The Animal Bones of 'Paviken I'

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Introduction

Excavations at 'Paviken I', led by Per Lundström in the 1960s-1970s, uncovered a great amount of animal bones. Now, in 2013, during an excavation of Dan Carlsson and Ölle Hoffman at 'Paviken I' animals bones have been found as well. The aim of the excavations in 2013 is to gain an understanding of the past excavations by Per Lundström. The site of 'Paviken I' is interpreted as a harbor/trading center (Carlsson n.d.: 3). Multiple other harbor sites have been found on Gotland as well and research about trade and manufacturing processes has been done.

This paper is focused on the finds of animal bones. These animal bones range from raw materials, such as fragmented animal bones, to objects such as antler combs.

In this paper I will first give a quick overview of what animal bones can tell us: what can it tell us about the economy? What can it tell us about the hinterlands of the area? Second of all I will focus on the "finished products" that have been found: are there any traces of bone and antler working at 'Paviken I'? Finally, I will take all this information in consideration for an spatial analysis.
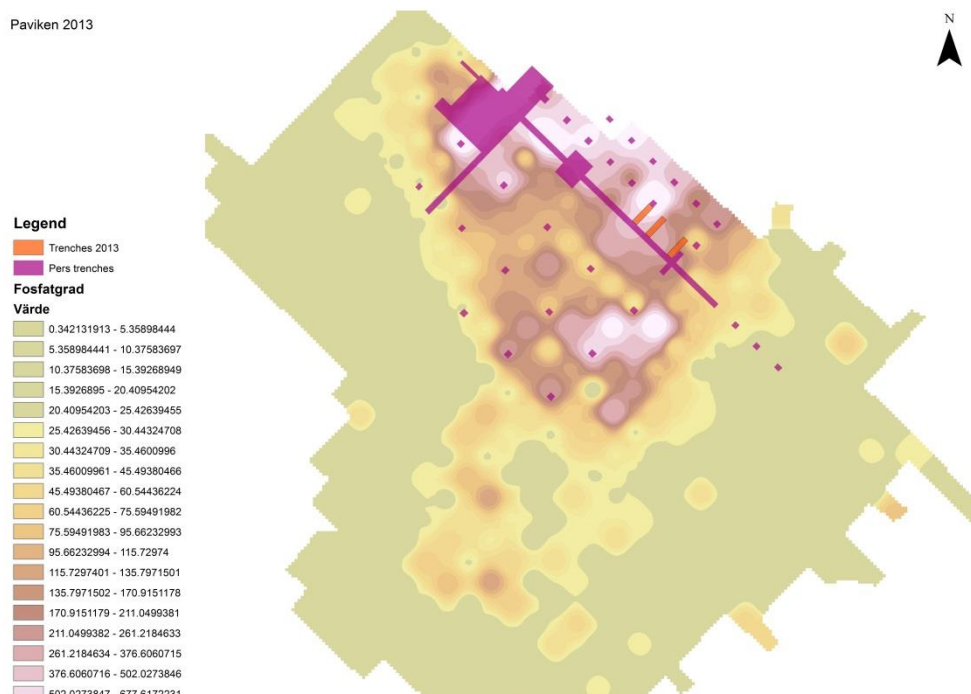

Figure 1: Map of 'Paviken I'. The purple areas are excavated by Pers Lundström in the 1960s – 1970s. The orange areas are excavated in 2013. The different colors of the area of 'Paviken I' represents the phosphate mapping as can be seen in the legend.
Source: GIS-map made by Amanda Karn

What animal bone can tell us

Animal bones can give us information about the economy, exchange, wealth and money, religion and health in the past. In this paper I will only focus on the information about economy and exchange.

The Economy of the Hinterland

Animal bones can give us quite an insight in life of the people in the Viking Age. We'll first look at the information that animal bones can provide about the hinterland's economy. There are different methods that can be looked at, but it's always important to identify the found animals first. We can then research the economy by using a few different methods. First of all we can weigh the bones or secondly we can calculate the MNI (Minimal Number of Individuals) of each species. The weight of bones signifies the meat or dietary contribution. There is a relationship between bone and carcass weight and with this data you can then calculate how much food a certain animal contributed to a settlement. This calculation has to be done with a special index, since different animals have a different amount of meat. The Minimal Number of Individuals represents the relative number of animals that have been killed in the area (Rackham 1994: 48).

