

More than 100 years of data show Pennsylvania tick population shift

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A "questing" female *Ixodes scapularis* (blacklegged tick) reaches out in hopes of climbing aboard a host. Researchers say the blacklegged tick, the primary vector of Lyme disease, was almost nonexistent in Pennsylvania in the 1960s but now is the state's dominant tick species. Credit: Joyce Sakamoto/Penn State

The prevalence of the most abundant species of ticks found in

Pennsylvania has shifted over the last century, according to Penn State scientists, who analyzed 117 years' worth of specimens and data submitted primarily by residents from around the state.

The researchers said understanding the spatial distribution patterns and host associations revealed by their analysis is important for assessing and reducing the risk of diseases caused by [tick](#)-borne pathogens.

The Centers for Disease Control and Prevention reported a 3.5-fold increase in vector-borne diseases in the United States between 2004 and 2016, with more than 76 percent of cases caused by tick-borne pathogens. The vast majority of these cases are Lyme disease, attributed to *Borrelia burgdorferi*. Pennsylvania has had the highest number of total Lyme disease cases in the U.S since 2000.

Since the early 1900s, people have submitted ticks for identification to the Penn State Department of Entomology and its forerunners, and these specimens have become part of Penn State's Frost Entomological Museum collection, noted Joyce Sakamoto, assistant research professor of entomology in the College of Agricultural Sciences.

"Then in the 1960s, the late entomology professor Robert Snetsinger ran a statewide media campaign to encourage tick submissions, and he received thousands from citizen scientists," she said. "He also conducted [active surveillance](#), capturing and collecting ticks in the field."

Another Penn State entomologist, Steven Jacobs, a now-retired senior extension associate, led a similar public-service media campaign in the 1990s, resulting in another surge in tick submissions from citizens around the state.

The research team—Sakamoto, Jacobs and first author Damie Pak, doctoral candidate in biology—compiled data from more than 7,000 of

these tick specimens dating from 1900 and analyzed the submissions for tick-community composition, host associations and spatio-temporal dynamics. Ticks were submitted from all 67 counties in Pennsylvania, and the specimens included 24 species.

Five species make up more than 90 percent of submissions, *Amblyomma americanum* —lone star tick; *Dermacentor variabilis*—American dog tick; *Ixodes cookei* —groundhog tick or woodchuck tick; *Ixodes scapularis*—blacklegged tick; and *Rhipicephalus sanguineus*—brown dog tick.

"We found that based on these collections, there have been several shifts in the dominant species of ticks over the last 117 years," Sakamoto said. "For example, before 1990, the majority of tick submissions were identified as *Ixodes cookei* (groundhog or woodchuck tick). Right now, the dominant species is *Ixodes scapularis*, or blacklegged tick, which is the primary vector of Lyme disease. But this tick was almost nonexistent in Pennsylvania in the 1960s."

The researchers, who reported their results today (May 3) in *Parasites & Vectors*, said such changes in surveillance data can be correlated with climate change and variability; shifts in land use that can lead to [habitat loss](#) and fragmentation; and changes in human or animal behavior that may bring ticks and hosts into closer proximity.

Sakamoto explained that the blacklegged tick's population likely declined in the early 20th century because timber-harvesting practices such as clearcutting caused deforestation and destroyed habitat for deer and other wildlife that serve as hosts. As reforestation was achieved and habitat restored in the late 1900s, the population of these ticks—which sometimes are called deer ticks—exploded.

Blacklegged ticks now are found in every county in Pennsylvania,

although the researchers' analysis suggests that their highest prevalence rates—per 100,000 people—occurred in northcentral Pennsylvania counties such as Elk, Forest and Cameron.

In addition to tick prevalence and geographic distribution, host-association data accompanying submitted tick specimens also can help in assessing risk, according to the researchers.

"Some species' common names are misleading because they imply only one host," Sakamoto said. "For instance, *Ixodes cookei*, the so-called groundhog tick, is really a generalist that also will feed on opossums, raccoons and other species—and may bite humans if given the opportunity. This tick also is a potentially important vector of Powassan encephalitis virus—a serious pathogen—so commonly held misconceptions about tick-host associations may result in people underestimating or ignoring the risk."

The researchers conclude that the ideal tick surveillance program would employ both passive and active collection methods and would not focus solely on the most important "tick du jour," such as the current emphasis on the Lyme-carrying blacklegged tick.

"The goal of surveillance should be to look for everything—not just the species that currently poses the biggest threat—so we can be prepared for what's coming," Sakamoto said. "The consequences of neglecting other potential ticks of epidemiological significance include missing shifts in tick biodiversity, not monitoring range expansions of vectors, and not detecting the presence of introduced species, such as the Asian longhorned tick recently found in Pennsylvania.

"Conducting robust surveillance and analyzing historical data sets such as this can help public health officials and researchers to identify high-risk areas, discover ecological trends and develop predictive models for

assessing the risk of tick-borne disease," she said.

Provided by Pennsylvania State University

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