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Software to simulate ancient migrations

Mum Scientists Develop New Algorithm

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In a recent eureka moment, a group of physicists and life scientists from the Tata Institute of Fundamental Research and Centre for Excellence in Basic Scienees in Mumbai have developed a computer algorithm that allows tracking of prehistoric movements of humans based on their habitable needs and current topographical satellite data. It may prove a watershed in determining how populations have grown and shrunk even when no genetic information is available, help archaeologists look for prehistoric settlements, and challenge long-held racial beliefs.

Curiosity stirred these researchers – Mayank Vahia, Pavan Mahathe and Deepak Mathur and Uma Ladiwala – into rethinking existing ideas about human movements. "Whatever studies had happened in the past were localized," said Vahia, lead scientist on the project explaining why archaeological data can often be patchy. "Migration patterns were decided by people walking around for signs of habitation, taking specimens and analyzing their age to create a sample map. People were looking at a village here or a town there and then trying to put the entire dynamics together to tell how many were farmers or soldiers. Some of those were destroyed by modern civilization and some never discovered. It was based partly on archaeological evidence and partly on simulations. There's never been a systematic handle on large scale migration or patterns of settlement because it was thought of as too complicated to computer model."

To ensure their computer simulation conformed to reality, the scientists chose the British Isles as their pilot territory which because of its geographical isolation offered a "near-ideal laboratory".

Habitability parameters – closeness to water bodies, lower altitudes and flat land – priorities for moving from one point to another were mapped with satellite-based geographical and hydrological data, all of which were coded into a software program they named SIMPLE (Simulation of Movement of People). This simulation does not take into account wars, technological or industrial advances.

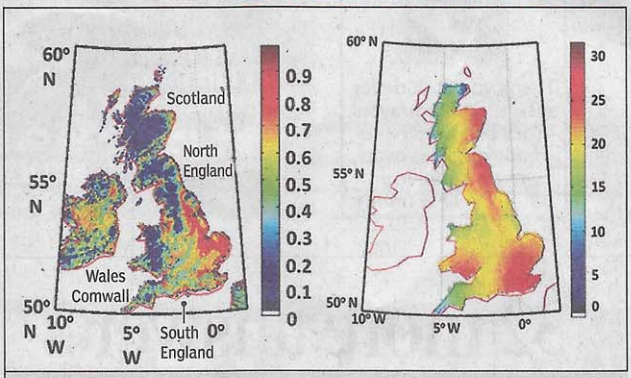
It took three years for the scientists to sort the computational complexities and use their model to identify precise regions where people and cultures must have merged. Their findings were validated only last year when a group of British scientists published a genetic map of Britain. "We compared the information obtained with DNA samples of 6,209 Europeans and our work was confirmed. The genetic data was similar to what our habitability data suggests," he says. Anecdotal evidences – archaeological, historical and linguistic like physical features, names, and vocabulary further corroborated their findings.

A striking correlation between genetic clusters and geography backed up claims the Scots have always made about being a distinct ethnic group. "Our study shows that the population of Scotland remained bound to the highlands while the North English population who found it hard to move northward made much faster strides to the south because of connected rivers leaving Scots isolated until much later. This is also reflected in the genetic data," says Vahia.

Details of their simulation procedure were published last month in PLoS One, one of the world's largest scientific journals. "It is readily implementable now," says Vahia. But the software is not up for grabs. "One is free to refer to our algorithm and convert that into a program for their research. Or they can collaborate with us," adds Vahia.

While this alternative clue to the migration enigma is validated for use in a variety of geographical areas, an interesting side effect is its potential to dispel racist beliefs. "SIMPLE can be used to argue whether one really belongs to a pure race. It could actually be used to break racial stereotypes. And xenophobia," signed off Vahia, readying to trace the peopling of early India, next.

PREHISTORIC MOVEMENT PATTERNS



(Left) Habitability map of England, Wales and Scotland before the entry of humans around 10, 000 BC; (right) Simulated distribution of population 2000 years after people entered Britain. The population density is highest in the red regions and sparsest in the blue regions. The habitability scale runs from 0 (least suitable for living) to 1

Habitability parameters

- Proximity to water
- Altitude
- Flatness of land
- Population density

The simulation stages

- Britain is divided into 1 km x 1 km square segments as primary units for computation
- At each step the program checks the relative habitability of the east, west, north, and south of a certain location
- Assuming that humans drift at the rate of one km per year and each step amounts to one year of dispersion, the simulation was run for 2000 steps at a time to determine the progressive evolution of population from their initial entry points
- Local habitability decides the speed at which a population spreads