It's therefore important to identify the different animals bones, which species they belong to and what bones have been found (Rackhan 1994: 48). Using the identification of the animals you can use this data for further information about the economy and the hinterlands of the area.

Animal bones can also tell us about the exploitation, by humans, of a live herd. Specific patterns of husbandry can be identified by the use of the animal bone assemblages. There are different patterns for meat production, dairy production and wool production.

Animal husbandry for meat production can be recognized, at the farm, by the absence of young males at their optimum size (1-2 years) with a few left to breed with. Most of the females will be kept alive for breeding purposes and will be slaughtered when they cease to be productive. Thus, if a bone assemblage contains a high quantity of young males (1-2 years of age) and a few old adults it is possible to interpret it as husbandry geared to meat production (Rackham 1994: 49). A husbandry geared at dairy production yields another pattern. In this case very young (mainly male) animals dominate the bone assemblage. Once lactation has been established in the female the young will be killed, usually before the age of six months. Therefore, the bone assemblage contains a lot of young male animals, females

that fail to reproduce and a few breeding males, but only in small numbers. This applies to sheep, goat and cattle (Rackham 1994: 49). The production of wool as a primary product holds the last, different, pattern. This pattern only applies to sheep and goat, since they are the only animals that produce wool. Sheep and goat usually get their fleece taken off between the age of two to six years. The fleece is of a better quality when the animal is still young and gets more hairy at later ages. Both females and males are kept until the quality of their wool drops because of age. The slaughter pattern is therefore expected to be made almost entirely out of adults (of both sexes) (Rackham 1994: 49).

The identification of the animals is therefore important. It can tell us about the economy of the surrounding farms and villages and give us insight in their daily life. In a harbor town like Paviken it is expected that there are mixed up patterns of husbandry shown in the bone assemblage. This can be related to seasonal differences related to the food supply or different specializations by different farms (Rackham 1994: 49). The analysis of animal bone at Paviken should therefore be done to gain an idea of the economy of the hinterland. This includes the identification of the animal as well as the age.

A small analysis of the animal bone assemblage of 'Paviken I has been done by Berit Vilkans. Up until then there was a total of 410,58 kg of animal bone found. However, since this was too much for her to analyse in a small timeframe. She has only investigated and identified 12,40 kg of the bones. Her research showed that, of the 12,40 kg of animal bone she identified, 4,85 kg belonged to cattle, 484,5 grams to pigs, 728 to goat/sheep, 102,5 grams to horse, 45 grams to sheep, 6,5 grams to bird, 4 grams to dog, 1 gram to perch, 1 gram to pike and 1 gram to fish in general (Vilkans: 1-2). She analyzed less than 3% of the total bone assemblage and therefore the data is not representative for the total assemblage. The animal bones could be biased towards a certain pattern when discarded and it's therefore not possible to make any interpretations based on this data. However, we can use this information to look at the animals that have been found in Paviken. The data lacks exotic animals, which could be used to recognize trade, but because it's only 3% of the total amount of animal bone this says nothing.

Workshops and Secondary products: Bone, Hide, Horn and Antler working

The slaughtering of an animal generates secondary products. In the Middle Ages the domestic animals walked to the market and were slaughtered there. The secondary products of the animals were then removed during the butchering, which could then be sold elsewhere. These secondary products include bone, hide, horns and antler (Rackham 1994: 56).

Horns are mostly represented by horn-cones. Horn-cores are made out of bone and grow below the layer of horn. Horn itself is almost never found because it normally degrades in the soil. The horn-cores are the waste-product of the horn industry and, when used, show chop marks. These marks show us that they were removed from the skull. The chop marks are usually situated on the back or below the horn itself. It's also possible that the horn-core is still attached to the skull while being worked (Rackman 1994: 56-57).
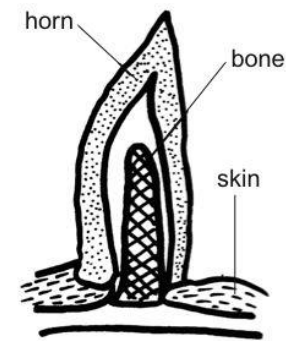
Figure 2: image of the horn of an animal. The 'bone' is also known as the 'horn-core'.
source: upload.wikipedia.org

Skinners and tanners can be recognized by a specific animal bone assemblage as well. The skinners left the feet intact and kept them attached to the skin . They dismembered the limbs at the knuckle or ankles. Tanners could be recognized by a bone assemblage with a predominance of feet bones. An assemblage with the predominance of foot bones can be interpreted as the waste products from the tanning process, since they remove the knuckles and ankles in this stage. There are also specific cut-marks that are associated with the skinning of the animal (Rackman 1994: 57).

