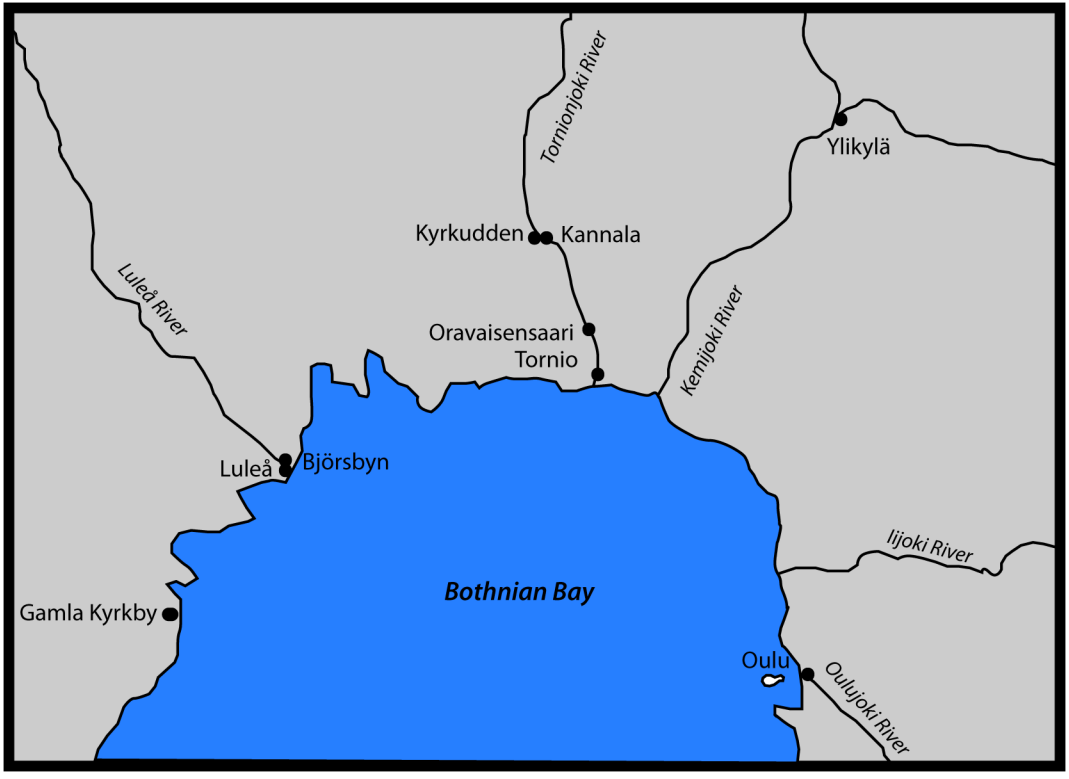
Figure 1. Map of northern Fennoscandia and the archaeological sites mentioned in the paper.

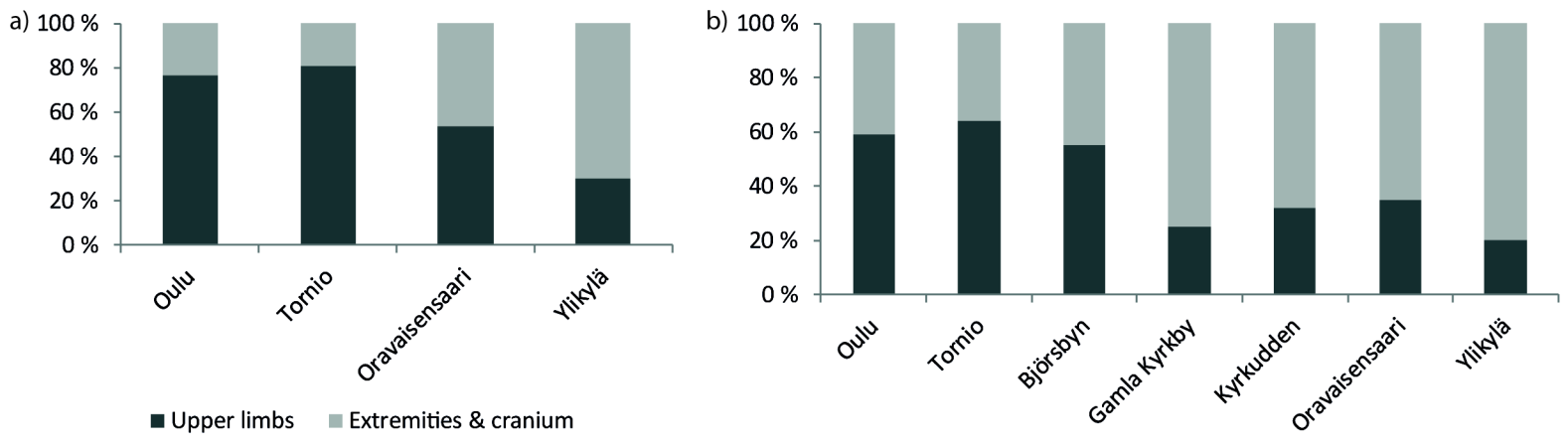
Figure 2. Percentages of cranial bones and extremities vs. upper limb bones as a) MNE and b) NISP. Only NISP counts are presented for some of the sites due to missing information in the osteological reports.

