Natural Selection Leaves Fresh Footprints on a Canadian Island

By NICHOLAS WADE
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From parish records in a French-Canadian island, researchers have uncovered what may be the most recent known instance of human evolution in response to natural selection.

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The island, Île aux Coudres, lies in the St. Lawrence River 50 miles northeast of Quebec. Its church registries hold an unusually complete record of births, marriages and deaths. From this data, a team of researchers led by Emmanuel Milot and Denis Réale of the University of Quebec at Montreal have extracted the histories of women born on the island between 1799 and 1940.

Over this 140-year period, the age at which a woman had her first child — a trait that is highly heritable — fell to 22 years, from 26. Because of this change, women on average had four more children during their reproductive lifetime, the researchers report.

The finding "supports the idea that humans are still evolving," the researchers write in Monday's issue of The Proceedings of the National Academy of Sciences.

Dr. Milot said statistical tests allowed the researchers to distinguish between the effects of natural selection and those of cultural practices affecting the age of marriage.

"The common view is that evolution is a slow process," he said. "But evolutionary biologists have known for several decades that evolution can occur fast."

It was long assumed that people protected themselves from the forces of natural selection when they learned to put a roof over their heads and grow their own food. Data from the human genome in the last decade has shown this assumption is untrue: The fingerprints of natural selection are visible across at least 10 percent of the genome.

And this is selection that occurred in just the last 25,000 to 5,000 years, because the signal from older episodes of selection is muffled by constant mutation in the DNA sequence.

Geneticists examining that sequence cannot spot episodes of natural selection more recent than 5,000 years or so, unless the signal is particularly strong, because it takes many generations for a new and improved version of a gene to sweep through a population. But evolutionary biologists believe they can detect natural selection at work in the very recent past by looking at so-called phenotypic, or bodily, data.

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These data are found in large medical studies, like the Framingham heart study, in which many traits of a population are monitored over many years. Using sophisticated statistical techniques, biologists say they can distinguish traits that are changing under pressure of natural selection from both those caused by environmental effects and those due to genetic drift — the random genetic change that takes place between generations.

Summarizing the results of 14 such studies in an article last year in Nature Reviews Genetics, a group led by Stephen C. Stearns of Yale wrote that "the emerging picture is that selection is acting in postindustrial societies to reduce age at first reproduction in both sexes, to increase age at menopause in females and to improve traits such as total blood cholesterol that are associated with the risk of disease and mortality."

The study by the University of Quebec biologists is a good analysis of an "extraordinary data set," Dr. Stearns said, and is "the most recent known example of a genetic response to selection in a human population."

"Our culture is changing and our biology is trying to keep up," he said. "But culture changes faster — genes can't change fast enough to keep up with iPads."

Dr. Milot said the genetic changes in his study showed up so clearly because other factors that might cloud them had been held to a minimum by the particular social conditions on Île aux Coudres. The island was granted by royal decree to the priests who managed the Quebec seminary and was settled by 30 families who arrived between 1720 and 1773. The families took up farming, then other professions, like fishing. Throughout the period, considerable equality was maintained, and the population lacked the gradations of wealth that can influence who has how many children.

Also, because most people married locally, the island's population became considerably inbred, despite a ban on marrying first or second cousins.

These two factors, and the homogeneity of the population, left the field open for genetic effects to become prominent, Dr. Milot said.

Studies like those of Île aux Coudres can detect the hand of natural selection only in the data that happen to be recorded in church registries. But many human traits besides those of life history are probably being shaped by natural selection. Many aspects of personality are heritable, Dr. Milot said, and "it would be extremely interesting to see whether our changing societies cause modifications in the selection pressures on such traits in humans."

Jonathan Pritchard, a population geneticist at the University of Chicago, said that "rapid adaptation of this sort is plausible in principle."

In traits that are influenced by many genes, natural selection can act quickly because it does not have to wait for a favorable new mutation to come along. All it needs to do is increase the abundance of some of the genes affecting the trait in question, a process known as a "soft sweep." If the age of first reproduction is influenced by many different genes, "it is conceivable that selection might be extremely strong," he said.

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