

3 principles for looking at Lehi's DNA

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Editor's note: Third of four articles

DNA science can't tell us if Book of Mormon prophet Lehi and his small group came to the Americas 2,600 years ago. But Lehi's intrepid group of seafaring Israelites is a great example for understanding how a small group can enter a land, flourish and then leave no identifiable genetic trace.

Among the many principles of population genetics are three that are essential to understanding what may have happened to Lehi's DNA: Genetic drift, founder effect and population bottleneck. "If people dismiss these three principles ... they show that they do not understand population genetics," said Ugo Perego, senior researcher at Sorenson Molecular Genealogy Foundation.

These three principles apply whether you are talking about people in Indiana or Iceland. Lehi's group is a good hypothetical to look at these principles — whether you believe he existed or not.

Genetic drift

Genetic drift explains how a lineage, also called a "haplogroup," can disappear by random genetic interaction. "If you start with a population of 10 or 20 lineages, after many generations you might only have two or three of these lineages represented," Perego said.

Perego used a well-known analogy: Imagine a jar has 10 red marbles and 10 blue. Pick one marble at random — let's say red. Put the marble back in the jar and put

a new red marble in a second jar. The new marble carries on that particular "red" haplogroup or lineage.

Keep picking random marbles until the second jar has 20 new marbles, perhaps six red and 14 blue. Now pick random marbles from the second jar to determine a third jar's contents, perhaps three red and 17 blue. By the fourth or fifth jar, it is possible to have only blue marbles. Blue is fixed. The sixth, seventh, or even 3,500th jar will all be blue. Red is gone forever.

Population geneticists trace groups by using mitochondrial DNA (mtDNA), which only passes from mothers. In Lehi's group this leaves two possible sources of mtDNA: Lehi's wife Sariah and Ishmael's wife. Imagine that Ishmael's wife's mtDNA became fixed and Sariah's disappeared through genetic drift.

If the continent was heavily populated when Lehi arrived, inevitable intermarriage and genetic drift could make Ishmael's wife's mtDNA disappear like a red marble in a sea of blue.

The founder effect

In the founder effect, a rare lineage will remain rare in a large population. If a small group that has that rare lineage founds an isolated colony, that rare lineage can become the dominant lineage. If the colony came to a populated area, founder effect would have less impact than genetic drift.

If Sariah or Ishmael's wife had a rare lineage, then the descendants of Lehi's group would also have that rare lineage — that is, until it was lost in the genetic drift of a larger population.

Population bottleneck

A large population can become small very quickly in the case of disease or disaster. After the event, the population may build up again, but many lineages may not have survived that disaster — that "bottleneck."

Perego said that Native Americans hit a considerable population bottleneck when the Europeans came to the Americas. A study showed gene pools were reduced to between one-third and 1/25th of their former size. "What we have today represents the survivors of the European arrival. It does not represent (all the lineages of) the people who arrived here 2,000 years ago, 2,600 years ago or 10,000 years ago," Perego said.

This becomes important when you are looking for remnant lineages from a small family that colonized in a populated area.

"You had a lot of (genetic) variation before the Europeans came," Perego said. "Then came the destruction, the killing, the disease, the slavery. ... Some villages were wiped out completely — especially if you look at the East Coast. There are Native American groups for which there are no survivors."

The "deCODE Project" in Iceland is a good example of how these principles work. Researchers had DNA samples of people born in Iceland after 1972. They were also able to trace their genealogies back to 1742. They discovered that the vast majority of the people alive today in Iceland are the descendants of a very small percentage of the people who lived in 1742.

"Many people who were living in 1742 have no living descendants or do not have any genetic lineages represented ... in the modern population," Perego said. "Why? Because lineages just disappear. We don't normally realize how much they do, but here we have a tremendous discrepancy between who lived 300 years ago and who live now. Think about 2,600 years ago (when Lehi came), how much that would have an effect. This is a powerful example."

Some people may counter that Iceland was a special case because it had migrations and volcanic eruptions. "But the same thing happened to America," Perego said, "There were Europeans coming and disease."

Genetic drift, population bottleneck and founder effect can eliminate genetic lineages through time — making it possible that mtDNA from Lehi's group went the way of the red marble.

Next week: The DNA X-theory

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