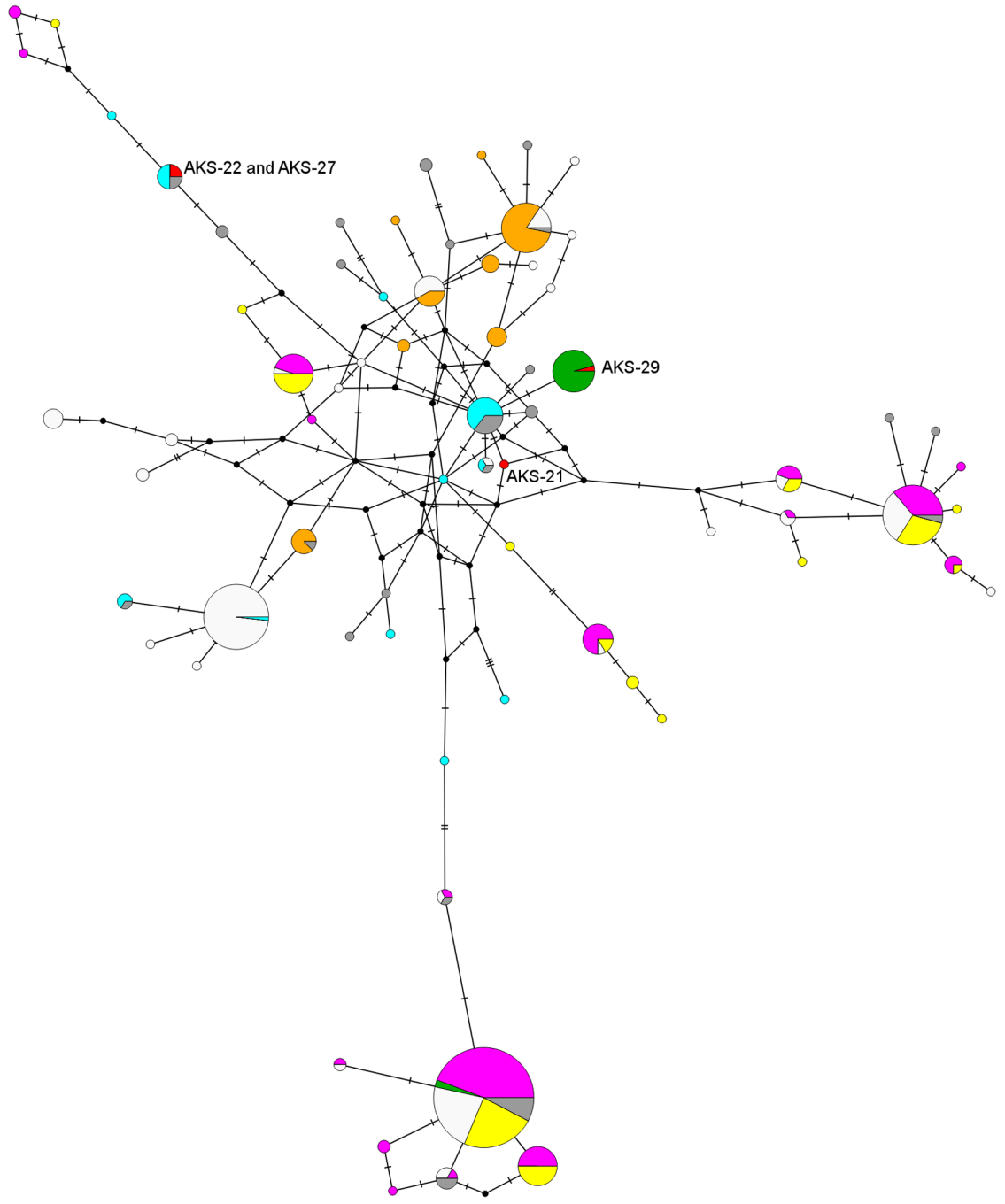
Figure 3. Median-Joining network of the study samples and the historical and modern reference samples. The samples are color-coded as follows: study samples in red, modern domestic reindeer from Fennoscandia in pink, domestic reindeer from the early twentieth century from northern Fennoscandia in yellow, modern Finnish forest reindeer in green, modern wild Norwegian mountain reindeer in white, reindeer from Hardangervidda from the period between ca. 1210 and 1310 AD in orange, reindeer from Finnmark from the period between ca. 3400 and 500 BCE in turquoise, and reindeer from Finnmark from the period between ca. 100 and 1750 AD in grey. The sizes of the circles correspond to the observed frequency of each haplotype. Mutations are shown as hatch marks and median vectors as black circles.