Bone and antler were also used as a secondary products. We can find archaeological traces of workshops that specialize in bone objects, in the medieval period. We can recognize these workshops by sawn offcuts and other waste materials, such as fragmented/worked fragments of bone (Rackman 1994: 59). The "flat" bones, such as the ribs, jaws and scapula, were generally used for flat objects, such as bone plaques or playing pieces. The metapodial (long bone) from cattle, horse and deer were used for the manufacturing of needles, awls and pins and the long bones of birds were used to make flutes (Roesdahl and Wilson 1992: 202). The waste of these objects is the sawn off ends of these bones (Rackman 1994: 59-60).

In antler workshops we can also find waste products of comb production. These include broken or poorly cut pieces, shavings or flakes, broken off tines, offcuts from the crown and trial pieces (Rackman 1994: 59). Combs itself are mostly found in Viking graves and are

made out of elk or deer antler. It's thought that each woman and man had their own comb that was then buried along with them. Up until the 11th century the combs only have teeth on one side. These combs were made out of different plates of antler. The teeth were cut out of the antler plates. These plates were then riveted between two supporting plates of antler, which represented the handle. In the 11th century the double combs appear. These combs were harder to make, since they were made out of one piece of antler. The comb had teeth on both sides, which were opposite of each other. These sides were different: one side was coarse-toothed and the other was fine-toothed (Dahlström 2002: 23-24). Bone became the more commonly used material for combs during later times (Roesdahl and Wilson 1992: 202).
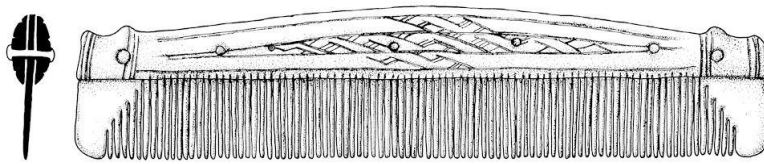
Figure 4: single-sided comb, from Birka, Sweden. Also found on Gotland.
source: intarch.ac.uk.ezproxy.leidenuniv.nl
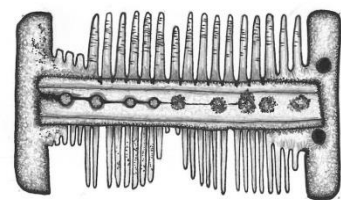
Figure 3: double-comb. from Freswick Links, Caithness, Scotland, also found on Gorland
source: intarch.ac.uk.ezproxy.leidenuniv.nl

During excavations in Fröjel, north of Paviken, deer and elk antler has been found in large quantities. Deer/elk antler was not indigenous to Gotland in the Medieval times, so it must be traded to the island as complete objects or as raw material. In total 157 finds have been found: 48 combs (30,6%), 62 needles (39,5%), 3 game pieces (1,9%) and 33 pieces of semi-finished products, waste and raw material (21,1) and 11 decorated fragments. The comb is the most common find in the Viking settlement (Lietha 1997: 19). From the archaeological assemblage we can conclude that both pins and combs were produced on this site, but it's not clear to what extent and where (Lietha 1997: 19). The occurrence of antler implies that this settlement didn't only trade with other settlements in Gotland, but also with the mainland (Lietha 1997: 20).

Traces of Trade

The site of 'Paviken I' has been interpreted as a harbor/trading center. So, there will be traces of trade in the animal bone assemblage. There is evidence for the development of fish trade in the medieval times. Fish would be prepared, this includes gutting, de-heading, filleting and the drying of the fish, which would then be exported. The fish's head would be removed during the preparation and therefore lack in the animal bone assemblage of the settlement it

was traded it with. The lack of the head bones but the presence of the vertebrae of the fish is seen as the evidence of trade (Rackham 1994: 52).

We can also find other traces of trade in the bone assemblage. Here we use an example which comes from the site of Birka. This is a medieval harbor, on the coast of Sweden. Only the terminal bones of the legs of foxes were found here. This can be interpreted as raw skin trade. The skin was prepared elsewhere and then traded off to Birka (Ambrosiani and Clarke 1995: 85). The skinners left the foot bones, including the ankles and knuckles, attached to the skin/hide. After the primary preparation the product would be sold and traded like this. The furrier removed the foot bones of the animal, this process took place after the trade. So, if only foot bones of a certain animal are found in a settlement, we can interpret this as the trade of raw skin to that village.

