

Disease-carrying mosquitoes rare in undisturbed tropical forests

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Aedes is a genus of mosquitoes that includes species that transmit dengue fever, Zika virus, yellow fever and chikungunya virus. It was originally found in the

tropics and subtropics and is now found on all continents except Antarctica.
Credit: Jose Loaiza

A new study by scientists from the Smithsonian, the Panamanian government and the U.S. Environmental Protection Agency, among other institutions, concludes that conserving old-growth tropical rainforest is "highly recommended" to prevent new outbreaks of viral and parasitic mosquito-borne diseases.

"We found that fewer mosquito species known to carry disease-causing pathogens live in forested areas compared to disturbed ones," said Jose Loaiza staff scientist at the Panamanian Institute of Scientific Research and High Technology Services (INDICASAT) and Research Associate at the Smithsonian Tropical Research Institute (STRI) in Panama.

"Mosquito species from altered [forest](#) sites are more likely to transmit disease than [mosquitoes](#) native to an area of mature tropical forest."

Loaiza's team used DNA barcoding to identify almost 8,000 mosquito larvae representing more than 50 species from water standing in natural or artificial containers or ground water at 245 sites where tropical lowland forest was highly disturbed (Las Pavas on the west bank of the Panama Canal), somewhat disturbed (Achiote, on the east bank of the canal) and undisturbed (at the Smithsonian's research station on Barro Colorado Island).

The French attempt to build the Panama Canal failed because no one knew how malaria and yellow fever spread. The Cuban discovery that mosquitoes carried disease-causing agents made it possible for the U.S. to complete the interoceanic canal in 1914.



Some members of *Anopheles*, a mosquito genus, transmit malaria. Credit: Jose Loaiza

Because mosquito control was so important to the success of the Panama Canal project throughout the 20th century, there is a large amount of

information available about disease-transmitting mosquitoes in Panama. The Walter Reed Biosystematics Unit Mosquito Catalog and in-country sources recorded 286 species of *Culicidae* (the Mosquito family) in Panama. *Anopheles albimanus* is the main vector of malaria in Central America. *Culex nigripalpus* is the main vector of Eastern Equine *Encephalitis Virus* in the US and *C. pedroi* is the main vector of *Eastern Equine Encephalitis Virus* in Peru. All occur in Panama.

"Disease-carrying mosquito species were conspicuous in disturbed forest settings but almost nonexistent at undisturbed forest sites like the Smithsonian research station on Barro Colorado Island," said Oris Sanjur, STRI associate director for science administration and molecular biologist on the study. "Our results have important implications for tropical disease prevention and control. This is vital knowledge as global warming progresses and tropical disease organisms move into new areas."

Researchers tested a controversial ecological model that predicted that the highest mosquito species diversity should occur at medium forest disturbance, known as the Intermediate Disturbance Hypothesis. They did not find this to be true.

"It may be possible to displace disease-carrying mosquitoes by introducing other species that compete with them at the larval stage," Loaiza said.

More information: Jose R. Loaiza et al, Disturbance and mosquito diversity in the lowland tropical rainforest of central Panama, *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-07476-2](https://doi.org/10.1038/s41598-017-07476-2)

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