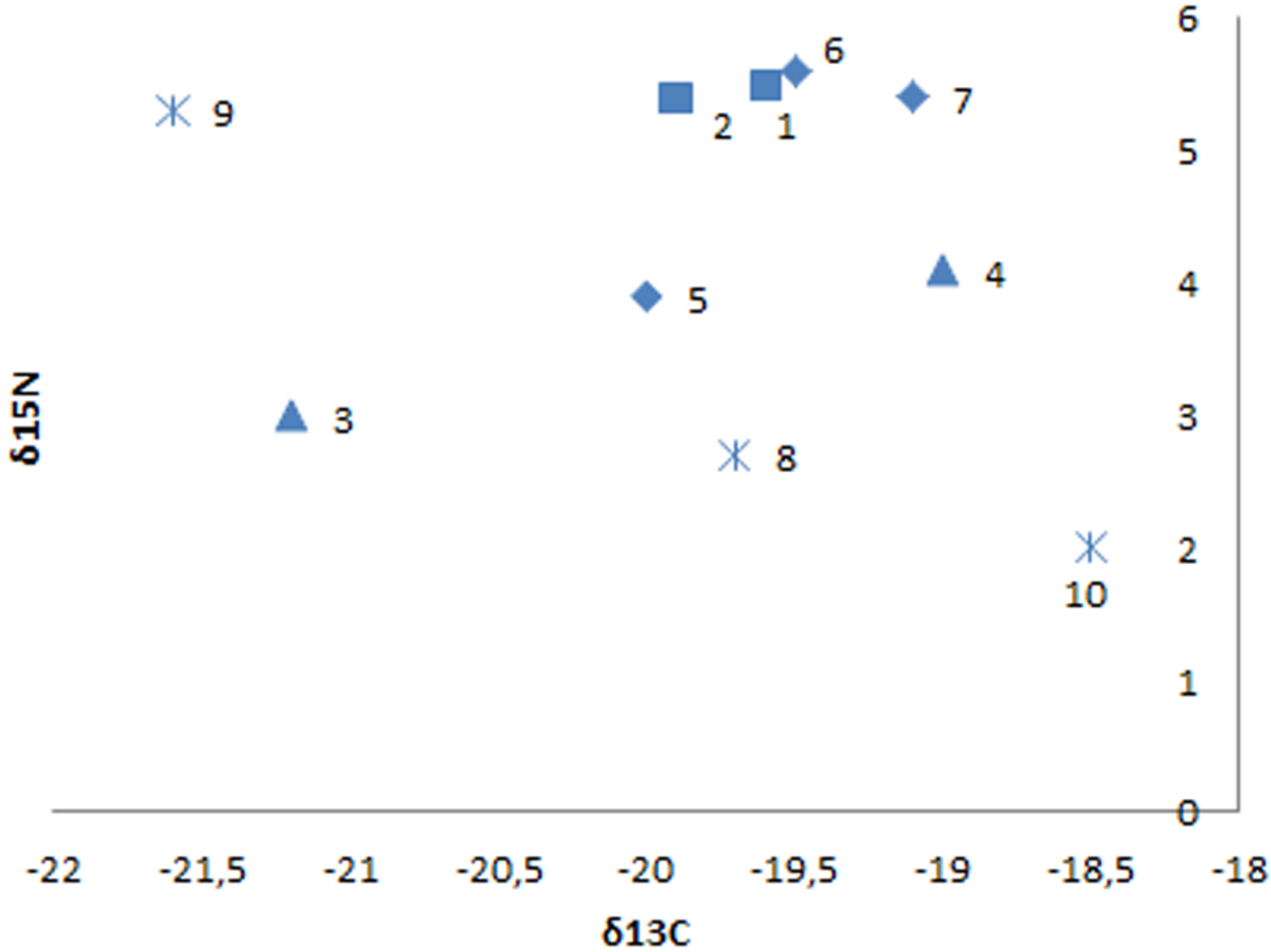
Figure 4. Scatterplot of $\delta^{13}C$ and $\delta^{15}N$. ■ Oulu, ▲ Tornio, ◊ Ylikylä, * Oravaisensaari.

