

Dengue mosquitoes hitch rides on Amazon river boats

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The research team boards a large barge, at left, to survey for mosquitoes. Credit: Photo courtesy of Sarah Anne Guagliardo, Emory University

The urban mosquito that carries the dengue fever virus is hitching rides on river boats connecting the Amazonian town of Iquitos, Peru, with

rural areas.

PLOS Neglected Tropical Diseases published a study by disease ecologists at Emory University, showing how the *Aedes aegypti* mosquito, which is normally associated with urban areas, is tapping human transportation networks to expand its range.

"The majority of large barges we surveyed were heavily infested," says Sarah Anne Guagliardo, who led the study as a PhD student in the lab of Uriel Kitron, chair of Emory's Department of Environmental Sciences. "As the barges move across the Peruvian Amazon they are carrying large populations of these [mosquitoes](#), which can transmit many viral diseases, the most important of which is [dengue fever](#)."

Like the housefly, *Aedes aegypti* is perfectly adapted to the domestic life of humans. It especially thrives in densely populated urban areas, since it feeds almost exclusively on human blood and has a limited flight range of about 100 meters.

"When *Aedes aegypti* mosquitoes began popping up in [rural areas](#) around Iquitos, we knew that humans must somehow be involved in that transportation process," Guagliardo says.

Iquitos, located deep in the Amazonian rainforest, is one of the most isolated cities in the world, accessible only by boat or plane, except for one two-lane road connecting it to a much smaller town. The population of 400,000 is surrounded by thick jungle that is difficult to clear, inhibiting urban expansion.

To learn how the mosquitoes of Iquitos hitch rides with humans, the researchers investigated six different vehicle types, from large and medium-sized barges, water taxis and speedboats to buses and road taxis.

Large barges (71.9 percent) and medium barges (39 percent infested) accounted for most of the infestations. In contrast, buses had an overall infestation rate of 12.5 percent.

The cargo hold of large barges, where water often collects in puddles, was ground zero for the infestations. "We were collecting not just adult mosquitoes, but also pupae, larvae and eggs," Guagliardo says. "The mosquitoes are not just riding the boats, they are reproducing on the boats."

These large barges, which can be about 60 meters long, may have as many as four floors in addition to the cargo hold. They carry human passengers along with a variety of cargo, from livestock, plantains, fish and gasoline and other goods. The medium barges tend to be half the size and lack cargo holds.

The researchers surveyed for mosquitos using the Prokopack aspirator, a mosquito "vacuum" co-invented by Emory disease ecologist Gonzalo Vazquez-Prokopec.

"The cargo hold is in the bottom of the large barges and you have to crawl into really dark spaces to collect mosquitos," Guagliardo says. "There's often rotting organic matter from things like plantains and fish. And it's moldy and damp. Many of the barges are really old and rust holes form on each floor and ceiling. Every time it rains, water drips down and collects in the cargo hold."

It's a first-class ride, however, for these disease-carrying mosquitoes. The adults have a dark, cool resting place, while their eggs and larvae can incubate in standing puddles. If the mosquitoes get hungry, a captive group of human hosts is nearby for blood meals.

"I think it's important that people are aware that this is a problem,"

Guagliardo says. "Our study is the first of its kind, to my knowledge, comparing mosquito infestations across a range of vehicles. I'm curious how these mosquitoes may use modes of transport in other parts of the world."

Some of the large barges of Iquitos with infestations of adult and immature mosquitoes were surveyed repeatedly by the research team during different seasons of the year. "It turns out the barges that were infested were consistently infested, and that a small proportion of barges produce the vast majority of mosquitoes," Guagliardo says. "Some boats may act as super-transporters of mosquitoes, just as individual human hosts may act as super-spreaders of pathogens."

The researchers propose that governmental agencies invest in mosquito control programs for aquatic transport, and implement more stringent punitive policies and incentives to ensure the cooperation of boat owners. The programs could target those boats producing the greatest amount of mosquitoes.

During the last 50 years, the incidence of dengue, which causes debilitating pain and can be fatal, has increased 30-fold. The World Health Organization estimates that 50-100 million dengue infections occur each year.

Guagliardo, who received her PhD from Emory in May, currently works on HIV/AIDS programs for the Centers for Disease Control and Prevention.

Provided by Emory University

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