Spatial Analysis of 'Paviken I'

The spatial analysis includes the animal bone data from the earlier excavations by Per Lundström as well as the excavation by Ölle Hoffman and Dan Carlsson in 2013. Based on the data, three different GIS-maps are made from the excavated area: one of animal bones (weight), one of different bone objects, which ranges from worked bone to gaming pieces and needles, and the last one of worked antler, which is connected to the production of combs. I have separated worked bone and antler objects from the production of combs because it is seen as its own, different, specialization.

Data has been extracted from Per Lundström's database. The database is quite un-regular and not all data has been provided in this database. For example, if we look at FIND ID 31158, the only description that this object has is: 'three processed bone fragments'. It's unclear what Per Lundström means with the term 'processed'. Questions remain about how these bone fragments are 'processed', what they look like and what the finished product could have been. Maybe he even means that there are cut-marks on the bone, which could be proof for a butchery.

Different workshops produce different patterns of bone. A butcher removes all the secondary products of an animal: bone, horn, antler and skin/hides. It's therefore possible to find all the different secondary products at a butchery. The butcher will then sell these secondary products and the they will be processed in further specialized workshops. These workshop include skinners, tanners, furriers and, bone workers and antler and horn workers.
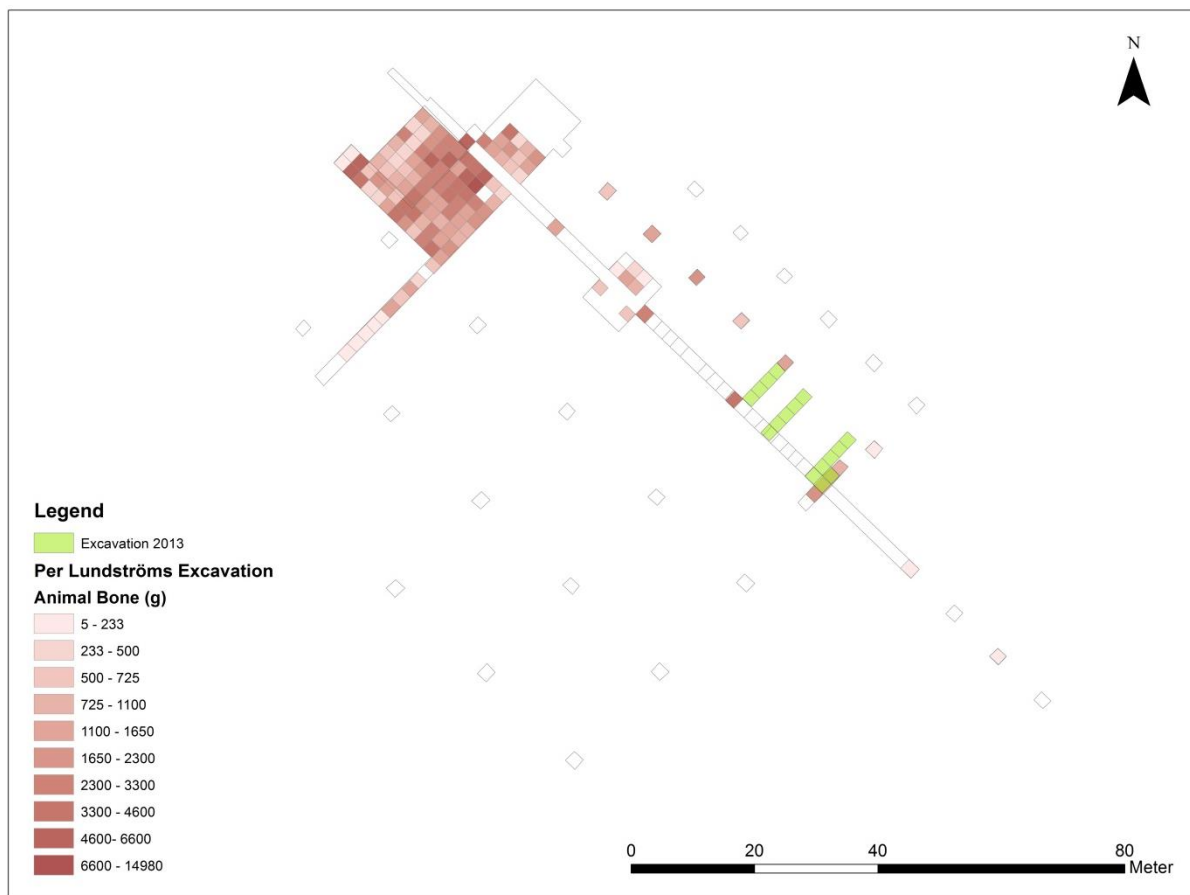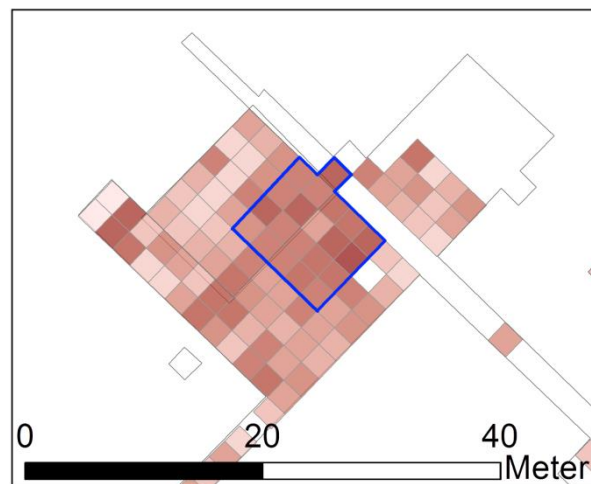
Figure 5: Distribution of animal bone of excavations in the 1960s – 1970s by Per Lundström.
Source: Source: GIS-map made by Amanda Karn, based on Per Lundström's database.