Figure 5. Explorers and scientists travelling in northern Fennoscandia engaged with transport reindeer. Réginald Outhier travelled to Lapland with the expedition of Pierre-Louis Maupertuis, occasionally rode on reindeer sleighs, and documented the journey (Outhier 1975[1744]).


Torniojoki River
Ylikylä
Kyrkudden
Kannala
Luleå River
Oravaisensaari
Tornio
Kemijoki River
Luleå
Björsbyn
Iijoki River
Bothnian Bay
Gamla Kyrkby
Oulu
Oulujoki River


a)
100 %
80 %
60 %
40 %
20 %
0 %
Oulu
Tornio
Oravaisensaari
Ylikylä
Upper limbs
Extremities & cranium
b)
100 %
80 %
60 %
40 %
20 %
0 %
Oulu
Tornio
Björsbyn
Gamla Kyrkby
Kyrkudden
Oravaisensaari
Ylikylä


AKS-22 and AKS-27
AKS-29
AKS-21


6
5
4
3
2
1
0
δ15N
-22
-21,5
-21
-20,5
-20
-19,5
-19
-18,5
-18
δ13C
9
6
2
1
7
5
4
3
8
10

A. *Reene attelé au petit Traineau* B. *nommé Pulka sur la glace.* C. *Cabane de Lappons.* D. *Lappon marchant sur la neige avec une planche de Sapin a chaque pied, et un baton garni d'un Cerceau pour ne pas enfoncer dans la neige.*
EE. *Signaux dressés sur les Montagnes.*

Table 1. Species frequencies as NISP (Number if Identified Specimens) and MNI (Minimum Number of Individuals) (in brackets). In some cases, only NISP or MNI data is presented due to missing information in the osteological reports.

NISP/(MNI)	Oravaisensaari	Ylikylä	Tornio	Oulu	Kyrkudden	Gamla Kyrkby	Björsbyn
Cattle (Bos taurus)	94	52 (2)	1904 (27)	1293 (46)	(24)	2428	403
Sheep or goat (Ovis aries/Capra hircus)	40	3 (1)	782 (23)	474 (25)	(4)	1196	87
Pig (Sus scrofa domesticus)	32		282 (13)	227 (17)	(1)	497	36
Reindeer (Rangifer tarandus)	54	26 (2)	85 (10)	95 (5)	(8)	76	22
Elk (Alces alces)					(1)	123	
Horse (Equus caballus)	1		7 (2)	5 (1)	(3)	41	
Arctic hare (Lepus timidus)	7	1 (1)	239 (17)	52 (7)	(1)		
Beaver (Castor fiber)	1				(1)		
Red squirrel (Sciurus vulgaris)			3 (1)	1 (1)			1
Red fox (Vulpes vulpes)			16 (2)	9 (1)			
Dog (Canis familiaris)						1	
Ermine (Mustela erminea)				3 (1)			
Brown bear (Ursus arctos)	5						
Seal (Phocidae)	1		91 (3)	42 (9)		797	166
Wood grouse (Tetrao urogallus)	11	2 (2)	326 (17)	158 (21)	(1)		4
Black grouse (Tetrao tetrix)	2	1 (1)	73 (12)	79 (19)		24	
Willow grouse (Lagopus lagopus)	2		133 (18)	54 (13)		4	
Hazelhen (Bonasa bonasia)	1		7 (3)	26 (8)			
Chicken (Gallus domesticus)	1			7 (3)			
Black-throated loon (Gavia arctica)					(1)		
Goosander (Mergus merganser)			5 (1)	2 (1)			
Red-breasted merganser (M. serrator)			11 (2)				
Long-tailed duck (Clangula hyemalis)			1 (1)				
Greater scaup (Aythya marila)			2 (1)				
Tufted duck (Aythya fuligula)			2 (1)				
Greylag goose (Anser anser)			13 (5)			2	
Lesser white-fronted goose (Anser erythropus)			3 (1)				1

