Crowdsourced Surveillance Program Improves Public Understanding of Tickborne Diseases

ENTOMOLOGY TODAY 20 HOURS AGO LEAVE A COMMENT

TickSpotters identified common tick species with an accuracy of over 98 percent. This is not always easy to do, as these photos show. The image at left shows a female blacklegged tick (Ixodes scapularis) from Clinton, New Jersey, that has been feeding for about three days. The image at right shows a female American dog tick (Dermacentor variabilis) from Plymouth, Michigan, that has been feeding for about four to five days. Note that both ticks have a dorsal shield called a scutum and that the scutum looks different in these species. (Photos courtesy of Thomas Mather, Ph.D.)

By John P. Roche, Ph.D.

Incidences of tick-borne diseases in the U.S. have been increasing, and the U.S. Centers for Disease Control and Prevention (CDC) estimates that as many as 300,000 people might contract Lyme disease in the U.S. each year. Surveillance of the prevalence of different tick species that spread disease is important because it provides information on the health risks of tick bites. Surveillance can be active, such as the use of lures or other direct collection methods, or it can be passive, such as encouraging the public to send in tick specimens to experts. Active surveillance has the advantage of gathering info on factors related to disease risk, such as the density of tick populations and the proportion of infected ticks. The drawbacks are that active surveillance is labor intensive, time intensive, and expensive. Heather Kopsco, Ph.D., and Thomas Mather, Ph.D., of the University of Rhode Island (URI) and Guang Xu, Chu-Yuan Luo, and Stephen Rich of the University of Massachusetts Amherst (UMass Amherst) tested the accuracy of crowdsourced passive surveillance using submitted tick photos. Their findings, published this week in the *Journal of Medical Entomology* (https://doi.org/10.1093/jme/tjaa140), have wide significance for medical entomology and public health.

Passive surveillance, such as the use of photos, offers high spatial coverage and good temporal coverage, and it can provide results much faster than mailed-in specimens can. It can also help avoid treating people with antibiotics where they are not needed, focusing treatment on instances where they are medically necessary. If accurate, passive surveillance offers clear advantages.

Heather Kopsco, Ph.D., who earned her doctorate at the at the University of Rhode Island's TickEncounter Resource Center, discovered that entomologists at TickEncounter could identify crowdsourced

The only previous study (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5471820/) to test the accuracy of passive surveillance was done by Jules Koffi and colleagues in Canada in 2017. Trained entomologists examined photos submitted on the eTick web platform (http://www.etick.ca/) from veterinarians. Of

284 suitable images, they found that the entomologists were 97.2 percent accurate in identifying common tick species.

photos of ticks submitted by the public with a high degree of accuracy. Such crowdsourcing has considerable significance for helping inform treatment of tickborne diseases such as Lyme disease, and in helping educate the public about tick vectors. (Photo courtesy of Heather Kopsco, Ph.D.)

The current study used a larger sample size to test the accuracy of passive photo surveillance by comparing identification by photo with identification by microscopy and molecular analysis. Photos submitted to TickSpotters (https://tickencounter.org/tickspotters) at the University of Rhode Island's TickEncounter Resource Center were compared with physical tick specimens sent to the TickReport program (https://www.tickreport.com/) at the UMass Amherst Laboratory of Medical Zoology. Entomologists at URI's TickSpotters examined submitted photos to visually identify tick species and determine the amount of time the tick spent feeding. TickReport at UMass Amherst identified species under a microscope, and then confirmed the species using PCR. Results that were not definitive from PCR were resolved using DNA sequencing.

Kopsco et al.'s study found that photo identification of species was correct 96.7 percent of the time. Photo identification of the three most medically important tick species—the blacklegged tick (*Ixodes scapularis*) that can vector Lyme disease, the American dog tick (*Dermacentor variabilis*) that can vector Rocky Mountain spotted fever, and the lone star tick (*Amblyomma americanum*) that can vector ehrlichiosis—was correct over 98 percent of the time for each species. The study's first author, Heather Kopsco, says, "Our results indicate that commonly encountered ticks can be identified by photograph with a very high degree of accuracy."