The figure above shows the distribution of animal bone of Per Lundström's excavation (figure 1). According to his database, 360,79 kg of animal bones has been found during these excavations. The marked green areas are the areas that are excavated this year, 2013.

We can see a high concentration of animal bones in the left area, shown in the image to the right (FIGURE). The area where the animal bones is most concentrated is surrounded by a (custom made) blue line. This area could have been from a butchery,

Figure 6: Distribution of animal bone of excavation in the 1960 – 1970s. The blue line is surrounding a high concentration of bone. The legend of figure 5 applies for this figure as well, since this figure is only a zoomed in version of figure 5.
Source: GIS-map made by Amanda Karn, based on Per Lundström's database.

since it contains a high amount of bone and bone is one of the secondary products that results

from butchery. However, it's not possible to base the interpretation on unidentified bone, which has not been specified. If this area were to be of a butchery, there would be chop-marks on the bone. These include marks from when the meat, and all the other secondary products, were removed from the animal. This is the reason why three different GIS-maps were made of the animal objects, to look at the occurrence of all the different secondary products together.

However, there is a problem with the animal bone weight of Per Lundström. He doesn't differentiate between burned bone and non-burned bone. Burned bone can signify a cremation, or that bone was used as fuel. Non-burned bone, however, is mostly waste, or a secondary product resulting from a butchery.
