Tracking the genetic arms race between humans and mosquitoes

June 25 2015

Anopheles gambiae mosquito, feeding on blood. Credit: James Gathany, Centers for Disease Control and Prevention

Every time you put on bug spray this summer, you're launching a strike in the ongoing war between humans and mosquitoes—one that is rapidly

driving the evolution of the pests.

Scientists studying mosquitoes in various types of environments in the United States and in Russia found that between 5 and 20 percent of a mosquito population's genome is subject to evolutionary pressures at any given time—creating a strong signature of local adaptation to environment and humans.

This means that individual populations are likely to have evolved resistance to whatever local selection pressures are typical in their area—and that understanding the genomes of those populations could one day help inform agencies about which pesticides are likely to be most effective against them.

"Mosquitoes adapt to heat, lifestyle, pesticides and so on—and we see traces of that in their genome," said Sergey Nuzhdin, USC Dornsife College of Letters, arts and sciences professor and corresponding author of the study, which was published by *Proceedings of the Royal Society B* on June 17.

For the study, scientists in the U.S. and Russia teamed up to sequence the genomes of various populations of mosquitoes—looking at urban and suburban mosquitoes in their countries and also at two different but related species: *Culex pipiens* and *Culex torrentium*.

They then tracked which genes were evolving the fastest by noting which were preserved most accurately in each genome.

Genes are subject to various copying errors. If there are a lot of variations throughout a population of a specific gene, then it probably isn't crucial to their survival. If, however, all members of a population have a near perfect copy of a given gene, then there's a good chance that natural selection is acting on it.

Based on which genes are being driven by evolution, the researchers found the widest variation between geographically separated populations than they did between populations in different types of environments. That is—a suburban mosquito in the States has more in common with an urban mosquito in the States than it does with a suburban mosquito in Russia.

"In addition to the insights into the contemporary evolution of mosquitoes, the methods we used in this study can be applied to compare genes under natural selection across populations of any species, including humans," said Hosseinali Asgharian, lead author of the study and Ph.D. student at USC Dornsife.

The scientists hope that the knowledge will help inform strategies to control mosquito populations. *C. pipiens*, for example, can carry West Nile Virus, a disease that has no medications to treat it nor vaccines to prevent it. Of the 2,205 West Nile Virus cases reported in the U.S. in 2014, 801 were in California, according to the Centers for Disease Control and Prevention. Of those 801 cases, 31 were fatal.

More information: *Proceedings of the Royal Society B* rspb.royalsocietypublishing.or … nt/282/1810/20150728

Provided by University of Southern California