Of the 21,287 photos submitted to TickSpotters used in this study, 34.8 percent were black-legged ticks, 34.8 percent were American dog ticks, and 17.0 percent were lone star ticks. Of the 816 overlapping specimens found in both data sets, 68.6 percent were black-legged ticks, 13.9 percent were American dog ticks, 13.4 percent were lone star ticks, and 2.21 percent were western black-legged ticks. "TickReport at UMass gets more black-legged ticks because people are concerned about Lyme disease from black-legged ticks, and thus are more likely to send those in for testing than other species," says TickEncounter's director, Thomas Mather.

Estimating the amount of time that a tick was attached and feeding is valuable information because medical entomologists believe that it generally takes 24 hours

or more for an infective dose of the bacteria that cause Lyme disease to enter a person. TickSpotters estimates the amount of feeding time through comparison with a tick growth reference tool (https://tickencounter.org/tick_identification/tick_growth_comparison) on the URI TickEncounter Resource Center's website. Of overlapping specimens found in both data sets, 29.3 percent were unfed or had fed less than one day, 46.9 percent had fed one to three days, 21.6 percent had fed three and a half to five days, and only 2.2 percent had fed longer than five days.

The benefits of this type of crowdsourcing surveillance are significant. It provides timely information that can inform effective medical care, it can allay anxiety in citizens, and it can increase public understanding of tick species and their capacity to vector disease. For example, visitors to the TickSpotters website learn that American dog ticks don't spread Lyme disease; black-legged ticks do. As Mather says, "There is a huge need for what we are offering people."

Another advantage is that TickSpotters is free of scientific biases. "It is free, it is simple, it is fast, and it is readily available on the internet. Anyone can use it and get a reply," Mather says.

Kopsco began work in Professor Mather's lab in 2015 and completed her Ph.D. at URI in May 2020. She is now a postdoctoral researcher at the University of Illinois College of Veterinary Medicine. "It was an exciting challenge to take on a computational and "big data" project for my Ph.D. work," says Kopsco. "It gave me the skill set I needed to tackle ecological questions from numerous angles."

Kopsco has a dual interest in ecology and communication. "One of the most profound insights I learned in my training is the utmost importance of being able to communicate with the public about research. This was massively important as I worked on citizen science projects, and to help communicate disease risk to the public. It is absolutely critical to know the audience, their motivations, and to listen; these skills make me a better scientist, as well as a better science communicator."

The future applications to health care are promising. As Kopsco says, "Marketing these surveillance platforms to healthcare clinics would be a great way to assist in guiding tickborne disease testing and treatment practices, in particular to ensure that tickborne diseases are detected in a timely fashion, but also that antibiotics are not administered unnecessarily. This type of service would fit well within the new parameters of telehealth."

The scientific value of crowdsourced surveillance is also huge. Kopsco says, “This method can help identify specific sites of interest for targeted sampling, examine socioecological connections to tick encounters and tickborne disease, as well as track where tick species are moving.”

In terms of future follow-up research possibilities, Mather says, “We’ve barely skimmed the possibilities of questions that can be addressed.” TickSpotters is observing changes in the ranges of some tick species, including the lone star tick, which is spreading north. Why is this, and what might the medical significance be? The range of potential insights gained from crowdsourced entomological surveillance is vast.

More information about TickEncounter at URI and a form for submitting tick photos to TickSpotters is available at https://tickencounter.org (https://tickencounter.org/).

Read More

“Crowdsourced Photographs as an Effective Method for Large-Scale Passive Tick Surveillance”
(http://doi.org/10.1093/jme/tjaa140)

Journal of Medical Entomology

***John P. Roche, Ph.D**, is an author, biologist, and educator dedicated to making rigorous science clear and accessible. Director of Science View Productions and Adjunct Professor at the College of the Holy Cross, Dr. Roche has published over 200 articles and has written and taught extensively about science. For more information, visit https://authorjohnproche.com (https://authorjohnproche.com/).*

Related


New CDC Tick Study Adds to Promise of Permethrin-


In Tick Management, Species Matters


Different Tick, Same Repellents: CDC Study