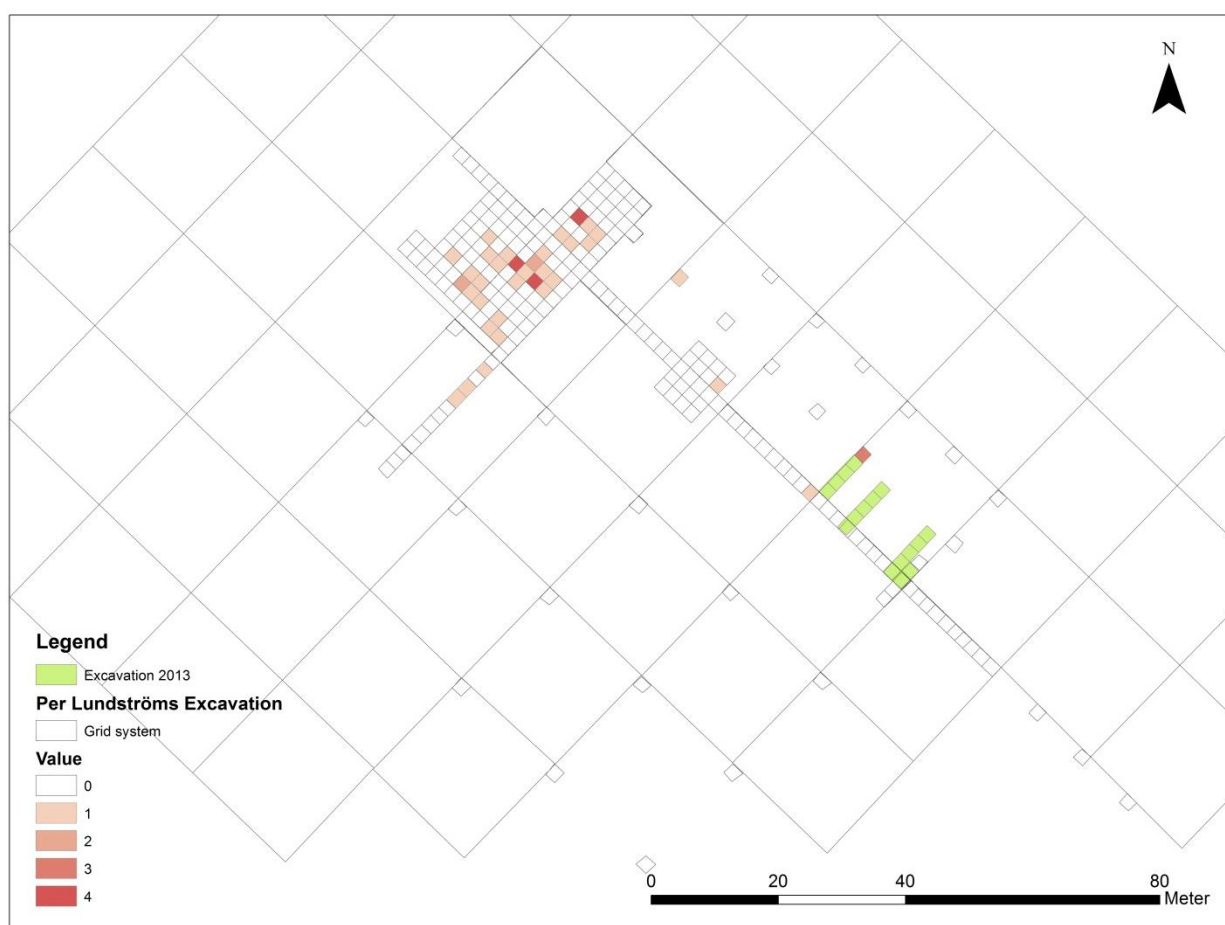
Figure 7: Distribution of worked antler and bone, including fragments and objects. This GIS-map is based on Pers Lundström's database.
Source: GIS-Map made by Amanda Karn, based on Pers Lundström database.

The GIS-map that's situated above shows the occurrence of worked antler and bone fragments and objects. It's clear that there aren't a lot of these finds, but I think it's also because not all worked bone and antler is being recognized. Per Lundström 's descriptions are not clear. Worked bone and antler , by definition, can range from small cutmarks to big unfinished products.

When looking at the map it stands out that worked bone and antler is found in the same squares as where we found the highest concentration of bone. But we don't know what 'processed' bone means. Also, if there was a butchery there, wouldn't we find more secondary products and bone with cut-marks? Alas, the lack of information of Per Lundström's description is a problem. This could be solved in the future with a visit to the depot to look at the finds and the matching descriptions.
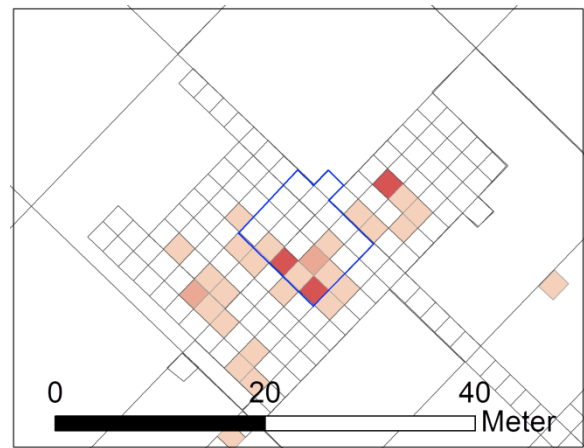
Figure 8: Distribution of animal bone and antler objects and fragments. This map is based on excavation in the 1960 – 1970s. The blue line is surrounding the same area as in figure 6, where a high concentration of bone was found. The legend of figure 7 applies for this figure as well, since this figure is only a zoomed in version of figure 7.
Source: GIS-map made by Amanda Karn, based on Per Lundström's database.

