War on bugs: New research could lead to better bed bug control

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These are bed bug samples in Regina Baucom's lab at the University of Cincinnati. Credit: Tom Robinette, University of Cincinnati

As if trapped in a never-ending B movie about evil invaders, Cincinnatians have been tormented by a six-legged scourge for years. To the chagrin of many throughout the Queen City, this monster isn't an actor in a rubber alien costume; it's the real thing – Cimex lectularius,

better known as the common bed bug.

The tiny, bloodsucking arthropods have burrowed so deeply and so broadly into the cracks, crevices and cushions of Greater Cincinnati's households, they've literally given the city an itch it can't scratch enough to make it go away.

But there's hope. Regina Baucom, an assistant professor of biological sciences at the University of Cincinnati, has researched the DNA of local bed bug populations, and she's found something that could lead to a better way to control the notoriously tough insects.

Baucom's research paper, "A 454 Survey Reveals the Community Composition and Core Microbiome of the Common Bed Bug (*Cimex lectularius*) Across an Urban Landscape," was published in *PLOS ONE*, a peer-reviewed, open-access journal of the nonprofit Public Library of Science. Additional contributors to Baucom's research were Sara Matthews, a technician in the Baucom lab, and Rita Rio, an assistant professor of biology at West Virginia University. First author of the study is Matt Meriweather, a senior biological sciences major in UC's McMicken College of Arts & Sciences.

"This research makes use of pyrosequencing to give us a relatively unbiased view of what bacteria are in or on the bed bugs around the city, and is an ecological genomics question applied to the bed bug problem in Cincinnati," Baucom says.

A long-suffering city's scientific salvation?

For the past few years Cincinnati has been at or near the top of lists of most bed bug-infested cities in the nation as ranked by pest control companies such as Terminix and Orkin. In 2008, bed bugs were becoming such a nuisance in Cincinnati that the health department

developed the Bed Bug Strategic Plan, one of the first of its kind in the nation. Cincinnati isn't alone in its bed bug misery. Many factors – including the creature's resistance to insecticides – have contributed to a surge in bed bug activity across the U.S. during the past decade.

The bed bug's ability to survive common pest control applications is part of what originally attracted Baucom to this research. She's interested in studying alternative defense strategies of biological organisms and has done USDA-supported research on the common morning glory's resistance to herbicides.

For her work on bed bugs, Baucom and her team performed genetic analysis on 31 individual bed bugs from eight distinct collections obtained from different residences in Cincinnati. This gave Baucom a clearer picture of which microbes were associated with the bed bugs and the locations where these microbes were concentrated. The central idea: The better the understanding of a bed bug population's microbial makeup and whereabouts, the better the chances of finding improved ways of controlling that population.

"Our research could be a useful starting point for someone interested in various aspects of biocontrol, potentially similar to the mosquito story," Baucom says.

Bacteria a possible weakness to exploit

She found that 97 percent of the microbial community is made up of two dominant bacterial types. One of these bacteria, Wolbachia, is a nutritional mutualist, in this case assisting the bed bug with growth and reproduction. There is less known about the other bacterium, an unnamed gamma-proteobacteria, but it also might serve a beneficial function for its host. The abundance and consistency of these bacteria and the seemingly important role they play in bed bug health make them

a prime target for biological pest control methods.

"Finding out how the microbial community varies across different areas gives you an idea of what's out there naturally and thus what to expect," Baucom says. "Studies of the core microbiome, or the microbial community that might be necessary for the happy functioning of an organism, are really taking off in relation to human health initiatives and can provide basic information critical to the next step: What happens to the organism when there are deviations from the core microbiome?"

When it comes to happily functioning, if bed bugs are, humans aren't. The little creepers are like vampires – they feed on human blood, prefer the cover of darkness and are hard to kill. Their bites have been known to cause itchy rashes, anaphylaxis and other reactions. Existing research is unclear as to whether bed bugs directly transmit harmful pathogens to humans the way mosquitoes or ticks do, but nearly 50 human pathogens have been identified within or on bed bugs or their waste. Baucom's study alone uncovered five genera to which known or assumed human pathogen species belong.

Considering such serious public health implications, Baucom advocates further examination of the parasite's core microbiome. Funding for her research was provided by UC and the Department of Biological Sciences. But without that direct link from bed bug to human, additional research funding can be as difficult to find as bed bugs are to exterminate.

"Because there are few links showing transmission of disease from bed bugs to humans, funding for basic research on bed bugs has been scarce," Baucom says. "This is unfortunate, because they certainly can cause psychological harm to people and allergic reactions."

Discovery of direct pathogen transmission could one day bring

additional support for research and eventually a better weapon to battle the little beasts.

Provided by University of Cincinnati