Bean goose (Anser fabalis)			24 (4)				
Whooper swan (Cygnus cygnus)			30 (5)	1 (1)			
Eurasian sparrowhawk (Accipiter nisus)						1	
Pike (Esox lucius)	9				(3)	34	
Perch (Perca fluviatilis)	5				(5)	17	3
Bream (Abramis brama)	2					6	
Cod (Gadus morhua)							1
Burbot (Lota lota)						1	
European whitefish (Coregonus lavaretus)							1
Pike-perch (Sander lucioperca)		4 (1)					
Salmon or trout (Salmo sp.)	8			1			1
Total NISP (MNI)	276	89 (10)	4049 (169)	2529 (179)	(53)	5248	726
% reindeer bones NISP (MNI)	20	29 (20)	2 (6)	4 (3)	(15)	1	3

Table 2. Samples taken for stable isotope and aDNA analysis and the results of stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$). Stable isotope data from Lahtinen and Salmi (2018) (1-4), Oinonen 2017a, 2017b (5-9). Age estimations for long bone epiphyseal fusion Takken-Beijersbergen and Hufthammer (2012).

Sample No.	Sample ID	GenBank no.	Site	Skeletal element	Age (months)	dC13(‰)	dN15(‰)	% C	% N	C/N	Dating ID	BP	cal AD/*Context date*
1	OFRA-1-D		Oulu	Tibia dist	>18-30	-19,6	5,5	43,0	15	3,4			*17th century*
2	TOKE-4023		Tornio	Humerus dist	> 6-15	-21,2	3	43,3	13	4,0			*1621-1660*
3	TOKE-SY22P		Tornio	Humerus dist	>6-15	-19	4,1	44,6	16	3,3			*1621-1660*
4	ROTI-1458		Ylikylä	Humerus	>6-15	-20	3,9	44,9	15	3,5			*1449-1706*
5	AKS-21	MH010859	Ylikylä	Metatarsal	>18-30	-19,5	5,6	41,3	16	3,1	Hela 4056	261±21	1527-1797
6	AKS-22	MH010860	Ylikylä	Tibia dist	>18-30	-19,1	5,4	41,4	15	3,2	Hela 4057	440±21	1426-1471
7	AKS-27	MH010861	Oravaisensaari	Ulna prox	>42-48	-19,7	2,7	39,3	15	3,2	Hela 4062	445±22	1425-1467
8	AKS-29	MH010862	Oravaisensaari	Antler		-21,6	5,3	37,2	14	3,2	Hela 4064	514±21	1401-1441
9	AKS-30		Oravaisensaari	Metatarsal prox		-18,5	2	35,8	13	3,1	Hela 4065	375±22	1448-1629

Table 3. Skeletal frequencies as NISP, MNE and MAU. In some cases, only NISP data is presented due to missing information in the osteological reports. The data from Gamla Kyrkby is missing due to missing sample sizes in percentage calculations in the osteological report.

	Oulu*			Tornio			Oravaisensaari			Ylikylä			Björsbyn	Kyrkudden
Anatomical element	NISP	MNE	MAU	NISP	MNE	MAU	NISP	MNE	MAU	NISP	MNE	MAU	NISP	NISP
Cranium	8	1	1,00	5	2	1,00	25	5	5,00	7	2	2,00	4	7
Antler							7	1	0,50					5
Scapula	4	4	2,00	8	4	2,00							2	
Humerus	13	11	5,50	17	16	8,00	6	4	2,00	1	1	0,50	3	1
Radioulna	10	6	3,00	3	3	1,50	4	3	1,50	3	2	1,00		
Pelvis	10	3	3,00	3	2	1,00	6	3	1,50				3	3
Femur	10	6	3,00	11	7	3,50	3	2	1,00				2	3
Tibia	11	9	4,50	1	1	0,50	5	4	2,00				2	
Metacarpus										1	1	0,50	2	
Metatarsus							4	4	2,00	5	2	1,00	4	
Metapodial I/IV	4	2	1,00											
Carpals	14	6	3,00	4	2	1,00								
Tarsals	10	6	3,00	1	1	0,50	3	3	1,50	1	1	0,50		
Phalanges	4	1	0,04	14	3	0,13	6	1	0,04	3	1	0,04		3

* Excluding the Virastotalo assemblage, information not available, N=26

Table 4. Used PCR primers.

Primer pair name	Sequence	PCR length (bp)	Reference
RangD	Forward: TATAATAGTACATTAAAYTAYATRCCCC Reverse: GGGGRCGGGATACGCATGTTG	141	This study
RangE	Forward: GTACATRGCACATTRRGTCAAATC Reverse: GGGATCCCTGCCAAGCGGGTTG	114	This study
RangF	Forward: CAACATGCGTATCCCGYCCCC Reverse: AATTCATTAAATAGCTACCCCCAC	130	This study