Most of the items that are plotted in the worked bone and antler are 'processed bone'. When we only look at the actually found objects that are found we are left with this table:

Find ID	Square	Material	Object	Remarks
32926	35:50	Bone	dice	Half of a dice
33010	35:49	antler	gamepiece	It has some kind of semispherical shape and has a hole at the bottom.
31910	51:35	Teeth	gamepiece	Gamepiece of tooth.
31071	21:72	bone	Needle	Bone fragment of a needle. The fragment has a triangular head and the eye of the needle is round.
33114	35:38	bone	Needle	Most likely processed.
32937	35:40	bone	Needle	Broken at both ends.
33165	35:67	Bone	Pendant	A pendant of horn/antler. The pendant has a loop on the top and the base is shaped in a point (downwards).

Table 1: Bone and antler objects that were found during Per Lundströms excavation. 'processed bone' is taken out of these data, since we can't deduce any information from them.
Source: GIS-Map made by Amanda Karn.

During excavations in 2013 only a bone needle has been found in square 24:84. This find doesn't influence the GIS-map much.
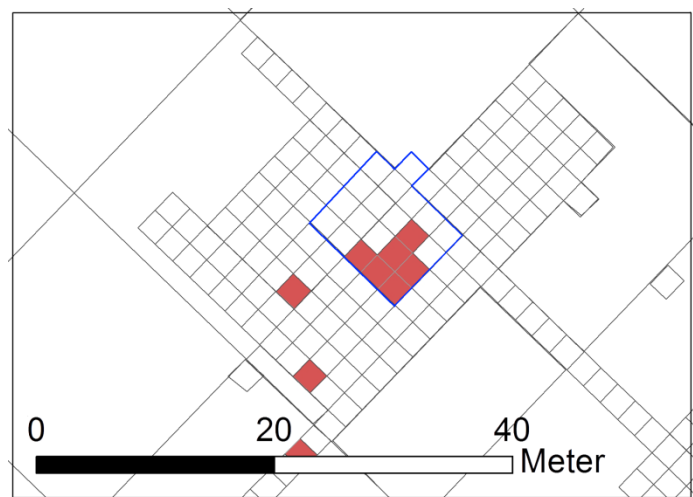
Next, we'll look at the occurrence of combs. A total of 14 combs and comb fragments has been found. We have not found any comb fragments during excavations in 2013. If we look to the distribution it stands out that comb fragments and combs are only found in the western part of the site 'Paviken I' (figure 9).
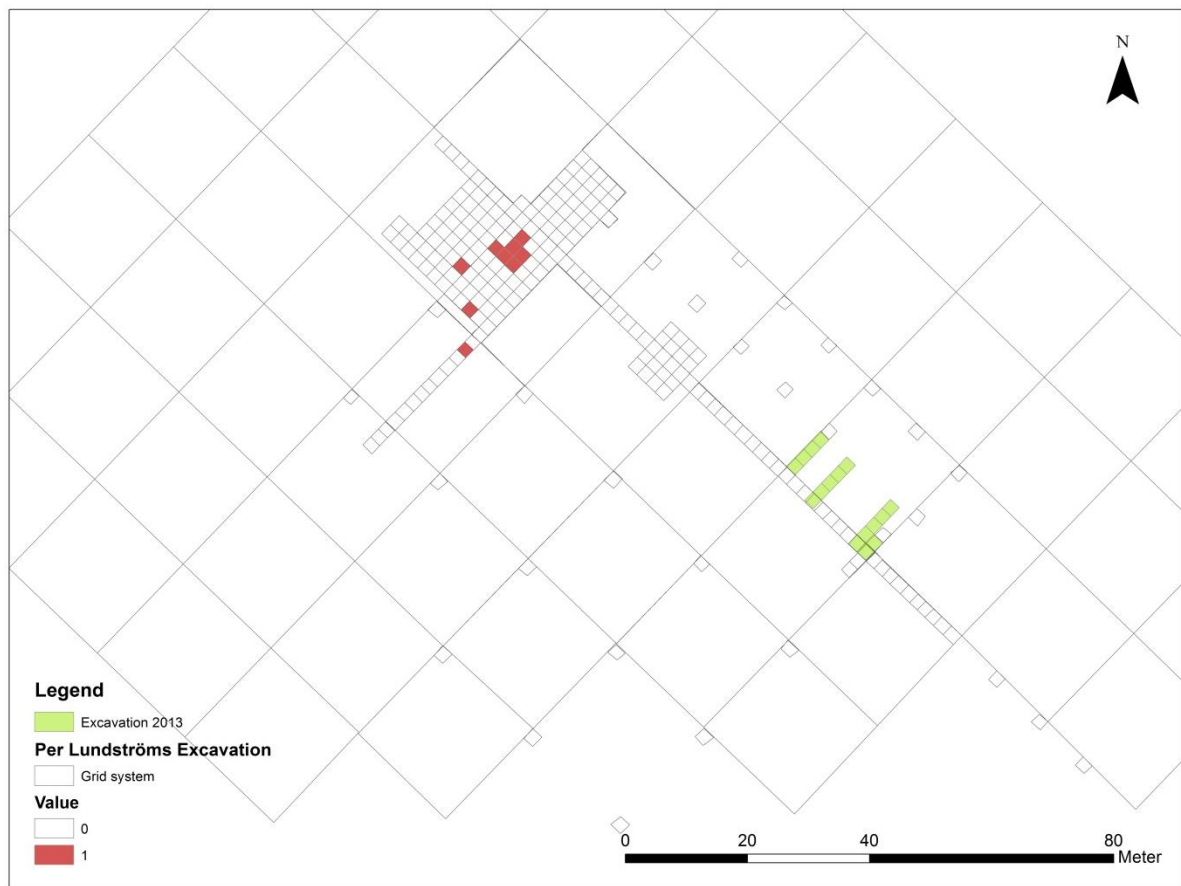
Figure 9: Distribution of worked antler combs and fragments. This GIS-map is based on Pers Lundström's database.
Source: GIS-Map made by Amanda Karn, based on Pers Lundström database.

