Deforestation and disease

Leslie Bienen

New research suggests that deforestation in Mexico probably helped a strain of Venezuelan equine encephalitis virus, VEE subtype IE, make its way into a new mosquito, *Ochlerotatus taeniorhynchus*. *Culex (Melanoconion) taeniopus* was the preferred vector of VEE IE before deforestation wiped out this mosquito in large parts of Mexico. Unlike the *Culex* species, and unfortunately for horses and humans, *O taeniorhynchus* prefers large mammals and does not need forest to survive.

In 1993, in Chiapas, Mexico, and in 1996, in Oaxaca, there were two major VEE outbreaks in horses. When Scott Weaver (University of Texas Medical Branch, Galveston, TX) and colleagues looked at isolates from the outbreaks, they realized that the culprit was IE, a strain that had not caused illness in horses before. “Undoubtedly, there was also undocumented human illness at the time”, says Weaver. Human serosamples collected later showed a high prevalence of antibodies to the IE strain.

All mosquito-borne VEE viruses isolated during past outbreaks produced high viremia in horses. Humans are infected when mosquitoes bite horses, then people. These “epizootic” strains cause neurologic illness in about 50% of horses, and fever, muscular pain, and headache in most infected humans. About 15% of humans develop neurologic disease, some have permanent deficits, and less than 1% die.

In the Mexican outbreaks, however, the horses were not highly viremic. “This means there may be some other amplification host”, says Weaver, “such as the cotton rat”. The new IE strain may cause sufficient viremia in humans to infect mosquitoes, which can then infect other people and horses. “Serosurveys show that people in the region are getting the IE strain all the time”, continues Weaver. “We’re working with local clinics to identify [symptomatic] people, to get samples while they’re still viremic.” By establishing levels of viremia in humans, Weaver’s team will know whether a host other than the horse is necessary for humans to become infected.

The researchers looked for viral mutations to explain the pathogen’s host range expansion and found one that allowed the virus to more efficiently infect *O taeniorhynchus*. “Making the connection between the mutation and deforestation isn’t much of a leap”, says Aaron Brault (University of Texas Medical Branch, Galveston, TX). Coastal Mexico has been so heavily deforested, Brault adds, “We couldn't even find the *Culex* vector. Given those circumstances, deforestation likely acted as a strong selection force. Eventually, you’d expect this new virus to become the dominant genotype.” ■

Beetle biology for beating fires

Adrian Burton

German scientists have developed a prototype fire detection system, based on the biology of the jewel beetle (*Melanophila acuminata*) that may eventually provide a cheap way to protect forests against wildfires.

Jewel beetles are great at detecting forest fires – some can home in on one from 50 miles away. Hundreds may swarm in behind a fireline to mate and lay their eggs under the bark of charred trees, often just after the flames have subsided. Here, their larvae develop, safe from the trees’ defense mechanisms and virtually free of any competition.

The beetles detect the infrared wavelengths emitted by forest fires using sensory organs (sensillae) located in organ pits on the underside of the thorax. “These infrared feelers are modified mechanoreceptors”,

Courtesy of H Schmitz, University of Bonn

*A jewel beetle (*Melanophila acuminata*) moves in after a fire.*

explains detection system developer Helmut Schmitz (Infrared Sensing Systems Project Leader, University of Bonn, Germany). “The finger-shaped protrusion of an individual mechanoreceptor is inserted into a tiny sphere made of cuticula, the same material that forms the insect’s armor. The beetle’s cuticula is particularly good at absorbing thermal radiation with a wavelength of about 3 μm, which is exactly what is typically emitted by a fierce forest fire. When a fire occurs, the sphere heats up and expands, directly stimulating the mechanoreceptor.”

To mimic the biological system, Schmitz’ team used a polythene platelet, which absorbs radiation of the same wavelength. As the polythene expands it squeezes a piezo crystal that gives off an electrical discharge.

The system is currently still well short of the sensitivity obtained with conventional – but far more expensive – infrared radiation detectors, but Schmitz is confident this can be overcome if a commercial partner can be found. “If we are lucky, [a fully operational model could be produced] in 2 or 3 years”, he predicts.

According to Jorge Miguel Lobo, an expert in Coleoptera at the Museum of Natural Sciences, Madrid, Spain, “If these can be made cheaply enough and linked within a telematic web, they might provide an excellent way of automatically monitoring large forest areas in fire hotspots such as Southern Europe, Australia, or California”. ■