MOSQUITOES AND TICKS THAT CARRY PATHOGENS ARE DIFFICULT TO CONTROL.

Parasites, viruses, and other pathogens transmitted by mosquitoes and ticks can cause sickness and death in humans and livestock as well as serious economic impacts. Treating infections is costly, and many of the diseases spread by ticks and mosquitoes have no vaccine or treatment available. Prevention relies on avoiding and controlling ticks and mosquitoes. Unfortunately, tick and mosquito populations continue to grow and spread, fueled by increasing urbanization, climate change, invasive species, and other factors.

UNIVERSITIES ARE COLLABORATING TO REDUCE THREATS.

Researchers across the U.S. are working together on a multistate project to manage ticks and mosquitoes and the pathogens they carry. Through collaboration, scientists with diverse expertise can learn from each other, share research resources, and study multiple species at the same time over wider ranges. Having members in multiple states ensures that monitoring, outreach, and control efforts are consistent nationwide, but also tailored to the needs of certain areas.

Research-based information will lead to faster detection of outbreaks and more effective management strategies. Better outreach will lead to greater use of cost-effective control efforts.

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Asian tiger mosquito.

RESEARCH HIGHLIGHTS:

Researchers provided resources that help other scientists study ticks, mosquitoes, and the pathogens they carry, including:

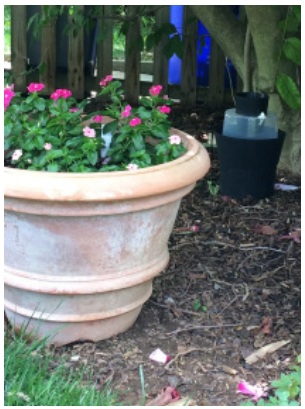
- A catalog of research materials with detailed information on origins, contributors, and shipping and regulatory rules
- Standardized protocols that show researchers how to conduct consistent studies with reliable results

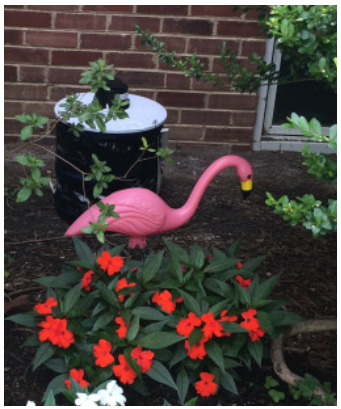
Studies shed new light on mosquito behavior, guiding mosquito control:

- Mosquitoes are typically more common in areas with abandoned properties (where water can accumulate in containers for long periods of time), but when precipitation is low, abundance peaks in high-income areas with artificial irrigation like sprinklers
- Older neighborhoods often have lower mosquito diversity, but higher numbers of mosquitoes that transmit human pathogens

To help monitor ticks and mosquitoes, predict disease outbreaks, and dictate control activities, researchers:

- Showed that drones and AI can be used to monitor mosquito habitats
- Created models to predict the expanding range of ticks
- Documented the expansion of invasive Asian tiger mosquitoes and increases in *Aedes aegypti* in some areas
- Used proteins from the salivary glands of *Anopheles* mosquitoes to create biomarkers for tests that determine bite intensity and malaria risk
- Standardized a method to detect exposure to lone star ticks based on the presence of certain antibodies in human blood serum





Rutgers University scientists designed an urban mosquito control program, in which scientific advisors guide residents. This approach builds trust and gives the community ownership. A Maryland town that tested the approach had 80% of residents deploy traps and a 76% reduction in mosquito biting.

American dog tick. Photo by Jim Occi, Rutgers University.

Scientists refined strategies to combat ticks, mosquitoes, and the pathogens they carry:

- A new tick management approach that uses an array of least-toxic control options is effective, safe, inexpensive, and easy to implement in residential communities
- The combination of rodent bait boxes and the fungus *Metarhizium anisopliae* reduces blacklegged tick nymph numbers by 78-95%
- Stations that attract mosquitoes and coat them with powerful insect-specific insecticide could control species that breed in containers better than conventional spraying
- Backyard mosquito barrier spraying is just as effective for neighboring yards as for the target household
- UV-B radiation can kill some mosquito larvae
- Carnivorous aquatic plants could control mosquito populations by feeding on larvae
- Microsporidian fungi can impair the ability of infected mosquitoes to transmit malaria parasites through their bites
- *Wolbachia* bacteria make it harder for viruses like dengue, Zika, and yellow fever to survive in mosquitoes
- New approaches for "silencing" genes to impair the production of proteins essential for mosquito development and survival

To increase adoption of research-based management, team members:

- Created fact sheets for the public
- Led workshops on mosquito surveillance and testing techniques
- Compiled a database of tick and mosquito courses and tools
- Helped other researchers and professionals incorporate emerging technologies into their activities
- Identified and dispelled misconceptions about mosquitoes