As can be seen in figure 10, the highest concentration of combs are found, again, in the highest concentration of animal bone. These combs/comb fragments are not found in a grave context. One of the combs is made out of bone.

It could be that this area, where the highest concentration of bone and combs is found, is a general production area of bone and antler. However, we lack much of the production waste that should be found with it. It could be that the production

Figure 10: Figure 11: Distribution of antler combs and fragments. This map is based on excavation in the 1960 – 1970s. The blue line is surrounding the same area as in figure 6, where a high concentration of bone was found. The legend of figure 9 applies for this figure as well, since this figure is only a zoomed in version of figure 9.
Source: GIS-map made by Amanda Karn, based on Per Lundström's database.

waste is overlooked or that Per Lundström meant that with 'worked bone'/ 'worked antler'.

Find ID	Square	Material	Find Type
33544	35:09	-	Comb Fragment
32991	35:70	Antler	Comb Fragment
31562	36:02	-	Comb Fragment
31983	36:12	Antler	Comb fragment
31658	36:22	-	Comb case
31659	36:22	-	Comb tooth
31995	36:23	Antler	Comb fragment
32003	36:31	-	Comb Fragment
32004	36:33	Antler	Comb fragment
32382	36:83	Antler	Comb Fragment
33706	38:07	Bone	Comb Fragment
33516	38:08	-	Comb fragment
31889	51:15	Antler	Comb Fragment

Table 2: combs and combs fragments that were found during excavations in 1960-1970 and 2013. Source: Pers Lundström's database.

Conclusion

I think that further analysis of the animal bone on 'Paviken I' should be done before any other interpretations, based on the data, is done. First of all, the animal bones should be identified so that the economy of the hinterland and trade in exotic animals can be figured out. If we find any exotic animals (that aren't indigenous to Gotland) we can have a better understanding of trade in the past. Also, the occurrence of foot bones can be seen as the exchange of skins and hides. We can also see a similar pattern with fish. If fish is being traded the fish is gutted, de-headed, filleted and then dried. The head is removed during the preparation and the fish is traded without the head as well. This means that the fish bones of the head lack in the archaeological deposit (where the fish is traded to).

Secondly the database of Per Lundström should be looked into. We need to have a better understanding of what he means with different terms, like 'processed bone'. Is this a result of slaughtering the animal or is it the result of someone working the bone? Also, we now don't know if the 'animal bones' are burned or not. Sometimes it's mentioned in the database that the animal bones are 'partly burned'. This, however, isn't precise enough. Burned bone had a different usage than non-burned bone. For example, bone could have been used as fuel, which non-burned bones can't be.

Further analysis by osteologists is necessarily for a good interpretation of the animal bones. This includes going through Per Lundströms excavated material, to find out what everything means (in his database) and what is actually found. This should also be done with the excavations from 2013, since worked and unworked bone isn't separated.

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