23 August 2011 Last updated at 23:15 GMT

DNA study deals blow to theory of European origins

By Paul Rincon Science editor, BBC News website

Did Palaeolithic hunters leave a genetic legacy in today's European males?

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A new study deals a blow to the idea that most European men are descended from farmers who migrated from the Near East 5,000-10,000 years ago.

The findings challenge previous research showing that the genetic signature of the farmers displaced that of Europe's indigenous hunters.

The latest work leans towards the idea that most of Europe's males trace a line of descent to stone-age hunters.

But the authors say more work is needed to answer this question.

The work, by an international team, is published in the journal Proceedings of the Royal Society B.

"I would say that we are putting the ball back in the middle of the field"
Dr Cristian Capelli University of Oxford
Archaeological finds show that modern humans first settled in Europe from about 40,000 years

ago - during a time known as the Palaeolithic.

These people survived an Ice Age some 20,000 years ago by retreating to relatively warm refuges in the south of the continent, before expanding into northern Europe again when the ice melted.

But just a few thousand years after Europe had been resettled by these hunter-gatherers, the continent underwent momentous cultural change. Farmers spread westwards from the area that is now Turkey, bringing with them a new economy and way of life.

The extent to which modern Europeans are descended from these early farmers versus the indigenous hunter-gatherers who settled the continent thousands of years previously is a matter of heated debate.

The results vary depending on the genetic markers studied and are subject to differing interpretations.

Family tree

The latest study focused on the Y chromosome - a package of DNA which is passed down more or less unchanged from father to son.

The Y chromosomes carried by people today can be classified into different types, or lineages, which - to some extent - reflect their geographical origins.

More than 100 million European men carry a type called R-M269, so identifying when this genetic group spread out is vital to understanding the peopling of Europe.

R-M269 is most common in western Europe, reaching frequencies of 90% or more in Spain, Ireland and Wales.

The Neolithic was a time of momentous cultural change in Europe

But while this type reaches its highest distribution on the Atlantic fringe, Patricia Balaresque and colleagues at the University of Leicester published a paper in 2010 showing that the genetic diversity of R-M269 increases as one moves east - reaching a peak in Anatolia (modern Turkey).

Genetic diversity is used as a measure of age; lineages that have been around for a long time

accumulate more diversity. So this principle can be used to estimate the age of a population.

When the Leicester team estimated how old R-M269 was in different populations across Europe, they found the age ranges were more compatible with an expansion in Neolithic times (between 5,000 and 10,000 years ago).

The team's conclusions received support from papers published in August 2010 and in June this year. But one study which appeared last year backed the idea of a more ancient, Palaeolithic origin for R-M269.

Age estimates

Now, a team including Cristian Capelli and George Busby at Oxford University have explored the question.

Their results, based on a sample of more than 4,500 men from Europe and western Asia, showed no geographical trends in the diversity of R-M269. Such trends would be expected if the lineage had expanded from Anatolia with Neolithic farmers.

Furthermore, they suggest that some of the markers on the Y chromosome are less reliable than others for estimating the ages of genetic lineages. On these grounds, they argue that current analytical tools are unsuitable for dating the expansion of R-M269.

Studies of DNA from ancient remains could shed more light on European origins

Indeed, Dr Capelli and his team say the problem extends to other studies of Y-chromosome lineages: dates based on the analysis of conventional DNA markers may have been "systematically underestimated", they write in Proceedings B.

But Dr Capelli stressed that his study could not answer the question of when the ubiquitous R-M269 expanded in Europe, although his lab is carrying out more work on the subject.

"At the moment it's not possible to claim anything about the age of this lineage," he told BBC News, "I would say that we are putting the ball back in the middle of the field."

The increasing frequency of R-M269 towards western Europe had long been seen by some researchers as an indication that Palaeolithic European genes survived in this region - alongside other clues.

A more recent origin for R-M269 than the Neolithic is still possible. But researchers point out

that after the advent of agriculture, populations in Europe exploded, meaning that it would have been more difficult for incoming migrants to displace local people.

Page last updated at 16:21 GMT, Wednesday, 20 January 2010

Most European males 'descended from farmers'

By Paul Rincon
Science reporter, BBC News

Farmers brought new ideas and technology into Europe

Most men in Europe can trace a line of descent to early farmers who migrated from the Near East, a study says.

