

Genomics tracks migration from lost empires to modern cities

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New genomic tools are enabling researchers to overturn long-held beliefs about the origins of populations, a researcher will tell the annual conference of the European Society of Human Genetics today (Monday). Dr Eran Elhaik, Assistant Professor of Animal and Plant Sciences at the University of Sheffield, Sheffield, UK, will say that new technologies are enabling scientists to track the origins and migrations of populations with increasing accuracy.

Until recently, assumptions about origins were based on where people were buried. "However, this does not take into account the migrations which we now know took place thousands of years ago," says Dr Elhaik, who carried out the research with colleagues including Dr Umberto Esposito.

Using a recently-developed technology, the ancient Geographic Population Structure (aGPS) tool, the researchers were able to find the geographical origins of ancient DNA, with the only limitation being the availability of DNA data. This in turn enabled them to combine hundreds of snapshots from the past into a reconstruction of modern history from 12,000 BC to the modern era. "This is by far the most comprehensive reconstruction of our genetic history. Our work reveals the colonisation of Europe, step by step, and answers many questions concerning the origins and migrations of Europeans," says Dr Elhaik.

Applied to a dataset of over 300 ancient Eurasians and Near-Easterners during the Ice Age to Late Iron Age period, aGPS localised around 50%

of the samples at up to 200km from their burial site, about 32% at between 200 and 1000km, and the remainder at between 1000 and 3,175km. "The [migration](#) patterns revealed by our work were remarkably complex and dynamic, and the difficulties in interpreting them correctly are significant.

"The challenge for us now is to understand why these migrations took place. What caused a particular group of people to make a journey of over 3000km at a time when travel was complicated and dangerous? When we combine our results with archaeological and climate data, we can begin to see why," says Dr Elhaik. "For example, we can identify areas where the land became exhausted from over-farming, and thus caused the movement of populations. We can also pinpoint the formation of city states and 'biodiversity centres', corresponding to ancient empires that drew immigrants from other countries."

The results allow the researchers to confirm the theory of the massive migration of populations from the steppes of the Caucasus (the Yamnaya) to Central Europe during the Late Neolithic period (3500 to 2300 BC). "We discovered that Central Europeans were always on the move, continuously mixing with other populations and forming ancient cities in Germany, Denmark and Hungary, for example close to modern-day Hamburg and Berlin, and Budapest. In contrast, Near Eastern peoples tended to stay close to home," says Dr Elhaik.

"Genetic data can answer many questions that archaeology alone cannot. For example, is a specific decoration indicative of an alien culture, or simply an import? These new insights are fascinating, not just in a historical context, but because they provide additional proof of the unlikelihood of a 'day zero' of ethnic homogeneity, except perhaps in a very few isolated places. Even if it had existed, there must be practically no-one alive on earth who could trace all their ancestors to one ethnically homogenous [population](#)".

There are endless challenges in this research. "Imagine working with a very short DNA sequences with more holes than bases - not only can we not align this with other ancient sequences, but we also do not know where it is from. And this is before we get to the question of "when?" which is, again, linked to "where?" because different regions entered developmental periods, like the Iron Age, at different times.

"However, our findings to date have already brought about a far greater understanding of the identity of Old World residents, and our goal is now to reconstruct the full "Human Atlas" showing ancient migration patterns worldwide," he will conclude.

Chair of the ESHG conference, Professor Joris Veltman, Director of the Institute of Genetic Medicine at Newcastle University, Newcastle, United Kingdom, said: "This fascinating work illustrates the power of modern genetic approaches to study human history and migration. The scientists demonstrate that information in ancient DNA samples, even of low quality, can be used to provide a very precise geographical localisation of the origin of a person."

Provided by European Society of Human Genetics

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