Stone Age gum-like artefacts, which were spat out in western Sweden nearly 10000 years ago, harbour ancient human DNA.

This is a brief story on how we established a new source of ancient DNA, which will widen our window into the prehistoric life. In recent decades ancient DNA has been continuously used as a part of the tool-kit for studying human history and evolution. Ancient human DNA is found in both organic and inorganic material, for example: bones, teeth, mummified materials, coprolites, soil etc.

The biggest amount of human ancient DNA can be found in bones and teeth, however the preservation of such material is often a problem and the amount of well-preserved human remains is scarce. What is a different issue, is that the most ancient human remains often can not be connected to material culture, lacking any traces of it at the location where the human remains are found. This becomes especially problematic for interdisciplinary studies, where material culture is affiliated to a certain group of people. The lack of a clear connection between material culture and genetic makeup of the individuals practicing it has been a subject of criticism for using ancient DNA as a interdisciplinary method within archaeological and demographic studies.

In our study we extract nearly 10,000 years old human DNA from new material, masticated lumps from an early Mesolithic maritime hunter-fisher site in western Sweden. This type of sticky glue product from birch bark was widely used as an adhesive agent by people all across Eurasia during the Stone Age. Remnants of this glue are found on different artefacts, from spear-heads to vessels and pottery and as chewed pieces as well. We can not confirm or deny the use of masticates as chewing gums in the Mesolithic age, but since these mastic pieces had “chewing gum” morphology and some carry teeth imprints, we call them chewing gums within our project. The morphology of these mastic pieces gave the idea of looking for ancient DNA in this material. This study showcases DNA from three mastic gums and associated artefacts of stone tool production from the same site, fusing archaeology and population genetics in a novel way.

The mastic and stone tools analysed in this study derive from the “deep pit” deposit of Huseby Klev site, which was excavated in the early 1990’s. Archaeologists in the "Pioneers of the North-Western Europe" project at the University of Oslo Cultural Historical Museum, funded by the Research Council of Norway, initiated the project involving extraction of ancient DNA and lithic analysis of the ”deep pit” material. In collaboration with Stockholm University DNA extraction and bioinformatic analyses were performed and we conducted lithic technological analysis on the material from the “deep pit”.

The DNA from the three masticated lumps turned out to be fragmented, as ancient DNA should be and with relatively low level of modern contamination. The sequences were plotted together with ancient european hunter-gatherers, which was another way to confirm that this DNA was indeed from mesolithic individuals from Huseby Klev site. The combination of genetic and lithic analysis results suggest that stone tool technology found at Huseby Klev and the genetic makeup of the people who used the technology, can be traced to different areas of origin in Ice Age Eurasia. The technology was brought to Scandinavia from the East European Plain, while the DNA from the mastics can be attributed to the early postglacial inhabitants of Western Europe. Such a clear connection between material culture and genetics is possible because “chewing gums” preserve DNA from people who were present at the site when it was used, and may have participated in everyday activities, tool production and maintenance. We confirm that both sexes were present at the site, and that we find more than just human DNA in the chewing gums, as a large number of metagenomic sequences were obtained from shotgun sequencing of the DNA from the samples. DNA contained in the mastics is the earliest human genomic evidence from the Scandinavia to date. The mastics material allows us to study both archaeological contexts and human genetics were we do not find any human remains.

In conclusion, we discovered a snapshot of DNA from living mesolithic people. The internal joke is that we confirm a Jurassic-park scenario, but instead of dino-blood in amber-capsuled insect, we find human saliva DNA in chewed masticated lumps from Stone Age. The DNA in the mastics is a forensic artefact, which clearly connects the genetics and the cultural affiliation of the mesolithic dwellers of the Huseby Klev site. The DNA from this material is beneficial for many reasons, but for our study we used human DNA to research the demography and culture of ancient dwellers of Western Scandinavia. We discuss the western origin of these pioneers, who used a lithic technology from the east. With this we state that ancient masticates are a reliable source for ancient human DNA. We have a lot of question to answer in our further research, and we hope that other researchers start using this material to update our ancient human DNA database.