The research, which looked at the most common genetic lineage in European males, appears in Plos Biology.

However, other scientists subscribe to a different interpretation - that this common lineage arrived in Europe during or before the last Ice Age.

The invention of farming was one of the most important cultural changes in the history of modern humans.

There has been much debate about whether the westerly spread of agriculture from the Near East involved the large-scale migration of farmers into Europe or whether it occurred through the take-up of ideas and new technology by indigenous hunter-gatherers.

> **Maybe, back then, it was just sexier to be a farmer**
>
> Patricia Balaresque, CNRS

If the latter was the more important process, one would expect the large part of European male and female lineages to trace back to Palaeolithic times (between 40,000 and 10,000 years ago).

Leicester University scientists Patricia Balaresque (who is now based with the French National Centre for Scientific Research in France), Mark Jobling, Turi King and their colleagues examined the genetic diversity of the Y chromosome - a package of DNA which is passed down more or less unchanged from father to son.

Y chromosomes can be classified into different lineages (haplogroups) which, to some extent, reflect a person's geographical ancestry.

Dr Jobling, who led the research, said: "We focused on the commonest Y-chromosome lineage in Europe, carried by about 110 million men - it follows a gradient from south-east to north-west, reaching almost 100% frequency in Ireland.

"We looked at how the lineage is distributed, how diverse it is in different parts of Europe, and how old it is."

Go west

The male lineage in question, known as R1b1b2, is most common in western Europe, reaching frequencies of 90% or more in Ireland, Wales and Spain.

Stonehenge in England was started in the Neolithic

But while this lineage reaches its highest frequencies on the Atlantic fringe, the researchers found that the genetic diversity within it increases as one moves east - reaching a peak in Anatolia (modern Turkey).

Genetic diversity is used as a measure of age; populations or lineages that have been around for a long time tend to accumulate a lot of diversity. This principle can be used to estimate the ages of populations.

When the researchers estimated how old the R1b1b2 lineage was in different populations across Europe, the age ranges suggested it had expanded in the Neolithic (between 5,000 and 10,000 years ago).

Previous studies suggested an origin in the Palaeolithic (40,000 - 10,000 years ago). And controversies remain over how exactly to estimate the ages of Y chromosome lineages.

Crest of a wave

Studies of mitochondrial DNA (mtDNA), which is inherited maternally, tell a different story. The majority of European mtDNA haplogroups appear to have arrived on the continent during the Palaeolithic.

Dr Patricia Balaresque, first author of the study, said: "In total, this means that more than 80% of European Y chromosomes descend from incoming farmers. In contrast, most maternal genetic lineages seem to descend from hunter-gatherers.

"To us, this suggests a reproductive advantage for farming males over indigenous hunter-

gatherer males during the switch from hunting and gathering, to farming - maybe, back then, it was just sexier to be a farmer."

Studies of mtDNA have uncovered the signal of a migration undertaken by hunters from northern Iberia (Spain and Portugal) into northern Europe as the ice caps thawed some 10,000 years ago.

However, the latest study found no clear evidence of such a signal in its analysis of Europe's most common male lineage.

Dr Balaresque told BBC News: "The variance of reproductive success between males and females is completely different. If you look at a population, even now, most of the females have children, which is absolutely not the case for males.

"We estimate that about 40% of males do not leave any descendents. This means that each generation, you are losing the traces of 40% of males in that generation. The turnover for males is much higher than it is for females."

While R1b1b2 is most common in western Europe, some other lineages thought to have been brought into Europe by Neolithic farmers tend to be most frequent in the Near East, where the farmers started their journey. Their frequency in populations drops as one moves from the south-east to the north-west of the continent, the route taken by the agriculturalists.

But in their Plos Biology paper, the researchers write: "Mutations arising at the front of a wave of expansion have a high probability of surviving and being propagated, and can reach high frequencies far from their source."

The researchers from the University of Leicester collaborated with scientists from the Faculty of Medicine in Nantes, France, the Peninsula Medical School in Plymouth, UK, the universities of Ferrara and Pavia in Italy, Newcastle University and the Wellcome Trust Sanger Institute in Hinxton, UK.

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