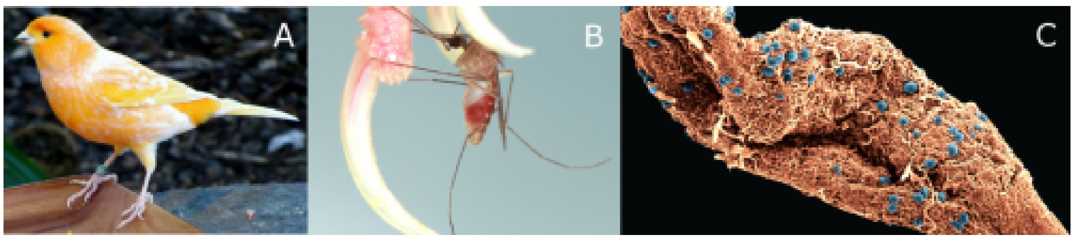
Malaria parasites sense and react to mosquito presence to increase transmission

September 11 2014



Female Culex mosquito blood feeding on the feet of a common canary (panel A: photo Flickr, Rachel Cramer and B: photo Jacques Denoyelle) translates into higher levels of *Plasmodium oocysts* (colored in blue) in mosquito gut (panel C; photo by Antoine Nicot and Jacques Denoyelle). Credit: panel A: photo Flickr, Rachel Cramer, panel B: photo Jacques Denoyelle, panel C: photo by Antoine Nicot and Jacques Denoyelle

Many pathogens are transmitted by insect bites. The abundance of vectors (as the transmitting insects are called) depends on seasonal and other environmental fluctuations. An article published on September 11thin *PLOS Pathogens* demonstrates that *Plasmodium* parasites react to mosquitoes biting their hosts, and that the parasite responses increase transmission to the mosquito vector.

Sylvain Gandon, from the CNRS in Montpellier, France, and colleagues first studied the theoretical evolution of parasite evolution in a variable environment. Using a mathematical model, they found that when insect vectors are present only some of the time, "plastic" transmission strategies—those that depend on the ability to sense and respond to vector availability—can outcompete constant strategies, even when evolution of the former is associated with some costs to parasite fitness.

The researchers then went on to test whether such plastic transmission strategies actually exist for malaria parasites. Like many other parasites, *Plasmodium* goes through a phase of chronic infection during which most of the parasites are in a dormant (or latent) stage, and parasite numbers in the blood are very low. Every now and then, however, the parasites "relapse". Relapses are characterized by increased parasite counts in the blood, but what causes them is not well-understood. The researchers therefore asked (1) whether mosquito bites of the hosts can trigger relapses in *Plasmodium* during chronic infections, and (2) whether relapses are associated with higher rates of transmission to the vector, i.e. infection of the mosquitoes.

Specifically, the researchers studied the interaction between *Plasmodium relictum*, the parasite responsible for most cases of bird malaria in European songbirds, and its natural vector, a mosquito called Culex pipiens. They infected domestic canaries with *P. relictum* and tested whether bites from uninfected Culex mosquitoes could trigger malaria relapses during chronic infection. They found that, indeed, parasite numbers in the blood routinely increased after the canaries were bitten. Moreover, the higher parasite loads following mosquito bites translated into higher infection rates of the mosquitoes.

The researchers summarize, "In line with our theoretical predictions, we show that *P. relictum* has the ability to boost its own transmission during the chronic phase of the vertebrate infection after being exposed to mosquito bites." And while the contribution of plastic transmission in human malaria remains to be determined, the researchers suggest that better understanding of such strategies may eventually improve malaria control.

In addition, they argue that "as many other pathogens also alternate between acute and dormant phases, including Herpes Simplex virus, Mycobacterium tuberculosis, and HIV, better understanding of the ecological determinants as well as the evolutionary forces governing parasite relapses is not only of academic interest: it is also urgently needed to improve the efficacy of public health strategies".

More information: *PLOS Pathogens*, dx.plos.org/10.1371/journal.ppat.1004308

Provided by Public Library of Science