

MOSQUITO MAGNETS



TO PROTECT WARFIGHTERS AGAINST DISEASE CARRYING INSECTS,
ISCA DEVELOPS SEMIOCHEMICAL SOLUTIONS 

Few sounds are as distinctive as the high-pitched whine of a mosquito. With more than 3,500 known species, some mosquitoes can flap their wings up to 600 times per second, and travel 1.5 miles per hour. If you are one of the unfortunate few that mosquitoes are especially attracted to, avoiding them can be a real annoyance. Now imagine being a foot soldier on the front lines of a military conflict. In that situation, you might think the biggest threat to your survival is enemy fire. In fact, it could be the mosquito buzzing in your ear. According to the American Mosquito Control Association, more than one million people die every year from mosquito-borne diseases. From dengue and malaria, to West Nile and Zika, mosquitoes and other disease vectors (disease-carrying pests) transmit deadly diseases that affect humans, livestock, pets, and wildlife.

Recent conflicts in the desert regions of Africa and the Middle East have presented U.S. Warfighters with unprecedented exposure to vector-borne diseases. During the second Gulf War in Afghanistan, Operation Enduring Freedom, American soldiers were being bitten by mosquitoes and sandflies at alarming rates—some 1,000 times per hour—oftentimes resulting in

open wounds infected with the leishmania parasite. Many of the infected soldiers later developed a deadly form of kala-azar, or visceral leishmaniasis, requiring costly evacuations and intensive medical intervention. Kala-azar is the second-leading parasitic killer in the world (after malaria), responsible for an estimated 50,000 to 90,000 infections annually, according to the World Health Organization, and is nearly always fatal if untreated.

In an effort to reduce the impact of insect-borne diseases on Warfighters, the U.S. Army put out a call in 2002, with a Small Business Innovation Research (SBIR) topic seeking an effective trapping system for adult mosquito vectors. ISCA Technologies, headquartered in Riverside, California, responded.

Company founder Agenor Mafra-Neto said, “Initially the biggest problem for the Warfighter was that they were going into new regions around the world, bringing troops who were being ravaged by mosquitoes, sandflies, and other blood seeking arthropods. They needed to know what kind and how many vector insects were present. At the time, all monitoring traps were based on carbon dioxide (CO₂), requiring large, heavy cylinders that slowly release the CO₂. It is very

difficult to manage these traps, especially in a war zone, and they only last overnight. The military wanted to create long lasting lures, or attractants, for mosquitoes that you could put into a liquid formulation or on a slow release system that would be small and easy to manage.”

This challenge, according to Mafra-Neto, is what motivated him to respond. “If we could replace the whole cylinder with a little package the size of a Tic Tac container, that would be a tremendous advantage for the military, allowing for the increase in monitoring areas and number of traps. However, once you have a trap that brings insects in, you still need an entomologist to separate, identify the species, and count the number of mosquitoes caught. We wanted to create a complete system that incorporated a rugged, long lasting trap that could be deployed anywhere, requiring only a small amount of lure, and that would classify the species as they came in to the trap.”

What is it about humans that is attractive to mosquitoes and other vector pests? Carbon dioxide was obvious, but what about the thousands of compounds emanating from humans skin? ISCA set out to create “a human in a bottle,” or a liquid broth composed of the different components on the skin that attract mosquitoes.

Recalling the development process, Mafra-Neto said, “In 12 hours we were able to create the same smell that attracts a mosquito.” They developed a group of semiochemicals, or chemical attractants like pheromones, that could be condensed and carried into the field without costly compressed cylinders.

The next challenge was the automatic classifier. The military wanted a visual system to identify insect species and gender. At the



time, only very expensive industrial automation cameras were available to capture images of mosquitoes landing on a platform.

In collaboration with University of California, Riverside, ISCA experimented with classifying the sound of a mosquito’s wing beat, with each species having a unique frequency. Using only a simple microphone, the company was able to successfully field a classifying device. However, ambient noise was a problem, and one that would only intensify in military applications. In order to overcome that constraint, the team

conceived of a system that used a laser to measure the frequency of the moving shadows resulting from the wing beat. With this new approach, background noise no longer mattered.

ISCA’s SBIR empowered solutions have impacted the vector-control industry. SkinLure—an early mosquito attractant, was used by the U.S. Centers for Disease Control as bait for traps in Puerto Rico to identify the species

of mosquitoes that were transmitting West Nile virus to chickens in the territory. And FlightSensor, which allows mosquito control personnel and agricultural growers to track with their smartphones how many and what species enter the traps, in real time, is poised to revolutionize pest control by providing immediate warnings of pest invasions.

“Without these early SBIR awards,” Mafra-Neto said, “we would not be where we are today.” The company has successfully leveraged their seminal SBIR work into other productive partnerships with the U.S. Department of Defense, the U.S. Department of Agriculture, the National Institute of Health, the National Science Foundation, Bill and Melinda Gates Foundation, and Vodafone, among others. 🌟

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ISCA Technologies, Inc.

Modernization Priorities: Biotechnology, General Warfighting Requirements (GWR)
Riverside, CA • SBIR contract: DAMD17-03-C-0030 • Agency: Army • Topic: A02-186, Innovative Trap Lured with Highly Effective Attractant for Adult Mosquitoes Vector of Dengue Fever